

DEEP-SEA FISHES FROM THE ANDAMAN SEA BY R/V CHAKRATONG TONGYAI DURING 1996–2000. PART 8: ORDER MYCTOPHIFORMES

Kota Obata^{1*}, Asuka Sugiyama¹, Toshio Kawai¹, Fumihito Tashiro², Hisashi Imamura^{1,2}, Charatsee Aungtonya³ and Surangkana Tuanapaya³

¹ Faculty, Graduate School / School of Fisheries Sciences, Hokkaido University, Hakodate, Hokkaido 041-8611, Japan

² Fisheries Science Center, The Hokkaido University Museum, Hakodate, Hokkaido 041-8611, Japan

³ Phuket Marine Biological Center, Wichit Subdistrict, Mueang District, Phuket 83000, Thailand

*Corresponding author: obata.kota.z2497v3@gmail.com

ABSTRACT: During the Biodiversity of the Andaman Sea Shelf (BIOSHelf) project in 1996–2000, many myctophiform fishes (blackchins and lanternfishes) were collected from the Andaman Sea off Phuket, Thailand by the R/V Chakratong Tongyai. We studied these specimens taxonomically and identified them as 24 species belonging to 2 families. This study represents the first records of the following 8 species from the Andaman Sea: i.e., 1 species of Neoscopelidae: *Scopelogadus tristis* Alcock, 1890; 7 species of Myctophidae: *Diaphus garmani* Gilbert, 1906, *Diaphus impostor* Nafpaktitis, Robertson and Paxton, 1995, *Diaphus signatus* Gilbert, 1908, *Bolinichthys pyrosobolus* (Alcock, 1890), *Lampanyctus crypticus* (Zahuranec, 2000), *Lampanyctus macropterus* (Brauer, 1904) and *Dasyscopelus spinosus* (Steindachner, 1867).

Key words: BIOSHelf, blackchin, Indian Ocean, lanternfish, Myctophidae, Neoscopelidae, Thailand

INTRODUCTION

The order Myctophiformes are one of the most species-rich groups of mesopelagic fishes, composed of ca. 250 species which belong to two families, Neoscopelidae (blackchins) and Myctophidae (lanternfishes) (Nelson 2006; Martin *et al.* 2018). The fauna of myctophiform fishes in the Indian Ocean has been studied by several researchers (e.g., Nafpaktitis and Nafpaktitis 1969; Becker 1983; Dolpadado and Gjørseter 1993; Vipin *et al.* 2011; Meera and Sanjeevan 2019). However, there are few studies referring to the fauna of Myctophiformes in the Andaman Sea, northeastern Indian Ocean (e.g., Nafpaktitis 1978; Pokapunt *et al.* 1983; Satapoomin 2011; Psomadakis *et al.* 2019; Bangchongmanee *et al.* 2023).

During the Biodiversity of the Andaman Sea Shelf (BIOSHelf) project, many deep-sea fishes were collected from the continental slope in the Andaman Sea off Phuket, Thailand by the R/V Chakratong Tongyai (see details in Aungtonya *et al.* 2000). These specimens have been studied taxonomically in the following orders (*sensu* Nelson 2006): Albuliformes, Argentiniformes, Stomiiformes, Ateleopodiformes, Lampriformes, Beryciformes,

Stephanoberyciformes, Perciformes, Scorpaeniformes, Pleuronectiformes and Tetraodontiformes (Kawai *et al.* 2017; 2020a; 2020b; 2020c; Kimura *et al.* 2019a; 2019b; Kishimoto *et al.* 2019; Senda *et al.* 2020; Obata *et al.* 2023). In the present study, the species of Myctophiformes (*sensu* Nelson 2006) are newly reported.

MATERIALS AND METHODS

All specimens, which were caught from deep-sea waters of the Andaman Sea during the BIOSHelf project (Aungtonya *et al.* 2000; Fig. 1), have been kept in 70% ethyl alcohol after fixation by 10% formalin and have been deposited at the Reference Collection of Phuket Marine Biological Center, Phuket, Thailand (PMBC). Several specimens were transferred to the Hokkaido University Museum, Hakodate, Japan (HUMZ).

Generic and subfamilial classifications of Myctophidae follow Martin *et al.* (2018). Counts and proportional measurements mainly follow Hubbs and Lagler (1958) except for the counts of dorsal- and anal-fin rays and gill rakers, which follow Wisner (1976). Terminology of photophores follows Nafpaktitis (1977) for Neoscopelidae

(LO: lateral photophores) and Nakabo (2002) for Myctophidae (Ant: antorbital organ; AOa: anterior anal organs; AOp: posterior anal organs; Cp: cheek photophores; Dn: dorsonasal organ; INGL: infracaudal luminous gland; Op: opercular organs; PLO: suprapectoral organ; PO: thoracic organs; Pol: postero-lateral organ; Prc: precaudal organs; PVO: subpectoral organs; SAO: supraanal organs; So: suborbital organ; SUGL: supracaudal luminous gland; Suo: supraorbital organ; VLO: supraventral organ; Vn: ventronasal organ; VO: ventral organs). Standard length is abbreviated as SL. Measurements were made to the nearest 0.1 mm with digital calipers. Vertebrae were counted from radiographs. Specimens without detailed examination, meaning only species identification and measurement of SL, are tagged with asterisks after catalog number. Abbreviation after PMBC accession number: B, bad condition; D, dried condition; S, small specimen; and L, large specimen.

SPECIES LIST

Family Neoscopelidae Jordan, 1901

Neoscopelus cf. *microchir* Matsubara, 1943

Fig. 2

Diagnosis. Pectoral-fin rays 14; total gill rakers $4 + 1 + 10 - 11 = 15 - 16$; LO 20–22, arranged in continuous single row, its end behind anal-fin base (present study).

Materials. PMBC 15836*, 9 specimens, 52.6–110.8 mm SL, St. L6, 6°45'N 98°06'E to 6°44'N 98°05'E, 303–313 m depth, Agassiz trawl, 23 Feb. 2000; PMBC 15837, 4 specimens, 34.1–46.2 mm SL, PMBC 15837(L)*, 3 specimens, 93.1–101.4 mm SL, PMBC 15837(S)*, 6 specimens, 30.8–40.7 mm SL, St. E7, 8°30'N 97°01'E to 8°29'N 97°03'E, 449–446 m depth, Agassiz trawl, 8 Feb. 2000; PMBC 15838*, 1 specimen, 126.2 mm SL, St. K6, 7°02'N 98°10'E to 7°04'N 98°09'E, 277–288 m depth, otter trawl, 1 Mar. 2000; PMBC 15839*, 37 specimens, 113.9–162.4 mm SL, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000; PMBC 15840*, 24 specimens, 114.9–150.9 mm SL, St. J8, 7°21'N 97°26'E to 7°20'N 97°25'E, 520–531 m depth, otter trawl, 27 Jan. 1999; PMBC 15841*, 3 specimens, 86.8–101.4 mm SL, St. E7, 8°30'N 97°07'E to 8°29'N 97°04'E, 435–444 m depth, otter trawl, 9 Feb. 2000; PMBC 15842*, 1 specimen, 144.4 mm

SL, St. K8, 7°00'N 97°26'E to 7°01'N 97°28'E, 556–520 m depth, Agassiz trawl, 17 Nov. 1999; PMBC 15843*, 1 specimen, 138.8 mm SL, St. B8, 9°10'N 96°18'E to 9°09'N 96°16'E, 489–504 m depth, otter trawl, 11 Feb. 1999; PMBC 15847*, 35 specimens, 118.0–154.8 mm SL, St. Z3, 7°42'N 97°20'E to 7°42'N 97°18'E, 493–322 m depth, otter trawl, 24 Jan. 1999; PMBC 15848(L)*, 1 specimen, 113.9 mm SL, PMBC 15848(S)*, 27 specimens, 15.7–41.6 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 15849*, 1 specimen, 131.1 mm SL, St. G8, 8°00'N 97°06'E to 8°00'N 97°04'E, 508–518 m depth, otter trawl, 20 Nov. 1999; PMBC 15850*, 1 specimen, 132.9 mm SL, St. J8, 7°15'N 97°33'E to 7°15'N 97°30'E, 473–494 m depth, otter trawl, 18 Feb. 2000; PMBC 15851*, 4 specimens, 116.3–135.1 mm SL, St. G8, 8°00'N 97°11'E to 8°00'N 97°13'E, 495–488 m depth, Agassiz trawl, 9 Feb. 2000; PMBC 29272*, 13 specimens, 94.4–144.2 mm SL, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000; PMBC 29609, 1 specimen, 31.7 mm SL, St. B10, 9°11'N 96°12'E to 9°10'N 96°14'E, 689–549 m depth, otter trawl, 11 Feb. 1999; PMBC 29914, 1 specimen, 129.2 mm SL (figured), St. Z4, 7°34'N 97°03'E to 7°35'N 97°04'E, 660–633 m depth, otter trawl, 25 Jan. 1999.

Comparative materials. *Neoscopelus* cf. *microchir*: PMBC 4717, 4 specimens, 85.2–98.4 mm SL, Andaman Sea, 300–400 m depth, otter trawl, 8 Sep. 1980; PMBC 29930, 1 specimen, 126.8 mm SL, Andaman Sea, 340 m depth, otter trawl, M/V Paknam, 19 Mar. 1989.

Distribution. Andaman Sea (present study).

Remarks. The characters of the present specimens (see diagnosis) are very close to those of *Neoscopelus microchir* Matsubara, 1943, which has the following characters: pectoral-fin rays 15–18; total gill rakers 14–18; LO 20–26, continuous in single row, its end behind anal-fin base (Fujii 1984a; Okamura 1984a; Roberts 2015). However, the recent studies suggested the presence of an undescribed species close to *N. microchir* in the Atlantic and Indian oceans (Hulley and Paxton 2016a; Psomadakis *et al.* 2019; Sutton *et al.* 2020; Bañón *et al.* 2022). Because the diagnostic characters for the undescribed species were not indicated in these studies, we tentatively treat the present specimens as *Neoscopelus* cf. *microchir*.

Deep-sea fishes from the Andaman Sea

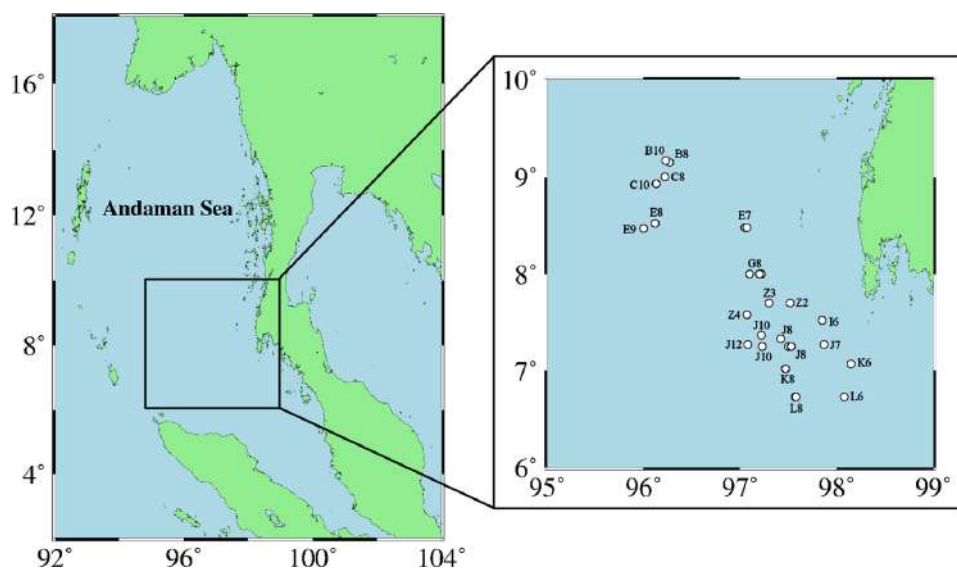


Figure 1. Map showing the sampling localities of the present specimens with the station numbers of BIOSHELF project.



Figure 2. *Neoscopelus* cf. *microchir*, PMBC 29914, 129.2 mm SL. Scale bar 20 mm.



Figure 3. *Scopelengys tristis*, PMBC 24804(L), 125.3 mm SL. Scale bar 10 mm.

***Scopelengys tristis* Alcock, 1890**

Fig. 3

Diagnosis. Dorsal-fin rays 11–13; anal-fin rays 12–14; pectoral-fin rays 14–17; vertebrae 29–32; body depth highest in nape; least caudal peduncle depth 5.6–8.3% SL; photophores absent on body (Butler and Ahlstrom 1976; Nafpaktitis 1977; Uyeno and Kishida 1977; Fujii 1983a; Becker and Shcherbachev 1990).

Materials. PMBC 24804(L), 5 specimens, 34.2–127.8 mm SL (figured), PMBC 24804(S), 1 specimen, 20.3 mm SL, PMBC 24804(B)*, 3 specimens, 22.1–37.1 mm SL, HUMZ 234846(D), 1 specimen, SL unknown due to damage, St. J10, 7°15'N 97°16'E to 7°15'N 97°14'E, 662–696 m depth, otter trawl, 19 Feb. 2000; PMBC 37591, 1 specimen, 38.7 mm SL, St. J10, 7°20'N 97°14'E to 7°22'N 97°13'E, 655–651 m depth, otter trawl, 28 Jan. 1999.

Distribution. Tropical to subarctic waters in Atlantic, Indian and Pacific oceans (e.g., Fujii 1983a; 1984a; Hulley 1984a; 1986a; 1990a; Becker and Shcherbachev 1990; Balanov and Fedorov 1996; Paxton and Hulley 1999a; Hartel and Craddock 2002; Romero 2009a; Stevenson *et al.* 2009; Hulley and Paxton 2016a; Sutton *et al.* 2020; Mincarone *et al.* 2022) including Andaman Sea (present study).

Remarks. Because *S. tristis* has never been reported from the Andaman Sea (e.g., Butler and Ahlstrom 1976; Becker and Shcherbachev 1990), this is the first record of *S. tristis* from this sea.

Family Myctophidae Gill, 1893**Subfamily Diaphinae Paxton, 1972*****Diaphus coeruleus* (Klunzinger, 1871)**

Fig. 4

Diagnosis. Dorsal-fin rays 13–15; gill rakers 5–7 + 1 + 11–14 = 17–21; dorsal-fin origin ahead of pelvic-fin insertion; Ant, Suo and So absent; Dn and Vn confluent; Dn smaller than a body photophore; Vn not extending posteriorly below anterior margin of pupil; PLO closer to pectoral-fin insertion than lateral line; VLO closer to pelvic-fin insertion than lateral line; SAO series nearly straight; SAO₃ and Pol twice or more times their diameters below lateral line; AO 5–6 + 5–6; AOa₁ anterodorsal to AOa₂; last few photophores of AOp not elevated;

Prc₄ twice its diameter below lateral line, widely separated from Prc₃; luminous scale present at PLO (Nafpaktitis 1978; Becker 1983; Becker and Shcherbachev 1990).

Materials. PMBC 29296, 4 specimens, 77.3–84.0 mm SL (figured), St. K6, 7°02'N 98°10'E to 7°04'N 98°09'E, 277–288 m depth, otter trawl, 1 Mar. 2000; PMBC 29402, 2 specimens, 76.1–77.7 mm SL, St. L6, 6°45'N 98°06'E to 6°44'N 98°05'E, 303–313 m depth, Agassiz trawl, 23 Feb. 2000.

Distribution. Tropical to subtropical waters in Indian and western Pacific oceans (e.g., Becker 1983; Kailola 1987; Becker and Shcherbachev 1990; Paxton and Hulley 1999b; Wang and Chen 2001; Paxton *et al.* 2006; Satapoomin 2011; Vipin *et al.* 2011; Rajan *et al.* 2013; Gloerfelt-Tarp and Kailola 2022).

***Diaphus garmani* Gilbert, 1906**

Fig. 5

Diagnosis. Dorsal-fin rays 13–16; gill rakers 6–8 (rarely 4) + 1 + 13–14 (rarely 12 or 15) = 20–23 (rarely 18); dorsal-fin origin slightly ahead of pelvic-fin insertion; Ant, So and Suo absent; Dn and Vn confluent; Dn large; Vn not extending posteriorly below anterior margin of pupil; PLO closer to lateral line than pectoral-fin insertion (adult) or at middle of gap between them (juvenile); VLO at middle of gap between lateral line and pelvic-fin insertion; SAO series nearly straight; SAO₃ and Pol attached to lateral line; AO 6–8 + 4–6 (rarely 7); AOa₁ anterodorsal to or just above AOa₂; last few photophores of AOp not elevated; Prc₄ 1–2 times its diameter below lateral line, widely separated from Prc₃; luminous scale present at PLO (Kawaguchi and Shimizu 1978; Nafpaktitis 1978; Becker 1983).

Materials. PMBC 3887, 1 specimen, 43.7 mm SL (figured), PMBC 3887(B), 1 specimen, 48.0 mm SL, St. I6, 7°30'N 97°50'E to 7°31'N 97°51'E, 300–284 m depth, Agassiz trawl, 9 Nov. 1999; PMBC 4827*, 1 specimen, 32.6 mm SL, St. B10, 9°11'N 96°12'E to 9°10'N 96°14'E, 689–549 m depth, otter trawl, 11 Feb. 1999; PMBC 4900, 1 specimen, 42.3 mm SL, St. J12, 7°16'N 97°03'E to 7°16'N 97°05'E, 944–912 m depth, Agassiz trawl, 20 Feb. 2000; PMBC 29425, 1 specimen, 42.5 mm SL, St. E7, 8°30'N 97°01'E to 8°29'N 97°03'E, 449–446 m depth, Agassiz trawl, 8 Feb. 2000; PMBC 29918, 6 specimens,

41.8–52.2 mm SL, St. K6, 7°02'N 98°10'E to 7°04'N 98°09'E, 277–288 m depth, otter trawl, 1 Mar. 2000; PMBC 29934, 1 specimen, 45.6 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999.

Distribution. Tropical to temperate waters in western Atlantic, Indian, and Pacific oceans (e.g., Becker 1983; Fujii 1983b; 1984b; Okamura 1984b; Hulley 1986b; 1990b; Paxton and Hulley 1999b; Wang and Chen 2001; Craddock and Hartel 2002; Paxton *et al.* 2006; Bineesh *et al.* 2010; Hulley and Paxton 2016b; Teramura 2020; Gloerfelt-Tarp and Kailola 2022) including Andaman Sea (present study).

Remarks. Although *D. garmani* is widely distributed in the world ocean (e.g., Nafpaktitis 1978; Bineesh *et al.* 2010), this species was unknown from the Andaman Sea (e.g., Satapoomin 2011; Rajan *et al.* 2013). Therefore, this is the first record of *D. garmani* from this sea.

Diaphus impostor

Nafpaktitis, Robertson and Paxton, 1995

Fig. 6

Diagnosis. Dorsal-fin rays 13–14; gill rakers 4–6 + 1 + 11–12 = 17–18 (rarely 19); gill rakers slender, not leaf-like; dorsal-fin origin above pelvic-fin base; Ant and Suo absent; So small; Dn and Vn separated; Dn small; Vn shorter than distance between Vn and So, extending posteriorly below anterior margin of orbit; PLO closer to pectoral-fin insertion than lateral line; VLO at middle of gap between lateral line and pelvic-fin insertion; SAO series angulate; SAO₃ and Pol more than their diameter below lateral line; AO 4–5 + 4–5; AOa₁ anterodorsal to AOa₂; last few photophores of AOp not elevated; Prc₁ 1.5–2 times its diameter below lateral line, not widely separated from Prc₃; luminous scale present at PLO (Nafpaktitis 1978; Nafpaktitis *et al.* 1995).

Material. PMBC 38063, 1 specimen, 23.7 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999.

Distribution. Tropical water in Indian and western Pacific oceans (Nafpaktitis *et al.* 1995; Paxton and Hulley 1999b; Paxton *et al.* 2006; Fricke *et al.* 2011) including Andaman Sea (present study).

Remarks. *Diaphus impostor* is widely distributed in the Indian Ocean. However, this has never been recorded from the Andaman Sea (e.g., Nafpaktitis *et al.* 1995; Vipin *et al.* 2011). Therefore, the present study represents the first record of *D. impostor* from this sea.

Diaphus lucidus (Goode and Bean, 1896)

Fig. 7

Diagnosis. Dorsal-fin rays 16–18; gill rakers 5–6 + 1 + 10–12 = 17–19; posterodorsal margin of opercle weakly serrated; dorsal-fin origin above pelvic-fin origin; Ant, So and Suo absent; Dn and Vn confluent; Dn as same as or larger than nasal rosette, extending above horizontal level of upper margin of orbit; Vn not extending below anterior margin of pupil; PLO at middle of gap between lateral line and pectoral-fin base; VLO closer to lateral line than pelvic-fin insertion; SAO series nearly straight; SAO₂ closer to SAO₁ than SAO₃; SAO₃ and Pol 1.0–1.5 times their own diameters below lateral line; AO 7–8 + 4–6; AOa₁ anterodorsal to AOa₂; last few photophores of AOp not elevated; Prc photophores evenly spaced; Prc₄ 2.5–3 times its diameter below lateral line; luminous scale present at PLO (Kawaguchi and Shimizu 1978; Nafpaktitis 1978; Becker 1983; Gjøsæter 1989).

Materials. PMBC 4828*, 2 specimens, 74.7–75.5 mm SL, St. B10, 9°11'N 96°12'E to 9°10'N 96°14'E, 689–549 m depth, otter trawl, 11 Feb. 1999; PMBC 4999, 1 specimen, 43.7 mm SL, PMBC 4999*, 3 specimens, 68.1–71.7 mm SL, St. J10, 7°15'N 97°16'E to 7°15'N 97°14'E, 662–696 m depth, otter trawl, 19 Feb. 2000; PMBC 26485, 5 specimens, 74.7–82.4 mm SL, PMBC 26485*, 1 specimen, 76.6 mm SL, St. J8, 7°15'N 97°33'E to 7°15'N 97°30'E, 473–494 m depth, otter trawl, 18 Feb. 2000; PMBC 29276, 2 specimens, 58.4–61.2 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 29341, 2 specimens, 60.7–69.6 mm SL (figured), St. K6, 7°02'N 98°10'E to 7°04'N 98°09'E, 277–288 m depth, otter trawl, 1 Mar. 2000; PMBC 29367*, 1 specimen, 70.8 mm SL, St. C8, 9°00'N 96°15'E to 9°00'N 96°13'E, 478–480 m depth, Agassiz trawl, 3 Feb. 2000; PMBC 29423*, 1 specimen, 59.2 mm SL, St. E7, 8°30'N 97°01'E to 8°29'N 97°03'E, 449–446 m depth, Agassiz trawl, 8 Feb. 2000.



Figure 4. *Diaphus coeruleus*, PMBC 29296, 77.4 mm SL. Scale bar 10 mm.



Figure 5. *Diaphus garmani*, PMBC 3887, 43.7 mm SL. Scale bar 10 mm.



Figure 6. *Diaphus impostor*, PMBC 38063, 23.7 mm SL. Scale bar 5 mm.



Figure 7. *Diaphus lucidus*, PMBC 29341, 60.7 mm SL. Scale bar 10 mm.

Distribution. Tropical to subtropical waters in Atlantic, Indian and Pacific oceans (*e.g.*, Becker 1983; Hulley 1984b; 1986b; 1990b; Kailola 1987; Paxton and Hulley 1999b; Craddock and Hartel 2002; Paxton *et al.* 2006; Satapoomin 2011; Vipin *et al.* 2011; Robertson and Clements 2015; Hulley and Paxton 2016b; Fricke *et al.* 2018; Sutton *et al.* 2020; Gloerfelt-Tarp and Kailola 2022).

***Diaphus luetkeni* (Brauer, 1904)**

Fig. 8

Diagnosis. Dorsal-fin rays 15–17; gill rakers 6–7 + 1 + 13–15 = 20–22; dorsal-fin origin slightly behind pelvic-fin insertion; Ant, So and Suo absent; Dn and Vn widely separated from each other; Dn small, posterodorsal to nasal rosette; Vn elongated along ventral margin of orbit with 3–5 tiny round luminous organs arranged along its dorsal margin; PLO closer to pectoral-fin insertion than lateral line; VLO closer to lateral line than pelvic-fin insertion or at middle of gap between them; SAO series nearly straight; SAO₁ at same height with VO₅; SAO₂ closer to SAO₁ than SAO₃; SAO₃ and Pol 1.5 times their diameters or less below lateral line; AO 5–7 + 4–6; AOa₁ anterodorsal to AOa₂; last few photophores of AOp not elevated; Prc₄ twice its diameter below lateral line, widely separated from Prc₃; luminous scale present at PLO (Nafpaktitis *et al.* 1977; Kawaguchi and Shimizu 1978; Nafpaktitis 1978; Becker 1983).

Materials. PMBC 29114, 1 specimen, 43.6 mm SL (figured), St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 37995*, 1 specimen, 46.3 mm SL, St. B8, 9°10'N 96°18'E to 9°09'N 96°16'E, 489–504 m depth, otter trawl, 11 Feb. 1999.

Distribution. Tropical to temperate (mainly tropical) waters in Atlantic, Indian, and western and central Pacific oceans (*e.g.*, Parin *et al.* 1973; Wisner 1976; Becker 1983; Fujii 1984b; Hulley 1986b; 1990b; Paxton and Hulley 1999b; Wang and Chen 2001; Craddock and Hartel 2002; Paxton *et al.* 2006; Vipin *et al.* 2011; Robertson and Clements 2015; Hulley and Paxton 2016b; Fricke *et al.* 2018; Sutton *et al.* 2020).

***Diaphus parri* Tåning, 1932**

Fig. 9

Diagnosis. Dorsal-fin rays 12–14; gill rakers 5–6 + 1 + 11–14 = 17–21; dorsal-fin origin above pelvic-fin insertion; Ant and Suo absent; So on posteroventral margin of orbit; Dn and Vn separated from each other, and each surrounded by dark pigments; Dn one third of nasal rosette; Vn reaching anteriorly below posterior margin of nasal rosette in male, not in female; PLO closer to pectoral-fin insertion than lateral line; VLO closer to pelvic-fin insertion than lateral line; SAO slightly angulate; SAO₃ and Pol 2.5–3.5 and 2.0–2.5 times their diameters below lateral line, respectively; AO 4–6 + 3–5; AOa₁ not or slightly elevated; Prc₄ 2.5–3.0 times its diameter below lateral line, not widely separated from Prc₃; luminous scale present at PLO (Nafpaktitis 1973; 1978; Kawaguchi and Shimizu 1978; Becker 1983).

Materials. PMBC 4974, 1 specimen, 42.9 mm SL, St. J10, 7°15'N 97°16'E to 7°15'N 97°14'E, 662–696 m depth, otter trawl, 19 Feb. 2000; PMBC 29962*, 2 specimens, 18.3–23.5 mm SL (figured), St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999.

Distribution. Tropical to subtropical waters in southeastern Atlantic, Indian, and western and central Pacific oceans (*e.g.*, Parin *et al.* 1977; Becker 1983; Fujii 1984b; Hulley 1986b; Kailola 1987; Paxton and Hulley 1999b; Paxton *et al.* 2006; Vipin *et al.* 2011; Robertson and Clements 2015; Fricke *et al.* 2018; Sutton *et al.* 2020).

***Diaphus regani* Tåning, 1932**

Fig. 10

Diagnosis. Dorsal-fin rays 15–16; gill rakers 5–8 + 1 + 11–14 = 18–21 (rarely 17); dorsal-fin origin above or slightly ahead of pelvic-fin insertion; Dn and Vn confluent; Dn slightly smaller than nasal rosette; Vn not extending posteriorly below anterior margin of pupil; PLO at middle of gap between lateral line and pectoral-fin insertion or slightly higher; VLO closer to lateral line than pelvic-fin insertion; SAO series straight or slightly angulate;

SAO₃ and Pol attached to lateral line; AO 5–7 + 5–6 = 11–13; AOa series except for AOa₁ ascending posteriorly; AOa₁ highly elevated; last one or two photophores of AOp series elevated; Prc₄ attached to lateral line, widely separated from Prc₃; luminous scale present at PLO (Nafpaktitis 1973; 1978; Kawaguchi and Shimizu 1978; Becker 1983).

Materials. PMBC 29068*, 2 specimens, 40.7–47.0 mm SL, PMBC 29068(B)*, 1 specimen, 41.7 mm SL, St. J10, 7°20'N 97°14'E to 7°22'N 97°13'E, 655–651 m depth, otter trawl, 28 Jan. 2000; PMBC 29935, 6 specimens, 39.2–48.7 mm SL, PMBC 29935*, 12 specimens, 30.6–50.4 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 29291, 1 specimen, 50.4 mm SL (figured), PMBC 29291*, 2 specimens, 42.1–43.4 mm SL, St. K6, 7°02'N 98°10'E to 7°04'N 98°09'E, 277–288 m depth, otter trawl, 1 Mar. 2000; PMBC 29426*, 1 specimen, 46.3 mm SL, St. E7, 8°30'N 97°01'E to 8°29'N 97°03'E, 449–446 m depth, Agassiz trawl, 8 Feb. 2000; PMBC 29849*, 1 specimen, 48.0 mm SL, St. Z4, 7°34'N 97°03'E to 7°35'N 97°04'E, 660–633 m depth, otter trawl, 25 Jan. 1999; PMBC 29915, 1 specimen, 50.2 mm SL, St. G8, 8°00'N 97°12'E to 8°00'N 97°12'E, 488–488 m depth, Pierce-Rothlisberg hyperbenthic sledge, 20 Nov. 1999.

Distribution. Tropical to temperate waters in Indian, and western and central Pacific oceans (e.g., Wisner 1976; Becker 1983; Fujii 1984b; Kailola 1987; Dalpadado and Gjøsæter 1993; Paxton and Hulley 1999b; Paxton *et al.* 2006; Vipin *et al.* 2011; Fricke *et al.* 2014).

Diaphus signatus Gilbert, 1908

Fig. 11

Diagnosis. Dorsal-fin rays 14–16; gill rakers 5–7 + 1 + 13–15 = 20–22; dorsal-fin origin behind pelvic-fin insertion; Dn and Vn confluent; Dn a half of nasal rosette; Vn not extending posteriorly below anterior margin of orbit; PLO at middle of gap between lateral line and pectoral-fin insertion; VLO closer to lateral line than pelvic-fin insertion; SAO series straight or slightly angulate; SAO₂ closer to SAO₁ than SAO₃; SAO₃ and Pol nearly attached to lateral line; AO 5–7 + 5–6; AOa₁ highly elevated at same height with SAO₂; last photophores

of AOa and AOp series elevated; Prc₄ 1.5 times its diameter below lateral line, widely separated from Prc₃; luminous scale present at PLO (Kawaguchi and Shimizu 1978; Nafpaktitis 1978; Becker 1983; present study).

Materials. PMBC 29932, 2 specimens, 40.8–49.1 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999.

Distribution. Tropical to temperate (mainly tropical) waters in Indian, and western and central Pacific oceans (e.g., Wisner 1976; Parin *et al.* 1977; Becker 1983; Fujii 1984b; Hulley 1986b; Kailola 1987; Dalpadado and Gjøsæter 1993; Paxton and Hulley 1999b; Wang and Chen 2001; Vipin *et al.* 2011; Fricke *et al.* 2018; Sutton *et al.* 2020; Gloerfelt-Tarp and Kailola 2022) including Andaman Sea (present study).

Remarks. The number of dorsal-fin rays of PMBC 29932 (14) is slightly fewer than that of previous descriptions (15–16: Kawaguchi and Shimizu 1978; Nafpaktitis 1978).

Diaphus signatus has been unknown from the Andaman Sea (e.g., Nafpaktitis 1978; Becker 1983; Rajan *et al.* 2013). Therefore, the present specimen represents the first record of *D. signatus* from this sea.

Diaphus suborbitalis Weber, 1913

Fig. 12

Diagnosis. Dorsal-fin rays 13–15; gill rakers 8–12 + 1 + 15–17 = 24–30; dorsal-fin origin above pelvic-fin origin; Ant, So and Suo absent; Dn and Vn widely separated; Dn as same as a body photophore; Vn elliptical, protruding into ventral margin of orbit, slightly posterior below center of pupil, its size as same as nasal rosette; PLO at middle of gap between lateral line and pectoral-fin base or slightly closer to pectoral-fin insertion; VLO closer to lateral line than pelvic-fin insertion; SAO series nearly straight; SAO₃ and Pol slightly below lateral line; AO 6–7 (rarely 5) + 4–6; AOa₁ and last AOa photophore elevated; Prc₄ 1.0–1.5 times its diameter below lateral line, widely separated from Prc₃; luminous scale present at PLO, VLO, SAO₃, Pol and Prc₄ (Kawaguchi and Shimizu 1978; Nafpaktitis 1978; Becker 1983; Fujii 1984b).

Deep-sea fishes from the Andaman Sea



Figure 8. *Diaphusluetkeni*, PMBC 29114, 43.6 mm SL. Scale bar 10 mm.



Figure 9. *Diaphusparri*, PMBC 29962, 23.5 mm SL. Scale bar 10 mm.



Figure 10. *Diaphusregani*, PMBC 29291, 50.4 mm SL. Scale bar 10 mm.

Material. PMBC 38188, 1 specimen, 24.2 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999.

Distribution. Tropical to temperate waters in Indian and western Pacific oceans (e.g., Becker 1983; Fujii 1984b; Okamura 1984b; Becker and Shcherbachev 1990; Paxton and Hulley 1999b; Wang and Chen 2001; Mundy 2005; Vipin *et al.* 2011; Rajan *et al.* 2013; Robertson and Clements 2015; Teramura 2020; Gloerfelt-Tarp and Kailola 2022).

Subfamily Lampanyctinae Paxton, 1972

Bolinichthys longipes (Brauer, 1906)

Fig. 13

Diagnosis. Pectoral-fin rays 12–13; gill rakers 3–5 + 1 + 9–12 = 13–18; distance between upper and lower edges of posterodorsal concavity of opercle about twice as long as pectoral-fin insertion; ventral edge of interopercle smooth; pectoral fin long, reaching adipose-fin origin; VO 5; VO₂ highly elevated; VLO slightly below lateral line; AO 4–6 + 3–5; three small photophores present along posterior edge of orbit; 2–3 pairs of patches of luminous tissue on top of head; luminous patches absent above pectoral-fin base and around PVO₁; single luminous scale-like patch present at pelvic-fin base; luminous patches at dorsal-fin base 1–2 (rarely 3); single luminous patch present or absent at anal-fin base; INGL elongate, usually reaching to last AOP (Nafpaktitis and Nafpaktitis 1969; Wisner 1976; Becker 1983; Hulley and Duhamel 2009).

Materials. PMBC 29939, 4 specimens, 18.2–28.9 mm SL (figured), PMBC 29939*, 1 specimen, 32.8 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 32825*, 1 specimen, 25.0 mm SL, St. J10, 7°15'N 97°16'E to 7°15'N 97°14'E, 662–696 m depth, otter trawl, 19 Feb. 2000.

Distribution. Tropical and temperate waters in Indian and Pacific oceans (e.g., Becker 1983; Fujii 1984b; Hulley 1986b; Kailola 1987; Dalpadado and Gjørseter 1993; Paxton and Hulley 1999b; Wang and Chen 2001; Mundy 2005; Paxton *et al.* 2006; Hulley and Duhamel 2009; Vipin *et al.* 2011; Fricke *et al.* 2014; Robertson and Clements 2015; Teramura 2020).

Bolinichthys pyrsobolus (Alcock, 1890)

Fig. 14

Diagnosis. Pectoral-fin rays 11–15; gill rakers 5–7 + 1 + 10–14 = 17–22; distance between upper and lower edges of posterodorsal concavity of opercle twice of pectoral-fin base; ventral edge of interopercle smooth; pectoral fin long, reaching SAO₃; VO 4–5; VO₂ highly elevated; VLO at middle of gap between lateral line and pelvic-fin insertion or slightly closer to lateral line; AO 4–6 + 3–4; small photophores absent behind orbit; luminous tissue on top of head absent; luminous patches absent on pelvic- and dorsal-fin bases; 3–5 luminous patches present along anal-fin base; INGL composed of 3–4 luminous patches, attached to AOP₂ and AOP₃ (Becker 1978; 1983; Hulley and Duhamel 2009; Furusho *et al.* 2024).

Materials. PMBC 308*, 3 specimens, 51.7–64.2 mm SL, PMBC 308(B)*, 1 specimen, 59.2 mm SL, St. J8, 7°15'N 97°30'E to 7°15'N 97°32'E, 490–479 m depth, Agassiz trawl, 18 Feb. 2000; PMBC 4727*, 1 specimen, 62.6 mm SL, St. E8, 8°32'N 96°04'E to 8°31'N 96°07'E, 488–478 m depth, otter trawl, 6 Feb. 1999; PMBC 4917*, 3 specimens, 57.9–64.8 mm SL, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000; PMBC 4928*, 1 specimen, 52.6 mm SL, PMBC 4928(D)*, 11 specimens, 49.7–59.4 mm SL, PMBC 4928(B)*, 2 specimens, 46.4–63.4 mm SL, St. G8, 8°00'N 97°11'E to 8°00'N 97°13'E, 495–488 m depth, Agassiz trawl, 9 Feb. 2000; PMBC 4938*, 4 specimens, 39.7–73.6 mm SL, PMBC 4938(B)*, 1 specimen, 47.2 mm SL, St. J10, 7°15'N 97°16'E to 7°15'N 97°14'E, 662–696 m depth, otter trawl, 19 Feb. 2000; PMBC 5062*, 5 specimens, 46.4–63.5 mm SL, St. Z3, 7°42'N 97°20'E to 7°42'N 97°18'E, 493–322 m depth, otter trawl, 24 Jan. 1999; PMBC 13520*, 25 specimens, 49.4–71.4 mm SL, St. B8, 9°10'N 96°18'E to 9°09'N 96°16'E, 489–504 m depth, otter trawl, 11 Feb. 1999; PMBC 29070, 5 specimens, 56.9–67.0 mm SL (figured), PMBC 29070, 1 specimen, 50.8 mm SL, PMBC 29070*, 14 specimens, 48.2–69.4 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 29199, 1 specimen, 28.5 mm SL, St. G8, 8°00'N 97°06'E to 8°00'N 97°04'E, 508–518 m depth, otter trawl, 20 Nov. 1999; PMBC 29202*, 3 specimens, 56.1–63.5 mm SL, St. L8, 6°45'N 97°36'E to

6°44'N 97°34'E, 482–507 m depth, Agassiz trawl, 22 Feb. 2000; PMBC 29344*, 1 specimen, 68.5 mm SL, St. K6, 7°02'N 98°10'E to 7°04'N 98°09'E, 277–288 m depth, otter trawl, 1 Mar. 2000; PMBC 29347*, 3 specimens, 58.1–75.7 mm SL, St. K8, 7°00'N 97°26'E to 7°01'N 97°28'E, 556–520 m depth, Agassiz trawl, 17 Nov. 1999; PMBC 29539*, 1 specimen, 63.5 mm SL, St. E7, 8°30'N 97°01'E to 8°29'N 97°03'E, 449–446 m depth, Agassiz trawl, 8 Feb. 2000; PMBC 29901*, 2 specimens 50.6–57.4 mm SL, St. E7, 8°30'N 97°07'E to 8°29'N 97°04'E, 435–444 m depth, otter trawl, 9 Feb. 2000; PMBC 29904*, 2 specimens, 34.2–35.3 mm SL, PMBC 29904(B)*, 1 specimen, 37.8 mm SL, St. J8, 7°15'N 97°30'E to 7°15'N 97°32'E, 490–479 m depth, Agassiz trawl, 18 Feb. 2000.

Distribution. Tropical to temperate waters in Indian and Pacific oceans (e.g., Becker 1983; Kailola 1987; Paxton and Hulley 1999b; Paxton *et al.* 2006; Hulley and Duhamel 2009; Vipin *et al.* 2011; Fricke *et al.* 2014; Furusho *et al.* 2024) including Andaman Sea (present study).

Remarks. In the Indian Ocean, *B. pyrsobolus* has been recorded only from the Arabian Sea and off northwestern Australia (Becker 1983; Hulley and Duhamel 2009). Therefore, this is the first record of *B. pyrsobolus* from the Andaman Sea.

Ceratoscopelus townsendi (Lütken, 1892)

Fig. 15

Diagnosis. Gill rakers $3-5 + 1 + 8-12 = 12-17$; forward-directed supraorbital spines present; dorsal-fin origin almost above pelvic-fin insertion; PO 5; PO₄ not elevated; VO 5; VLO at middle of gap between lateral line and pelvic-fin insertion; SAO series almost straight or slightly angulate; AO 4–7 + 4–7 (usually 5–6 + 5–6); Pol 2; luminous scales present ahead of and behind dorsal-fin base, on dorsal- and anal-fin bases, and on midventral line between pelvic fin and anus (Becker and Borodulina 1968; Nafpaktitis *et al.* 1977; Becker 1983; Badcock and Araújo 1988).

Material. PMBC 14555, 1 specimen, 45.3 mm SL, St. B8, 9°10'N 96°18'E to 9°09'N 96°16'E, 489–504 m depth, otter trawl, 11 Feb. 1999.

Distribution. Tropical to temperate waters in Atlantic, Indian and Pacific oceans (e.g., Nafpaktitis and

Nafpaktitis 1969; Wisner 1976; Becker 1983; Fujii 1982; 1983b; 1984b; Hulley 1984b; 1986b; 1990b; Dalpadado and Gjøsæter 1993; Jayaprakash 1996; Paxton and Hulley 1999b; Wang and Chen 2001; Craddock and Hartel 2002; Paxton *et al.* 2006; Romero 2009b; Vipin *et al.* 2011; Hulley and Paxton 2016b).

Lampadena luminosa (Garman, 1899)

Fig. 16

Diagnosis. Gill rakers $4 + 1 + 8-10 = 13-15$; PO₄ elevated at higher than PO₃; AO 5–7 + 2; no photophores of AOa series behind anal-fin base; Prc₁ and Prc₂ separated from each other; lengths of SUGL and INGL almost same; INGL short, its length equal or slightly longer than distance between INGL and anal-fin base (Nafpaktitis and Paxton 1968; Nafpaktitis and Nafpaktitis 1969; Wisner 1976).

Materials. PMBC 309*, 1 specimen, 53.2 mm SL, St. C10, 8°59'N 96°08'E to 8°56'N 96°08'E, 691–684 m depth, Agassiz trawl, 4 Feb. 2000; PMBC 4901, 1 specimen, 90.0 mm SL, St. L8, 6°46'N 97°33'E to 6°44'N 97°35'E, 513–501 m depth, otter trawl, 22 Feb. 2000; PMBC 5045, 1 specimen, 125.0 mm SL, St. Z3, 7°42'N 97°20'E to 7°42'N 97°18'E, 493–322 m depth, otter trawl, 24 Jan. 1999; PMBC 13450, 2 specimens, 105.8–113.1 mm SL (figured), St. B8, 9°10'N 96°18'E to 9°09'N 96°16'E, 489–504 m depth, otter trawl, 11 Feb. 1999; PMBC 25235, 1 specimen, 95.4 mm SL, St. J8, 7°15'N 97°33'E to 7°15'N 97°30'E, 473–494 m depth, otter trawl, 18 Feb. 2000; PMBC 29922, 1 specimen, 82.1 mm SL, St. Z4, 7°34'N 97°03'E to 7°35'N 97°04'E, 660–633 m depth, otter trawl, 25 Jan. 1999; PMBC 29963, 1 specimen, 105.2 mm SL, St. E9, 8°30'N 95°58'E to 8°28'N 95°58'E, 649–550 m depth, otter trawl, 5 Feb. 1999; PMBC 30273, 1 specimen, 116.6 mm SL, St. J8, 7°21'N 97°26'E to 7°20'N 97°25'E, 520–531 m depth, otter trawl, 27 Jan. 1999.

Distribution. Tropical to temperate waters in Atlantic, Indian and Pacific oceans (e.g., Becker 1983; Fujii 1983b; 1984b; Hulley 1986b; 1990b; Paxton and Hulley 1999b; Wang and Chen 2001; Craddock and Hartel 2002; Paxton *et al.* 2006; Vipin *et al.* 2011; Hulley and Paxton 2016b; Psomadakis *et al.* 2019; Sutton *et al.* 2020).



Figure 11. *Diaphus signatus*, PMBC 29932, 49.1 mm SL. Scale bar 10 mm.



Figure 12. *Diaphus suborbitalis*, PMBC 38188, 24.2 mm SL. Scale bar 5 mm.



Figure 13. *Bolinichthys longipes*, PMBC 29939, 28.9 mm SL. Scale bar 10 mm.

***Lampanyctus crypticus* (Zahuranec, 2000)**

Fig. 17

Diagnosis. Dorsal-fin rays 12–15; anal-fin rays 15–19; rudimentary pectoral-fin rays present in specimens of less than 90 mm SL; gill rakers 4 + 1 + 7–10 = 12–15; tooth patches on lower limb of second gill arch 8–9; Cp absent; VO₂ at middle of gap between VO₁ and VO₃, not elevated; SAO₁ above or slightly ahead of VO₃; AO 5 + 6–7; Prc₂ not elevated; Prc₃ at almost same vertical line through Prc₄; luminous glands without black pigmented cap; INGL short, covered with 4–6 scales (Zahuranec 2000; present study).

Materials. PMBC 29841(D), 1 specimen, 62.8 mm SL, PMBC 29841*, 1 specimen, 69.2 mm SL (figured), PMBC 29841(D)*, 2 specimens, 51.8–55.7 mm SL, St. Z4, 7°34'N 97°03'E to 7°35'N 97°04'E, 660–633 m depth, otter trawl, 25 Jan. 1999; PMBC 37592, 6 specimens, 48.4–71.5 mm SL, HUMZ 234847(D), 1 specimen, 51.2 mm SL, HUMZ 234848(D), 1 specimen, 55.8 mm SL, HUMZ 234849(D), 1 specimen, 67.6 mm SL, St. J10, 7°15'N 97°16'E to 7°15'N 97°14'E, otter trawl, 662–696 m depth, 19 Feb. 2000.

Distribution. Tropical water in Pacific Ocean (Zahuranec 2000; Castellanos-Galindo *et al.* 2006) and Andaman Sea (present study).

Remarks. The number of tooth patches on the lower limb of the second gill arch of the present specimens (8–9) is slightly more than that of the types of *L. crypticus* (8: Zahuranec 2000).

Lampanyctus crypticus has been recorded only from the equatorial Pacific Ocean (Zahuranec 2000; Castellanos-Galindo *et al.* 2006). Therefore, this is the first record of *L. crypticus* from the Indian Ocean.

***Lampanyctus macropterus* (Brauer, 1904)**

Fig. 18

Diagnosis. Dorsal-fin rays 13–15; anal-fin rays 18–20; pectoral-fin rays 12–15; gill rakers 3 + 1 + 8–10 = 12–14; pectoral fin long, reaching Pol₁; luminous scale absent at adipose-fin base; no small

photophores scattered on head and body; Cp absent; PVO₁ above or anteroventral to PVO₂; VLO at middle of gap between lateral line and pelvic-fin insertion, or slightly closer to lateral line; VO₂ above or posterodorsal to VO₁; SAO₁ usually above VO₃; AO 4–7 + 8–10; Prc₁ well separated from last AOp; Prc₃ highly elevated at anteroventral to Prc₄; INGL elongate, occupying almost entire ventral surface of caudal peduncle (Brauer 1906; Nafpaktitis and Nafpaktitis 1969; Wisner 1976; Becker 1983).

Materials. PMBC 13419, 1 specimen, 35.9 mm SL, St. Z3, 7°42'N 97°20'E to 7°42'N 97°18'E, 493–322 m depth, otter trawl, 24 Jan. 1999; PMBC 29968, 1 specimen, 28.4 mm SL, St. Z4, 7°34'N 97°03'E to 7°35'N 97°04'E, 660–633 m depth, otter trawl, 25 Jan. 1999; PMBC 38413*, 2 specimens, 21.8–33.0 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 38417*, 1 specimen, 47.2 mm SL, St. C8, 9°00'N 96°15'E to 9°00'N 96°13'E, 478–480 m depth, Agassiz trawl, 3 Feb. 2000; PMBC 38418, 1 specimen, 27.6 mm SL (figured), St. J10, 7°20'N 97°14'E to 7°22'N 97°13'E, 655–651 m depth, otter trawl, 28 Jan. 1999; PMBC 37593(D), 2 specimens, 22.9–37.3 mm SL, HUMZ 234850(D), 1 specimen, 40.0 mm SL, St. J10, 7°15'N 97°16'E to 7°15'N 97°14'E, otter trawl, 662–696 m depth, 19 Feb. 2000.

Distribution. Tropical to subtropical waters in Indian Ocean (*e.g.*, Becker 1983; Dalpadado and Gjøsæter 1993; Mundy 2005; Vipin *et al.* 2011) including Andaman Sea (present study).

Remarks. *Lampanyctus macropterus* has variations in positions of photophores (Brauer 1904; 1906; Wisner 1976). Among them, positions of VO₂, SAO₁ and each Prc in the present specimens are very close to those in a drawing of a syntype in Brauer (1906: fig. 167). The position of each PVO of the present specimens is closer to that of the non-types in Nafpaktitis and Nafpaktitis (1969: fig. 61) than that of the syntypes (Brauer 1906: fig. 166).

Lampanyctus macropterus has been unknown from the Andaman Sea (*e.g.*, Becker 1983; Vipin *et al.* 2011; Satapoomin *et al.* 2011). Therefore, this is the first record of *L. macropterus* from this sea.



Figure 14. *Bolinichthys pyrsobolus*, PMBC 29070, 62.2 mm SL. Scale bar 10 mm.



Figure 15. *Ceratoscopelus townsendi*, PMBC 14555, 45.3 mm SL. Scale bar 10 mm.



Figure 16. *Lampadena luminosa*, PMBC 13450, 113.1 mm SL. Scale bar 10 mm.



Figure 17. *Lampanyctus crypticus*, PMBC 29841*, 69.2 mm SL. Scale bar 10 mm.

***Lampanyctus nobilis* Tåning, 1928**

Fig. 19

Diagnosis. Dorsal-fin rays 14–16; anal-fin rays 17–19; pectoral-fin rays 13–15; gill rakers 3–4 + 1 + 8–10 = 12–15; pectoral fin long, reaching AO_{a4} or AO_{a5}; luminous scale absent at adipose-fin base; no small photophores scattered on head and body; Cp absent; PVO₁ posteroventral to PVO₂; VLO at middle of gap between lateral line and pelvic-fin insertion or slightly closer to lateral line; VO₂ elevated; SAO₁ above VO₃; AO 5–7 + 8–10; Prc₁ well separated from last AOp; Prc₃ highly elevated anterodorsally to Prc₄; Prc₄ well posterior to caudal-fin base; INGL elongate, occupying entire ventral surface of caudal peduncle (Nafpaktitis and Nafpaktitis 1969; Nafpaktitis 1973; Wisner 1976; Becker 1983; Fujii 1984b; Hulley 1986b).

Materials. PMBC 307*, 2 specimens, 34.1–34.2 mm SL, St. J10, 7°20'N 97°14'E to 7°22'N 97°13'E, 655–651 m depth, otter trawl, 28 Jan. 1999; PMBC 5050, 1 specimen, 29.2 mm SL, St. Z3, 7°42'N 97°20'E to 7°42'N 97°18'E, 493–322 m depth, otter trawl, 24 Jan. 1999; PMBC 13544, 1 specimen, 29.9 mm SL, St. B8, 9°10'N 96°18'E to 9°09'N 96°16'E, 489–504 m depth, otter trawl, 11 Feb. 1999; PMBC 14621, 3 specimens, 29.4–74.9 mm SL (figured), PMBC 14621*, 2 specimens, 64.7–65.8 mm SL, St. C8, 9°00'N 96°15'E to 9°00'N 96°13'E, 478–480 m depth, Agassiz trawl, 3 Feb. 2000; PMBC 27154*, 5 specimens, 53.7–78.7 mm SL, St. E9, 8°30'N 95°58'E to 8°28'N 95°58'E, 649–550 m depth, otter trawl, 5 Feb. 1999; PMBC 29424*, 1 specimen, 35.0 mm SL, St. E7, 8°30'N 97°01'E to 8°29'N 97°03'E, 449–446 m depth, Agassiz trawl, 8 Feb. 2000; PMBC 29811* 1 specimen, 71.9 mm SL, St. Z4, 7°34'N 97°03'E to 7°35'N 97°04'E, 660–633 m depth, otter trawl, 25 Jan. 1999; PMBC 29905*, 6 specimens, 38.9–72.2 mm SL, PMBC 29905, 1 specimen, 30.4 mm SL, St. J8, 7°15'N 97°30'E to 7°15'N 97°32'E, 490–479 m depth, Agassiz trawl, 18 Feb. 2000; PMBC 29931, 1 specimen, 28.2–29.3 mm SL, PMBC 29931*, 3 specimens, 16.4–29.3 mm SL, St. Z2, 7°42'N 97°28'E to 7°42'N 97°31'E, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 37594(D), 1 specimen, 56.1 mm SL, St. J10, 7°15'N 97°16'E to 7°15'N 97°14'E, 662–696 m depth, otter trawl, 19 Feb. 2000.

Distribution. Tropical to subtropical waters in Atlantic, Indian, and western and central Pacific oceans (e.g., Parin *et al.* 1977; Fujii 1982; 1983b; 1984b; Becker 1983; Hulley 1986b; Kailola 1987; Wang and Chen 2001; Mundy 2005; Vipin *et al.* 2011; Nakabo and Kai 2013; Fricke *et al.* 2014; Robertson and Clements 2015; Hulley and Paxton 2016b; Sutton *et al.* 2020; Teramura 2020).

Remarks. Although it has been considered that *Lampanyctus nobilis* and related species are taxonomically confused (e.g., Wisner 1976; Fujii 1984b; Nakabo and Kai 2013; Psomadakis *et al.* 2019; Teramura 2020), the present specimens were identified as *L. nobilis* because their meristic characters and positions of photophores are very close to those of the lectotype of *L. nobilis* shown by Nafpaktitis and Nafpaktitis (1969: fig. 59) and Nafpaktitis (1973: fig. 40).

***Lampanyctus tenuiformis* (Brauer, 1906)**

Fig. 20

Diagnosis. Dorsal-fin rays 13–15; anal-fin rays 17–19; pectoral-fin rays 12–15; gill rakers 4 + 1 + 8–10 = 13–15; luminous scale absent at adipose-fin base; no small luminous tissues scattered on head and body; Cp absent; PVO₁ below or posteroventral to PVO₂; VLO at middle of gap between lateral line and pelvic-fin insertion or slightly closer to lateral line; VO₂ not elevated; SAO₁ above VO₃; AO 6–7 + 6–8; AOa series not curved; Prc₁ not well separated from last AOp; Prc₃ at almost same height with Prc₁; INGL short, occupying about four fifth or two thirds of entire ventral surface of caudal peduncle (Nafpaktitis and Nafpaktitis 1969; Nafpaktitis *et al.* 1977; Becker 1983; Fujii 1984b; Hulley 1986b).

Materials. PMBC 29808, 2 specimens, 65.7–70.1 mm SL, St. Z4, 7°34'N 97°03'E to 7°35'N 97°04'E, 660–633 m depth, otter trawl, 25 Jan. 1999.

Distribution. Tropical to subtropical waters in Atlantic, Indian and western and central Pacific oceans (e.g., Parin *et al.* 1977; Becker 1983; Fujii 1984b; Hulley 1986b; 1990b; Kailola 1987; Paxton and Hulley 1999b; Wang and Chen 2001; Craddock and Hartel 2002; Mundy 2005; Vipin *et al.* 2011; Robertson and Clements 2015; Hulley and Paxton 2016b; Teramura 2020).



Figure 18. *Lampanyctus macropterus*, PMBC 38418, 27.6 mm SL. Scale bar 5 mm.



Figure 19. *Lampanyctus nobilis*, PMBC 14621, 74.9 mm SL. Scale bar 10 mm.



Figure 20. *Lampanyctus tenuiformis*, PMBC 29808, 65.7 mm SL. Scale bar 10 mm.

Subfamily Myctophinae Gill, 1893***Benthosema fibulatum*****(Gilbert and Cramer, 1897)**

Fig. 21

Diagnosis. Gill rakers $6-7 + 1 + 14-15 = 20-24$; So absent; Op_2 at same height with lower margin of eye or slightly higher; PLO higher than Op_2 , closer to lateral line than pectoral-fin insertion; SAO series angulate; SAO_1 below horizontal level of SAO_2 , and below line through VLO and SAO_2 ; VO_2 highly elevated and nearly over VO_1 ; Prc_2 slightly below lateral line; SUGL and INGL present in both of male and female over 30.0 mm SL (Nafpaktitis and Nafpaktitis 1969; Wisner 1976; Becker 1983; Paxton and Hulley 1999b).

Materials. PMBC 29376, 13 specimens, 28.1–61.0 mm SL (figured), St. L6, $6^{\circ}45'N$ $98^{\circ}06'E$ to $6^{\circ}44'N$ $98^{\circ}05'E$, 303–313 m depth, Agassiz trawl, 23 Feb. 2000; PMBC 29591, 1 specimen, 50.9 mm SL, St. J7, $7^{\circ}15'N$ $97^{\circ}53'E$ to $7^{\circ}16'N$ $97^{\circ}52'E$, 356–360 m depth, Agassiz trawl, 17 Feb. 2000; PMBC 29916, 3 specimens, 37.9–42.3 mm SL, PMBC 29916*, 2 specimens, 40.5–42.2 mm SL, St. K6, $7^{\circ}02'N$ $98^{\circ}10'E$ to $7^{\circ}04'N$ $98^{\circ}09'E$, 277–288 m depth, otter trawl, 1 Mar. 2000; PMBC 29938, 1 specimen, 47.9 mm SL, St. Z2, $7^{\circ}42'N$ $97^{\circ}28'E$ to $7^{\circ}42'N$ $97^{\circ}31'E$, 464–464 m depth, otter trawl, 23 Jan. 1999.

Distribution. Tropical to temperate waters in Indian, and western and central Pacific oceans (e.g., Becker 1983; Fujii 1984b; Hulley 1986b; Becker and Shcherbachev 1990; Dalpadado and Gjøsæter 1993; Wang and Chen 2001; Mundy 2005; Paxton *et al.* 2006; Vipin *et al.* 2011; Fricke *et al.* 2014; 2018; Psomadakis *et al.* 2015; 2019; Teramura 2020; Gloerfelt-Tarp and Kailola 2022).

***Dasyscopelus brachygnathos* (Bleeker, 1856)**

Fig. 22

Diagnosis. Pectoral-fin rays $16-19$; gill rakers $6-9 + 1 + 16-19 = 23-28$; interorbital width more than three times in head length; orbital diameter equal to distance from posterior margin of orbit to posterior margin of operculum; posterodorsal margin of operculum smooth without striation, serration and angulation; scales moderately ctenoid; scales on anal-fin base without elongate spines; PVO_1 over or very slightly behind PO_2 ; PLO at nearly middle

of gap between lateral line and pectoral-fin insertion; $AO\ 6-8 + 3-5$; Prc_2 well below lateral line (Becker and Borodulina 1971; 1976; Kawaguchi and Aioi 1972; Nafpaktitis 1973; Wisner 1976; Becker 1983; Bangchongmanee *et al.* 2023).

Material. PMBC 29427, 1 specimen, 50.5 mm SL, St. E7, $8^{\circ}30'N$ $97^{\circ}01'E$ to $8^{\circ}29'N$ $97^{\circ}03'E$, 449–446 m depth, Agassiz trawl, 8 Feb. 2000.

Distribution. Tropical to subtropical waters in Indian, and western and central Pacific oceans (e.g., Becker 1983; Kailola 1987; Paxton and Hulley 1999b; Paxton *et al.* 2006; Vipin *et al.* 2011; Gloerfelt-Tarp and Kailola 2022; Bangchongmanee *et al.* 2023).

***Dasyscopelus spinosus* (Steindachner, 1867)**

Fig. 23

Diagnosis. Pectoral-fin rays $12-15$; gill rakers $5-8 + 1 + 12-18 = 18-25$; posterodorsal margin of operculum serrated without angulation; scales ctenoid; scales with small spines over anal-fin base; SAO series straight or slightly angulate; SAO_1 behind vertical line through VO_3 ; straight line through SAO_1 and SAO_3 passing through middle of gap between VO_2 and VO_3 or closer to VO_3 ; Pol anterior to adipose-fin base; $AO\ 6-8 + 5-8$ (usually $7 + 6$); Prc_2 closer to Prc_1 than lateral line (Nafpaktitis and Nafpaktitis 1969; Wisner 1970; 1976; Kawaguchi and Aioi 1972; Becker and Borodulina 1976; Becker 1983).

Materials. PMBC 29042, 2 specimens, 40.0–41.7 mm SL, St. L8, $6^{\circ}46'N$ $97^{\circ}33'E$ to $6^{\circ}44'N$ $97^{\circ}35'E$, 513–501 m depth, otter trawl, 22 Feb. 2000; PMBC 29126, 2 specimens, 41.3–51.5 mm SL (figured), St. Z2, $7^{\circ}42'N$ $97^{\circ}28'E$ to $7^{\circ}42'N$ $97^{\circ}31'E$, 464–464 m depth, otter trawl, 23 Jan. 1999; PMBC 29295, 1 specimen, 44.9 mm SL, St. K6, $7^{\circ}02'N$ $98^{\circ}10'E$ to $7^{\circ}04'N$ $98^{\circ}09'E$, 277–288 m depth, otter trawl, 1 Mar. 2000.

Distribution. Tropical to subtropical waters in Indian and Pacific oceans (e.g., Wisner 1970; Parin *et al.* 1973; Fujii 1982; 1984b; Becker 1983; Hulley 1986b; Dalpadado and Gjøsæter 1993; Jayaprakash 1996; Paxton and Hulley 1999b; Wang and Chen 2001; Paxton *et al.* 2006; Vipin *et al.* 2011; Robertson and Clements 2015; Fricke *et al.* 2018) including Andaman Sea (present study).

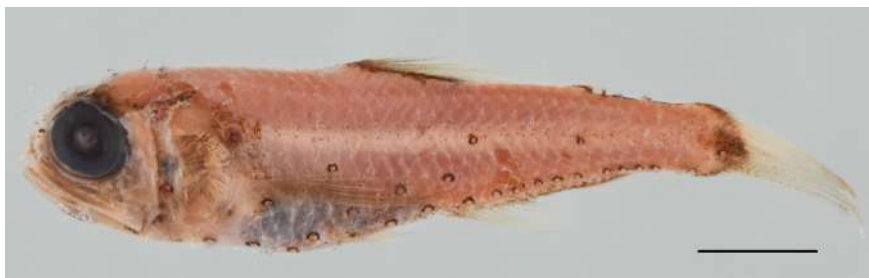


Figure 21. *Benthosema fibulatum*, PMBC 29376, 58.3 mm SL. Scale bar 10 mm.



Figure 22. *Dasyscopelus brachygnathos*, PMBC 29427, 50.5 mm SL. Scale bar 10 mm.



Figure 23. *Dasyscopelus spinosus*, PMBC 29126, 51.5 mm SL. Scale bar 10 mm.



Figure 24. *Hygophum* cf. *reinhardtii*, PMBC 29422, 39.3 mm SL. Scale bar 5 mm.

Remarks. *Dasy Scopelus spinosus* is widely distributed in the Indian Ocean (e.g., Nafpaktitis and Nafpaktitis 1969; Becker 1983). However, this species is unknown from the Andaman Sea (e.g., Satapoomin 2011; Rajan *et al.* 2013). Therefore, this is the first record of *D. spinosus* from this sea.

***Hygophum cf. reinhardtii* (Lütken, 1892)**

Fig. 24

Diagnosis. Gill rakers $4 + 1 + 12 - 13 = 17 - 18$; maxilla slightly extending posteriorly below posterior margin of orbit; uppermost edge of pectoral-fin insertion at almost same height with center of eye; PLO closer to lateral line than pectoral-fin insertion; VLO at middle of gap between lateral line and pelvic-fin insertion, and at slightly above height of SAO_1 ; SAO_1 above middle of gap between VO_2 and VO_3 , and at almost same height with SAO_2 ; upper Pol ahead of adipose-fin base; Prc_2 slightly below lateral line (present study).

Material. PMBC 29422, 1 specimen, 39.3 mm SL, St. E7, $8^{\circ}30'N$ $97^{\circ}01'E$ to $8^{\circ}29'N$ $97^{\circ}03'E$, 449–446 m depth, Agassiz trawl, 8 Feb. 2000.

Distribution. Andaman Sea (present study).

Remarks. The number of gill rakers and the positions of photophores of the present specimen are congruent with those of *Hygophum reinhardtii* (Lütken, 1892) (e.g., gill rakers $3 - 5 + 1 + 11 - 15 = 16 - 19$ in *H. reinhardtii*; Becker 1965; 1983; Wisner 1976; Nafpaktitis *et al.* 1977; Hulley 1986b), which is distributed in the tropical to temperate waters in world oceans except for the equatorial Indian Ocean (e.g., Parin *et al.* 1973; 1977; Becker 1983; Fujii 1984b; Kailola

1987; Fricke *et al.* 2011). However, some of the important taxonomic characters of *H. reinhardtii*, i.e., the numbers of anal-fin rays, lateral line scales and AOa, are uncountable in the present specimen due to its damage. Therefore, we tentatively identified the present specimen as *Hygophum cf. reinhardtii*.

***Symbolophorus evermanni* (Gilbert, 1905)**

Fig. 25

Diagnosis. VLO anterodorsal to pelvic-fin insertion; SAO_1 over or slightly behind VO_2 ; SAO_1 at middle of gap between VLO and SAO_2 or slightly nearer to SAO_2 ; Pol slightly ahead of adipose-fin base; AOa series not curved; AOp_1 (very rarely AOp_1 and AOp_2) on anal-fin base; posterior edge of each element of SUGL not concave in male (Nafpaktitis and Nafpaktitis 1969; Wisner 1976; Becker 1983; Gago and Ricord 2005).

Materials. PMBC 23404, 1 specimen, 43.4 mm SL (figured), St. C8, $9^{\circ}00'N$ $96^{\circ}15'E$ to $9^{\circ}00'N$ $96^{\circ}13'E$, 478–480 m depth, Agassiz trawl, 3 Feb. 2000; PMBC 29837, 1 specimen, 57.1 mm SL, St. Z4, $7^{\circ}34'N$ $97^{\circ}03'E$ to $7^{\circ}35'N$ $97^{\circ}04'E$, 660–633 m depth, otter trawl, 25 Jan. 1999.

Distribution. Tropical to subtropical waters in Indian and western Pacific oceans, rarely occurred in central and eastern Pacific oceans (e.g., Parin *et al.* 1973; Fujii 1982; 1984b; Becker 1983; Hulley 1986b; Dalpadado and Gjøsæter 1993; Jayaprakash 1996; Paxton and Hulley 1999b; Wang and Chen 2001; Paxton *et al.* 2006; Vipin *et al.* 2011; Robertson and Clements 2015; Nakayama 2017; Fricke *et al.* 2018; Psomadakis *et al.* 2019).



Figure 25. *Symbolophorus evermanni*, PMBC 23404, 58.3 mm SL. Scale bar 10 mm.

ACKNOWLEDGEMENT

We are grateful to Ms. Tipamat Upanoi (Director of PMBC), Acting Maj. Suthep Jualaong and Dr. Kongkiat Kittiwatanawong (former Directors of PMBC), Dr. Somchai Bussarawit (formerly specialist, Marine and Coastal Resources Research and Development Institute, Thailand), Mr. Supasit

Boonphienphol and Mr. Surapong Banchongmanee (PMBC), and staff of the Reference Collection of PMBC for their help of our research in PMBC. We express gratitude to Mr. Makoto Furusho (Hokkaido University) for providing help with collecting literatures. This study was partially supported by JSPS KAKENHI Grant Number JP23K05364 and JST SPRING Grant Number JPMJSP2119.

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