



New records of *Thysanoteuthis rhombus* (Cephalopoda: Thysanoteuthidae) in the Mediterranean Sea

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KEY WORDS: Cephalopoda, *Thysanoteuthis rhombus*, Mediterranean Sea, Adriatic Sea, new records, distribution, reproduction.

ABSTRACT: Two Mediterranean occurrences of *Thysanoteuthis rhombus* are reported. The first one concerns a pair of beaks found in the stomach contents of a swordfish caught in the southern Adriatic Sea; it represents the first record of the species in this sea. The second occurrence consists in the stranding ashore in the Straits of Messina of a pair (male and female) of adults. Previous Mediterranean records of *T. rhombus* are reviewed. They show that it is distributed all over the Mediterranean Sea and completes its whole life cycle in this sea.

RIASSUNTO: Si riferisce di due ritrovamenti di *Thysanoteuthis rhombus* nel Mediterraneo. Il primo rappresenta la prima segnalazione per l'Adriatico e consiste in una coppia di becchi rinvenuti nel contenuto gastrico di un pesce spada pescato nella parte meridionale di questo mare. Il secondo ritrovamento riguarda lo spiaggiamento di una coppia di adulti (maschio e femmina) sulla costa siciliana dello Stretto di Messina. La revisione delle precedenti segnalazioni della specie nel Mediterraneo evidenzia che essa è distribuita nell'intero il bacino e che qui compie l'intero ciclo biologico.

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INTRODUCTION

The diamond-shaped squid, *Thysanoteuthis rhombus* Troschel, 1857 (Cephalopoda: Thysanoteuthidae), is a cosmopolitan species distributed in warm and temperate waters of the world ocean (CLARKE, 1966). It is an epipelagic oceanic cephalopod, often occurring in pairs or small schools in surface waters; the lower limits of its depth distributions are unknown; it appears to be more abundant in the Japan Sea, where a local fishery exists for this species (ROPER *et al.*, 1984). *Thysanoteuthis rhombus* is the only species of its genus. It may be promptly identified thanks to the broad, rhombic fins that occupy the entire length of the mantle, the thick, muscular mantle, and the transverse t-shaped mantle-funnel locking apparatus (ROPER *et al.*, 1984). Important information on the reproductive behaviour and strat-

egy is reported by ARKHIPKIN *et al.* (1983a, 1983b) and NIGMATULLIN *et al.* (1991, 1995); NIGMATULLIN & ARKHIPKIN (1998) present a thorough review of its biology.

The occurrence of *T. rhombus* in the Mediterranean Sea has been recorded several times, starting with the collection of the type specimen in the Straits of Messina (TROSCHER, 1857) (see review by CLARKE, 1966). In the last two decades, additional Mediterranean records of the diamond-shaped squid have been reported in the scientific literature as well as in popular magazines: juvenile specimens (BERDAR & CAVALLARO, 1975; BIAGI, 1982), single sub-adults or adults (MORALES, 1981; GALLO, 1991; DEIANA *et al.*, 1993; BIAGI, 1984 and pers. comm.), and pairs of specimens (VARDALA-THEODOROU *et al.*, 1991; TEMPLADO & LUQUE *in* GUERRA, 1992; BIAGI, 1992; JEREB & RAGONESE, 1994; GIORDANO *et al.*, 1998).

In the present note two new Mediterranean records of *T. rhombus* are reported: a juvenile from the Adriatic Sea, which represents the first Adriatic record of the diamond-shaped squid, and a pair of adults from the Straits of Messina.

These records provide an occasion to discuss the distribution and the reproductive behaviour of *T. rhombus* in the Mediterranean Sea.

MATERIAL AND METHODS

The first occurrence of *Thysanoteuthis rhombus* is represented by a pair of beaks (mandibles) found in the stomach of a swordfish caught in the southern Adriatic Sea on the 23 January 1993 by a boat from Savelltri (province of Brindisi). The swordfish fork length was 120 cm; its dressed weight 21 kg. The beaks were identified using CLARKE (1962, 1986). The mantle length (ML) and weight (W) of the diamond-shaped squid to whom the beaks belonged were estimated by the regression equations given in CLARKE (1986).

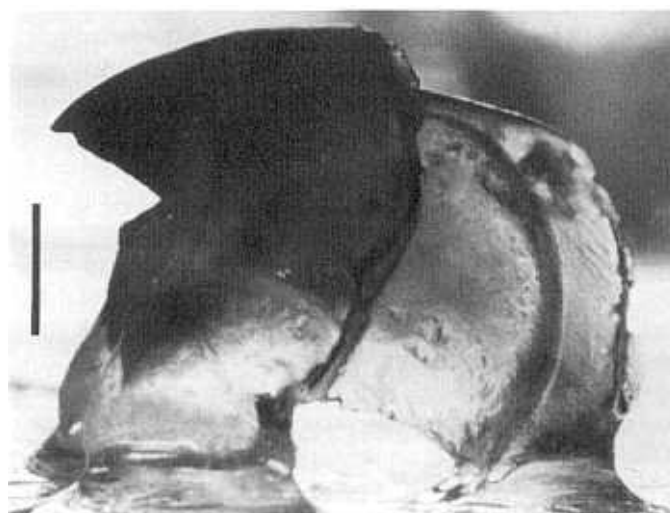


Fig. 1 Lower beak of *Thysanoteuthis rhombus* found in the stomach contents of swordfish caught in the Adriatic sea. Scale bar: 2 mm.



The second occurrence is represented by a pair of adult diamond-shaped squids stranded on the Sicilian coast of the Straits of Messina. On the 12th of August 1995, the "Gazzetta del Sud", the daily newspaper of Messina (Sicily), reported the story and photographs of the capture of two "maxi-totani" (maxi-squids) by four sport-fishermen (ANONYMOUS, 1995). The squids had run aground two nights before, on the sandy beach of Pace, 6 km north of Messina. A few days later, the present author contacted one of the sport-fishermen, Mr. Maurizio Quarto, who kindly provided him with information about the squids and showed him some frozen pieces of them.

RESULTS

Remains of a diamond-shaped squid from the stomach contents of an Adriatic swordfish

The remains consisted of a pair of matching beaks. The characteristics of these beaks are a rostrum much longer than deep and the lateral walls of the lower beak with no crest nor fold. The beaks of *Thysanoteuthis rhombus* are somewhat similar to those of *Architeuthis* (CLARKE, 1986), which however does not occur in the Mediterranean Sea. The rostral lengths were: lower = 2.3 mm, upper = 2.3 mm. The wings and large parts of the lateral walls of both beaks were not dark (Fig. 1), indicating that the animal was immature. This hypothesis is corroborated by the estimated size of the squid: ML = 14.2 cm, W = 222 gr. This is the first record of *T. rhombus* in the Adriatic Sea.

Pair of diamond-shaped squids stranded on the Sicilian coast of the Straits of Messina

On the 10th of August 1995, at 9:30 p.m., at about 300-400 m from the coast, four sport-fishermen in a small inflatable rowboat were heading back to their landing place. The fishermen noticed two very large squids following the boat at short distance, which fact somewhat scared them. The animals continued to follow the boat for about 5 minutes, until it landed on the beach of Pace, and the squids were stranded. The fishermen unsuccessfully tried to put the squids back into the sea. After their death, the animals were photographed (Fig. 2) and butchered.

Examination of the frozen remains, a few days later, showed that the two cephalopods were male and female; the presence of purple-red ripe oocytes showed that the female, at least, was mature. The frozen pieces of mantle were 5 cm thick. The reported weight of the squids is 32 and 38 kg (ANONYMOUS, 1995); the present author does not know whether the animals were actually weighed and how they were weighed, so that these measures are not reliable (according to the regression equation $BW = 0.056 ML^{2.89}$, given by NIGMATULLIN & ARKHIPKIN, 1998, the estimated weight at ML = 80 cm is 17.7 kg, that at ML = 100 cm is 33.7 kg). The mantle length of one specimen was 80 cm mantle long or slightly longer, estimated by proportion with objects of known size in the photographs.

The identification of the squids in the photographs as *Thysanoteuthis rhombus* is unmistakable thanks to the peculiarity of the fin shape; the attribution to *T. rhombus* of the specimens is further corroborated by their behaviour (see Discussion) and

the muscularity and thickness of the mantle (CLARKE, 1966; NIGMATULLIN & ARKHIPKIN, 1998).

DISCUSSION

Thysanoteuthis rhombus is believed to be rare in the Mediterranean Sea (MANGOLD & BOLETZKY, 1987; JEREB & RAGONESE, 1994). Indeed, many diamond-shaped squids have been collected in the Mediterranean Sea, the very first one being the type specimen from the Straits of Messina, described by TROSCHEL (1857). A list of ten papers up to 1966 reporting on Mediterranean occurrences of diamond squids is given by CLARKE (1966); in the introduction to the present paper, more recent records are cited. According to JEREB & RAGONESE (1994), *T. rhombus* might be less rare in the Mediterranean Sea than previously supposed. Several recent Mediterranean finds of this species indicate that it is not actually rare but just elusive, as many oegopsid squids are. It appears that the "rare-species" status of *T. rhombus* followed the same fate as other Mediterranean oceanic squids in the last few decades. Thanks to renewed approaches to teuthological studies—such as the analysis of teuthophagous predator stomach contents—several cephalopods were found to be common, e.g. *Todarodes sagittatus*, *Histioteuthis bonnellii*, *Histioteuthis reversa* (BELLO, 1997).

The geographical distribution of *T. rhombus* within the Mediterranean Sea a decade ago is summarized in a map by MANGOLD & BOLETZKY (1987: 700); the Aegean and Adriatic Seas are not part of that distribution area. The occurrence of *T. rhombus* in the Aegean Sea reported by VARDALA-THEODOROU *et al.* (1991) and its first record in the Adriatic Sea (present results) indicate that this squid is distributed all over the Mediterranean Sea.

Particular attention should be paid to the occurrence of pairs of *T. rhombus*. As far as the Mediterranean Sea is concerned, there are at least six records of pairs. VARDALA-THEODOROU *et al.* (1991): male (ML = 73.4 cm) and ripe female (ML = 69.7); TEMPLADO & LUQUE *in* GUERRA (1992): unsexed specimens; BIAGI (1992): adult male and female (W = 15 and 17 kg); JEREB & RAGONESE (1994): adult unsexed specimens (ML = 67.9 and 77.4 cm); GIORDANO *et al.* (1998): adult male (ML = 71 cm) and adult female (ML = 78 cm); present record from Pace: mature male and female (ML 80 cm). The reproductive strategy of *T. rhombus* has been studied by ARKHIPKIN *et al.* (1983a, 1983b) and NIGMATULLIN *et al.* (1995). This squid displays a unique behaviour, characterised by pair (male and female) formation and "pulsatory" or multiple spawning; a female *T. rhombus* produces an estimated 3 to 5 million ova, 1.5 to 1.8 mm in diameter, while the small oviducts can only accommodate about 150,000 eggs. Paired diamond squids usually swim slowly by fin undulation; burst swimming by jet propulsion occurs when they are in danger. Diamond squids conduct a monogamous mode of life and form pairs long before sexual maturation (NIGMATULLIN *et al.*, 1995). Also the feature of having small volume (in comparison with gonads) organs in which ripe sexual products are accumulated (*i.e.* female oviducts and male Needham's sac) is well cor-



Fig. 2 Pair of *Thysanoteuthis rhombus* stranded on the beach of Pace (Messina). Photo: V. Sturniolo.

related with pair formation and multiple spawning (NIGMATULLIN *et al.*, 1991).

To conclude, several data show that *T. rhombus* is a true Mediterranean species that completes its whole life cycle in this sea. In addition to the occurrence of reproductive pairs in the Mediterranean Sea concisely discussed above, samples of all life stages of *T. rhombus* have been collected here. SANZO (1929) described the pelagic egg mass of *T. rhombus*, collected in the Straits of Messina. It was gelatinous and sausage-shaped, ca. 70 x 20 cm, with the eggs arranged in double rows in the superficial layers. The occurrence of another egg mass in the Mediterranean Sea was recently reported by GUERRA & ROCHA (1997) (size: ca. 100x20 cm); diamond-shaped squid egg masses were also found in the Atlantic and Pacific Oceans (SABIROV *et al.*, 1987). SANZO (*loc. cit.*) and GUERRA & ROCHA (*loc. cit.*) also described the eggs, hatchlings, and earliest juvenile stages deriving from the egg mass. Early juveniles at subsequent later stages were collected in the plankton and described by ISSEL (1920), DEGNER (1925), and ROPER (1972). Descriptions of 8 and 9 cm mantle long juveniles, which had already attained the typical features of the species, are reported by JATTA (1896), NAEF (1923) and BIAGI (1982). Occurrences of later juveniles, estimated ML = 14.2 cm and ML = 22.5 cm, are recorded in the present paper and in JATTA (1896), respectively. In particular, a diamond squid as large as the Adriatic specimen (EML =

14.2 cm) is about 4 months old according to the growth curve reported by NIGMATULLIN *et al.* (1995). Hence the specimen found on the 23 of January was probably born in late September; which is in agreement with the spawning period (summer and early autumn) in peripheral distribution regions (NIGMATULLIN *et al.*, 1995).

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NOTE ADDED IN PRESS

When this paper was already in press, Roberto D'Alessandro informed me of the sighting of a pair of diamond-shaped squids in the southern Adriatic Sea, about 21 nautical miles off Bari (Apulia, Italy), on the 25 October 1998 at 10:30. The two squids were at the surface, close to each other, swimming very slowly by fin undulation. The estimated total length of both animals was about 1.5 m. This sighting confirms the occurrence of *Thysanoteuthis rhombus* in the Adriatic Sea.



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