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NOTA

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The finding of diamond squid *Thysanoteuthis rhombus* in the Gulf of Tehuantepec, Northeastern Tropical Pacific

El hallazgo del calamar diamante *Thysanoteuthis rhombus* en el Golfo de Tehuantepec, Pacífico tropical noreste

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ABSTRACT

Background. The presence of *Thysanoteuthis rhombus* Troschel, 1857 in the eastern Pacific Ocean was estimated based on the geographic range of the species constructed from scattered locations of adults, juveniles, and egg masses. **Goals**. This note describes morphometric characteristics of the southernmost registry of the diamond squid *T. rhombus* in Mexican waters of the Gulf of Tehuantepec (16°N-95°W). **Methods**. In January 2015 we found a stranded adult female weighing a total of 12.5 kg, with a total length of 92 cm, and a mantle length of 45.5 cm. **Results**. This was a mature female, with oocytes inside the oviducts that averaged 1.2 mm in diameter, and seven attached spermatophores on the buccal membrane of the female, as evidence of mating. **Conclusions**. This late registry in the Gulf of Tehuantepec could simply be due to their relative scarcity in the eastern Pacific Ocean.

Keywords: Cephalopoda, Gulf of Tehuantepec, *Thysanoteuthis rhombus*

RESUMEN

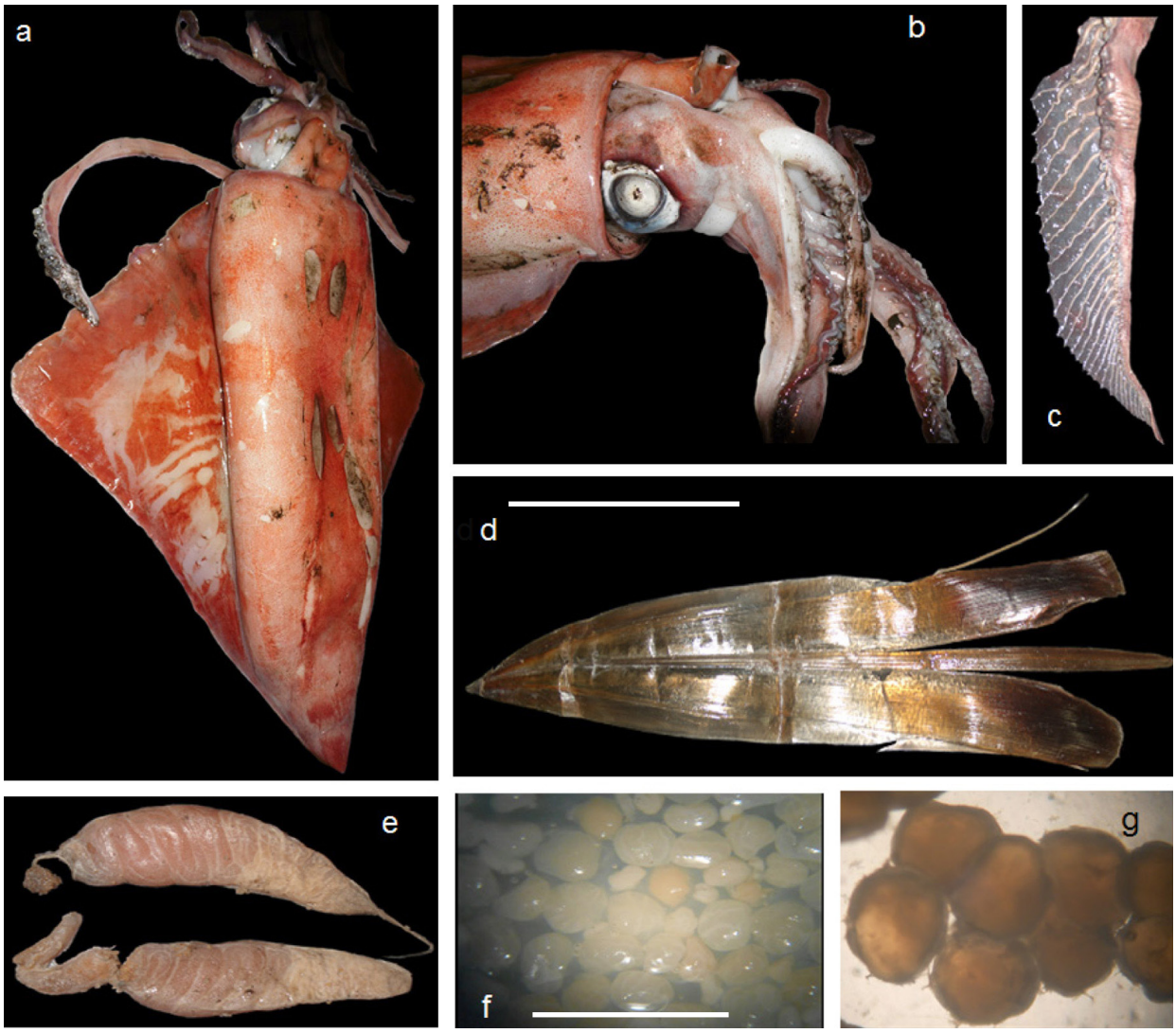
Antecedentes. La presencia de *Thysanoteuthis rhombus* Troschel, 1857 en el Océano Pacífico oriental se estimó en función del rango geográfico de las especies, construidas a partir de lugares de dispersión de adultos, juveniles y masas de huevos. **Objetivos**. La presente nota describe las características morfométricas del registro más sureño del calamar *T rhombus* en aguas mexicanas (Golfo de Tehuantepec, 16°N-95°W). **Métodos**. En enero de 2015 encontramos una hembra adulta de 12.5 kg de peso total, 92 cm de largo total y 45.5 cm de ancho del manto. **Resultados**. El espécimen correspondió a una hembra madura, con ovocitos dentro de los oviductos con un promedio de 1.2 mm de diámetro, además se registró siete espermatóforos adheridos en la membrana bucal de la hembra como evidencia de apareamiento. **Conclusiones**. Este registro tardío en el Golfo de Tehuantepec podría deberse simplemente a su relativa escasez en el Océano Pacífico oriental.

Palabras clave: Cephalopoda, Golfo de Tehuantepec, *Thysanoteuthis rhombus*

The diamond squid *Thysanoteuthis rhombus* Troschel, 1857 is the single species of the family Thysanoteuthidae. It is one of the largest cephalopods, with maximum mantle lengths of both sexes of 100 cm (possibly to 130 cm), and maximum body weight of 24 to 30 kg (Roper and Jered, 2010). This squid is unique insofar as it is monogamous, living in stable couples throughout most of their life cycle (Nigmatullin *et al*., 1995).

Thysanoteuthis rhombus is widely distributed in warmer waters (Guerra *et al*., 2002), although their presence in many tropical and subtropical countries has not been completely confirmed. It is commercially fished in the Sea of Japan but is apparently very scarce in other parts of the world (Miyahara *et al*., 2008). Findings of adults in other regions occurs when specimens are stranded or caught near the surface, most of whom are probably at the end of their life cycle (Sartor *et al*., 2008). It is an epi-mesopelagic oceanic squid that rarely approaches the continental shelf zone, but is driven there by warm currents in the peripheral range of the species. Paralarvae and juveniles live in the epipelagic zone, while subadults and adults make daily vertical migrations in the upper 600 to 800 m depth (Nigmatullin & Arkhipkin, 1998). They lay characteristic egg masses that float on the surface of the ocean (Guerra *et al*., 2002)

The presence of *T. rhombus* in the eastern Pacific Ocean was estimated based on the geographic range of the species constructed from scattered locations of adults, juveniles, and egg masses (Nigmatullin *et*



Figures 1a-g. *Thysanoteuthis rhombus* Troschel, 1857, adult female stranded on 30 January 2015, Salina Cruz, Oaxaca, Mexico. a) Ventral view (ML= 45.5 cm); b) Head; c) Veil arm III; d) Dorsal view of gladius (51 cm); e) Oviducts; f) Oocytes in ovary; g) Oocytes in oviducts. Scale bars: a-d = 20 mm; e-g = 1 mm.

al., 1995; Nigmatullin & Arkhipkin, 1998). It is an elusive species. They never appear in meso-scale detailed studies about squid (Granados-Amores, 2008). Their paralarvae could be collected from the Gulf of Tehuantepec (Alejo-Plata *et al*., 2013) or the Gulf of California (De Silva *et al*., 2015). A single registry was reported from the Gulf of California (Hendrickx *et al*., 2007). In the Baja California Peninsula, *T. rhombus* has been recorded only from stomach contents of their predators (Galván-Magaña *et al*., 2013). This species appears to replace large jumbo squid (*Dosidicus gigas* (d'Orbigny, 1835)) in the swordfish diet when the latter are absent, and few records exist from the California Current (Markaida & Hochberg, 2005). The aim of this note is to register the southernmost record for *T. rhombus* in México.

A female (45.5 cm mantle length, ML) was found dying and stranded on Punta Chivo, a rocky promontory located about 20 m away from the coast opposite Bahia Guelaguichi in the Gulf of Tehuantepec (16.103º N, 95.278 W) on 20 January 2015. The morphological characters fully agreed with the diagnostic features of the species (Roper & Jereb, 2010). Meristic data, sex, and maturity stage were recorded (Table 1). Because the mantle was damaged, only head, arms, and the gladius were preserved in 70% ethanol in the cephalopod collection at the Universidad del Mar, Puerto Ángel, Oaxaca, Mexico (reference number MHNUMAR-CEPHA 5101).

We reported a mature female (Table 1), with oocytes inside the oviducts that averaged 1.2 mm in diameter. We found 7 attached spermatophores on the buccal membrane of the female, as evidence of mating. The complex morpho-ecological adaptations of *T. rhombus* are reflected in the distinctive features of the reproductive system (Nigmatullin *et al*., 1991). We observed very large oviducal glands, small oviducts in

Table 1. Morphometric characters of the adult female of Thysanoteuthis rhombus Troschel, 1857, collected in the Gulf of Tehuantepec, Mexico.

Characters				
Mantle length (cm)	45.5			
Total length (cm)	92			
Total weight (kg)	12.5			
Head length (cm)	9.5			
Head width (cm)	14			
Fin length (cm)	42			
Fin width (cm)	40.5			
Eye diameter (cm)	4.28			
Ovary weight (g)	750			
Nidamental glands				
Length (cm)	22.75			
Weight (g)	625			
Arm length (cm)	I	II	III	IV
Right (cm)	16	16	25	15
Left (cm)	16.4	16	26	15.5
Tentacle (cm)	33.5			
Gladius length	51 cm			
Gladius weight (g)	10 g			
LRL (cm)	4.3			

LRL = Rhachis length

comparison with the ovary size, and a straight distal portion (Fig. 1e). Oocytes from the ovary were at various stages of development, thus exhibiting asynchronous development. It was possible to distinguish six size groups of oocytes (0.02 to 1.1 mm diameter (Figs 1f-g)). This suggests that the squid has multiple spawnings of the pulsate type as mentioned by Nigmatullin *et al.* (1995). The potential fecundity in both oviducts was 146,000 eggs, which is in the range reported in other studies (Roper & Jereb, 2010).

This squid has one of fastest growth rates among cephalopods. Life span is about one year, and males and females mature when they are eight months old (Nigmatullin & Arkhipkin, 1998). Commonly, individuals mature at 85 cm ML or more (Nigmatullin *et al.*, 1995). The size of the present specimen (45.5 cm LM) is very similar to that of the small mature specimens collected in the equatorial and adjacent waters (ML 42-50 cm) (Nigmatullin *et al.*, 1995), suggesting that there is a small-sized mature group.

The Gulf of Tehuantepec is characterized by its continental shelf, which widens to the east, reaching a maximum width of 106.8 km at 93-94° W, and stretches to the west, with a minimum amplitude of ~17.8 km at 95.5° W. There are two main climatic seasons: one is dry (November to April), and the other is rainy (May to October). High seasonal productivity and low sea-surface water temperature are due to strong vertical mixing and entrainment associated with mountain gap winds (Trasviña & Barton, 1995), mainly from November to April. The unusual stranding of *T. rhombus* may be related with this upwelling. This squid is an epipelagic to mesopelagic species that inhabits open ocean water, rarely approaching the coast, has a passive migration, and is regulated by oceanographic conditions (Miyahara *et al.*, 2008). This late record in the Gulf of Tehuantepec could simply be due to their relative scarcity in the eastern Pacific Ocean.

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