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ON A GREAT WHITE SHARK, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758), TRAPPED IN A TUNA CAGE OFF LIBYA, MEDITERRANEAN SEA

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ABSTRACT

On June 12, 2002, a towing boat on its way from Libya to Spain stopped at 33º 50´ N, 13º 50´ E, 55 miles off Tripoli, for a check of its 50-m diameter tuna cage containing 60 tons of blue-fin tuna. Here, an estimated 5-m female long white shark suddenly tore the net and entered the cage, where the tuna farm staff then observed it for 2.5 hours. Photographic and filmed evidence was collected. The towing boat continued its journey, and two days later the shark left the cage. Other cases of sharks trapped in tuna cages in the Mediterranean include two blue sharks in a cage between Italy and Spain in 2001, and a shortfin mako in a cage between the Baleares Islands and Murcia, Spain, in 2002. The vulnerable status of white sharks in the Mediterranean necessitates monitoring of the interactions between white sharks and the tuna farm industry, in order that an appropriate action is taken during the attempts to release sharks trapped in tuna cages.

Key words: great white shark, *Carcharodon carcharias*, tuna farm, Mediterranean Sea

SU DI UNO SQUALO BIANCO, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758), INTRAPPOLATO IN UNA GABBIA PER TONNI AL LARGO DELLA COSTA LIBICA, MARE MEDITERRANEO

SINTESI

Il 12 Giugno 2002, una gabbia per tonni di 50 m di diametro contenente 60 tonnellate di tonni rossi si trovava a 33º 50´ N, 13º 50´ E, 55 miglia al largo di Tripoli, Libia, quando venne fermata per un controllo. Qui una femmina di squalo bianco di lunghezza stimata intorno a 5 m ruppe la rete ed entrò nella gabbia, dove lo staff della tuna farm la osservò per 2,5 ore. Testimonianza fotografica e filmata venne raccolta. La nave rimorchio continuò il suo viaggio e due giorni dopo lo squalo aveva riguadagnato la libertà. Altri casi di squali intrappolati in gabbie per tonni nel Mediterraneo comprendono due verdesche in una gabbia tra Italia e Spagna nel 2001, e un mako dalle pinne corte in una gabbia tra le Isole Baleari e Murcia, Spagna, nel 2002. Lo stato vulnerabile dello squalo bianco nel Mediterraneo rende necessario monitorare le interazioni tra squali bianchi e allevamenti di tonni in modo tale da intraprendere azioni appropriate per rilasciare gli squali quando questi restino intrappolati nelle gabbie per tonni.

Parole chiave: squalo bianco, *Carcharodon carcharias*, tuna farm, Mare Mediterraneo

INTRODUCTION

There have been several reports of great white sharks *Carcharodon carcharias* (Linnaeus, 1758) (order Lamniformes, family Lamnidae) being captured in tuna tow cages and in inshore tuna farm cages. Exact numbers are not known, as captures are not always reported. In some cases, tuna farm staff attempted to release white sharks trapped in tuna cages, but it is only recently that successful releases have occurred (K. Rodda, *pers. comm.)*. Malcolm *et al*. (2001) reported nine confirmed captures by tuna farm industry over a period of about five years: in six of these cases, the shark was killed, while in three cases the shark was already dead. A large great white shark was killed in a tuna cage off South Australia in October 2002 (Gorton, 2003b). A 3.8 m male great white shark apparently drowned or died due to the stress in a tow cage off Boston Island, South Australia, in January 2003 (Gorton, 2003a). On 19 June, 2003, a 4.4 m female great white shark was trapped in an experimental tuna farm cage of the South Australian Research and Development Institute (SARDI) off Port Lincoln, South Australia, and remained in it until 24 June, when the attempts to release it finally proved successful (K. Rodda, *pers. comm.;* I. Gordon, *pers. comm.)*. On 30 June, 2003, a 5.5-m female great white shark was caught inside a blue tuna cage, 300 miles offshore in front of Coronado Islands, Mexico; due to its large size, the tuna farm staff could not find a way to release it and eventually decided to kill it (J. L. Castillo-Geniz, *pers. comm.)*. Another white shark, estimated to be over 4 m long, was trapped in a tuna cage, containing no tuna, off Port Lincoln, South Australia, in September 2003, and set free (Gorton, 2003c). In May 2004, two 4-m white sharks were trapped in a tuna cage off Port Lincoln, South Australia, and both were released (K. Rodda, *pers. comm.*; Gorton, 2004a, b). In August 2004, about 3-m white shark was trapped in a tuna cage near Port Lincoln, South Australia, and released (K. Rodda, *pers. comm.*; Gorton, 2004a, b).

In recent years, the great white shark has been the subject of several studies in the Mediterranean Sea, focusing on different aspects of its biology and ecology (Fergusson, 1996; Mojetta *et al*., 1997; De Maddalena, 2000a, b; Storai *et al*., 2000; Barrull & Mate, 2001; Celona *et al*., 2001; De Maddalena *et al*., 2001; Celona, 2002; De Maddalena, 2002; Soldo & Jardas, 2002a, b; Kabasakal, 2003). However, relationships between great white sharks and tuna farms in the Mediterranean have never been described. In the present paper, we present the case of a great white shark trapped in a tuna cage off the Libyan coast.

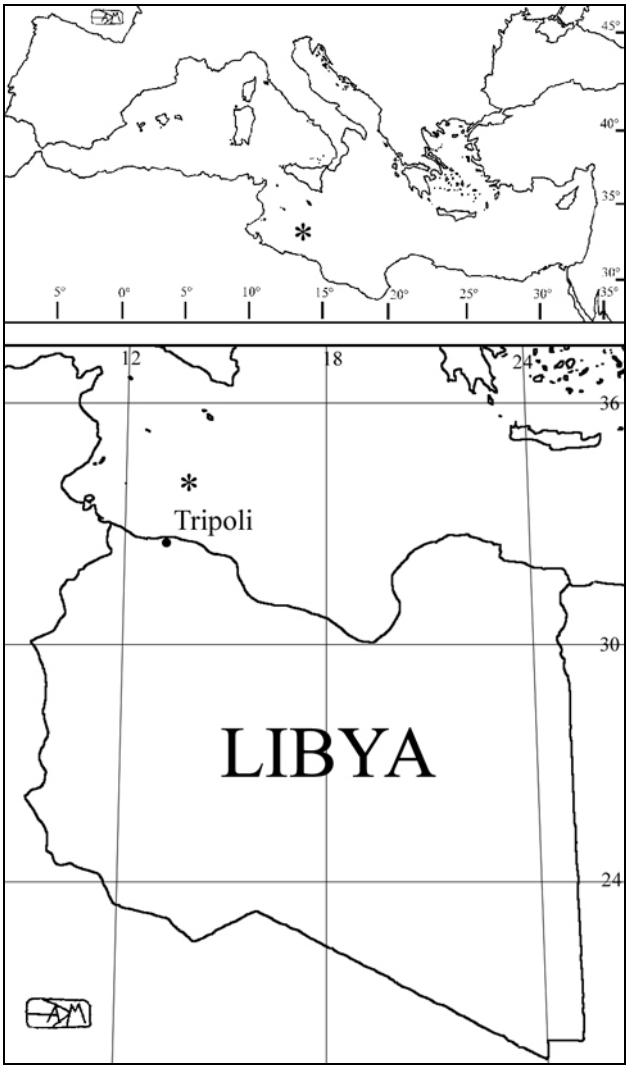

Fig. 1: Maps of the Mediterranean Sea and Libya showing the locality where an estimated 5-m long great white shark *Carcharodon carcharias* ***was trapped in a tuna cage, at 33º50´ N, 13º50´ E, 55 miles off Tripoli, Libya. (Drawing: A. De Maddalena)***
Sl. 1: Zemljevida Sredozemskega morja in Libije z lokaliteto na zemljepisni točki 33º50´ N, 13º50´ E, 55 milj od Tripolija, kjer se je v kletko za tune ujel 5 m dolg beli morski volk *Carcharodon carcharias****. (Risba: A. De Maddalena)***

MATERIALS AND METHODS

Information and photographic evidence of a great white shark trapped in a tuna tow cage on 12 June, 2002, at 33º50´ N, 13º50´ E, 55 miles off Tripoli, Libya, are presented. The information is based on direct observations of the specimen by one of the authors (T. Galaz). The size of the shark was estimated following close examination and by comparison with tuna cage's parts of

known size. It was also possible to collect photographs, including underwater pictures, and a video of the shark swimming inside the cage.

RESULTS

In summer 2002, a 50-m diameter tuna cage belonging to a European tuna farm, was being towed from Libya to Spain. In the morning of 12 June, when the tuna cage was located at 33º50´ N, 13º50´ E, 55 miles off Tripoli, Libya (Fig. 1), the towing boat was stopped for a check of the tuna cage. During the past 5 days, bad weather hindered the tuna farm company's staff to check the cage, but on that day it was sunny and calm.

Here one of the authors went with some divers to check the cage containing 60 tons of blue-fin tuna, *Thunnus thynnus*. When the author dived into the cage for the first check, he did not see anything unusual, but

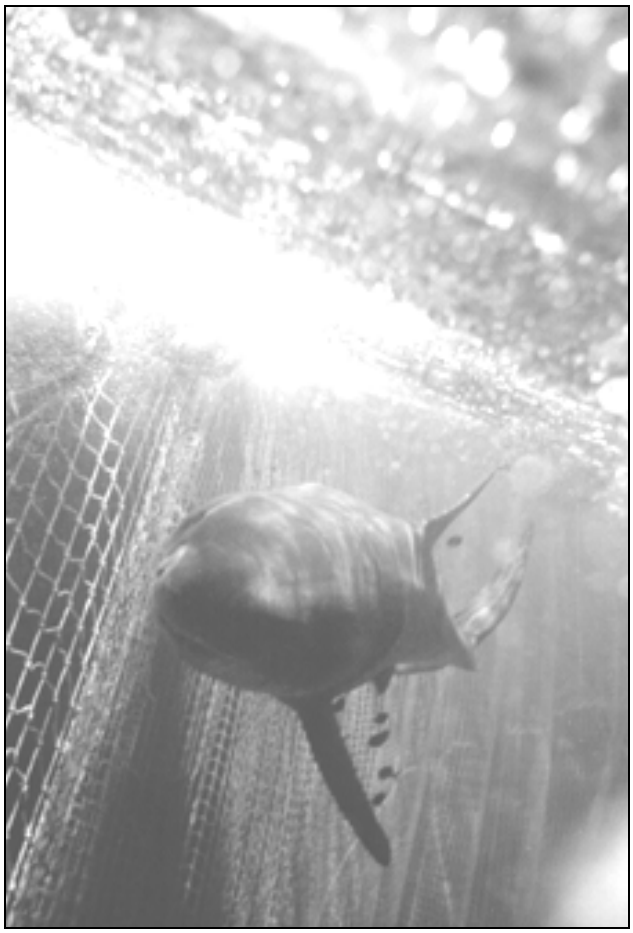

Fig. 2: An estimated 5 m long great white shark swimming in a 50 m diameter tuna cage off Tripoli, Libya. (Photo: L. Millan)
Sl. 2: Kakih 5 m dolg beli morski volk plava v tunji kletki s premerom 50 m, 55 milj od Tripolija, Libija. (Foto: L. Millan)

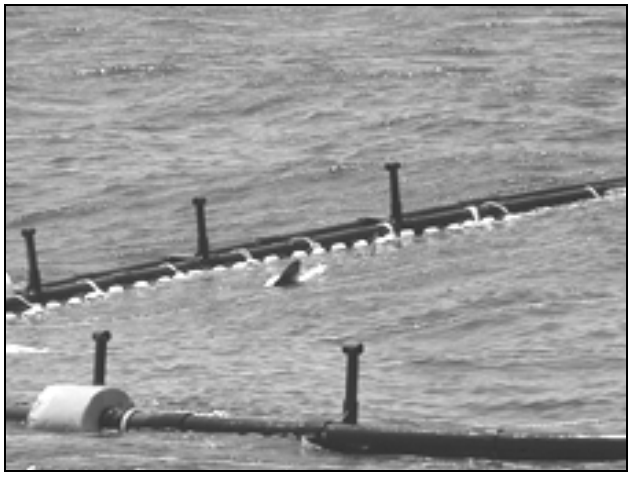

Fig. 3: An estimated 5 m long great white shark swimming slowly in circle, with its dorsal and caudal fin protruding above the surface, in a 50 m diameter tuna cage. (Photo: T. Galaz)
Sl. 3: Petmetrski beli morski volk med počasnim krožnim plavanjem v tunji kletki s premerom 50 m, s hrbtno in repno plavutjo štrlečo iz vode. (Foto: T. Galaz)

he ordered some divers to proceed to the bottom of the net to take out some dead tunas. It was about 10:00 am. When the divers reached the bottom, they suddenly noticed a large white shark breaking the net there, and it took only 5 seconds to enter the tuna cage. It is likely that the white shark had followed the tuna cage for quite some time and tore the net when the boat stopped. As soon as the shark entered the cage, tuna became alarmed, and the divers left the cage. The author and the rest of the tuna farm company's staff remained at the cage for about two hours and a half, watching the shark's movements. It began to swim in circles inside the cage, initially about 20 m deep, then moving closer to the surface. After some 5 minutes from its arrival, the shark rapidly snapped at the net, but only after a couple of seconds it continued to swim, without showing any desire to tear the net. The large predator appeared relaxed, and simply continued to swim about 1 to 2 m deep near the inside edge of the cage, coming to the surface a couple of times.

The shark was observed closely and its total length was estimated at about 5 m. Although it was watched for a long time, it was impossible to see its claspers to determine its sex, but considering that in males of this size the claspers are very long and well developed, the dealt with specimen was most probably a female. A couple of underwater photographs were taken by immersing the camera in the water from the surface (Fig. 2). Some additional non-underwater photos of the shark swimming slowly in the cage with its dorsal fin protruding above the surface were also made (Fig. 3) and a low-quality

video shot. Surprisingly, the tunas soon calmed down.

They no longer seemed to be nervous due to the presence of the large predator so close to them, and merely swam as far as possible from it. No tuna escaped through the relatively small hole made by the shark on the bottom of the cage (they simply avoided to swim close to the net, as they usually do). The shark was not seen attacking any tuna, but it could not be excluded that it fed on one or more tuna during the time it remained inside the cage. The shark was possibly more concerned with the fact that it was trapped in the cage than paying attention to its potential prey. However, during the time when observed it made no attempt to break the net, even though this was surely no great obstacle for it, considering the ease it showed in tearing the net when it entered. Then the tuna farm staff left the cage alone, and the towing boat was ordered to continue its journey. As soon as it moved on, the shark seemed fairly uncomfortable in the cage. Two days later, however, the shark was no longer in the tuna cage. It is not known when it actually left it, but in order to get out of it, the predator made a hole in the net, on the lateral wall of the cage.

In the nine years spent by one of the authors (T. Galaz) in Mediterranean tuna farming, this is the first time that such an event, involving a great white shark, was observed. Other cases of sharks trapped in tuna cages in the Mediterranean Sea included the following: in 2001, two blue sharks *Prionace glauca* entered a tuna cage being towed from Italy to Spain; and in 2002, a 40 kg shortfin mako *Isurus oxyrinchus* entered a tuna cage between Baleares Island and Murcia, Spain.

DISCUSSION

The described event is one of the very few cases in which a great white shark was observed for an extended time in a captive condition. Great white sharks are particularly difficult to keep in captivity because they need to make fast movements to stay alive (Ellis & McCosker, 1991). Only 16% of great white sharks were alive when found in the protective nets off Natal, South Africa (Cliff *et al.*, 1989) and this low percentage reflects their high oxygen requirements (at the time of writing only the Monterey Bay Aquarium, California, has succeeded in keeping a great white shark alive in captivity for over two months and a half).

Concerning the white shark's behaviour, it was similar to the one described for the 4.4-m female specimen trapped in an experimental tuna farm of the SARDI off Port Lincoln, South Australia, from 19 to 24 June, 2003 (I. Gordon, *pers. comm.;* K. Rodda, *pers. comm.).* Both sharks entered the cage by making a small hole in the net, strictly adequate for them to enter through it, both sharks appeared relaxed and swam slowly near the inside edge of the cage, and in both cases the captive white sharks neither killed nor disturbed the tuna in the cage.

It is interesting to note that of the 466 records of white sharks in the Mediterranean Sea collected in the Italian Great White Shark Data Bank, while the cases accompanied by photographic evidence are numerous, in only three of these cases the photos are underwater pictures. A female white shark was filmed by Michel Lobreaux off Favignana, Egadi Islands, Italy, in the late 1960s and the sequence was included in the documentary *"Uomini e squali"* by the Italian director Bruno Vailati (S. Carletti, *pers. comm.);* an estimated 5-m female white shark was photographed in the shallow waters of Pantelleria, Italy, in July 1991 (R. Andreoli, *pers. comm.);* an estimated 5-m white shark was photographed off Strombolicchio, Eolie Islands, Italy in June 1995 or 1996, but unfortunately the picture seems to be lost (De Maddalena, 2002). Therefore the photo featured in this work is one of the few underwater image of a live white shark made in the Mediterranean Sea.

According to Malcolm *et al.* (2001), unsubstantiated reports have been made in Australia on up to 10-20 captures of white sharks by tuna farm industry and multiple interactions each year. Tuna farm industry has been only recently developed in the Mediterranean Sea, with the first tuna farm established in this area in 1995. Nowadays, tuna farming in the Mediterranean involves Spain, Italy, Croatia, Turkey, Cyprus, Greece, Tunisia and Libya. The paucity of great white sharks in the Mediterranean Sea makes the capture of white sharks in tuna cages in this area a rare event. However, further work is required to accurately estimate the number of sharks that may be trapped in tuna cages. Tuna has always been a primary food source for Mediterranean white sharks, and interactions between these large predators and tuna-traps, once numerous in the area, have been described in details (Barrull & Mate, 2001; De Maddalena, 2000a, 2002). Even considering that white sharks are now less abundant in the Mediterranean Sea than they were in the 19th and in the first half of the 20th century, we may therefore expect a higher number of interactions between these cartilaginous fishes and the newborn tuna farm industry. We expect that other cases will be reported in the near future. However, the lack of reports concerning relationships between sharks in general and tuna farms in the Mediterranean is an additional evidence of the alarming paucity of these cartilaginous fishes in these waters.

The great white shark is a protected species in Australia, and the Primary Industries and Resources South Australia issued a protocol for any interactions between tuna cages and sharks or marine mammals to be reported, so that appropriate action can be taken. The vulnerable status of white sharks in the Mediterranean Sea, its inclusion in the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterra-

nean of the Barcelona Convention as a species in need of protection, the protection of the species in Italy and Malta, and the recent proposal by the Convention on International Trade in Endangered Species (CITES) for a regulation of the international trade in great white sharks, necessitate monitoring of the interactions between white sharks and tuna farm industry. When a white shark is trapped in a tuna cage, attempts to release it have to be made, even though the attempt to remove a great white shark from a tuna cage is a difficult task and may sometimes present a notable risk to the people involved. There is the possibility to design new tuna cages with shark escape hatches built in them, if found to be practical. A possible kind of opening could be similar to the one that allowed a successful release of the white shark trapped in a tuna cage off Port Lincoln in June 2003. The gate opening was made in such a way that it was 9 m deep, then ropes were attached to the following edge at the top and bottom, so that when it was pulled it drew the gate open inwards and formed a V-shaped tunnel, expanding the opening, so that the shark would have a greater chance of seeing it swimming into or sense the net wall (about 3 m long) and turn away from it through the opening (I. Gordon, *pers. comm.;* K. Rodda, *pers. comm.).*

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O BELEM MORSKEM VOLKU, *CARCHARODON CARCHARIAS* (LINNÉ, 1758), UJETEM V TUNJI KLETKI V VODAH SREDOZEMSKEGA MORJA SEVERNO OD LIBIJE

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POVZETEK

Na zemljepisni točki 33º 50´ N, 13º 50´ E, 55 milj od Tripolija, se je dne 12. junija 2002 med plovbo iz Libije v Španijo ustavil vlačilec, da bi pregledali kletko s premerom 50 m, ki so jo vlekli za seboj in v kateri je bilo 60 ton modroplavutih tun. Ko so se potapljači, uslužbenci neke evropske tunje farme, spustili h kletki, so ob njej nenadoma opazili kakih 5 metrov dolgo samico belega morskega volka. Zlahka je raztrgala mrežo in splavala v kletko, kjer so jo potapljači potem opazovali še dve uri in pol. Napravljenih je bilo nekaj fotografij in posnet kratek film. Vlačilec je nadaljeval plovbo, toda po dveh dneh je bilo ugotovljeno, da morskega volka ni več v kletki. Drugi primeri morskih psov, ujetih v tunjih kletkah v Sredozemskem morju, vključujejo dva sinja morska psa, ujeta v kletko med Italijo in Španijo leta 2001, in atlantskega maka, ujetega v kletko med Baleari in Murcio, Španija, leta 2002. Ker ima beli morski volk v Sredozemlju status ranljive vrste, avtorji članka menijo, da bi bilo treba spremljati medsebojne vplive med morskimi psi in tunjimi farmami, predvsem z namenom, da se med poskusi reševanja psov iz tunjih kletk reševalci odločijo za pravi poseg.

Ključne besede: beli morski volk, *Carcharodon carcharias*, tunje farme, Sredozemsko morje

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