HISTORICAL AND CONTEMPORARY PRESENCE OF THE GREAT WHITE SHARK, CARCHARODON CARCHARIAS (LINNAEUS, 1758), IN THE NORTHERN AND CENTRAL ADRIATIC SEA

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ABSTRACT

Data concerning the presence of Carcharodon carcharias (Linnaeus, 1758) in the Northern and Central Adriatic Sea, as recorded in the Italian Great White Shark Data Bank, is presented herewith. A total of 79 cases, corresponding to about 83 specimens, are presented, complete with all biological details collected. Moreover, a brief analysis of the data is given.

Key words: Great white shark, Carcharodon carcharias, Adriatic Sea

PRESENZA STORICA E ATTUALE DELLO SQUALO BIANCO, CARCHARODON CARCHARIAS (LINNAEUS, 1758), NELL'ALTO E MEDIO ADRIATICO

SINTESI

Vengono esposti i dati in merito alla presenza di Carcharodon carcharias (Linnaeus, 1758) nell'Alto e Medio Mare Adriatico registrati nella Banca Dati Italiana Squalo Bianco. E' riportato un totale di 79 casi, corrispondenti a circa 83 esemplari, completo di tutti i dettagli che è stato possibile rilevare. I dati vengono quindi brevemente analizzati.

Parole chiave: Squalo bianco, Carcharodon carcharias, Mare Adriatico

INTRODUCTION

Although the great white shark, Carcharodon carcharias (Linnaeus, 1758) (Fig. 1), has never been the subject of specific studies in the Adriatic Sea, its presence in these waters has been known for a long time, being recorded on many occasions by several authors. As a result of a program of data collection called the "Italian Great White Shark Data Bank" ("Banca Dati Italiana Squalo Bianco") and instigated in 1996, substantial information about historical and recent records of this species from the Adriatic Sea have been collected. These data are reported here in full.

MATERIALS AND METHODS

The search for data on white sharks from the Adriatic was effected by bibliographical research, location and study of materials preserved in natural history museums, collaborations with other researchers, coast guards, and private citizens. For every case, whenever possible, the following data were collected: date and location of the
Fig. 1: Great white shark Carcharodon carcharias (Linnaeus, 1758). Drawing by Alessandro De Maddalena. Sl. 1: Beli morski volk Carcharodon carcharias (Linne, 1758). Risba: Alessandro De Maddalena.

record, total length (TL) in cm, mass (P) in kg and sex (S) of the specimen, type of record (sighting, capture, attack on human or boat), register number in the International Shark Attack File (ISAF), depth of the sea at record location, distance from the coast, weather, information about specimens preserved in museums and catalogue number (cat. no.) in the collections, as well as any additional details.

**RESULTS**

326 records of *Carcharodon carcharias* in the Mediterranean Sea have been collected in the Italian Great White Shark Data Bank. Of these, a total of 79 cases (77 of which are deemed reliable) are referred to the Adriatic Sea (including Italy, Slovenia, Croatia, and unknown Country), corresponding to about 83 specimens (81 reliable) (Tab. 1). Only the large region encompassing Sicily, Egadi, Pantelleria, Pelagie, Malta and Tunisia has a larger number of records (105 specimens in total) as far as the Mediterranean is concerned.

With the exception of a few cases in which neither exact location nor Country is indicated - consequently they are indicated as occurring in the "Adriatic Sea" - the records are geographically well clustered in two zones: in the Eastern and Western Adriatic (Fig. 2). The lack of data from the Southern Adriatic supports a statement made by Bini (1967), who reported the great white shark as very rare in this zone.

**The Eastern Adriatic**

The high number of cases of great white sharks recorded from the Eastern Adriatic during the 19th century and in the first half of the 20th century indicate that a population - perhaps of substantial size - must be present in the northern part of this zone, particularly in the Gulf of Trieste and in the Kvarner. The presence of this population in the Northeastern Adriatic may be causally...

Fig. 2: Record location of great white sharks in the Adriatic Sea. Sl. 2: Lokacije belih morskih volkov, zabeleženih v Jadranškem morju.
Tab. 1: Data on great white sharks registered in the Adriatic Sea.
Tab. 1: Podatki o velikih morskih volkovih, zabeleženih v Jadranu.

<table>
<thead>
<tr>
<th>DATE</th>
<th>LOCATION</th>
<th>TL (cm)</th>
<th>P (kg)</th>
<th>S</th>
<th>REMARKS</th>
<th>REFERENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1827</td>
<td>Adriatic Sea</td>
<td></td>
<td></td>
<td></td>
<td>Capture; jaws preserved in the Museo di Anatomia Comparata</td>
<td>M. Zuffa (pers. comm.), De Maddalena (2000)</td>
</tr>
<tr>
<td></td>
<td>ITALY</td>
<td></td>
<td></td>
<td></td>
<td>of Bologna (cat. no. AC P 114).</td>
<td></td>
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<tr>
<td>Beginning of February</td>
<td>Civitanovala</td>
<td>600 ca</td>
<td>602</td>
<td>1814</td>
<td>Capture or standing; skeleton</td>
<td>Bonaparte (1839), Metaxà (1839), Vinciguerra (1855-1892), Condorelli &amp;</td>
</tr>
<tr>
<td>September 14th 1868</td>
<td>Jablanac, CROATIA</td>
<td></td>
<td></td>
<td></td>
<td>Capture. Preserved in the Croatian Museum Zagreb.</td>
<td>Brusina (1888)</td>
</tr>
<tr>
<td>April 1872 - July 1882</td>
<td>Eastern North</td>
<td>from 146</td>
<td>to 530</td>
<td>21 specimens</td>
<td>21 specimens captured. Surely some of these individuals are</td>
<td>Marchesetti (1884)</td>
</tr>
<tr>
<td>Adriatic Sea</td>
<td></td>
<td></td>
<td></td>
<td>captured. Surely some of these individuals are reported further.</td>
<td></td>
<td></td>
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<tr>
<td>April 16th 1872</td>
<td>Prefuka harbour</td>
<td>490</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td></td>
<td>CROATIA</td>
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<tr>
<td>April 19th 1872</td>
<td>Crato, ITALY</td>
<td>300</td>
<td></td>
<td></td>
<td>Capture, 4 miles offshore</td>
<td>Brusina (1888)</td>
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<tr>
<td>May 12th 1872</td>
<td>Opuzen CROATIA</td>
<td>95</td>
<td></td>
<td></td>
<td>Capture, 10 miles offshore</td>
<td>Brusina (1888)</td>
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<tr>
<td>May 12th 1872</td>
<td>Konac (Miljet)</td>
<td>237</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
</tr>
<tr>
<td>June 8th 1872</td>
<td>Prefuka harbour</td>
<td>131</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td></td>
<td>CROATIA</td>
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<tr>
<td>June 16th 1872</td>
<td>Dugi Otok CROATIA</td>
<td>146</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
</tr>
<tr>
<td>July 25th 1872</td>
<td>Cavtat CROATIA</td>
<td>260</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
</tr>
<tr>
<td>August 8th 1872</td>
<td>Rab CROATIA</td>
<td>130</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
</tr>
<tr>
<td>1873</td>
<td>Trieste ITALY</td>
<td>460</td>
<td>M</td>
<td></td>
<td>Capture</td>
<td>Doderlein (1881), Graefe (1886)</td>
</tr>
<tr>
<td>May 5th 1877</td>
<td>Ustrine (Cres)</td>
<td>460</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td>May 8th 1877</td>
<td>Sv. Martin (Cres)</td>
<td>413</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td>May 12th 1877</td>
<td>Adriatic Sea</td>
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<td></td>
<td></td>
<td>Capture</td>
<td>Perugia (1881), Ninni (1912)</td>
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<td></td>
<td>ITALY</td>
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<tr>
<td>May 12th 1877</td>
<td>Adriatic Sea</td>
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<td>Capture</td>
<td>Perugia (1881), Ninni (1912)</td>
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<td>ITALY</td>
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<tr>
<td>June 17th 1878</td>
<td>Osor - Cres CROATIA</td>
<td>371</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Perugia (1881), Brusina (1888), Ninni (1912)</td>
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<tr>
<td>May 21st 1879</td>
<td>Sv. Martin Cres</td>
<td>382</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
</tr>
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<td>DATE</td>
<td>LOCATION</td>
<td>TL (cm)</td>
<td>P (kg)</td>
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<td>REMARKS</td>
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<tr>
<td>June 1879</td>
<td>Kvarner CROATIA</td>
<td></td>
<td></td>
<td></td>
<td>Capture, Maybe in fact one of the two following cases.</td>
<td>Graeffe (1886), Tortonese (1956), Fergusson (1996)</td>
</tr>
<tr>
<td>June 17th</td>
<td>Adriatic CROATIA</td>
<td></td>
<td></td>
<td></td>
<td>Capture</td>
<td>Perugia (1881), Ninni (1912)</td>
</tr>
<tr>
<td>July 23rd</td>
<td>Split CROATIA</td>
<td>402 or</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Perugia (1881), Brusina (1888), Ninni (1912)</td>
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<tr>
<td>1879</td>
<td>445</td>
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<tr>
<td>September</td>
<td>Ustrine -Cres-</td>
<td>530</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Perugia (1881), Faber (1883), Brusina (1888), Ninni (1912)</td>
</tr>
<tr>
<td>21st 1879</td>
<td>CROATIA</td>
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<tr>
<td>November</td>
<td>Grado</td>
<td>250</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Perugia (1881), Ninni (1912)</td>
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<td>5th 1879</td>
<td>ITALY</td>
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<tr>
<td>1880</td>
<td>Golfo di Trieste</td>
<td>460</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Ninni (1912), Fergusson (1996), Mojetta et al. (1997)</td>
</tr>
<tr>
<td>Rab CROATIA</td>
<td>ITALY</td>
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<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td>October</td>
<td>Rab CROATIA</td>
<td>405</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td>16th 1881</td>
<td>Sv. Martin</td>
<td>529</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td>1882</td>
<td>(Cres) CROATIA</td>
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<tr>
<td>June 13th</td>
<td>Viroska (Hvar)</td>
<td>300</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<td>1883</td>
<td>CROATIA</td>
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<tr>
<td>September</td>
<td>Rab CROATIA</td>
<td>396</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td>26th 1883</td>
<td>Santa Croce di</td>
<td>400</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<td>Trieste ITALIA</td>
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<tr>
<td>March 3rd</td>
<td>Korcula</td>
<td>560</td>
<td></td>
<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<tr>
<td>1886</td>
<td>CROATIA</td>
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<tr>
<td>September</td>
<td>Krk CROATIA</td>
<td>470</td>
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<td></td>
<td>Capture</td>
<td>Brusina (1888)</td>
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<td>1902</td>
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<tr>
<td>May 29th</td>
<td>Kvarner CROATIA</td>
<td>522</td>
<td></td>
<td>F</td>
<td>Capture; preserved taxidermied in the Museo di Storia Naturale of Trieste (without cat. no.).</td>
<td>De Maddalena (2000)</td>
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<tr>
<td>1906</td>
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<tr>
<td>January</td>
<td>Medola CROATIA</td>
<td></td>
<td></td>
<td></td>
<td>Possible great white shark attack on Milena Scambelli.</td>
<td>M. Zuffa (pers. comm.), Anonymous (1908)</td>
</tr>
<tr>
<td>1908</td>
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<tr>
<td>May 19th</td>
<td>Stadival CROATIA</td>
<td>170</td>
<td></td>
<td></td>
<td>Captured by Simeone Armanini and Simeone Franceschini.</td>
<td>M. Zuffa (pers. comm.)</td>
</tr>
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<td>1908</td>
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<td>ITALY</td>
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<tr>
<td>October</td>
<td>Kraljevica CROATIA</td>
<td>550 ?</td>
<td></td>
<td></td>
<td>Capture</td>
<td>A. Mojetta (pers. comm.), Mojetta et al. (1997)</td>
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<tr>
<td>1909</td>
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<tr>
<td>1927</td>
<td>Rovinj CROATIA</td>
<td>600 ca.</td>
<td>1000</td>
<td></td>
<td>Capture. Stomach contained inedible objects.</td>
<td>De Maddalena (1999)</td>
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<td>DATE</td>
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<td>TL (cm)</td>
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<td>REMARKS</td>
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<tr>
<td>August 21&lt;sup&gt;st&lt;/sup&gt; 1934</td>
<td>Susak CROATIA</td>
<td></td>
<td></td>
<td>Unprovoked fatal attack on swimmer Agnes Novak. ISAF no. 370.</td>
<td>Giudici &amp; Fino (1989)</td>
<td></td>
</tr>
<tr>
<td>August 23&lt;sup&gt;rd&lt;/sup&gt; and 30&lt;sup&gt;th&lt;/sup&gt; 1934</td>
<td>Rijeka CROATIA</td>
<td>600 ca.</td>
<td>&gt;700</td>
<td>At least 2 specimens sighted.</td>
<td>Giudici &amp; Fino (1989)</td>
<td></td>
</tr>
<tr>
<td>August 30&lt;sup&gt;th&lt;/sup&gt; 1934</td>
<td>Rijeka CROATIA</td>
<td>600</td>
<td></td>
<td>Doubtful unprovoked fatal attack on swimmer Zorica Princ (or Prinz?). ISAF no. 974.</td>
<td>Fergusson (1996)</td>
<td></td>
</tr>
<tr>
<td>September 2&lt;sup&gt;nd&lt;/sup&gt; 1934</td>
<td>Kraljevica CROATIA</td>
<td>&gt;700</td>
<td>&gt;2000</td>
<td>Capture</td>
<td>Giudici &amp; Fino (1989)</td>
<td></td>
</tr>
<tr>
<td>September 7&lt;sup&gt;th&lt;/sup&gt; 1934</td>
<td>Moschiena CROATIA</td>
<td>500 ca.</td>
<td>800 ca.</td>
<td>Capture; pursuing school of tunas.</td>
<td>Giudici &amp; Fino (1989)</td>
<td></td>
</tr>
<tr>
<td>September 7&lt;sup&gt;th&lt;/sup&gt; 1934</td>
<td>Martinschizza CROATIA</td>
<td>&gt;600 ca.</td>
<td></td>
<td>Sightings; eating a small board of cork.</td>
<td>Giudici &amp; Fino (1989)</td>
<td></td>
</tr>
<tr>
<td>August 24&lt;sup&gt;th&lt;/sup&gt; 1938</td>
<td>Koper SLOVENIA</td>
<td>500 ca.</td>
<td></td>
<td>Sighted by Nicola Lubrano.</td>
<td>State Archives of Trieste</td>
<td></td>
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<tr>
<td>1940 ca.</td>
<td>Koper SLOVENIA</td>
<td></td>
<td></td>
<td>Attack on boat.</td>
<td>M. Zufa (pers. comm.)</td>
<td></td>
</tr>
<tr>
<td>October 22&lt;sup&gt;nd&lt;/sup&gt; 1963</td>
<td>Izola SLOVENIA</td>
<td>600</td>
<td>1100</td>
<td>Capture. Stomach contained 1 dolphin.</td>
<td>Lippe (1993-1994)</td>
<td></td>
</tr>
<tr>
<td>August 16&lt;sup&gt;th&lt;/sup&gt; 1966</td>
<td>Dalmata CROATIA</td>
<td></td>
<td></td>
<td>Fatal attack.</td>
<td>A. Mojetta (pers. comm.)</td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>Novigrad CROATIA</td>
<td>Unprovoked attack on diver Jurinčić.</td>
<td>A. Mojetta (pers. comm.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>Opatija CROATIA</td>
<td></td>
<td></td>
<td>Unprovoked fatal attack on a swimmer. ISAF no. 1640.</td>
<td>Fergusson (1996)</td>
<td></td>
</tr>
<tr>
<td>August 10&lt;sup&gt;th&lt;/sup&gt; 1974</td>
<td>Omiš CROATIA</td>
<td>500 ca.</td>
<td></td>
<td>Fatal attack on Rolf Schneider.</td>
<td>M. Zufa (pers. comm.)</td>
<td></td>
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<tr>
<td>A few days later</td>
<td>Caorle ITALY</td>
<td></td>
<td></td>
<td>Sighting</td>
<td>L. Alberotanza (pers. comm.)</td>
<td></td>
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<tr>
<td>August-September 1987</td>
<td>Pesaro ITALY</td>
<td>&gt;600</td>
<td></td>
<td>Sighting</td>
<td>Cardellini (1987), Mojetta et al. (1997)</td>
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<tr>
<td>DATE</td>
<td>LOCATION</td>
<td>TL (cm)</td>
<td>P (kg)</td>
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<tr>
<td>May 1988</td>
<td>Numana</td>
<td>450 ca.</td>
<td></td>
<td>Sighted by Fausto Fioretti.</td>
<td>M. Marconi (pers. comm.)</td>
<td></td>
</tr>
<tr>
<td>September 5th 1988</td>
<td>Porto Baricata</td>
<td>&gt;550</td>
<td></td>
<td>Sighting or possible attack on a boat.</td>
<td>A. Mojetta (pers. comm.), Mojetta et al. (1997)</td>
<td></td>
</tr>
<tr>
<td>September 1989</td>
<td>Pesaro</td>
<td>&gt;500</td>
<td></td>
<td>Sighting</td>
<td>Fergusson (1996)</td>
<td></td>
</tr>
<tr>
<td>August 1993</td>
<td>Sibenik</td>
<td>500</td>
<td></td>
<td>Capture</td>
<td>Fergusson (1996)</td>
<td></td>
</tr>
<tr>
<td>August 2nd 1998</td>
<td>Mljet</td>
<td></td>
<td></td>
<td>Sighting</td>
<td>De Sabata et al. (1999)</td>
<td></td>
</tr>
<tr>
<td>?</td>
<td>Foce del Po</td>
<td></td>
<td></td>
<td>Sighting</td>
<td>M. Zuffa (pers. comm.)</td>
<td></td>
</tr>
<tr>
<td>?</td>
<td>Adriatic Sea</td>
<td></td>
<td></td>
<td>Capture. Set of jaws preserved in the Museo di Storia Naturale of Trieste (without cat. no.)</td>
<td>De Maddalena (2000)</td>
<td></td>
</tr>
<tr>
<td>Before 1881</td>
<td>Golfo di Venezia</td>
<td>490</td>
<td></td>
<td>Capture</td>
<td>Doderlein (1881), Carus (1893), Fergusson (1996)</td>
<td></td>
</tr>
<tr>
<td>Before September 1891</td>
<td>Adriatic Sea</td>
<td>1003</td>
<td>4000</td>
<td>Capture</td>
<td>Anonymous (1891), Ellis &amp; McCosker (1991)</td>
<td></td>
</tr>
</tbody>
</table>

linked to the fact that there were once several commercial fisheries dedicated to catching tunas in this region. The fisheries were established in response to the massive and well-known quantity of tunas that passed along this part of the Adriatic. It is well known that tunas are among the favoured prey for great white sharks. Moreover, the long Croatian coast - consisting of several islands, straits and small bays - seems to be a habitat congenial to this species.

Between the years 1872 and 1905, the Imperial Maritime Austrian Government issued three circulars offering a reward of up to 500 florins for every great white shark captured. These circulars also mentioned other shark species, but primarily referred to Carcharodon carcharias. At the State Archives of Trieste, the orders of payment for these rewards are available but, unfortunately, in most cases the species for which they were issued is not listed. To obtain the monetary reward, fishermen must present their captured specimens to the Museo di Storia Naturale of Trieste to verify the species identification. From April 1872 to July 1882, 21 shark specimens were presented to the Museo di Storia Naturale of Trieste; the size of these specimens ranged from 1.46 to 5.3 metres, of which 7 (33.33%) were over 4
Fig. 3: 3.75 m specimen preserved in the Museo di Storia Naturale of Venezia (cat. no. 2039), caught off Trieste (Italy) in 1902. (Photo: A. De Maddalena) Sl. 3: 3.75 m dolgi primerek belega morskega volka v beneskim prirodoslovnom muzeju (kat. sl. 2039), ujet leta 1902 v blizini Trsta. (Foto: A. De Maddalena)

meters in length (Marchesetti, 1884). Among these 21 specimens are 11 captures recorded over the same period from the waters of Trieste, Grado (Italy), Osor, Kvarner, Split, Ustrine (Croatia) and other unspecified locations (Doderlein, 1881; Graeffe, 1886; Perugia, 1881; Faber, 1883; Inini, 1912; Tontonese, 1956; Ferguson, 1996; Mojetta et al., 1997). Moreover, Brusina (1888) reports 24 specimens, ranging from 1.3 to 5.6 meters in length, caught between September 1868 and September 1887 in the Eastern Adriatic; it is certain that some of these individuals are the same as those reported by Marchesetti (1884). This measure apparently produced the desired result, since from 1887 to 1902 no other records of large sharks from the Eastern Adriatic are known.

But from 1902, a number of the shark capture records were made again. These include several sightings of large sharks as well as attacks on humans and even boats. According to Boulenger (1939), "there does not pass a bathing season, especially on the Liburnian and Dalmatian coasts, without an attack on a bold swimmer by one of these tigers of the sea". In the museums of Venezia and Trieste there are two large taxidermied great white shark specimens captured in the Eastern Adriatic during the early years of the 20th century. The specimen in the Museo di Storia Naturale of Venezia (cat. no. 2039; Fig. 3) is a 3.75 m TL male caught off Trieste (Italy) in 1902 (Mizzan, 1994; De Maddalena, 2000), while that in the Museo di Storia Naturale di Trieste (without cat. no.; Fig. 4) is a 5.22 m TL female caught in Kvarner (Croatia) on May 29th 1906 and is the largest taxidermied C. carcharias preserved in Italy (De Maddalena, 2000).

In January 1908, some sharks approached a boat full of young women near Medola (Croatia). Perhaps one of the sharks attacked the boat, because Milena Scambelli fell suddenly into the sea. A shark bit her leg, lacerating it. Ms. Scambelli was rescued and taken to hospital, but did not survive (M. Zulfa, pers. comm.; Anonymous, 1908). Whatever precipitated the attack, the identity of the causal species must remain highly uncertain. It seems very strange that a witness specified that the sharks, "jumped around the boat". In fact, C. carcharias can breach entirely out of water, but does so relatively rarely.

On May 19th 1908, there was another capture of a shark in the Eastern Adriatic. The shark was caught near Stadival (Croatia) by fishermen Simeone Armanini and Simeone Franceschini. At the time it was identified as a shortfin mako (Isurus oxyrinchus), but subsequent examination of the available evidence suggests that it was probably a young C. carcharias (M. Zulfa, pers. comm.). The differences in the teeth of these two members of the Lamnidae family are less obvious in very young specimens and can sometimes generate some confusion. A short time after this capture of a small great white shark, in June 1908, Stelio Candela caught a large specimen weighing 1,400 kg in the Gulf of Trieste. A conclusive photographic evidence has been preserved about this incident (Arrasich, 1994). Another, 5.5 m long great white shark was caught in October of the following year in Krajévica (Croatia) (A. Mojetta, pers. comm.; Mojetta et al., 1997).

In Rovinj (Croatia), nine fishing boats captured, in 1927, a large specimen of great white shark, about 6 m long and weighing some 1,000 kg. Its stomach contained several inedible objects.

During the summer of 1934, there were a series of records of great white sharks in Croatian waters. On August 21st 1934, the island of Susak witnessed an attack
on a young woman, Agnes Novak, who was swimming near a tuna catching station. There was an anti-shark net, but Agnes entered the water outside this net. Eyewitnesses from a fishing boat heard the woman scream and they saw a large great white shark biting Agnes’s abdomen and dragging her underwater (Giudici & Fino, 1989). This fatal attack is no. 370 in the ISAF.

In the days that followed the attack on Agnes Novak, there were many sightings of sharks. The possibility cannot be excluded that one or more of these sharks could have been responsible for the attack on Novak. Sightings of at least two sharks occurred on August 23rd and 30th near Rijeka. On August 23, a large shark - estimated to be about 6 m long - was seen by some soldiers to be swimming near a torpedo-factory. Possibly the same shark was sighted later that afternoon by some fishermen, where it was seen swimming towards the shore of Diga Cagno. On August 30th, two large sharks were reported between Punte Bato and Diga Cagno. An hour later a shark - estimated to be more than 7 meters long - was swimming towards Labin channel, when it was encountered by some fishermen (Giudici & Fino, 1989).

A few days later, on September 2, an enormous shark - reportedly measuring 7 m in length and weighing 2 t - was caught at Kraljevica. Examination of its stomach contents did not indicate that it had been responsi-

ble for the attack on Novak (Giudici & Fino, 1989). A few days later yet another capture of a great white shark occurred: it was almost 5 m long and weighed 800 kg. The shark became trapped in a tuna net (Mošćenička Draga) while pursuing a school of tuna. On the same day, only a few hours after this capture, a shark longer than 6 m was seen near Martinšćica and, an hour later, probably the same shark was sighted near a fishing boat eating a small board of cork (Giudici & Fino, 1989).

This series of well-documented records ends with a very doubtful incident. ISAF case no. 974 concerns a fatal attack on a swimmer, named Zorica Prinč (or Prinzi), that occurred on August 30th near Rijeka, by a 6 m C. carcharias. Although Ferguson (1966) included it in his list of the Mediterranean great white shark attacks, the veracity of this incident must be regarded as questionable, because there is a strong possibility that it was merely a fabrication organised by a local newspaper.

At the State Archives of Trieste, I found a note attesting the following event: at 3 o'clock in the morning of August 24th 1938, a large shark of undisclosed species but measuring about 5 m TL carried away, in the Koper waters (Slovenia), a mile off the Ospizio Marino, the net of the fishing boat "S. Giovanni" belonging to Nicola Lubrano. On the basis of the shark’s behaviour and its sheer size, it seems reasonable to infer that it was probably a C. carcharias. Again in the Koper waters, an attack on a boat occurred around 1940, as a result of which a fragment of a tooth of the shark remained embossed in the wood of the hull (M. Zupka, pers. comm.).

From that moment, the records of great white sharks in the Eastern Adriatic become quite rare. The following incident occurred at Opatija, 21 years after the boat attack in the Koper waters, the record dated September 24th 1961. In the early afternoon of that day, student Sabit Plan was attacked by a large shark, which was subsequently identified as C. carcharias by Ferguson (1996). The young man was 100 m offshore when attacked. A boat was deployed to rescue him, but he had lost an arm and both legs so that - by the time it reached him - he was already dead (Anonymous, 1961; Giudici & Fino, 1989). This case is no. 946 in the ISAF.

On October 22nd 1963, a large shark measuring 6 m TL was caught near Izola (Slovenia) (Figs. 5 and 6). It approached a fishing boat while fishermen were turning in their nets and was killed with 23 rifle shots. According to the local newspapers, its stomach contained a dolphin, weighing about 200 kg (L. Lipić, pers. comm.; Lipić, 1993-1994). The source reports photographic evidence of this capture. A series of five attacks occurred in the Croatian waters between 1966 and 1974 (Dalmatia, August 16th 1966; Novigrad, 1970; Ika, September 1971; Opatija, 1971; Omiš, August 10th 1974). Afterward, for many years, there were no other records of great white sharks in the Eastern Adriatic. More recently, four cases occurred in the Croatian waters. In August 1993, there
was a capture of a 5-m specimen at Šibenik, followed by
some sightings by fishermen at Lošinj (Fergusson, 1996;
Mojetta et al., 1997). In the summer of 1998, there was
a sighting of a great white shark at Dubrovnik (on
September 4th), and another at Mljet on August 2nd (De
Sabata et al., 1999).

The Western Adriatic

Records of great white sharks from the Western
Adriatic have never been as frequent as those from
along the eastern coast. This may be because the greater
uniformity of the eastern coast of Italy does not favour
this species approaching the shore. Historical evidence
for the presence of C. carcharias on this side of the
Adriatic is provided by a set of jaws preserved in the
Museo di Anatomia Comparata of Bologna (cat. no. AC
P 114; Fig. 7) from a specimen caught in 1827 at an
unknown locality in the Western Adriatic which, upon
capture, was exhibited at the Bologna fish market (M.
Zuffa, pers. comm.; De Maddalena, 2000).

Early in February 1839, a very large great white
shark was captured or stranded (the various sources
differ on this point) in Civitanova, reported to be over 6 m
long and weighing 1,814 kg. Shipped to Rome, the
specimen was preserved at the University (Bonaparte,
1839; Metaxà, 1839; Vinciguerra, 1885-1892; Condorelli &
Pernando, 1903). Not long ago, in the Museo Civico di
Zoologia of Rome, the skin of this large shark was
again preserved, but it has since then been lost or
destroyed. The Museo di Anatomia Comparata of Rome
keeps the cranium, jaws and the vertebral column of this
large shark. From an analysis of the largest vertebra, I
calculated a TL of 6.02 m, making this the largest
verified specimen preserved in an Italian museum (De
Maddalena, 1998-1999). Among the undated cases, but
probably referable to the 19th century, is a 4.9 m
specimen caught in Golfo di Venezia some time before
1881 (Doderlein, 1881; Carus, 1893; Fergusson, 1996).

The following documented case occurred much later
than the Golfo di Venezia specimen. On July 7th 1963
(and not in 1961 as erroneously reported in Ellis, 1983),
in Riccione, spearfishing diver Manfred Gregor was the
victim of an unprovoked non-fatal attack by a C.
carcharias about 4.5 m long (Fergusson, 1996; Mojetta
et al., 1997). This incident constitutes case no. 1220 of the
ISAF.
A well documented case occurred on June 7th, 1978 in the Golfo di Venezia. Luigi Alberotanza and Luigi Cavaleri, two researchers of the Centro Nazionale delle Ricerche (C.N.R.), were on the research platform "Acqua alta", located 13 km off Lido, in waters 16 m deep. They were returning from a dive to clean the legs of the platform when they saw two dark fins on the surface. Imagining it was a shark, they waited in hope of seeing it better. Alberotanza tried to attract it by throwing a large steak in the water. Suddenly, the fins disappeared. Some moments later, while the men headed inside the platform to take off their wetsuits, the platform was shaken by a powerful bump. The men saw clearly a great white shark swimming close to the platform. They estimated the shark's length based on the known distance between the legs of the platform; it was about 5 m long. Luigi Cavaleri took even some photos of the shark. The shark disappeared, but the remains of a bottlenose dolphin, Tursiops truncatus (Montagu, 1821), were found near the platform. Examination of the dolphin remains indicated that they were regurgitated by the shark, perhaps following its collision with the platform (L. Alberotanza, pers. comm.; Luigi Cavaleri, pers. comm.; Beltrame, 1983; Albertarelli, 1990). In Ferguson (1996) this incident is erroneously dated and located as happening in July 1977 in the Venice Lagoon. Possibly the same specimen was sighted a few days later, near Caorle (L. Alberotanza, pers. comm.).

Late in September 1986, between Rimini and Pesaro, several sightings of a large great white shark occurred (Gatto, 2004; Giudici & Fino, 1989; Marin, 1989; Martelli, 1989; Ferguson, 2006). This specimen was described as being about 6 m long, but some estimates ranged as much as 8-9 m. It may also be the same individual that attacked the fishermen's boat and - possibly the same incident - snatched from the hand of a fisherman a whole crate of pilchards (Anonymous, 1986). This shark was first sighted on September 20th by the captain of the hydrofoil covering the Rimini-Yugoslavia route. On September 23rd, the shark was sighted off Rimini near the oil-platform "Antonella". On another occasion, it was seen 13 miles off Pesaro, near the oil-platform "Basil". It seems that Roberto Bartolini photographed and Marco Benelli filmed this shark but, to my knowledge, the pictures of this animal were never reproduced. Many anglers tried to capture the shark: Gabriele Bartoletti and Stefano Dragoni, on two separate occasions, succeeded in getting the shark swallow the bait, but they could not catch it. Several eyewitnesses described the shark as having a white coloration; perhaps they mistook a pale grey for white or possibly it was an albino specimen. Dubbed "Willy" by the fishermen of Rimini, this shark was resighted and recognized (based on characteristics unknown to me) during the period from 1986 to 1989. It seems that the shark was seen near Pesaro between August and September 1986, and resighted during the same period of the following year (Cardellini, 1987; Mojetta et al., 1997). In September 1989, there was a sighting, near Pesaro, of a large shark, estimated to be 5 m long and supported by photographic evidence (Ferguson, 1996). In the opinion of Notarbartolo di Sciara (1986), "Willy" was a basking shark, Cetorhinus maximus (Gunnerus, 1765), but this seems highly improbable, considering that the species was recognized as C. carcharias by many eyewitnesses. Moreover, if the reported attack on a fishing boat actually occurred, this hypothesis can be excluded.

Not far from Pesaro, in May 1988, 28 miles offshore 100° from Numana, Fausto Fioretti sighted from his boat a great white shark that he estimated to be 4.5 m long, in water 85-90 m deep. This occurred during a fishing tournament, so possibly the shark was attracted by the activity (M. Marconi, pers. comm.). Fioretti took some photos of this shark (Fig. 8).
In 1988, there was a documented record, dated September 9, of an encounter that occurred near Porto Barricata, but it is not clear whether it was a simple sighting or an attack on a boat (A. Mojetta, pers. comm.; Mojetta et al., 1997).

Over the years 1991-1992, captures of some young specimens were recorded, unfortunately with very few details. One specimen, captured in Ancona on December 17th 1991, was 2.1 m long (Fergusson, 1996), and 4 or 5 young specimens - of which one was a female measuring 2.3 m and weighing about 200 kg - were captured in Termoli, in Mid-March 1992 (Anonymous, 1992; Fergusson, 1996).

A very well documented case, one which Italian mass-media gave great publicity, occurred in 1998, on August 27th at 3 p.m., some 22 miles off Senigallia, in waters 72 m deep. A great white shark specimen, estimated 5-6 m long, came alongside the boat of Stefano Catalani. The angler had caught a thresher shark, Alopias vulpinus (Bonnaterre, 1788), which was subsequently fixed to the side of the hull. The shark circled the boat for about ten minutes, then bit the sack containing the bait and finally took a piece of the thresher shark carcass. Frightened, Catalani surrendered the carcass, but the great white shark remained close to the boat. After having filmed the shark for about half an hour, Catalani decided to leave (Imarisco, 1998; Montefiori, 1998).

Another recent well documented case involves an encounter offshore from Giulianova. It was September 1999, and the angler Elvio Mazzagulo was fishing for tunas in waters 250 m deep. A C. carcharias, estimated
to be 6 m long, approached the boat and started to eat one of the hooked tunas. When the tuna was hauled on to the boat, the shark bit the vessel's hull. Contrary to that reported by the press, no such attack occurred. The shark was even photographed (Fig. 9) (Graziosi, 1999).

Lastly, it must be mentioned that a sighting of a great white shark occurred on an unknown date near the mouth of the Po that is verified by photographic evidence (M. Zufa, pers. comm.).

In addition to the records described above, in the interests of completeness, it is of some interest to report that in some Italian natural history museums there are additional specimens of which the capture location is unknown, but for which it is easy to hypothesise that in some cases they may be from the Adriatic. Among these could be the 7 specimens preserved in the museums of Venezia, Padova, Modena, Ferrara, Reggio-Emilia, which are mostly referable to the 19th century (De Maddalena, 2000).

**DISCUSSION**

During the 19th century and the first half of the 20th, a population of great white shark perhaps of considerable size was present in the Eastern North Adriatic Sea in Kvarner (Croatia) and in the Gulf of Trieste (Italy), but has with the passing of time decreased significantly. Surely it must be the hunting of this species that has contributed to this decrease, although a more important factor may be an impoverishment - caused by an excessive exploitation by fisheries - of the species on which C. carcharias preys. Another possible factor could be the increasing pollution caused by human activities suffered by the Adriatic. In my opinion, the great white shark must be at this time considered sporadic in the Northern and Central Adriatic.

For 69 specimens (85.18% of all reliable specimens recorded), the months of encounters are indicated. Most great white shark specimens (51 or 73.91%) have been reported from May to September, with a peak in August-September (28 or 40.58%). Obviously it must be taken into account that in the summer months, due to the increasing frequination of Adriatic coasts by humans, there are more possibilities of encounters between men and sharks. But, strangely, only 3 specimens have been recorded from the region during the month of July.

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*Fig. 9: Specimen sighted off the shore of Giulianova (Italy) on September 26th 1999, estimated to be about 6 m long. (Photo: Elvio Mazzaugno)*

*Sl. 9: Primerek, dolži kolkje 6 m, opažen 26. septembra 1999 v bližini Giulianove (Italija). (Foto: Elvio Mazzaugno)*
On the matter of size, there are some interesting cases of very large great white shark specimens reported from the Adriatic, particularly of the enormous 1,005 cm TL great white shark caught before 1891 in an unspecified location (Anonymous, 1891; Ellis & McCosker, 1991), and other 11 specimens 6-7 m in length. Of the latter, in some cases length was merely estimated at the time of sighting, but in others the sharks were probably even measured. Unfortunately, there is no way of verifying or refuting the reported lengths of very large sharks like these, because it is unknown how these measurements were taken. The only verified case is that of the 6.02 m specimen caught near Civitanova in 1839 (De Maddalena, 1998-1999). Moreover, in Lipci (1993-1994) it was possible to examine a photo of the 6 m TL specimen captured in Izola in 1963 (Figs. 5 and 6); the shark's length can be compared to the dimensions of the humans photographed next it. There is also a photograph of the specimen, estimated to be 6 m long, sighted in September 1999 off Giulianova (Graziosi, 1999); unfortunately there are no objects visible near the shark that could be used to confirm its length (Fig. 9). There are 11 records of young specimens of great white sharks under 3 m in length, from the Adriatic. The smallest of these, caught in May 1872 off Opuzen, measured 95 cm (Brusina, 1888).

The number of cases in which great white shark stomach contents were reported, or in which the shark was observed during predation, are few. There are 2 cases of predation on dolphins (in 1 case the species was Tursiops truncatus; in the other, the species is not mentioned), 1 case of a specimen observed pursuing a school of tunas, and another of a shark feeding on a dead tuna (species not mentioned), 1 case of a great white shark feeding on a dead thresher, Alopias vulpinus, and 3 cases of sharks that had eaten inedible items (in 1 case, the kinds of objects is not mentioned, in another it was a small board of cork, and in another the items were a raincoat, 2 or 3 coats, and an automobile number-plate). In the Adriatic, the great white shark probably has the same diet as observed in the rest of the Mediterranean - and similar that noticed elsewhere in the world - being based on cetaceans, tunas, marine turtles, sharks, and swordfishes (Ferguson, 1996; De Maddalena, 1999).

Regarding the attacks on humans in the Adriatic, there are 9 reliable records (excluding 4 doubtful cases): 7 along the Croatian coast, 1 in Slovenian waters, and 1 in Italian waters. The attacks occurred against swimmers (3), divers doing underwater spearfishing (2), and a boat (1). The number of fatal attacks from the Adriatic is 6, of which none was reported as provoked. All attacks occurred in the 20th century, the most recent of which is dated 1974.

CONCLUSIONS

It is very important to continue collecting new and historical data on the occurrence of great white sharks in the Adriatic. This will, in time, permit filling the gaps in our knowledge of this species in general, and in the Adriatic in particular.

Everyone who wishes to communicate to the author records of great white sharks not represented in this work, from Adriatic and, more generally, from the Mediterranean Sea, can contact him at the address listed in the byline of this work. Whenever possible, please report the following: date, time, location of the encounter, depth of the sea, distance from the coast, weather, activity of observer at the time of the encounter, total length (in a straight line from the tip of the snout to the tip of the upper lobe of caudal fin), mass, sex, stomach contents and behaviour of the specimen, presence of other species in the immediate area, comments, photographs, names of all eyewitnesses, your name and contact address. It is very important, if at all possible, to retain teeth, vertebrae, samples of skin, and any embryos. Please also specify whether or not you authorize the publication of your data and pictures.

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ZGODOVINSKA IN NEDAVNA POJAVLJANJA BELEGA MORSKEGA VOLKA CARCHARODON CARCHARIAS (LINNÉ, 1758) V SEVERNEM IN SREDNjem JADRANU

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POZETEK

V 19. stoletju in v prvi polovici 20. stoletja se je v Kvamerju (Hrvaška) in Tržaškem zalivu pojavljala populacija belih morskih volkov precejšnje velikosti, ki pa se je sčasoma občutno zmanjšala. Ta upad lahko brez dvoma pripisemo lovam na to vrsto, še bolj pa ribiški industriji in njememu pretilanemu izkoriščanju vrst, s katerimi se bili morski volk hrani. Nadaljnji možni dejavniki bi lahko bila naraščajoče onesnaževanje zaradi vseh mogočih človekovih dejavnosti na Jadranu. Sicer pa avtor clanka meni, da je treba na belega morskega volka glede na na sporadično vrsto v severnem in srednjem Jadranu.

Za 69 osebkov (85,18% vseh zanesljivo opazenih) so podani meseci, v katerih so bili zabeleženi. Največ (51 ali 73,91%) jih je bilo opaženih med majem in septembrom, z vrhuncem v avgustu in septembru (28 ali 40,58%). Seveda pa je treba upoštevati dejstvo, da je v poletnih mesecih, ko je na jadranskih obalah precej več obiskovalcev kot sicer, možnosti za srečanje z morskimi psi primerne večce. Pa vendar so bili v mesecu juliju v tem območju zabeleženi samo trije beli morski volkovi.

O pojavljanju zelo velikih belih morskih volkov obstaja nekaj zelo zanimivih poročil, posebno o orjaškem 1005 cm dolgem osebkem, ujetem pred letom 1891 na nespecifičirani lokaciji (Anonymous, 1891; Ellis & McCosker, 1991), in se 11 osebkih, dolgih od 6 do 7 m. Kar zadeva slednje, je bila dolžina nekaterih izmed njih ocenjena v času, ko so bili opaženi, medtem ko so bili drugi verjetno celo izmerjeni. Žal pa ni načina, da bi preverili ali zavrnili podatke o dolžinah teh zelo velikih morskih volkov, saj ni znano, kako so bile meritve opravljene. Edini preverjeni primer je 602 cm dolgi osebek, ujet leta 1839 blizu Civenuve (De Maddalena, 1998-1999). Kar zadeva podatke L. Lipeja (1993-1994), pa je mogoče natančno ogledati fotografijo 6-metrskega osebka, ujetega leta 1963 v Izoli (Sl. 5 in 6); dolžino tega volka lahko nameščemo z dimenzijo ljudi, fotografiranih ob njem. Obstaja tudi fotografija osebka, opaženega oktobera 1999 v bližini Giulianovo (Graziosi, 1999); dolg naj bi bil 6 m, vendar pa v bližini tega volka niso vidni nobeni predmeti, ki bi jih lahko uporabili za potrditev njegove dolžine (Sl. 9). Iz Jadran obstaja 5 zapisov o mladih osebkih, krajših od 3 metrov; najmanjši med njimi, ujet maja 1872 blizu Opuzna, je meril 95 cm (Busina, 1888).

Število primerov, v katerih so poročali o vsebini volčjih zelodcev ali pa je bil volk opazovan med plenjenjem, so zelo redki. Obstajata 2 primera, ko sta morska volka uplenila delišča (en primeru veliko plisavko, v drugem pa vrsta ni omenjena), potem imamo 1 primer, ko je morski volk zasledoval jato tun, 1 primer, ko se je osebek hranil z mrtvo tuno (vrsta tune ni omenjena), 1 primer, ko se je beli morski volk hranil z morsko lisico Altopias vulpinus, in 3 primere, ko so morski volkovi trgali neudinone predmete (v 1 primeru predmet ni omenjen, v drugem je šlo za plutovinasto tablo, v tretjem pa za dežni plašč, dva ali 3 zimske plašče in avtomobilsko registro tablačico). V Jadranu se veliki morski volk najbrž prehranja bolj ali manj enako kot njegovi vrstniki drugov v Sredozemlju - in tudi drugod po svetu - in sicer predvsem s kitmi, tunami, morskimi želvami, morskimi psi in macearici (Ferguson, 1996; De Maddalena, 1999; De Maddalena, 2000).

Kar zadeva napade na ljudi v Jadranskem morju, imamo 9 zanesljivih poročil (neupostaje 4 dvomljive primere); 7 iz hrvaškega obalnega morja, 1 iz slovenskega in 1 iz italijanskega. V 3 primerih so bili morski volkovi napadli kopalce, v 2 podvodne ribice in v 1 primeru čoln z ljudmi. Šest napadov v Jadranskem morju je bilo pogubnih, pa čeprav poročila govorijo, da ti niso bili izvani. Vsi so se zgodili v 20. stoletju, zadnji leta 1974.

Ključne besede: beli morski volk, Carcharodon carcharias, Jadranjsko morje
REFERENCES


