

Short scientific article
Received: 2006-07-20

UDC 599.53:597.3(262)

EVIDENCE OF PREDATORY ATTACK ON A BOTTLENOSE DOLPHIN *TURSIOPS TRUNCATUS* BY A GREAT WHITE SHARK *CARCHARODON CARCHARIAS* IN THE MEDITERRANEAN SEA

Antonio CELONA

Aquastudio Research Institute, I-98121 Messina, Via Trapani 6, Italy

Alessandro DE MADDALENA

Banca Dati Italiana Squalo Bianco (Italian Great White Shark Data Bank), I-20145 Milano, Via L. Ariosto 4, Italy

E-mail: a-demaddalena@tiscali.it

Giorgia COMPARETTO

Necton Marine Research Society, I-95100 Catania, Via A. De Gasperi 187, Italy

ABSTRACT

A live adult bottlenose dolphin Tursiops truncatus, bearing two fresh bites of great white shark Carcharodon carcharias on its dorsal region, was encountered on May 5, 2006 near Lampedusa, Italy, Mediterranean Sea. It is estimated that the wounds suffered by this mammal were inflicted by a white shark greater than 4 meters in length. This is the first time that a bottlenose dolphin that survived a white shark attack has been reported from the Mediterranean, and is definitive evidence that C. carcharias actually attacks live bottlenose dolphins in these waters.

Key words: bottlenose dolphin, *Tursiops truncatus*, great white shark, *Carcharodon carcharias*, predation

TESTIMONIANZA DI ATTACCO PREDATORIO SU TURSIOPE *TURSIOPS TRUNCATUS* DA PARTE DI SQUALO BIANCO *CARCHARODON CARCHARIAS* NEL MARE MEDITERRANEO

SINTESI

Un tursiope Tursiops truncatus adulto, recante recenti ferite causate da due morsi di squalo bianco Carcharodon carcharias nella regione dorsale, è stato incontrato il 5 Maggio 2006 al largo di Lampedusa, Italia, Mare Mediterraneo. Si stima che le ferite siano state inferte dal cetaceo da parte di uno squalo bianco di oltre 4 metri di lunghezza. Questa è la prima volta che un tursiope sopravvissuto ad un attacco di squalo bianco viene segnalato nel Mediterraneo, ed è la prova definitiva che C. carcharias attacca effettivamente tursiopi vivi in queste acque.

Parole chiave: tursiope, *Tursiops truncatus*, squalo bianco, *Carcharodon carcharias*, predazione

INTRODUCTION

Cetacean remains are frequently found in the stomachs of great white sharks *Carcharodon carcharias* (Linnaeus, 1758), but a fundamental distinction must be made between scavenging a dead cetacean and the act of predation, by attacking or killing a live cetacean. Of over 479 species of sharks (Compagno, 2001), only about 6, including the great white shark, are known to prey on small odontocetes (Long & Jones, 1996). White shark's bite scars and fresh wounds have been used with success to identify the species of sharks responsible for predation and scavenging on humans, pinnipeds, cetaceans, and other animals (Cigala Fulgosi, 1990; Long & Jones, 1996; Long et al., 1996; Collier, 2003).

In the Mediterranean Sea, white sharks feed on cetaceans, including bottlenose dolphins *Tursiops truncatus* (Montagu, 1821), common dolphins *Delphinus delphis* Linnaeus, 1758, sperm whales *Physeter macrocephalus* Linnaeus, 1758, and fin whales *Balaenoptera physalus* (Linnaeus, 1758) (De Maddalena, 1999, 2002, unpubl. data), but white shark predation on cetaceans is poorly documented (Fergusson, 1994, 1996; Bianucci et al., 2002). Presented here is the first case of a white shark-bitten, live bottlenose dolphin *Tursiops truncatus* from the Mediterranean.

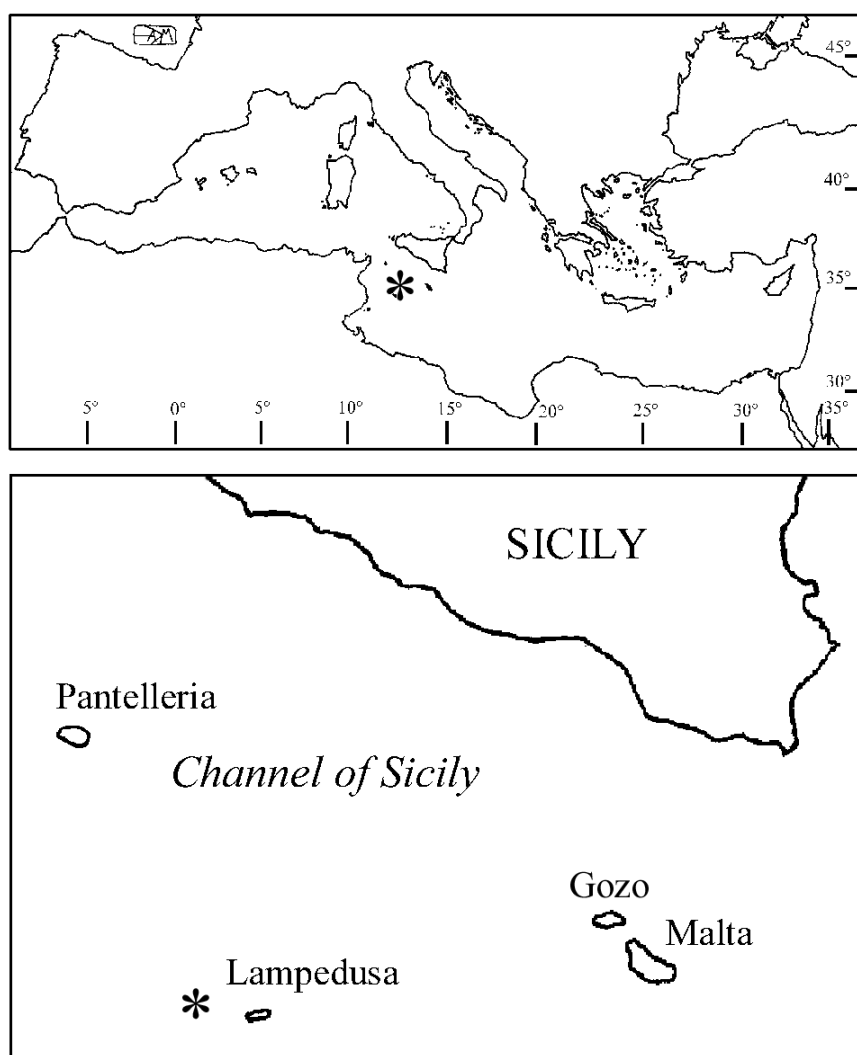


Fig. 1: Area of the Central Mediterranean Sea showing the location where a bottlenose dolphin *Tursiops truncatus* bearing two fresh bites of great white shark *Carcharodon carcharias* was encountered. (Drawing: A. De Maddalena)
Sl. 1: Območje osrednjega dela Sredozemskega morja z lokacijo, na kateri je bila opažena velika pliskavka *Tursiops truncatus* z dvema svežima ugrizoma, ki ji ju je prizadejal beli morski volk *Carcharodon carcharias*. (Risba: A. De Maddalena)

MATERIAL AND METHODS

Since 1996, the Italian Great White Shark Data Bank (Banca Dati Italiana Squalo Bianco) has collected a substantial amount of information regarding historical and recent records of the great white shark from the Mediterranean Sea. This data includes information on size, distribution, habitat, behaviour, reproduction, diet, fishery and attacks on humans (De Maddalena, 1998, 1999, 2000a, 2000b, 2002, 2005; Celona *et al.*, 2001; De Maddalena *et al.*, 2001, 2003; Galaz & De Maddalena, 2004). The study of the trophic relationships between great white sharks and the Mediterranean fauna is a fundamental part of this research program.

The observation reported in this work was made during a research program in the area of the Isole Pelagie, Italy, where Necton Marine Research Society manages and maintains a study of the marine mammals that regularly frequent the archipelago waters. The observations reported here were made near Lampedusa (35° 28,912 N, 12° 33,865 E) (Fig. 1). Surface and underwater observations were made during favourable weather conditions (sea state Beaufort 1). Surface photographs were taken using a Canon EOS 350D.

RESULTS AND DISCUSSION

On May 5, 2006, in the late afternoon, at approximately 17.00 hrs, two of the authors (A.C. and G.C.) were aboard a 6 m inflatable boat off Lampedusa. Nearby, four bottlenose dolphins were observed surfacing. The cetaceans travelled relatively slowly with their dorsal fins protruding above the surface. The group consisted of three adults and one calf that moved in two subgroups, comprised of two adults, and one adult with one calf, respectively. The dolphins followed a fishing boat that was fishing with a bottom trawl. The dolphins swam about 500 m from the boat stern, performing dives of four minutes. The subgroup formed by the two adults was about 50 m in front of the second subgroup. The dolphins never allowed the observers to approach them closer than 100 m. As the observers moved towards the dolphins, the cetaceans moved farther away or momentarily swam deeper out of visibility range and then reappeared on the opposite side of the boat. One of the adult bottlenose dolphins, approximately 3.5 m in length, showed fresh wounds from two shark bites on its dorsal region (Fig. 2). The whole encounter lasted 30 minutes in total.

By closely examining the wounds, the authors were able to identify the species of shark responsible for the attack as a great white shark. The wounds were located in the dolphin's dorsal region, and had a wide parabolic shape, suggesting an extremely wide mouth. The dorsal fin showed an evident bite mark on its anterior margin. The wounds were mainly made of regular marks, inflicted by the white shark's large, triangular, serrated,

well-spaced teeth. We believe the slice, or cut, in front of the dorsal fin is a primary bite from a white shark's lateral teeth. The secondary wound, which consists of the five distinct punctures below the dorsal fin, especially their spacing, is very suggestive of upper anterior teeth of a white shark. Counting two punctures down from the uppermost wound, the distance between the second and third punctures appears to be the centre of the jaw with the small cut, number five from the top,

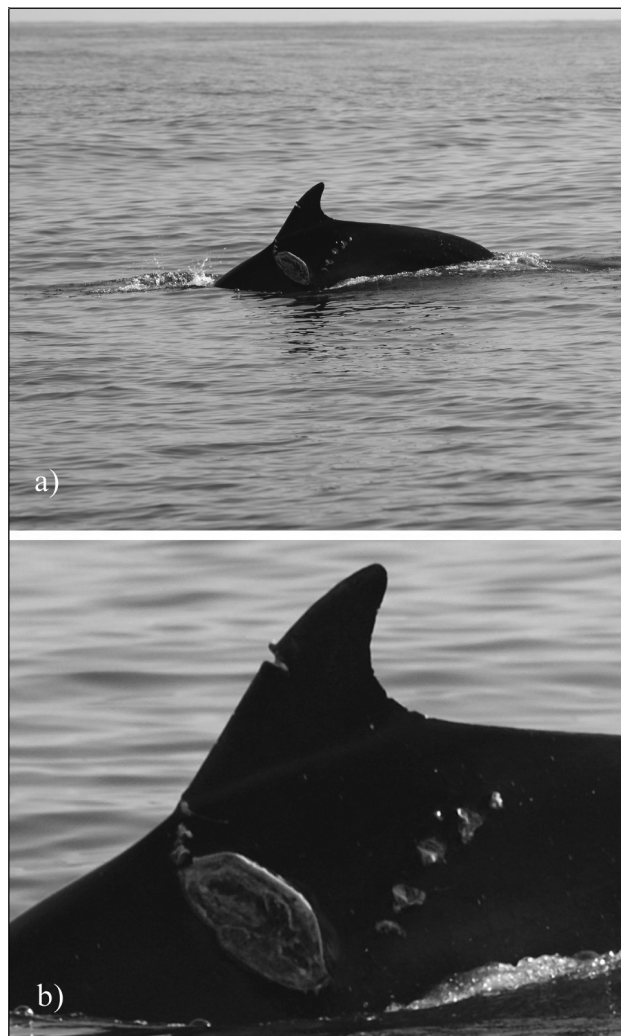


Fig. 2: (a) Estimated 3.5 m bottlenose dolphin *Tursiops truncatus*, photographed on May 5, 2006, near Lampedusa, Isole Pelagie, Italy. (b) Close-up of the dolphin's dorsal region that shows two fresh white shark bites. (Photo: E. D'Andrea)

Sl. 2: (a) Približno 3,5 m dolga velika pliskavka *Tursiops truncatus*, fotografirana 5. maja 2006 nedaleč od otoka Lampedusa v Pelagijskem otočju (Italija). (b) Na bližnjem posnetku hrbtne strani velike pliskavke sta lepo vidna sveža ugriza belega morskoga volka. (Foto: E. D'Andrea)

being the intermediate, or third tooth over from the centre of the jaw. This tooth is smaller than the first and second anterior, with the tip of the tooth pointing inwards toward the second anterior. The 'interspace' between the individual wounds also suggests the animal was greater than 4 meters in length.

The great white shark often suddenly attacks the fast-swimming animals on which it feeds; the success of this predatory strategy depends on the element of surprise (Strong, 1996). It is thought that the great white shark would have difficulty capturing a healthy, fast-swimming prey item if the animal were aware of the predator's presence. The victim typically never sees the shark until it is too late and is overwhelmed by the unexpected assault and the violent force with which it is executed. These sharks have been reported to attack seals, sea lions, sea otters, dolphin, tuna, and human beings using this method (Miller & Collier, 1980; Tricas & McCosker, 1984; Ames et al., 1996; Levine, 1996; Long & Jones, 1996; Long et al., 1996; West, 1996; Collier, 2003). We conclude that the great white shark bit the bottlenose dolphin during a surprise attack, inflicting two bites on it.

White shark approaches on a prey item can be oriented horizontally or vertically. The predator uses its heavy mass and speed to violently ram, disorient, and stun the prey. During vertical approaches, the white shark attacks its prey from below, swimming from depths as deep as 17 metres and moving on a line that is at an angle of 45-90° from the prey (Strong, 1996). The bottlenose dolphin has anteriorly directed sonar and a lateral visual field, so a surprise attack must be in the blind area, either from above, below, or behind to avoid detection (Long & Jones, 1996). We believe that the white shark approached from above and the side the bottlenose dolphin.

White sharks focus their bites on particular areas of the odontocete body: the caudal peduncle, the urogenital region, the abdominal area, and the dorsum. A bite in the first three cited regions may immediately immobilize or kill the cetacean. The dorsal region has a thicker blubber and muscle mass, and a bite in this area would less likely cause death, therefore healed shark wounds are more frequently seen on the backs of living odontocetes (Long & Jones, 1996). The wounds we observed on the dorsum of the bottlenose dolphin were certainly serious and very fresh.

Other 24 cases of trophic interactions between white sharks and dolphins in the Mediterranean have been collected by the Italian Great White Shark Data Bank, but this is the first time that a bottlenose dolphin that survived a white shark attack has been reported from the Mediterranean. Therefore the case reported is the definitive evidence that *C. carcharias* actually attacks live bottlenose dolphins in the Mediterranean.

ACKNOWLEDGMENTS

We must pay special homage to Ralph S. Collier (Shark Research Committee, Van Nuys, California, U.S.A.) who took the time to read and comment on the manuscript. Very special thanks to all the people that offered their help in preparing this work: Emiliano D'Andrea, the Lampedusa fishermen, the command of the Harbour Office and of the Custom Officer in Lampedusa. Special thanks to Bill Heim, who kindly edited the English text of the manuscript. I also thank the referees for their helpful comments. Particular thanks go to Alessandra Baldi and Antonio De Maddalena.

PLENILSKI NAPAD BELEGA MORSKEGA VOLKA *CARCHARODON CARCHARIAS* NA VELIKO PLISKAVKO *TURSIOPS TRUNCATUS* V SREDOZEMSKEM MORJU

Antonio CELONA

Aquastudio Research Institute, I-98121 Messina, Via Trapani 6, Italy

Alessandro DE MADDALENA

Banca Dati Italiana Squalo Bianco (Italian Great White Shark Data Bank), I-20145 Milano, Via L. Ariosto 4, Italy

E-mail: a-demaddalena@tiscali.it

Giorgia COMPARETTO

Necton Marine Research Society, I-95100 Catania, Via A. De Gasperi 187, Italy

POVZETEK

Dne 5. maja 2006 je bil v bližini Lampeduse (Italija, Sredozemsko morje) opažena živa odrasla velika pliskavka *Tursiops truncatus* z dvema svežima ugrizoma na hrbtu. Avtorji članka ocenjujejo, da je rane temu vodnemu sesalcu

prizadejal več kot 4 metre dolg beli morski volk *Carcharodon carcharias*. To je prvo poročilo iz Sredozemskega morja o veliki pliskavki, ki je preživela napad belega morskega volka, in nedvomen dokaz, da *C. carcharias* resnično napada žive velike pliskavke v teh vodah.

Ključne besede: velika pliskavka, *Tursiops truncatus*, beli morski volk, *Carcharodon carcharias*, plenilstvo

REFERENCES

- Ames, J. A., J. G. Geibel, F. E. Wendell & C. A. Pattison (1996): White shark-inflicted wounds of sea otters in California, 1968-1992. In: Klimley, A. P. & D. G. Ainley (eds.): Great white sharks: The biology of *Carcharodon carcharias*. Academic Press, San Diego, p. 309-316.
- Bianucci, G., M. Bisconti, W. Landini, T. Storai, M. Zuffa, S. Giuliani & A. Mojetta (2002): Trophic interaction between white shark, *Carcharodon carcharias*, and cetaceans: a comparison between Pliocene and recent data from Central Mediterranean Sea. In: Vacchi, M., G. La Mesa, F. Serena & B. Séret (eds.): Proc. 4^o Europ. Elasm. Assoc. Meet., Livorno (Italy). Vol. 1. ICRAM, ARPAT & SFI, Livorno, p. 33-48.
- Celona, A., N. Donato & A. De Maddalena (2001): In relation to the captures of a great white shark *Carcharodon carcharias* (Linnaeus, 1758) and a shortfin mako, *Isurus oxyrinchus* Rafinesque, 1809 in the Messina Strait. Annales, Ser. Hist. Nat., 11(1), 13-16.
- Cigala Fulgosi, F. (1990): Predation (or possible scavenging) by a great white shark on an extinct species of bottlenosed dolphin in the Italian Pliocene. Tertiary Research, 12(1), 17-36.
- Collier, R. (2003): Shark Attacks of the Twentieth Century from the Pacific Coast of North America. Scientia Publishing, LLC, Chatsworth, 296 pp.
- Compagno, L. J. V. (2001): Sharks of the World. Vol. 2. FAO Species Catalogue for Fishery Purposes, No. 1, Vol. 2, 100 pp.
- De Maddalena, A. (1998): Il più grande esemplare italiano di squalo bianco, *Carcharodon carcharias* (Linnaeus, 1758) individuato nei reperti conservati presso il Museo di Anatomia Comparata dell'Università "La Sapienza" di Roma. Museologia Scientifica, 15(2), 195-198.
- De Maddalena, A. (1999): Records of the great white shark in the Mediterranean Sea. Private publication, Milano, 54 pp.
- De Maddalena, A. (2000a): Sui reperti di 28 esemplari di squalo bianco, *Carcharodon carcharias* (Linnaeus, 1758), conservati in musei italiani. Ann. Mus. Civ. Stor. Nat. Giacomo Doria, 93, 565-605.
- De Maddalena, A. (2000b): Historical and contemporary presence of the great white shark *Carcharodon carcharias* (Linnaeus, 1758), in the Northern and Central Adriatic Sea. Annales, Ser. Hist. Nat., 10(1), 3-18.
- De Maddalena, A. (2002): Lo squalo bianco nei mari d'Italia. Ireco, Formello, 144 pp.
- De Maddalena, A. (2005): The great white shark, *Carcharodon carcharias* (Linnaeus, 1758) of the Settala Museum in Milan. Boll. Mus. Civ. Stor. Nat. Venezia, 57.
- De Maddalena, A., M. Zuffa, L. Lipej & A. Celona (2001): An analysis of the photographic evidences of the largest great white sharks, *Carcharodon carcharias* (Linnaeus, 1758), captured in the Mediterranean Sea with considerations about the maximum size of the species. Annales, Ser. Hist. Nat., 11(2), 193-206.
- De Maddalena, A., O. Glaizot & G. Oliver (2003): On the great white shark, *Carcharodon carcharias* (Linnaeus, 1758), preserved in the Museum of Zoology in Lausanne. Mar. Life, 13(1/2), 53-59.
- Fergusson, I. K. (1994): Preliminary notes on predation and scavenging by white sharks *Carcharodon carcharias* (Linnaeus, 1758) upon odontocetes in the Mediterranean Sea. Sharks, skate and ray Workshop. 15-16 February, 1994, London, p. 52-56.
- Fergusson, I. K. (1996): Distribution and autecology of the white shark in the Eastern North Atlantic Ocean and the Mediterranean Sea. In: Klimley, A. P. & D. G. Ainley (eds.): Great white sharks: The biology of *Carcharodon carcharias*. Academic Press, San Diego, p. 321-345.
- Galaz, T. & A. De Maddalena (2004): On a great white shark, *Carcharodon carcharias* (Linnaeus, 1758), trapped in a tuna cage off Libya, Mediterranean Sea. Annales, Ser. Hist. Nat., 14(2), 159-164.
- Levine, M. (1996): Unprovoked attacks by white sharks off the South African coast. In: Klimley, A. P. & D. G. Ainley (eds.): Great white sharks: The biology of *Carcharodon carcharias*. Academic Press, San Diego, p. 435-448.
- Long, D. J. & R. E. Jones (1996): White Shark predation and scavenging on Cetaceans in the Eastern North Pacific Ocean. In: Klimley, A. P. & D. G. Ainley (eds.): Great white sharks: The biology of *Carcharodon carcharias*. Academic Press, San Diego, p. 293-307.
- Long, D. J., K. D. Hanni, P. Pyle, J. Roletto, R. E. Jones & R. Bandar (1996): White shark predation on four pin-niped species in central California waters: geographic and temporal patterns inferred from wounded carcasses. In: Klimley, A. P. & D. G. Ainley (eds.): Great white sharks: The biology of *Carcharodon carcharias*. Academic Press, San Diego, p. 263-274.

Miller, D. J. & R. S. Collier (1980): Shark attacks in California and Oregon, 1926–1979. *Calif. Fish Game*, 67(2), 76–104.

Strong, W. R. Jr. (1996): Shape discrimination and visual predatory tactics in white sharks. In: Klimley, A. P. & D. G. Ainley (eds.): *Great white sharks: The biology of *Carcharodon carcharias**. Academic Press, San Diego, p. 229–240.

Tricas, T. C. & J. E. McCosker (1984): Predatory behavior of the White Shark (*Carcharodon carcharias*) with notes on its biology. *Proc. Calif. Acad. Sci.*, 43(14), 221–238.

West, J. (1996): White shark attacks in Australian waters. In: Klimley, A. P. & D. G. Ainley (eds.): *Great white sharks: The biology of *Carcharodon carcharias**. Academic Press, San Diego, p. 449–455.