received: 2020-12-24 DOI 10.19233/ASHN.2021.05

NOTES ON A RARE CASE OF BLUNTNOSE SIXGILL SHARK *HEXANCHUS GRISEUS* STRANDED ON THE COAST OF TUSCANY IN THE CENTRAL TYRRHENIAN SEA

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ABSTRACT

*A rare stranding event involving a 297 cm long mature male bluntnose sixgill shark (*Hexanchus griseus*) occurred on the Tuscan coast in the central Tyrrhenian Sea. The stranded specimen had 6 rows of teeth indicating that it belonged to the* H. griseus *and not to the* Hexanchus nakamurai *species, which only has 5. Biometric data on two teeth of the left front region of the lower jaw were collected. The body of the specimen did not show evidence of capture, only a deep cut at the height of the orbital arch suggesting a crash or the ramming of a boat.*

Key words: bluntnose sixgill shark, *Hexanchus griseus*, shark stranding, teeth, Mediterranean Sea

NOTE SU UN RARO CASO DI SPIAGGIAMENTO DI CAPOPIATTO *HEXANCHUS GRISEUS* LUNGO LA COSTA TOSCANA NEL MAR TIRRENO CENTRALE

SINTESI

*Un raro evento di spiaggiamento che ha coinvolto un capopiatto maschio maturo lungo 297 cm (*Hexanchus griseus*) si è verificato lungo la costa toscana nel mar Tirreno centrale. L'esemplare spiaggiato presentava 6 file di denti che indicavano l'appartenenza alla specie* H. griseus *e non alla specie* Hexanchus nakamurai*, che ne ha solo 5. Sono stati raccolti dati biometrici su due denti della regione anteriore sinistra della mascella inferiore. Il corpo dell'esemplare non mostrava segni di cattura, solo un profondo taglio all'altezza dell'arco orbitale che suggeriva una collisione o lo speronamento di una barca.*

Parole chiave: capopiatto, *Hexanchus griseus*, spiaggiamento di squalo, denti, Mediterraneo

INTRODUCTION

The bluntnose sixgill shark *Hexanchus griseus* (Bonnaterre, 1788) is a deepwater, benthic, littoral and semi-pelagic shark (Compagno *et al.*, 2005), listed as near threatened (NT) by the Red List of the International Union for Conservation of Nature (I.U.C.N.) (*Finucci et al.*, 2020). Juveniles may approach the coast in cold water, while adults live in shallow waters close to submarine canyons (Compagno *et al.*, 2005). *H. griseus* is found in the Pacific and Indian Oceans, off the eastern and western Atlantic coasts, and in the Mediterranean Sea (Bass *et al.*, 1975), up to 1875 meters deep (Compagno *et al.*, 2005). The bluntnose sixgill shark makes day and night excursions, moving from a depth of 250 m up to 20 m, near the surface (Andrews *et al.*, 2009). The biology of *H. griseus* in the Mediterranean is poorly known and the little information published focuses mostly on its ichthyological characteristics (Capapé *et al.*, 2003). Cases of hermaphroditism, although rare in elasmobranchs, seem to be present in bluntnose sixgill shark (Daniel, 1928). The maturity is reached at 309–330 cm of total length (TL) in males and 350–420 cm TL in females, while the maximum size reached is probably 550 cm TL (Compagno *et al.*, 2005). In the present article, authors report an incident of a stranded bluntnose sixgill shark found on the Tuscan coast (central Tyrrhenian Sea) and provide information on the examined specimen. Furthermore, the authors review the occurrence status of *H. griseus* in the Mediterranean Sea in light of available data.

MATERIAL AND METHODS

On 16 March 2016, a bluntnose sixgill shark was found on the beach of Marina di Grosseto in Tuscany (coordinates: 42°43′24.5″N 10°58′19.4″E), Italy (Fig. 1a). This area, located in the northwestern Mediterranean, more precisely, in the central Tyrrhenian Sea, is characterised by a sandy bottom that slowly degrades

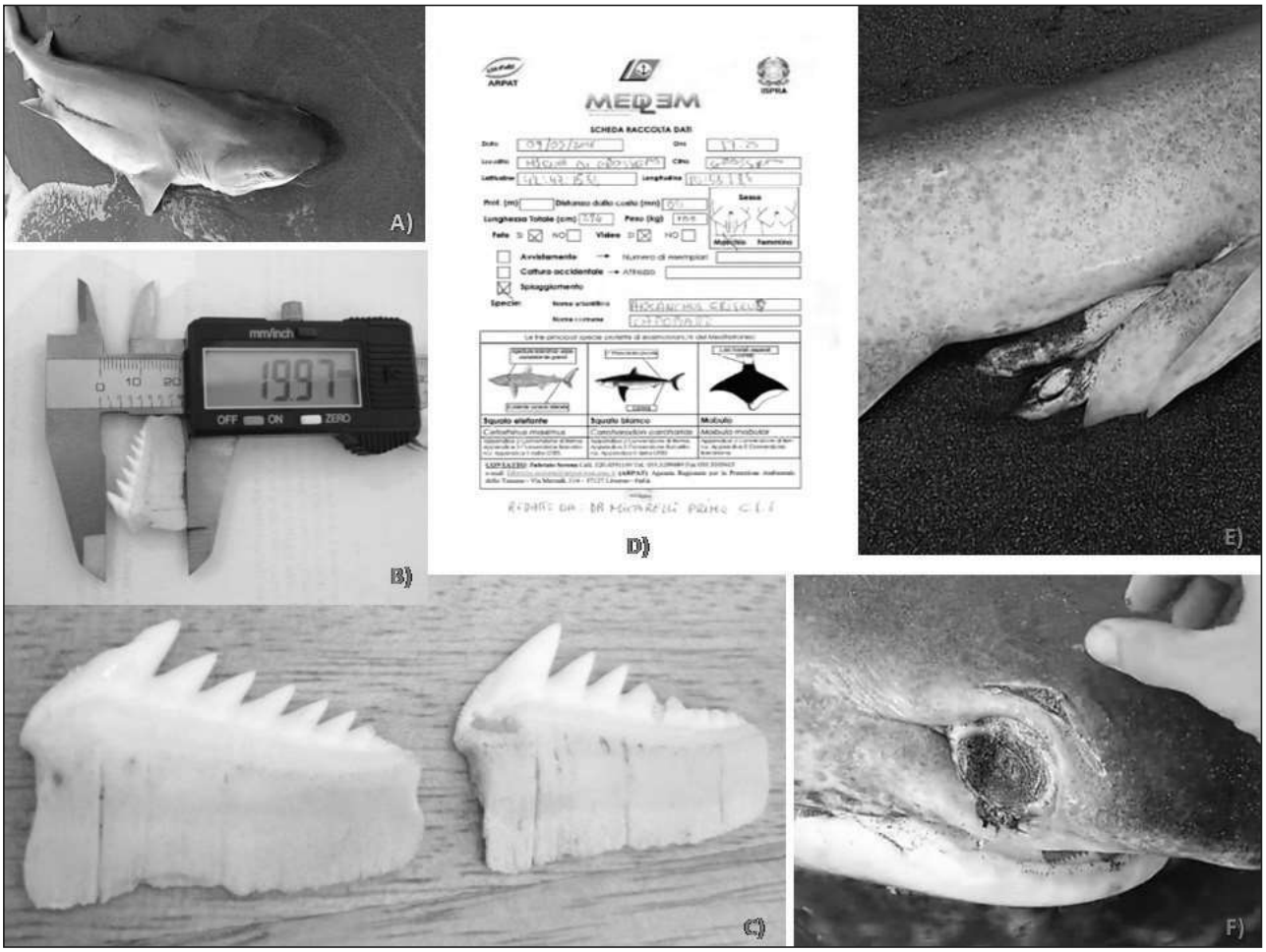

Fig. 1: *(A) Hexanchus griseus;* ***(B) tooth measurement; (C) teeth; (D) MEDLEM report; (E) claspers; (F) damaged eye.***
Sl. 1: *(A) Hexanchus griseus;* ***(B) merjenje zob; (C) zobovje; (D) MEDLEM poročilo; (E) klasperja; (F) poškodovano oko.***

before reaching significant depths. The specimen, found in late afternoon, was quickly collected and taken to landfill by the local authorities, thus only allowing for a collection of limited biometric data based on a few samples of teeth, and checking the external condition of the specimen. The shark was measured on the beach and its total length (TL) was recorded as a straight line extending from the tip of the snout to the tip of the upper lobe of the caudal fin, with the latter in the depressed position. This type of measurement represents the maximum length according to Compagno (1984). The available data were entered in the MEDLEM reporting form (Fig. 1d).

RESULTS

The male specimen displayed a pair of calcified claspers and was probably mature (Fig. 1e). Its size was 294 cm TL, it had no external abrasions or signs of capture by fishing gear; the mouth was free and without hooks. At the level of the left eye socket there was a deep horizontal cut and the eye was damaged (Fig. 1f). Six dental rows were observed and the dental formula 20/13 corresponded to that of H. griseus according to Last & Stevens (2009). Biometric analyses of two teeth A1 and A2 (Fig. 1c) of the front left region of the lower jaw were performed using a caliper (Fig. 1b). The biometric measurements, taken in mm, are shown in Table 1. The sixgill shark species *H. griseus* (Bonnaterre, 1788) and *Hexanchus nakamurai* (Teng, 1962) stand out for the presence of six rows of distinctly comb-shaped teeth in the lower jaw in the former and five rows in the latter species; moreover, *H. griseus* has a short, blunt, broadly rounded snout and a dorsal-caudal distance approximately equal to its dorsal fin base length, while *H. nakamurai* has a relatively longer snout that is more pointed and narrow, and a dorsal-caudal distance that is much longer than the dorsal-fin base length (Ebert *et al.*, 2013). In addition, Adnet (2006) stated that *H. griseus* and *H. nakamurai* are hard to distinguish, especially because of the similarity between the lower teeth of juvenile or sub-adult specimens in both species.

DISCUSSION

A historical survey of Mediterranean reports since 1892 shows that *H. griseus* has been captured in restricted areas of the western basin more commonly than in the eastern one (Capapé *et al.*, 2003). *H. griseus* is included in the I.U.C.N. Red List, and even though its populations are considered stable, they still require careful monitoring; in fact, species with similar life histories, often called 'K-selected' (Camhi *et al.*, 1998), can be affected by deepwater fishery (Walls *et al.*, 2015). Between 1666 and 2014, the MEDLEM (Serena *et al.*, 2014) database for the Mediterranean Sea recorded occurrences of bluntnose sixgill shark (*H. griseus*) in Maltese waters (20 specimens; GSA 15); in the northern Tyrrhenian Sea (45 specimens; GSA 9); in the southern Adriatic Sea; in the northern Ionian Sea; in the southern waters of Sicily (21 specimens; GSA 18, 19, and 16 respectively); along the coasts of Tunisia (GSA 13 and 14) (Capapé *et al.*, 2003; 2004); and in Turkish waters (24 specimens). The Mediterranean Sea has been divided into 30 geographical sub-areas, called GSAs, by the General Fishery Commission for the Mediterranean - GFCM. Kabasakal (2013) states that 150 specimens of *H. griseus* were caught by commercial fishing vessels in the seas of Turkey between 1967 and 2013, 90 of which were recorded in the Marmara Sea. Based on an analysis of internet-based media reports on rare and large sharks of Turkey, Kabasakal & Bilecenoğlu (2020) indicated that nearly 52 percent (139 out of 268 specimens) of sharks captured between 2006 and 2020 were *H. griseus*. The bluntnose sixgill shark is also regularly captured along the coast of Lebanon (Lteif, 2015) and along the coasts of Calabria (21 specimens; GSA 10 and 19), (Leonetti *et al.*, 2020). Stranding of bluntnose sixgill sharks in the Mediterranean Sea is rare, particularly in consideration of their presence at great depths. Kabasakal (2006) reported a female specimen (450 cm TL) stranded in the Dardanelles Strait on 5 June 1999. Although in the present case it was not possible to collect all the samples needed to provide a more useful contribution to the knowledge of the biology of this species, it was nevertheless possible to establish that the number of rows of teeth equalled 6, which excluded the possibility that the shark could be a *H. nakamurai*, whose maximum TL does not

Tab. 1: Five measurements were collected for each tooth: CH, crown height; RH, root height; TH, total height; BWT, basal width of the tooth; HC, height of the cusp.
Tab. 1: Za vsak zob je bilo opravljenih pet meritev: CH, višina krone; RH, višina korenine; TH, celotna višina; BWT, bazalna širina zoba; HC, višina grbice.

Biometric measurements of the teeth (mm)		
	A1	A2
CH	10.3	9.84
RH	12.3	11.42
TH	19.97	19.49
BWT	28.99	28.06
HC	6.69	6.36

exceed 180 cm. It is important to remember that it is difficult to distinguish between specimens of the two species without precise information on their body size or maturity and only by comparing the teeth. In fact, Adnet (2006) showed that the two recent species of the genus *Hexanchus* have a similar dental development but with a different growth rate: at same tooth width, *H. griseus* retains a "young" morphology compared to that of *H. nakamurai* and the distinction between the two species in relation to dentition is currently limited to the presence, in some individuals, of a vertical median cusp on the symphyseal tooth in *H. nakamurai*, and different dental formulae. The size of the stranded animal and the presence of hard and well-calcified claspers indicated its probable maturity, although its body size was slightly smaller than the minimum size at maturity indicated by Compagno et al. (2005), which is 309 cm for males. Observations suggest that H. griseus matures at a smaller size in the Mediterranean than elsewhere (Capapé *et al*., 2004). The examination of the collected teeth confirmed the equation for establishing the size of the animal based on the measurement of the tooth base. As a matter of fact, in large shark species such as *H. griseus*, the length of the body (Total Length according to Compagno, 1984) and the width of the teeth in each row are well correlated (R = from 0.95 to 0.98, $p < 0.001$). A simple linear regression equation expresses the relationship between the width of the lower teeth and the length of the shark's body, which can be calculated as follows: shark's length (in cm) = 111 × tooth's width (in cm) + 3.9 (R = 0.97, $p < 0.001$; N = 243) (Adnet, 2006). If we were to apply the equation in this instance, it would have been possible to estimate a length of about 325 cm, slightly greater than the measured one, thus confirming the correctness of the proposed equation. With regard to the reasons of the stranding, the absence of apparent damages from fishing tools and the presence of a deep cut at the eye level may suggest the possibility that this male specimen rose to the surface due to various reasons that could have also caused its death by ramming such as, for example, an accident with a boat. Injured sixgill sharks may be at risk for post-release or post-accident disability, or mortality due to long-term pathologic consequences of anthropogenically induced scars (Kabasakal, 2010). Andrews *et al*. (2009) found that in Puget Sound (USA), sixgill sharks showed consistent diel behavioural patterns throughout the year and inhabited greater depths during the day than during the night, being more active (with greater variation in depth and greater rates of vertical movement) at night. It is interesting to note that, in our case, the stranding occurred in March, right at the beginning of the spring season when, just like in Puget Sound, the movement to the surface of these sharks is more frequent. Seasonally, sixgill sharks occupy deeper habitats in autumn and winter than they do in spring, and are more active in autumn (Andrews *et al*., 2009). Moreover, in the Mediterranean, little is known about the behaviour of these sharks: Capapé *et al*. (2004) states that *H. griseus* is probably able to live and reproduce in the Mediterranean Sea; however, further observations are needed to confirm that a sustainable bluntnose sixgill shark population has been established here, especially off the Maghrebi coast. Incidental capture of a new-born specimen (60 cm TL) with an unhealed umbilical scar (birthmark) between the pectoral fins suggested the possibility of a nursery ground of *H. griseus* in northern Aegean Sea bathyal grounds (Kabasakal, 2013). Moreover, another possible nursery ground was suggested in the Marmara Sea, where several juveniles (120 to 250 cm TL) were incidentally captured (Kabasakal, 2013). Finally, lack of information on the movements of the specimens along Turkish coasts reveals the necessity of tagging surveys of *H. griseus* in the mentioned region to understand the spatial and bathymetric movement patterns of this species (Kabasakal, 2013). Meager & Sumpton (2016) suggest that an integrated approach of using stranding and bycatch data may provide an indicator of long-term trends for data-limited cetaceans, and that stranding programs can give a faithful representation of the species composition of cetacean assemblages, while standardised bycatch rates can provide a measure of relative abundance. Therefore, in the long term, the stranding of elasmobranchs, however rare and even in the case of animals living in the deep but periodically venturing to surface waters, could provide useful insights for an evaluation of their health status. This information provides a useful contribution to the biometric data available for this species, with particular reference to teeth, and testifies to a rare case of stranding.

ZAPIS O REDKEM PRIMERU MORSKEGA PSA ŠESTEROŠKRGARJA *HEXANCHUS GRISEUS*, KI JE NASEDEL NA TOSKANSKI OBALI V OSREDNJEM TIRENSKEM MORJU

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POVZETEK

*Avtorji poročajo o redkem primeru, ko je na toskanski obali v osrednjem Tirenskem morju nasedel 297 cm dolg odrasel samec morskega psa šesteroškrgarja (*Hexanchus griseus*). Nasedli primerek je imel 6 nizov zob, po katerih ga je bilo možno razlikovati od sorodne vrste* Hexanchus nakamurai*, ki ima 5 nizov. Avtorji so opravili biometrijo na dveh zobeh levega sprednjega dela. Na telesu morskega psa ni bilo videti znakov ulova, le globoka rana v višini očesnega loka priča o morebitnem trku s plovilom.*

Ključne besede: morski pes šesteroškrgar, *Hexanchus griseus*, nasedli morski pes, zobovje, Sredozemsko morje