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FIRST RECORD OF EGG MASSES OF DIAMONDBACK SQUID, *THYSANOTEUTHIS RHOMBUS* TROSCHEL, 1857 FROM THE ANDAMAN SEA, EAST INDIAN OCEAN

Jaruwat Nabhitabhata[1,2]*, Songwit Bunditthamm[3], Tanakit Suwanyangyaun[4], Surangkana Tuanapaya[5] Kittichai Tongtherm[6] and Aileen Tan Shua Wai[1]

[1]Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia, 11800 Penang, Malaysia
[2]Excellence Center for Biodiversity of Peninsular Thailand, Prince of Songkla University, Hatyai, Songkhla 90112, Thailand
[3]Crystal Sea Marine Co. Ltd., Royal Phuket Marina 63/302 Moo 2 Thepkasattri Road, Phuket 83200, Thailand
[4]Neverdry (Thailand), 275/4 Rama 3 Road, Bangkorlaem, Bangkok 10120 Thailand
[5]Reference Collections, Phuket Marine Biological Center, Phuket 8300, Thailand
[6]Princess Maha Chakri Sirndhorn Natural History Museum, Prince of Songkla University, Hatyai, Songkhla 90112, Thailand
**Corresponding author e-mail: jaruwat.n5@gmail.com*

ABSTRACT: Two egg masses of the diamondback squid, *Thysanoteuthis rhombus* Troschel, 1857 were observed for the first time in Thai waters of the Andaman Sea, East Indian Ocean, in January and March, 2024. The approximate lengths of the egg masses were 450 mm and 1,000 mm, containing between 11, 244–14,991 and 33,314 embryos, respectively. This suggests that *T. rhombus* also reproduces in the East Indian Ocean.

Key words: first record, egg masses, *Thysanoteuthis rhombus*

INTRODUCTION

The diamondback squid, *Thysanoteuthis rhombus* Troschel, 1857 is monotypic of the family Thysanoteuthidae Keferstein, 1866. The species inhabits epipelagic to mesopelagic zones of open oceanic waters worldwide (Dunning 1998; Roper and Jereb 2010). Daily vertical migration occurs at night from 400–600 m to 0–50 m. This squid inhabits tropical and subtropical zones, but Roper and Jereb (2010) stated that its distribution also depends on surface circulation.

Thysanoteuthis rhombus was first recorded from Thai waters, in the Andaman Sea by Nateewathana and Hylleberg (1989) and Nateewathana (1997). This species has also been recorded from the southern part of the Gulf of Thailand (Chotiyaputta *et al.* 1992; Dunning 1998; Kongphrom 2007; Chen *et al.* 2009, 2019; Roper and Jereb 2010; Okutani 2015) but is considered to be rare compared to the Andaman Sea where it is regularly observed (Nabhitabhata *et al.* 2017).

The egg mass of *T. rhombus* is often misidentified as a colony of pelagic urochordates (*Pyrosoma* spp.), but apparent characters in details are different (see Table 1). In general, the egg mass is an oblong transparent gelatinous cylinder with rounded ends. Each cylinder contains two rows of eggs that are arranged in a spiral (Nigmatullin *et al.* 1995; Nigmatullin and Arkhipkin 1998).

More than a hundred egg masses of the diamondback squid have been recorded and sighted worldwide (Brown *et al.* 2022; https://www.inaturalist.org/observations/) from both the Atlantic, Pacific, and Indian Oceans (Sabirov *et al.* 1987). In the Atlantic, they have been observed at the Canary Islands (Guerra *et al.* 2002, 2012; Perez *et al.* 2012), Strait of Messina (Italy), the Mediterranean Sea (Sanzo 1929; Guerra and Rocha 1997; Biagi and Bello 2009), and western Caribbean Sea, Honduras (Brown *et al.* 2022) as well as Jamaica (Aiken *et al.* 2007). From the Pacific Ocean, more than twenty egg masses have now been recorded from Japanese waters (Misaki and Okutani 1976; Suzuki *et al.* 1979; Watanabe *et al.* 1998; Ando *et al.* 2004; Miyahara *et al.* 2006), Vanuatu and New Guinea (Nimoho *et al.* 2014), Indonesian waters (Billings *et al.* 2001), Western Australia (Huisman 2006), and the Gulf of California (De Silva-Davila *et al.* 2019). From the Indian Ocean, JICA (2018) reported 41 cases of egg mass sightings based on

the questionnaire survey from Maldives. There was also a sighting of an egg mass from the Red Sea mentioned online (Brown *et al.* 2022). Here we provide for the first time observations of egg masses from the Andaman Sea, East Indian Ocean.

MATERIAL AND METHODS

Two egg masses were photographed from the East Andaman Sea in January and March 2024 by SB and TS, the second and the third author, respectively. They were identified based on their external characteristics as reported by Watanabe *et al.* (1998), Ando *et al.* (2004), Miyahara *et al.* (2006), Perez *et al.* (2012), De Silva-Davila *et al.* (2019), and Brown *et al.* (2022).

The numbers of embryos on the egg mass were estimated following Guerra *et al.* (2002), Biagi and Bello (2009) and Brown *et al.* (2022). This estimation assumed that 50% of the total surface area of the cylindrical mass was occupied by eggs, and housed an average of 5.3 eggs/cm^2

RESULTS AND DISCUSSION

According to the characteristics of the shape, opacity, texture, locomotion and presence of the embryos within, the masses in this study were identified as the egg masses of the diamondback squid, *Thysanoteuthis rhombus* Troschel, 1857.

The first egg mass (Fig. 1) was observed and photographed by SB from the neritic zone of the Phi Phi Islands at a depth of about 1 m during daytime low tide (1100 hrs) on January 16, 2024. The egg mass was approximately 450 mm in length, 150–200 mm in diameter, hollow cylindrical shape with a round region at one end. The other end was damaged and its shape could not be confirmed. The entire egg mass was soft, gelatinous, and transparent (Fig. 1). Strings of small cases of embryos were visible inside the egg mass. The mass was negatively buoyant, lying on gravel substrates near a rock reef with the soft coral colony on the surface. One undetermined fish was observed inside the mass. It is possible that the egg mass was used as a refuge by the fish because feeding on the embryos was not observed.

The second egg mass was photographed by TS from Similan Islands during the morning low tide (0834 hrs) on March 15, 2024 (Fig. 2). The mass was approximately 1,000 mm in length and 200 mm in diameter, and was neutrally buoyant at a depth of 5 m. It was cylindrical in shape, transparent, and open on either side of the two ends. Reddish embryos were visible in both egg masses.

However, the observed length might not be the true length of both masses due to damage observed at one end of each of the egg masses. They were likely to be fragments of larger egg masses, particularly the 450 mm length of the first egg mass observed at Phi Phi Island, compared to the whole length 600–2150 mm reported by Misaki and Okutani (1976), Suzuki *et al.* (1979), Guerra and Rocha (1997), Billings *et al.* (2001), Guerra *et al.* (2002), Miyahara *et al.* (2006), Aiken *et al.* (2007), Biagi and Bello (2009), Perez *et al.* (2012) and Brown *et al.* (2022) (Table 2).

Following Guerra *et al.* (2002), the first egg mass in this study (450 mm) possibly housed approximately 11,244–14,991 embryos and 33,314 embryos for the second one (1,000 mm), corresponding to egg masses from other localities (Table 2).

It is notable that the two egg masses in this study were observed during the positive phase of the Indian Ocean Dipole event, between September 2023 to March 2024, which allowed cold water to rise to the surface along the eastern Andaman coast (BOM 2024; Lange 2024). The egg masses might be transported to the shallow water zone by such currents, since they have no means of propelling themselves.

It was the same period when *T. rhombus* specimens of 100–500 mm mantle length were fished nearshore (personal observations of the authors from fish landings in Changwat Phuket and Phang Nga). *Thysanoteuthis rhombus* are oceanic squids but, on some occasions, could be fished in the neritic zone, as in 2007 when internal waves carrying cool water mass of 20–25ºC were reported to circulate near shore (Nabhitabhata *et al.* 2009). On the other hand, such migration might relate to reproduction as well. Nigmatullin and Arkhipkin (1998) reported that the optimum conditions for spawning of *T. rhombus* were 23–24ºC temperature and 34–35 PSU salinity.

Localities of egg masses could be used to determine the spawning ground of this species (Nigmatullin *et al.* 1995; Nigmatullin and Arkhipkin 1998). The results of this study also corroborate with the collection of juvenile specimens of *T. rhombus* by Nabhitabhata *et al.* (2017), suggesting that *T. rhombus* can reproduce in the Andaman Sea.

Table 1. Comparison on appearance of physical characters between pyrosome and diamondback squid egg mass. Characters listed are based on Watanabe *et al.* (1998), Ando *et al.* (2004), Miyahara *et al.* (2006), Perez *et al.* (2012) De Silva-Davila *et al.* (2019), Brown *et al.* (2022), and this study.

Characters	Pyrosome	Diamond squid egg mass
Shape	Cylindrical or cone shape	Cylindrical, tubular, round end
Opacity	Translucent	Transparent
Texture	Gelatinous, firm, robust	Soft, fragile
Luminescence	Bioluminescent	Non bioluminescent
Locomotion	Slow movement by jet propulsion	Planktonic, neutrally buoyant when supported by current
Appearance at close-up	Colony of small tubes (zooids)	String of small cases of embryos

Table 2. Dimension (mm), estimated number of eggs and localities where egg masses of *Thysanoteuthis rhombus* Troschel, 1857 were observed. (Numbers in brackets were estimated in present study.)

Dimension (mm)	Estimated Number of Eggs	Locality	References
600–700x 150–200	(14,991–23,320)	Messina, Italy	Sanzo (1929)
1000x150	(24,986)	Sea of Japan	Misaki and Okutani (1976)
1300x200	(43,309)	Japan	Suzuki *et al.* (1979)
1000–1050 x180	(29,982–31,482)	Russia	Sabirov *et al.* (1987)
650–700x 100–130	(10,827–15,158)		
850x150	(21,238)		
700–800x 150–160	(17,490–21,321)		
1000x200	66,800	East Mediterranean Sea	Guerra and Rocha (1997)
2000x150	180,000	Sulawesi, Indonesia	Billings *et al*. (2001)
1000x200	33,400	West Mediterranean Sea	Guerra *et al.* (2002)
800x180	24,100		
1300x200	43,800	East Atlantic	Guerra *et al.* (2002)
1500x150–200	(37,479–49,971)	Japan	Ando *et al.* (2004)
2000x150	(49,971)	Western Australia	Huisman (2006)
800x130	800–1,000	Sea of Japan	Miyahara *et al.* (2006)
900–1200x140	18,000–23,000		
900x150	23,000		
600–800x130	16,000–22,000		
1500x300	(74,957)	Jamaica	Aiken *et al.* (2007)
600x150	15,000	Italy	Biagi and Bello (2009)
fragment	31,552 (count)	Gulf of California	De Silva-Davila *et al.* (2019)
2150x220, 2000, 1500–2000	78,758	Western Caribbean Sea	Brown *et al.* (2022)
450x150–200	(11,244–14,991)	Andaman Sea, East	Present study

Dimension (mm)	Estimated Number of Eggs	Locality	References
1000x200	(33,314)	Indian Ocean Andaman Sea, East Indian Ocean	Present study

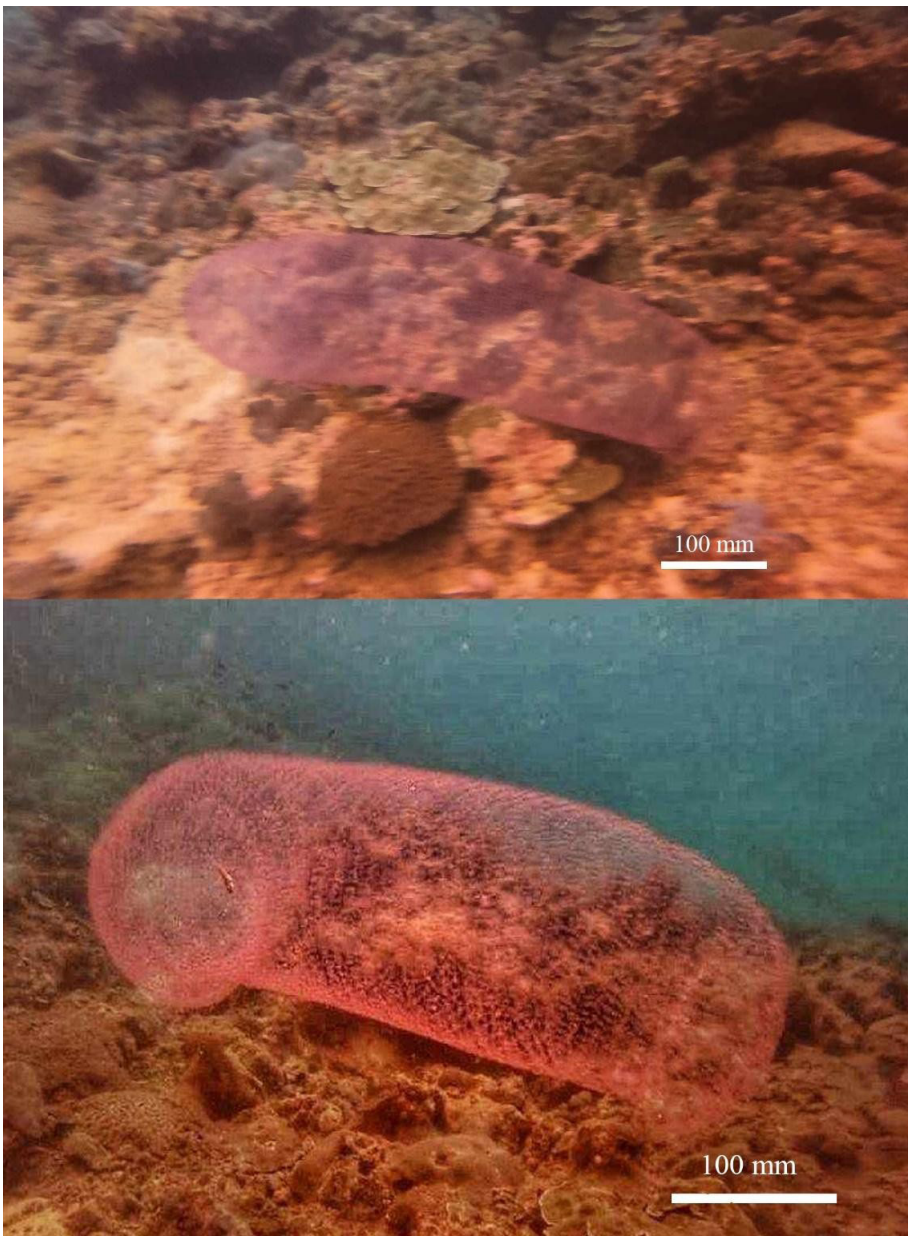

Figure 1. The first egg mass of *Thysanoteuthis rhombus* of approximately 450 mm in length lying on gravel substrates near a rock reef at Phi Phi Island, Andaman Sea with a small fish inside (lower; left end). (Photographs courtesy of Songwit Bundittham)

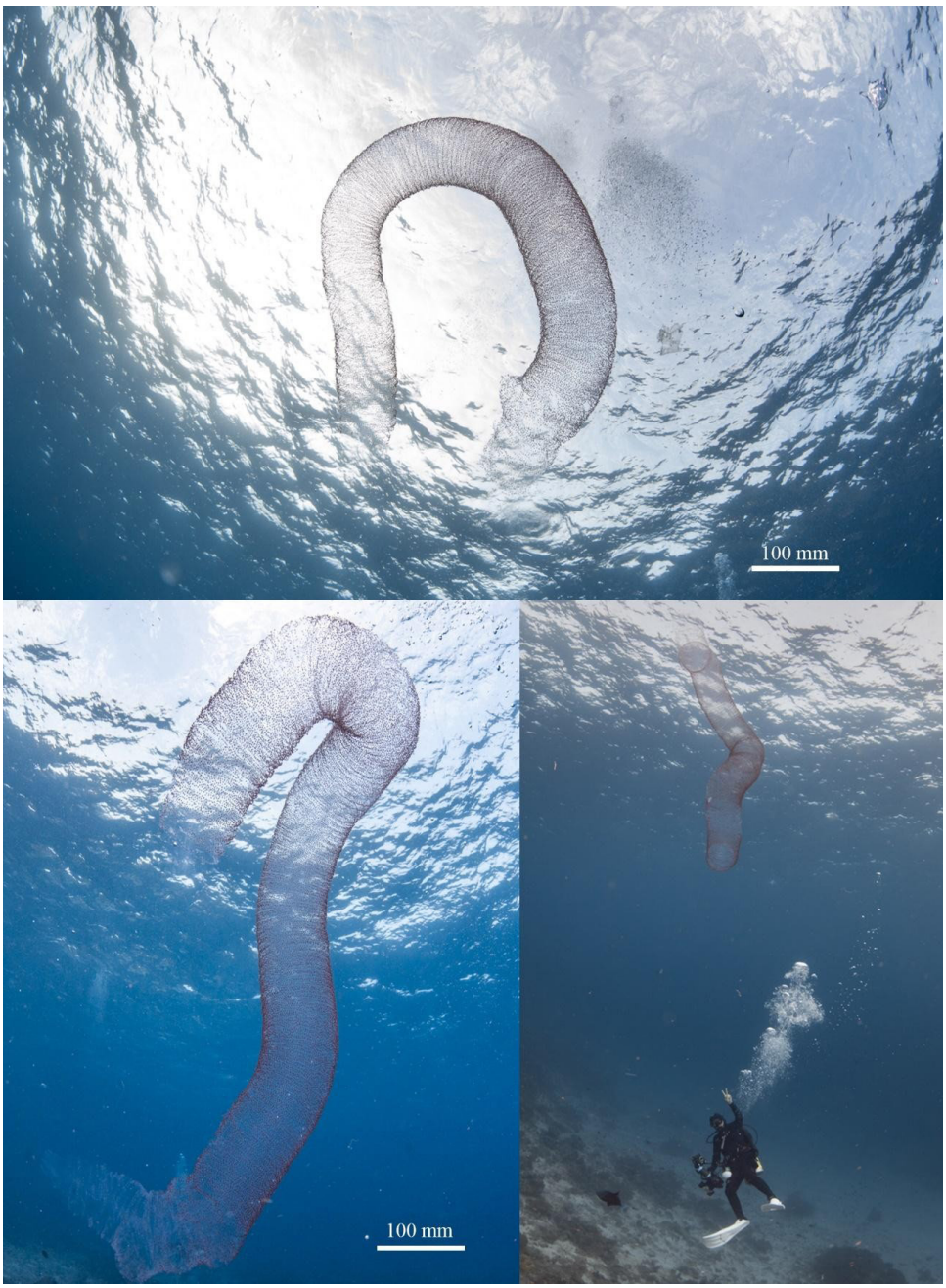

Figure 2. The second egg mass of *Thysanoteuthis rhombus* of approximately1000 mm in length floating in the water column off Similan Island, Andaman Sea. (Photographs courtesy of Tanakit Suwanyangyaun)

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