

preliminary report
received: 3. 12. 2001

UDC 597(262.3)

PRELIMINARY OBSERVATIONS ON ABNORMAL ABUNDANCE OF *CETORHINUS MAXIMUS* (GUNNERUS, 1765) IN THE CENTRAL AND NORTHERN ADRIATIC SEA

Marco ZUFFA

Museo "L. Donini", IT-40064 Ozzano nell'Emilia, Via Prunajo 1

Alen SOLDO

Institute of Oceanography and Fisheries, HR-21000 Split, P.O.BOX 500

E-mail: soldo@izor.hr

Tiziano STORAI

Museo Civico di Scienze Naturali della Valdinievole, IT-51017 Pescia, P.zza Leonardo da Vinci 1

E-mail: tstora@tin.it

ABSTRACT

*During 2000 and in the first months of 2001, numerous records of *Cetorhinus maximus* (Gunnerus, 1765) were made in the Central and Northern Adriatic Sea along the Italian, Croatian and Slovenian coasts. The collected records include 1) sightings of a single specimen and small groups; 2) reports on some accidental captures. The number of records collected in the last two years has highly increased in relation to the records made of basking sharks in previous years, due to which some considerations on the apparent migratory movement in the Adriatic and comparisons with the data concerning the Tyrrhenian Sea are presented. Some hypotheses about the causes of the unusual basking shark abundance in the area are also presented.*

Key words: *Cetorhinus maximus*, basking shark, Central and Northern Adriatic Sea

OSSERVAZIONI PRELIMINARI SULL'ABBONDANZA ANOMALA DI *CETORHINUS* *MAXIMUS* (GUNNERUS, 1765) IN ADRIATICO CENTRALE E SETTENTRIONALE

SINTESI

*Durante il 2000 e nei primi mesi del 2001, sono state registrate numerose segnalazioni di *Cetorhinus maximus* (Gunnerus, 1765) in Adriatico centrale e settentrionale, lungo le coste italiane, croate e slovene. Le segnalazioni riguardano: 1) avvistamenti di singoli esemplari e di piccoli gruppi; 2) resoconti di catture accidentali di qualche esemplare. Vengono presentate alcune considerazioni sull'apparente movimento migratorio in Adriatico ed il confronto con dati provenienti dal Tirreno. Vengono infine formulate alcune ipotesi sulle possibili cause dell'abbondanza inusuale dello squalo elefante nell'area.*

Parole chiave: *Cetorhinus maximus*, squalo elefante, Adriatico centrale e settentrionale

INTRODUCTION

The presence of *Cetorhinus maximus* (Gunnerus, 1765) in the Mediterranean basin has been recorded since 1795 (Macri, 1819). In the past few centuries the basking shark has been studied, due to its dimensions and behavioural habits, to a greater degree than any other shark. Accordingly, *C. maximus* is one of the species on which the modern marine researches have been focused mostly (Harvey-Clark et al., 1999; Sims, 2000; Sims et al., 2000; Valeiras et al., 2001).

Despite this attention, many aspects of the basking shark biology are still unknown. We do know, however, that basking shark is a highly migratory species, noteworthy for its seasonal appearance at different localities of the Pacific and Atlantic Oceans and its subsequent disappearance (Compagno, 1984). The same case is in the Mediterranean but, if there is any pattern in migratory movements of basking shark in this area, it still needs to be explained. However, periodic or even seasonal occurrences in the Central Mediterranean have been recorded for the Ligurian Sea (Vinciguerra, 1923; Tortonese & Trotti, 1949), Northern and Southern Tyrrhenian Sea (Senna, 1913; Serena & Vacchi, 1996), Sea of Sardinia (Monti, 1910), Sea of Sicily (Monterosso, 1931; La Cascia, 1935) and Tunisian waters (Najai, 1980).

In the Adriatic, the presence of *C. maximus*, has been reported since 1822 (Naccari, 1822), and it has been considered as occasional (Brusina, 1888; Soldo et al., 1999; Lipej et al., 2000). Therefore, the huge increase in the basking shark records, whether captures or sightings, reported in the Adriatic between March 2000 and September 2001 have a notable importance in relation to the actual knowledge on the distribution of the species in the Adriatic. Furthermore, its unusual high abundance in this area has forced researchers of different occupations to carry out more thorough investigations in order to establish the reasons for its unusually large numbers.

MATERIALS AND METHODS

Being a preliminary study, priority has been given to the collecting of all available data that can be useful for a general evaluation of the phenomenon.

All pieces of information, photographic evidences and videos collected have come from different Marine Institutes, Museums, Harbour Offices, fishermen and other private citizens and articles published in scientific as well as popular journals and newspapers. In some cases, the main body characteristics, such as length and weight, have not been measured but merely estimated.

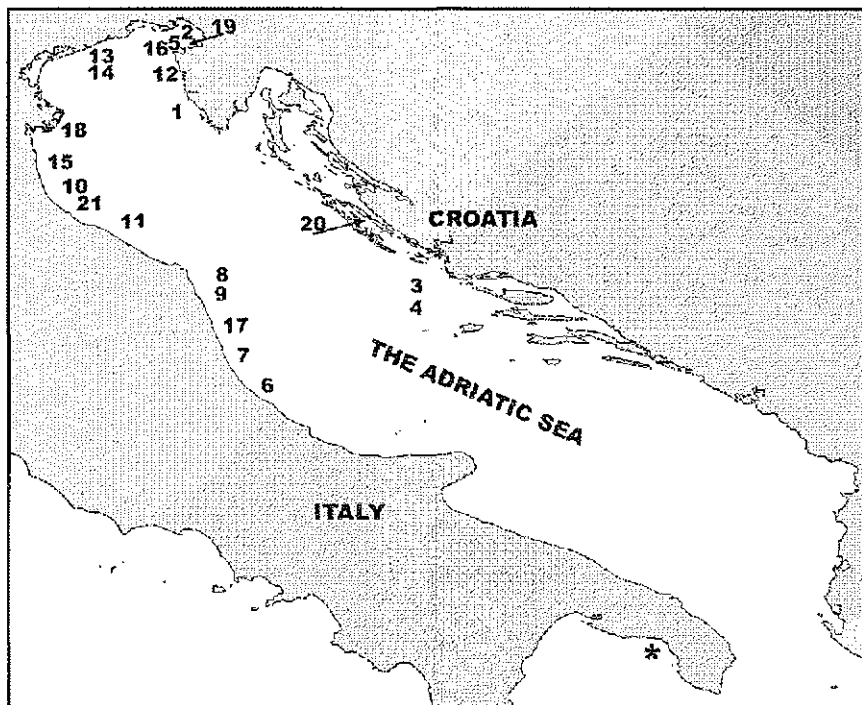


Fig. 1: Distribution of basking shark records in the Adriatic during 2000-2001 according to case numbers, including basking shark recorded on 5th February 2001 near Gallipoli (*).

Sl. 1: Razširjenost morskega psa orjaka v Jadranu v obdobju 2000-2001 glede na poročila iz tega območja, vključno s podatkom o orjaku, ujetem 5. 2. 2001 v bližini Gallipolija (*).

Tab. 1: Data on basking shark records in the Adriatic 2000-2001. *

Tab. 1: Podatki o psih orjakih, opaženih v Jadranu v obdobju 2000-2001.

N	DATE	PLACE	LENGTH (in cm)	SEX	NOTES	REFERENCES
1	March 2000	Istran coast near Rovinj (Croatia)	700		Specimen sighted several times. Finally captured by gillnet and released.	Soldo & Jardas, 2001
2	22 May 2000	Piran (Slovenia)	299	male	Captured with net some 7 miles off the coast. Weight 120 kg.	Lipej et al., 2000
3	23 May 2000	Blitvenica area (Croatia)	700		Specimen weighing 2000 kg caught by trawl.	Soldo & Jardas, 2001
4	5 June 2000	Blitvenica area (Croatia)	850		Specimen weighing 2500 kg caught by trawl.	Soldo & Jardas, 2001
5	19 July 2000	Piran (Slovenia)	249		Specimen of 70 kg caught by gillnet 6.4 miles off the coast.	Lipej et al., 2000
6	November 2000	Pescara (Italy)	500		Specimen caught. Recorded by G. Cugini.	De Maddalena, pers. comm.
7	5 February 2001	San Benedetto del Tronto (Italy)	600	male	Specimen caught by net. Examined by S. Giacoia and A. Bugari.	Anonymus, 2001b
8	5 March 2001	Ancona (Italy)	420	male	Specimen of about 300 kg caught by net some 16 miles off the coast. Verified by photographer L. Caretta and local fisherman V. Renzi.	Anonymus, 2001c
9	15 March 2001	Ancona (Italy)	1000-1200		Group of some 10 specimens sighted 12-13 miles off the coast. Harbour Office representatives neared and photographed only 1 individual.	Anonymus, 2001d
10	15 March 2001	Cesenatico (Italy)	800		Specimen sighted some 5 miles off the coast and photographed by Harbour Captain.	Drudi, 2001
11	20 March 2001	Fano (Italy)	700		Group of 5 specimens photographed by Harbour Office Captain G. Greco 5 miles off the coast.	Anonymus, 2001e
12	22 March 2001	Umag (Croatia)	600		Sighting. Photographed.	Soldo, unpubl. data
13	28 March 2001	Caorle (Italy)	500		Specimen sighted twice on the same day 3 miles off the coast and photographed by Harbour Office Captain G. Scattola Caorle.	Prevarin, 2001; Anonymus, 2001f
14	29 March 2001	Caorle (Italy)	<500		Specimen sighted several times by the same person as in the previous case is most probably not the same individual, as it may be concluded from the photo.	Prevarin, 2001
15	2 April 2001	Ravenna (Italy)	1000 (?)		Specimen caught by net 18 miles off the coast and released.	Anonymus, 2001g
16	April 2001	Istran coast between Izola and Piran (Slovenia)	-		Group of around 8 specimens observed several times by fishermen and researchers of the Slovene Marine Biology Station.	Lipej, pers. comm., Anonymus, 2001h
17	25 April 2001	Porto San Giorgio (Italy)	600 - 800		Sighting of 2 specimens.	Anonymus, 2001i
18	7 May 2001	Goro (Italy)	535	female	Specimen of 900 kg caught by net 2 miles off the coast and examined by G. Gavanelli and other researchers.	Anonymus, 2001j
19	9 May 2001	Trieste (Italy)	600		Sighting.	Anonymus, 2001k
20	20 May 2001	Kali / Ugljan Island (Croatia)	800		Specimen sighted several times.	Soldo, unpubl. data
21	12 September 2001	Cattolica (Italy)	430		Capture.	Zuffa, unpubl. data

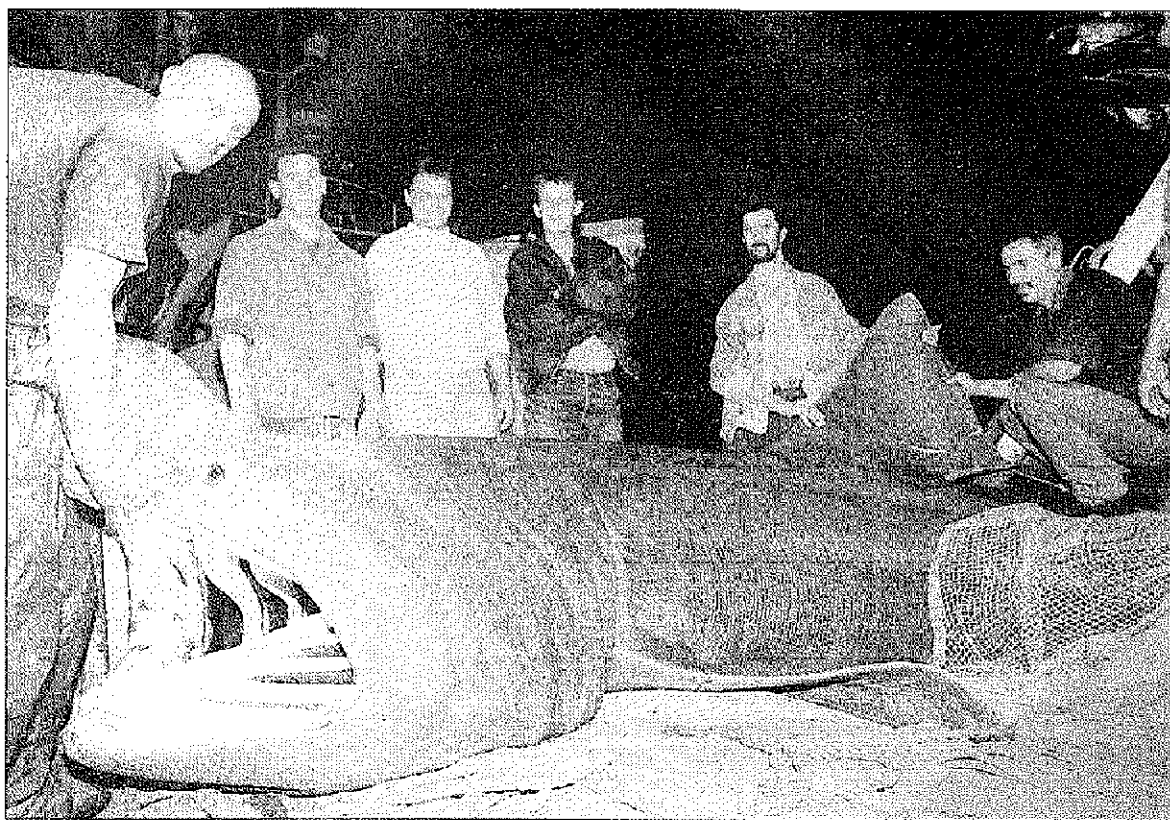


Fig. 2: Photo relative to case 3.
Sl. 2: Fotografija orjaka, ujetega 23. 5. 2000.

All the data have been carefully examined and cross-compared by eyewitnesses in order to verify every single case.

To answer the questions raised by this case, some hypotheses are presumed in the light of the first analysis of the recorded data and the investigations into different elements influencing the migratory behaviour of the species.

RESULTS AND DISCUSSION

The recent abundance of *Cetorhinus maximus* in the Adriatic basin (Fig. 1) is indeed anomalous in comparison with the records collected in the last 20 years in the same area. The first examination of 21 cases (Tab. 1) shows the presence of male (cases 2, 7 and 8) and female (case 18) specimens of various dimensions (Figs. 2, 3, 4). This observation underlines the contemporary presence of specimens with varied stages of development. In fact, those stages ranged from young specimens (cases 2 and 5) up to adults of grandiose dimensions (cases 4 and 15).

Aggregations of 5-10 sharks have been often observed (cases 9, 11 and 16), which speaks of a true migration than of occasional passage by single specimens.

A meaningful sign of the migratory movement from south to north, coming from the Ionian Sea, was the capture and eventual release of a large specimen estimated to be 800-900 cm long (Anonymus, 2001a; A. De Maddalena, *pers. comm.*). It took place on February 5th 2001 on the open sea in front of Gallipoli and was the start of a series of recorded sightings and captures during the year of 2001.

The case 7 is particularly interesting. Despite the fact that the capture was made during the winter (February 5th 2001 off S. Benedetto del Tronto), the specimen was showing gillrakers perfectly developed and apparently functional (S. Giacoia, *pers. comm.*). This case, together with similar capture of a basking shark with functional gillrakers that was made off Balearic Islands on February 3rd 1985 (Gallego & Alemany, 1985), could suggest that the loss of such organs during the winter season is not obligatory as suggested (Compagno, 1984). This morphological aspect could have a relevant importance on the knowledge of the shark's feeding behaviour, as some authors presumed that during the period without gillrakers, the basking shark could develop a lethargic behaviour (Ellis, 1983; Mojetta, 1997) or change its diet (Lipej *et al.*, 2000).

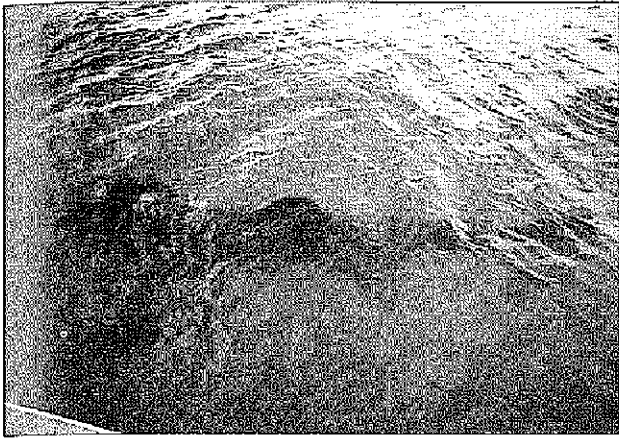


Fig. 3: Photo relative to case 13.

Sl. 3: Fotografija orjaka, opaženega 22. 3. 2001.

A preliminary investigation along the Tuscany coasts (about 120 km in length), frequently visited by *Cetorhinus maximus* (Storai & Zuffa, *unpubl. data*), shows almost (single record in July 2000) total absence of sighting or capture records in this area, while at the same time an increase in the frequency of the basking shark records in the Adriatic Sea has been observed.

If this observation could be confirmed by some other cross-comparisons, which would include other factors necessary for a better and true understanding of the basking shark behaviour, this could indicate a true pattern of migration for the basking shark population in the Central Mediterranean.

Unfortunately, the collected data do not allow us, at the moment, to make any final conclusions as to the causes of the dealt with phenomenon.

Different hypotheses have been taken into consideration, including various elements, as possible causes for the changes in the basking shark behaviour in the Adriatic. The hypotheses, which can throw light on the strange phenomenon presented, are as follows:

1. Climate changes

Certain changes in the Adriatic ichthyofauna due to climate changes in the Adriatic have been already observed (Dulčić *et al.*, 1999). Eleven subtropical and tropical fishes have been recorded for the first time, and several species, fairly rare or very rare until now, are more abundant. The main reason for such changes is the warmer seawater that is affecting marine ecosystem. Along with other hydrodynamic factors, such as salinity, this can explain the reasons for the increase of the basking shark records in this area.

2. Changes in zooplankton abundance

It is known that basking shark feeds exclusively on small planktonic organisms, such as small copepods, barnacles, decapod larvae and fish eggs (Compagno,

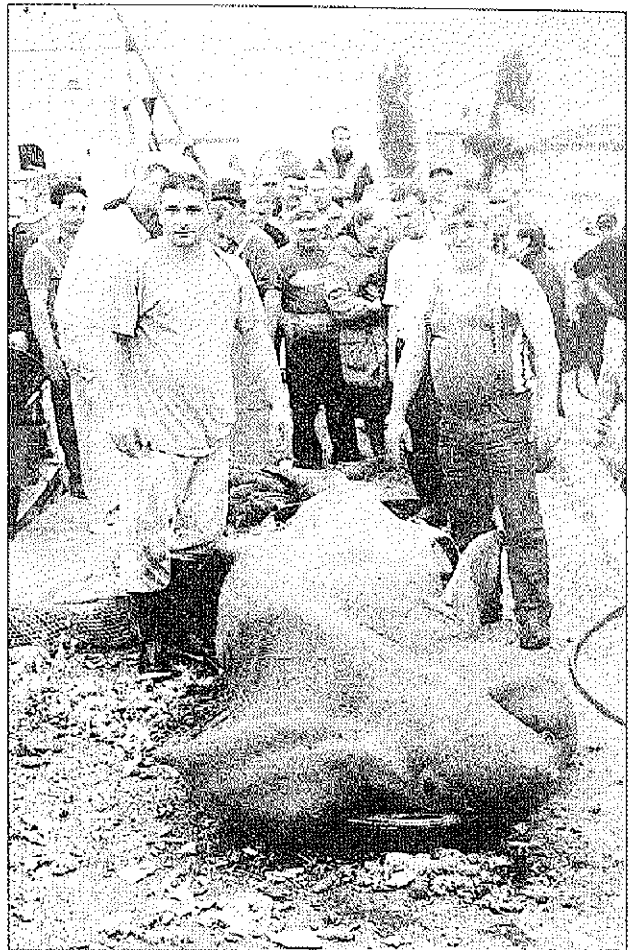


Fig. 4: Photo relative to case 18.

Sl. 4: Fotografija orjaka, ujetega 7. 5. 2001.

1984). Climate changes affect primary and secondary production, so it is possible that changes in abundance and species composition of zooplankton are causing basking shark to respond and follow these changes in the Adriatic. To prove such hypotheses, we would need new data on the monthly changes of zooplankton in the Adriatic. Currently, some projects regarding this subject are being conducted at the Institute of Oceanography and Fisheries in Split, and as soon as these data and comparison with basking shark data are made, this hypothesis could be proved either right or wrong.

3. Unknown aspects of the basking shark metabolism and behaviour

As there are numerous basking shark biology factors that are still unknown, a more thorough investigation on that subject would be necessary in order to fully understand the pattern of its response to different conditions.

At present, the main objectives would be monitoring and a more careful investigation into the absence of basking shark records in the Tyrrhenian Sea and into the

increase of its records in the Adriatic, which could indicate a possible pattern of migration from the Tyrrhenian to the Adriatic. Furthermore, the increase of records in the Adriatic Sea observed during 2000 and 2001 must be repeated for a longer period of time, before it could be accepted as a true change in the shark's migratory behaviour.

However, this abnormal occurrence of the basking shark has attracted the attention of numerous researchers of different occupations to carry out preliminary plans of tagging, photoidentification, genetic analysis, etc. Such plans have been made by a number of international researches joined in the Mediterranean Shark Research Group, whose intention is, among other scopes, to collect and monitor all the basking shark records made in the Mediterranean. Such collaboration and

exchange of information between researchers, different groups and institutes studying this subject are certainly most welcome in order to obtain reliable results and extend our knowledge of this giant species.

ACKNOWLEDGEMENTS

A particular thanks is due to the numerous Harbour Offices that enabled us to collect information and to photograph a number of basking sharks. Another particular thanks go to the Research Institutes that has helped us to verify certain data. Hence, thanks to Sergio Giacoia, Albano Bugari, Luigi Carretta, Gianluca Cugini and Boris Šuligoj. Finally, many thanks to Gildo Gavanelli, for his precious help.

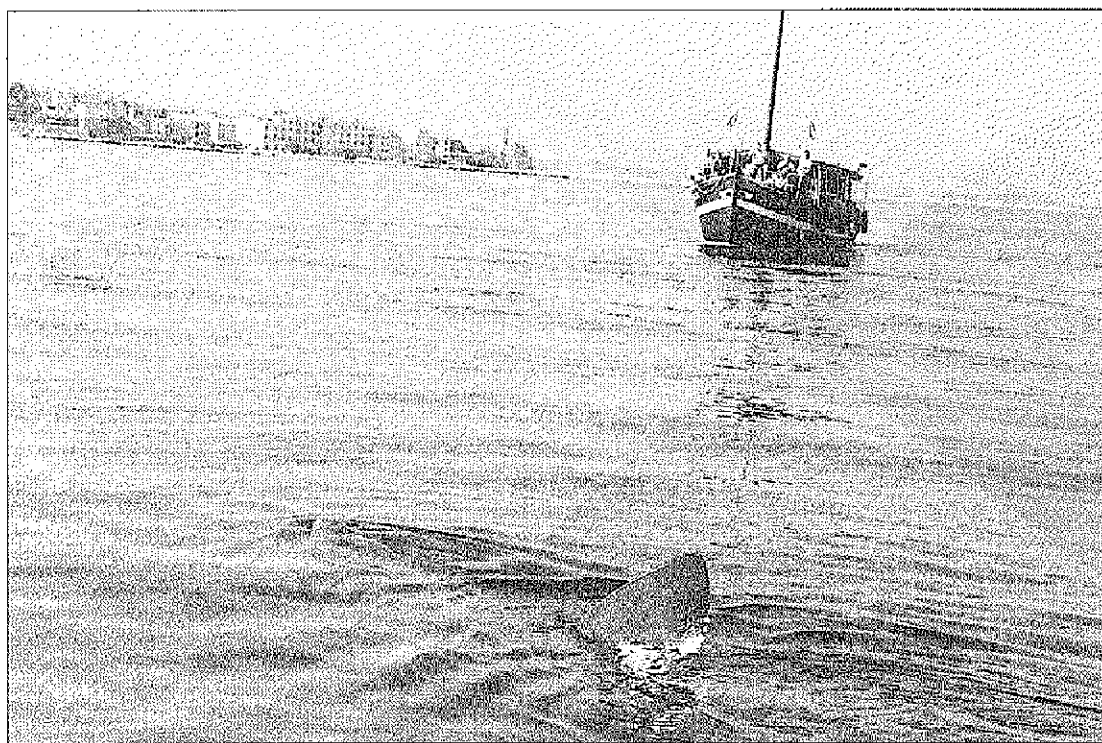


Fig. 5: Photo relative to case 16. (Photo: B. Šuligoj)

Sl. 5: Fotografija orjaka, opažena aprila 2001 pred Piranom, Slovenija. (Foto: B. Šuligoj)

PRVE UGOTOVITVE O NENAVADNO POGOSTEM POJAVLJANJU MORSKEGA PSA
ORJAKA *CETORHINUS MAXIMUS* (GUNNERUS, 1765) V SREDNJEM
IN SEVERNEM JADRANU

Marco ZUFFA

Museo "L. Donini", IT-40064 Ozzano nell'Emilia, Via Prunaio 1

Alen SOLDO

Inštitut za oceanografijo in ribištvo, HR-21000 Split, P.P. 500

E-mail: soldo@izor.hr

Tiziano STORA

Museo Civico di Scienze Naturali della Valdinievole, IT-51017 Pescia, P.zza Leonardo da Vinci 1

E-mail: tstora@tin.it

POVZETEK

V letu 2000 in v prvih mesecih leta 2001 so iz srednjega in severnega Jadrana poročali o nenavadno pogostem pojavljanju psa orjaka *Cetorhinus maximus* (Gunnerus, 1765) vzdolž italijanskega, slovenskega in hrvaškega obrežja. Zbrani podatki govorijo o: 1) opažanjih enega osebkov in majhnih skupin in 2) naključnih ulovih teh orjakov. Sicer pa se je število opažanj, zbranih o tej vrsti v zadnjih dveh letih, močno povečalo glede na opažanja v prejšnjih letih, kar je tudi razlog, da so v članku predstavljena razmišljanja avtorjev o očitnih selitvenih gibanjih psov orjakov v Jadranskem morju in primerjave s podatki te vrste iz Tirenskega morja. Avtorji nas seznanjajo tudi z nekaterimi domnevami o vzrokih za pojavljanje tako nenavadnega števila psov orjakov v obravnavanem območju.

Ključne besede: *Cetorhinus maximus*, pes orjak, srednji in severni Jadran

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