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SPECIMENS OF THE FAMILY MULLIDAE (ACTINOPTERYGII: TELEOSTEI) IN THE REFERENCE COLLECTION OF PHUKET MARINE BIOLOGICAL CENTER

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ABSTRACT: Two hundred and eighty specimens of the family Mullidae, deposited in the Reference Collection, Phuket Marine Biological Center, Thailand (PMBC), comprise 121 lots representing at least 16 species belonging to three genera (*Mulloidichthys, Parupeneus*, and *Upeneus*). Five species had not been previously recorded in the reference collection database.

Key words: *Mulloidichthys, Parupeneus, Upeneus,* Andaman Sea

INTRODUCTION

The goatfish family Mullidae includes at least 100 species in six genera, distributed in tropical to temperate waters in all major oceans (Echreshavi *et al.* 2022; Uiblein and Maclaine 2021; Uiblein and Randall 2022). All being diagnosed by a pair of barbels on the lower jaw, most species are bottom dwellers in coastal waters (Randall 2001; Uiblein and Randall 2022), including a number considered edible (Bandai 2022). In Southeast Asia, including Thailand, from which region several species have been reported (Satapoomin 2000, 2011; Tafzilmeriam 2013a), goatfishes are frequently seen in fish markets.

Numerous goatfish specimens deposited in the Reference Collection, Phuket Marine Biological Center (PMBC), had been collected from various Indo-West Pacific localities between 1952–2005. These included two expeditions by PMBC: Biodiversity of the Andaman Sea Shelf Project during 1996–2000 (BIOSHELF) (Aungtonya *et al.* 2000) and Biodiversity of Phang-nga Bay Project in 2001–2002, in addition to some collected from fish markets.

Because the family is still confused taxonomically, despite many new species having been described recently (Uiblein 2021; Uiblein and Motomura 2021; Uiblein and Maclaine 2021), a list of Mullidae specimens deposited in the Reference Collection, Phuket Marine Biological Center (PMBC) is provided here as an aid to future taxonomic studies.

MATERIALS AND METHODS

All specimens listed herein (in alphabetical order by species name) are housed in the Reference Collection, Phuket Marine Biological Center, Thailand (PMBC), and preserved in 70% alcohol. Identification of mullid species followed Randall (2004), Uiblein and Heemstra (2010), Uiblein (2011), Hatooka and Doiuchi (2013), Uiblein *et al.* (2017), Uiblein et al. (2019), Uiblein and Motomura (2021), and Uiblein and Randall (2022). Abbreviations are as follows- SL: standard length; HL: head length. Contents included in parenthesis following registration numbers are as follows: [specimen counts (if plural specimens included in lot)]; SL; collection locality, habitat, depth, gear method, collection date, expedition code/research vessel]. Collection data of specimens are omitted if the same as that of the following specimen. Measurements were made to the nearest 0.1 mm with digital vernier calipers. Species' diagnoses were taken from published studies.

RESULTS

The PMBC fish collection was found to include 280 goatfish specimens in 121 lots, representing at least 16 species belonging to three genera.

SPECIES LIST

Family Mullidae Rafinesque, 1815

Genus *Mulloidichthys* Whitley, 1929

Mulloidichthys vanicolensis (Valenciennes, 1831)

Fig. 1

Diagnosis. Pectoral-fin rays 15–17; gill rakers 7–10 + 23–26 = 31–35; lateral-line scales 36–38. As % of SL: body depth at first dorsal fin origin 24–30; body depth at anal fin origin 21–25; maximum head depth 21–25; HL 28–32; barbel length 19–24; first dorsal fin height 20–25; 15–18; caudal peduncle depth 9–11; caudal peduncle width 3–5. Body yellowish above lateral line, silvery-white ventrally; one yellow stripe on body from eye to caudal-fin base; fins yellow, except hyaline pectoral fin; barbels white (Uiblein 2011; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 6193, 225.2 mm SL, market in Phuket, 31 Aug. 1973; PMBC 20023, 2 specimens, 166.1–168.8 mm SL, Nai Yang Beach, Phuket, gill net, 22 Dec. 2001.

Remarks. In Thai waters, *M. vanicolensis* has been recorded from the Andaman Sea based on voucher specimens [Imamura 2009a (based on an underwater photograph); Satapoomin 2011; this study].

Genus Bleeker, 1863
(Lacepède, 1801)
Fig. 2

Diagnosis. Pectoral-fin rays 16–18; gill rakers 6 or 7 + 20–25 = 26–31. As % of SL: body depth at first dorsal fin origin 27–30; HL 33–38. As % of HL: snout length 48–67; barbel length 63–71; pectoral fin length 56–67; pelvic fin length 63–71. Body whitish, a black stripe from upper lip through eye to below posterior part of second dorsal fin or anterior part of caudal peduncle; black spot on side of caudal peduncle, extending above and below lateral line (Randall 2004; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 3614, 98.2 mm SL, Rawai Beach, Phuket, coral reef, 9 Nov. 1972; PMBC 5742, 260.3 mm SL, market in Phuket, 9 Nov. 1972; PMBC 20024, 186.8 mm SL, Nai Yang Beach, Phuket, gill net, 22 Dec. 2001; PMBC 34751, 112.2 mm SL, Miang Island, Phang-nga, rocky shore to sand and coral, 0.4 m depth, Rotenone, 14 Feb. 1972; PMBC 14012, 255.0 mm SL, Lipeh Island, Satun, coast area, gill net, 9 Dec. 1994. Philippines: PMBC 34756, 128.7 mm SL, Manila Bay, Luzon (obtained at market in Manila), 9 Sep. 1972; PMBC 6507, 95.9 mm SL, Calatagan, Batangas, Luzon, 17 Nov. 1958.

Remarks. In Thai waters, *P. barberinus* has been recorded from the Andaman Sea based on voucher specimens (Satapoomin 2011; this study).

(Lacepède, 1801) Fig. 3

Diagnosis. Pectoral-fin rays 15–17; gill rakers 6 or 7 + 22–26 = 29–33. As % of SL: body depth at first dorsal fin origin 26–30; HL 32–34. As % of HL: snout length 56–63; barbel length from 83 % of HL to longer than posterior margin of operculum; pectoral fin length 59–67; pelvic fin length 63–71. Body yellowish-gray in large adults; short radiating blue lines around eyes; a saddle-like yellow blotch on caudal peduncle; body entirely yellow in some small specimens (Randall 2004; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 7825, 147.7 mm SL, Rawai Beach, Phuket, 9 Apr. 1990; PMBC 14013, 278.7 mm SL, Similan Island, Phang-nga, hand line, 21 Apr. 1995.

Remarks. In Thai waters, *P. cyclostomus* has been recorded from the Andaman Sea based on voucher specimens [Imamura 2009b (based on an underwater photograph); Satapoomin 2011; this study].

(Lacepède, 1802)
Fig. 4

Diagnosis. Pectoral-fin rays 15–17; gill rakers 6 or 7 + 21–23 = 27–30. As % of SL: body depth at first dorsal fin origin 29–33; HL 30–34. As % of HL: snout length 48–56; barbel length 71–83; pectoral fin length 71–77; pelvic fin length 67–77; posterior margin of maxilla evenly convex. Body pale reddish-orange, silvery-white ventrally, a single small reddish spot on upper surface below seventh and eighth lateral-line scales (Randall 2004; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 3605, 2 specimens, 101.0–115.9 mm SL, landed at trawler harbor, Phuket, 23 June 1972; PMBC 3607, 2 specimens, 113.9–165.2 mm SL, PMBC 6194, 173.5 mm SL, landed at trawler harbor, Phuket, 14 Aug. 1972; PMBC 3615, 182.1 mm SL, market in Phuket, 9 Nov. 1972; PMBC 3616, 168.7 mm SL, market in Phuket, 23 Apr. 1973; PMBC 5747,

159.7 mm SL, landed at trawler harbor, Phuket, 23 Oct. 1972; PMBC 5748, 2 specimens, 173.7–179.9 mm SL, landed at trawler harbor, Phuket, 13 Oct. 1972; PMBC 5750, 128.6 mm SL, market in Phuket, 30 Aug. 1972; PMBC 5751, 180.7 mm SL, market in Phuket, 9 Aug. 1972; PMBC 20866, 2 specimens, 42.9–73.1 mm SL, Bang Rong, Phuket, seagrass bed, beach seine, 12 Oct. 2005; PMBC 5444, 3 specimens, 151.3–218.9 mm SL, Surin Island, Phang-nga, 70 m depth, bottom trawl, 1 June 1985, R.V. Fishery Research; PMBC 14014, 193.1 mm SL, Surin Nuea Island, Phang-nga, hand line, 2 May 1993; PMBC 25897, 5 specimens, 58.9–105.5 mm SL, Phang-nga Bay St. 4, 26 m depth, trawl, 23 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25901, 79.7 mm SL, Phang-nga Bay St. 7, 29 m depth, trawl, 17 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25902, 2 specimens, 121.3–122.0 mm SL, Phang-nga Bay St. 9, 43 m depth, trawl, 18 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 30307, 4 specimens, 100.3–113.1 mm SL, fish market, Kao-Surin Island, Phang-nga, 4 Mar. 1997; PMBC 14436, 6 specimens, 56.1–89.9 mm SL, Yonglum Beach, Trang, seagrass bed, 26 Nov. 1996; PMBC 25169, 4 specimens, 118.3–173.0 mm SL, BIOSHELF St. T3 (7°52'N 98°06'E to 7°50'N 98°06'E), 68 m depth, otter trawl, 3 Dec. 1998. Philippines: PMBC 6597, 164.0 mm SL, Manila Bay, Luzon (obtained at market in Manila), 9 Sep. 1972. Myanmar: PMBC 6710, 234.2 mm SL, Andaman Sea, 80–90 m depth, otter trawl, 13 Nov. 1989, R.V. Chulabhorn. India: PMBC 3609, 2 specimens, 162.6–212.0 mm SL, Cochin (currently Kochi), Kerala, Norwegian deep-sea trawl, 26 Sep. 1972, Vessel: Tuna INP.

Remarks. In Thai waters, *P. heptacanthus* has been recorded from the Andaman Sea and the Gulf of Thailand based on voucher specimens (Randall 2004; Satapoomin 2005a, 2009a, 2011; Tafzilmeriam 2013b; this study).

Figure 1. *Mulloidichthys vanicolensis,* PMBC 20023, 166.1 mm SL. Scale bar 30 mm.

Figure 2. *Parupeneus barberinus,* PMBC 20024, 186.8 mm SL. Scale bar 30 mm.

Figure 3. *Parupeneus cyclostomus,* PMBC 7825, 147.7 mm SL. Scale bar 30 mm.

Figure 4. *Parupeneus heptacanthus,* PMBC 3616, 168.7 mm SL. Scale bar 30 mm.

***Parupeneus indicus* (Shaw, 1803)**
Fig. 5

Diagnosis. Pectoral-fin rays 15–17; gill rakers 5–7 + 18–21 = 24–27. As % of SL: body depth at first dorsal fin origin 26–30; HL 30–34. As % of HL: snout length 50–59; barbel length 67–77; pectoral fin length 63–71; pelvic fin length 67–77. Body whitish, a broad yellow spot on upper surface between dorsal fins; black spot equal to or larger than eye on side of caudal peduncle, extending above and below lateral line (Randall 2004; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 3611, 223.7 mm SL, market in Phuket, 19 July 1972; PMBC 5743, 227.0 mm SL, market in Phuket, 9 Nov. 1972. Gulf of Thailand: PMBC 10952, 210.2 mm SL, Lang Suan, Chumphon, muddy sand, 22 m depth, 23 Feb. 1913. India: PMBC 5744, 2 specimens, 251.3–267.7 mm SL, Cochin (currently Kochi), Kerala, Norwegian deep-sea trawl, 26 Sep. 1972, Vessel: Tuna INP; PMBC 5746, 247.8 mm SL, Cochin (currently Kochi), Kerala, Norwegian deep-sea trawl, 2 Sep. 1972, Vessel: Tuna INP. Philippines: PMBC 6503, 98.1 mm SL, Calatagan, Batangas, Luzon, 17 Nov. 1958.

Remarks. In Thai waters, *P. indicus* has been recorded from the Andaman Sea and the Gulf of Thailand based on voucher specimens (Randall 2004; Satapoomin 2011; this study).

***Parupeneus macronemus* (Lacepède, 1801)**
Fig. 6

Diagnosis. Pectoral-fin rays 15–17; gill rakers 7–9 + 27–30 = 34-39. As % of SL: body depth at first dorsal fin origin 27–30; HL 31–36. As % of HL:

snout length 53–59; barbel length 77–91; pectoral fin length 67–77; pelvic fin length 67–83. Body grayish-red dorsally, whitish to pink ventrally, a black stripe from eye to below second dorsal fin, a broad white zone extending from posterior part of second dorsal fin to anterior part of caudal peduncle; a black spot on side of caudal peduncle, extending above and below lateral line; basal one-third to one-half of second dorsal fin black, dark pigment continuing to end of last ray and adjacent membrane (Randall 2004; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 3617, 182.7 mm SL, market in Phuket, 2 March 1973; PMBC 3618, 178.9 mm SL, market in Phuket, 9 Nov. 1972; PMBC 20067, 13 specimens, 41.0–62.4 mm SL, Racha Yai Island, Phuket, 25 Feb. 2002; PMBC 25170, 3 specimens, 87.2–105.7 mm SL, Miang Island, Similan Islands, Phang-nga, rocky shore to sand and coral, 0.4 m depth, Rotenone, 14 Feb. 1972; PMBC 18594, 134.4 mm SL, Ton Sai Bay, Phi Phi Don Island, Krabi, hand line, 29 Nov. 2001.

Remarks. In Thai waters, *P. macronemus* has been recorded from the Andaman Sea based on voucher specimens [Randall 2004; Imamura 2009c (based on an underwater photograph); this study]. Satapoomin (2011) reported the species from the Andaman Sea as *P. macronema* based on PMBC specimens without giving registration numbers.

Figure 5. *Parupeneus indicus,* PMBC 5744, 267.7 mm SL. Scale bar 30 mm.

Figure 6. *Parupeneus macronemus,* PMBC 18594, 134.4 mm SL. Scale bar 20 mm.

***Parupeneus multifasciatus* (Quoy & Gaimard, 1825)**
Fig. 7

Diagnosis. Pectoral-fin rays 15–17; gill rakers 7–10 + 28–33 = 36–41. As % of SL: body depth at first dorsal fin origin 27–32; HL 32–36. As % of HL: snout length 50–59; barbel length 77–100; pectoral fin length 63–71; pelvic fin length 67–77. Body whitish to reddish, a wide black bar below second dorsal fin and on caudal peduncle; posterior part of second dorsal-fin base blackish in adults (Randall 2004).

Material examined. Philippines: PMBC 34757, 124.5 mm SL, Manila Bay, Luzon (obtained at market in Manila), 9 Sep. 1972.

Remarks. Although *P. multifasciatus* is distributed in the eastern Indian and Pacific oceans from Cocos-Keeling Islands to southern Japan to Pitcairn Islands (Randall 2001, 2004; Hatooka and Doiuchi 2013), it has never been recorded from Thai waters (Randall 2004).

***Parupeneus pleurostigma* (Bennett, 1831)**
Fig. 8

Diagnosis. Pectoral-fin rays 15–17; gill rakers 6–8 + 21–25 = 28–32. As % of SL: body depth at first dorsal fin origin 25–29; HL 32–34. As % of HL: snout length 48–59; barbel length 63–77; pectoral fin length 67–77; pelvic fin length 67–77. Body whitish to pinkish, a large black blotch about 3 or 4 scales wide on side below posterior part of first dorsal fin, followed by whitish spot; second dorsal-fin base black (Randall 2004; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 14015, 138.2 mm SL, Similan Island, Phang-nga, coast area, 13–16 m depth, spear, 27 Jan 1997.

Remarks. In Thai waters, *P. pleurostigma* has been recorded from the Andaman Sea based on voucher specimens (Imamura 2009d; Satapoomin 2011; this study).

Genus *Upeneus* Cuvier, 1829
***Upeneus guttatus* (Day, 1868)**
Fig. 9

Diagnosis. Dorsal-fin spines 7, rays 9; pectoral-fin rays 12–14; gill rakers 5–8 + 16–19 = 22–26; lateral-line scales 28–31. As % of SL: body depth at first dorsal fin origin 21–26; body depth at anal fin origin 18–22; maximum head depth 18–22; HL 26–29; barbel length 16–20; first dorsal fin height 20–24; anal fin height 14–19; caudal peduncle depth 9–11; caudal fin length 27–31; pectoral fin length 19–22; pelvic fin length 19–23. Body silvery-white, sometimes mottled red above lateral line; reddish bars on upper and lower caudal-fin lobes; upper lobe with 4–6 bars of similar width to or narrower than pale interspaces, lower lobe with 2–10 irregular bars; barbels yellow (Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 5434, 4 specimens, 97.8–110.1 mm SL, Surin Island, Phang-nga, 65 m depth, bottom trawl, 1 June 1985, R.V. Fishery Research; PMBC 25903, 69.9 mm SL, Phang-nga Bay St. 8, 10 m depth, trawl, 20 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25905, 50.7 mm SL, Phang-nga Bay St. 7, 29 m depth, trawl, 17 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25908, 82.7 mm SL, Phang-nga Bay St. 14, 22 m depth, trawl, 19 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 34752, 36.9 mm SL, Phang-nga Bay St. 4, 26 m depth, trawl, 23 Dec. 2001, Biodiversity of Phang-nga Bay Project.

Remarks. In Thai waters, *U. guttatus* has been recorded from the Andaman Sea based on voucher specimens (Kimura 2009; this study). Satapoomin (2011) reported this species from the Andaman Sea without voucher specimens.

***Upeneus heterospinus* Uiblein & Pavlov, 2019**
Fig. 10

Diagnosis. Dorsal-fin spines 7 or 8 (first spine smallest in 8-spined individual), rays 9; pectoral-fin rays 13–15; gill rakers 4–6 + 15–18 = 21–24; lateral-line scales 28–30. As % of SL: body depth at first dorsal fin origin 22–26; body depth at anal fin origin 18–22; maximum head depth 19–23; HL 27–31; barbel length 16–20; first dorsal fin height 18–23; second dorsal fin height 16–20; anal fin height 15–19; caudal peduncle depth 9–10; caudal fin length 29–31; pectoral fin length 21; pelvic fin length 21–22. Body mottled, white ventrally with dots or blotches, a single stripe from snout through

eye to caudal-fin base; stripe covered by 1–4 patches with 1–4 dark dots; reddish or brownish bars on upper and lower caudal-fin lobe; upper caudal-fin lobe with 4–6 bars, lower lobe with 5–7 bars; tip of lower caudal-fin lobe sometimes black; barbels yellow (Uiblein *et al.* 2019).

Material examined. Philippines: PMBC 6504, 80.8 mm SL, Villareal, Samar, 9 June 1952.

Remarks. In Thai waters, *U. heterospinus* has been recorded from the Gulf of Thailand based on voucher specimens (Uiblein *et al.* 2019).

Figure 7. *Parupeneus multifasciatus*, PMBC 34757, 124.5 mm SL. Scale bar 20 mm.

Figure 8. *Parupeneus pleurostigma,* PMBC 14015, 138.2 mm SL. Scale bar 20 mm.

Figure 9. *Upeneus guttatus,* PMBC 5434, 106.8 mm SL. Scale bar 20 mm.

Figure 10. *Upeneus heterospinus,* PMBC 6504, 80.8 mm SL. Scale bar 10 mm.

***Upeneus luzonius* Jordan & Seale, 1907**
Fig. 11

Diagnosis. Dorsal-fin spines 8, rays 9; pectoral-fin rays 14 or 15; total gill rakers 18–21; lateral-line scales 31 or 32. As % of SL: body depth at first dorsal fin origin 22–26; body depth at anal fin origin 19–23; maximum head depth 20–23; HL 27–30; snout length 11–12; barbel length 17–20; first dorsal fin height 21–24; anal fin height 15–17; caudal peduncle depth 11–13; caudal fin length 26–29; pectoral fin length 19–23; pelvic fin length 21–22; inter-dorsal distance 12–15. Tip of first dorsal fin not dark; bars present on upper and lower caudal-fin lobes (Uiblein and Heemstra 2010; Uiblein *et al.* 2016; Uiblein *et al.* 2019).

Material examined. Thailand, Andaman Sea: PMBC 10436, 3 specimens, 83.0–100.6 mm SL, PMBC 34763, 20 specimens, 36.1–104.8 mm SL, Bang Rong, Phuket, mangrove area, push net, 30 June 1994; PMBC 25918, 2 specimens, 119.4–125.8 mm SL, Pu Island, Krabi, 23 Oct. 2004; PMBC 25920, 86.8 mm SL, Tha Lane Bay, Krabi, 26 Oct. 2004.

Remarks. The species has been recorded from Puducherry (India), the South China Sea, Philippines, Western Australia and the Northern territory (Australia) (Randall and Lim 2000; Hutchins 2001; Mishra and Krishnan 2003; Uiblein and Heemstra 2010; Larson *et al.* 2013; Uiblein *et al.* 2016). Therefore, the present specimens represent the first records from Thai waters. According to Uiblein *et al.* (2016), taxonomy of this species is not well researched, and specimens from outside the Philippines need to be reviewed.

Although morphological and taxonomic information on this species is sparse, the specimens were identified as *U. luzonius* due to having the characters indicated by Uiblein and Heemstra (2010), Uiblein *et al.* (2016) and Uiblein *et al.* (2019) as diagnostic of the species, viz. 8 dorsal-fin spines, 20 or 21 total gill rakers (right side), 31 lateral-line scales, first dorsal fin tip not dark, several bars on lower caudal-fin lobe.

***Upeneus margarethae* Uiblein & Heemstra, 2010**
Fig. 12

Diagnosis. Dorsal-fin spines 8, rays 9; pectoral-fin rays 13–15; gill rakers 5–7 + 15–18 = 21–24; lateral-line scales 28–30. As % of SL: body depth at first dorsal fin origin 22–27; body depth at anal fin origin 20–24; maximum head depth 18–23; HL 27–31; barbel length 15–20; first dorsal fin height 18–23; anal fin height 14–18; anal-fin base length 10–14; caudal peduncle depth 9–12; caudal fin length 27–31; pectoral fin length 19–24; pelvic fin length 20–24. Body mottled reddish or brown dorsally, white ventrally with reddish dots or blotches; a yellowish stripe from snout through eye to caudal-fin base; stripe sometimes covered by 1–4 patches with dark dots; tip of first dorsal fin pale; reddish bars on upper and lower caudal-fin lobes; upper caudal-fin lobe with 4–6 bars, lower lobe with 6–9 thin bars ventrally, overlain by a broad red band; barbels white (Uiblein *et al* 2019; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 20885, 42.5 mm SL, Pa Klok Village, Phuket,

seagrass bed, small push-net, 18 Mar. 2005; PMBC 25923, 66.4 mm SL, Phang-nga Bay St. 8, 10 m depth, trawl, 20 Dec. 2001, Biodiversity of Phang-nga Bay Project.

Remarks. In Thai waters, *U. margarethae* has been recorded from the Andaman Sea based on voucher specimens (Uiblein *et al* 2019; this study).

Upeneus sulphureus Cuvier, 1829
Fig. 13

Diagnosis. Dorsal-fin spines 8, rays 9; pectoral-fin rays 15–17; gill rakers 7 or 8 + 19–22 = 27–30; lateral-line scales 34–37. As % of SL: body depth at first dorsal fin origin 26–33; body depth at anal fin origin 24–26; head depth 22–25; HL 28–31; barbel length 15–21; first dorsal fin height 22–27; anal fin height 16–19; caudal peduncle depth 11-12; caudal fin length 27–30; pectoral fin length 22–26; pelvic fin length 18–22. Body pale brown above lateral line, silvery-white ventrally, two yellow lateral stripes; tip of first dorsal fin dark; no bars on caudal-fin lobes; barbels white (Bandai *et al.* 2019; Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 3600, 2 specimens, 118.5–126.9 mm SL, landed at trawler harbor, Phuket, 23 June 1972; PMBC 3602, 2 specimens, 81.1–85.5 mm SL, Panwa Cape, PMBC Beach, Phuket, bottom trawl, 27 June 1972; PMBC 3604, 126.7 mm SL, landed at trawler harbor, Phuket, 21 Aug. 1972; PMBC 3612, 122.0 mm SL, market in Phuket, 9 Nov. 1972; PMBC 5800, 61.6 mm SL, market in Phuket, 20 Nov. 1972; PMBC 20884, 2 specimens, 41.7–49.2 mm SL, Pa Klok Village, Phuket, seagrass bed, small push-net, 18 Mar. 2005; PMBC 20598, 2 specimens, 80.5–82.0 mm SL, Yao Noi Island, Phang-nga, trammel net, 15 July 2004; PMBC 20623, 3 specimens, 86.3–94.3 mm SL, Yao Noi Island, Phang-nga, trammel net, 17 July 2004; PMBC 25636, 45.8 mm SL, PMBC 25899, 84.5 mm SL, Phang-nga Bay St. 3 (7°55'05"N 98°33'07"E), 22 m depth, trawl, 22 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25900, 83.4 mm SL, Phang-nga Bay St. 3, 15 m depth, trawl, 22 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25904, 4 specimens, 59.6–78.1 mm SL, Phang-nga Bay St. 1, 18–24 m depth, trawl, 23 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25906, 14 specimens, 43.7–71.5 mm SL, Phang-nga Bay St. 4, 19 m depth, trawl, 24 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25907, 7 specimens, 45.8–57.6 mm SL, Phang-nga Bay St. 13, 10–20 m depth, trawl, 19 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25909, 2 specimens, 76.4–80.1 mm SL, Phang-nga Bay St. 1, 18 m depth, shrimp trawl, 25 Mar. 2002, Biodiversity of Phang-nga Bay Project; PMBC 25910, 88.3 mm SL, Phang-nga Bay St. 4, 25 m depth, shrimp trawl, 16 Aug. 2002, Biodiversity of Phang-nga Bay Project; PMBC 25911, 93.6 mm SL, Phang-nga Bay St. 3, 11–20 m depth, shrimp trawl, 12 June 2002, Biodiversity of Phang-nga Bay Project; PMBC 25913, 2 specimens, 46.0–52.8 mm SL, Phang-nga Bay St. 11, 17 m depth, trawl, 20 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25914, 50.0 mm SL, Phang-nga Bay St. 2 (8°04'17"N 98°38'42"E), 9 m depth, trawl, 24 Dec.2001, Biodiversity of Phang-nga Bay Project; PMBC 25915, 53.1 mm SL, Phang-nga Bay St. 15, 18 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25916, 50.1 mm SL, Phang-nga Bay St. 11, 19 m depth, shrimp trawl, 26 Mar. 2002, Biodiversity of Phang-nga Bay Project; PMBC 25924, 2 specimens, 75.8–80.3 mm SL, Phang-nga Bay St. 2 (8°06'03"N 98°39'44"E), 14–18 m depth, shrimp trawl, 13 June 2002, Biodiversity of Phang-nga Bay Project; PMBC 34754, 99.9 mm SL, Phang-nga Bay St. 1, 10 m depth, trawl, 22 Dec. 2001, Biodiversity of Phang-nga Bay Project. Malaysia: PMBC 3613, 138.9 mm SL, Kedah, 55–64 m depth, 7 Oct. 1972. Indonesia: PMBC 5753, 3 specimens, 74.0–98.4 mm SL, Bali, 9 Sep. 1972. Philippines: PMBC 34758, 4 specimens, 88.9–105.1 mm SL, Manila Bay, Luzon (obtained at market in Manila), 9 Sep. 1972; PMBC 6521, 87.4 mm SL, Cebu, 25 June 1958.

Remarks. In Thai waters, *U. sulphureus* has been recorded from the Andaman Sea and the Gulf of Thailand based on voucher specimens (Sirimontaporn 1984; Imamura 2009g, 2013; Satapoomin 2011; this study).

Upeneus sundaicus (Bleeker, 1855)
Fig. 14

Diagnosis. Dorsal-fin spines 8, rays 9; pectoral-fin rays 13–15; gill rakers 4–6 + 13–17 = 18–22; lateral-line scales 31–34. As % of SL: body depth at first

dorsal fin origin 22–28; body depth at anal fin origin 21–24; head depth 19–24; HL 26–30; barbel length 16–21; first dorsal fin height 22–27; anal fin height 15–18; caudal peduncle depth 11–13; caudal fin length 26–31; pectoral fin length 19–22; pelvic fin length 19–23. Body reddish or dark gray dorsally, pinkish ventrally, a brownish stripe from behind eye to caudal-fin base; 5 or 6 bars on upper caudal-fin lobe; no bars on lower lobe; tip of first dorsal fin not dark; barbels yellow (Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 6184, 111.6 mm SL, landed at trawler harbor, Phuket, 23 June 1972; PMBC 6189, 3 specimens, 108.3–121.8 mm SL, landed at trawler harbor, Phuket, 14 Aug.1972; PMBC 21195, 2 specimens, 119.6–146.8 mm SL, market in Phuket, 31 Jan. 2011; PMBC 34761, 2 specimens, 115.2–122.7 mm SL, market in Phuket, 23 June 1972; PMBC 25895, 116.2 mm SL, Phang-nga Bay, 28 m depth, trawl, 23 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25896, 118.0 mm SL, Phang-nga Bay, 10 m depth, trawl, 22 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25919, 129.1 mm SL, Hang Sung Canal, Prathong Island, Phang-nga, 18 June 2003.

Remarks. In Thai waters, *U. sundaicus* has been recorded from the Andaman Sea and the Gulf of 2011; Tafzilmeriam 2013c; this study).

Figure 11. *Upeneus luzonius,* PMBC 25918, 119.4 mm SL. Scale bar 20 mm.

Figure 12. *Upeneus margarethae,* PMBC 20885, 42.5 mm SL. Scale bar 0.05 mm.

Figure 13. *Upeneus sulphureus,* PMBC 20623, 94.2 mm SL. Scale bar 20 mm.

Figure 14. *Upeneus sundaicus,* PMBC 25896, 118.0 mm SL. Scale bar 20 mm.

Upeneus tragula Richardson, 1846
Fig. 15

Diagnosis. Dorsal-fin spines 8, rays 9; pectoral-fin rays 13 or 14; gill rakers 5 or 6 + 14–17 = 19–23; lateral-line scales 28–30. As % of SL: body depth at first dorsal fin origin 22–26; body depth at anal fin origin 20–22; maximum head depth 19–23; HL 27–31; barbel length 15–18; first dorsal fin height 21–24; anal fin height 16–19; caudal peduncle depth 10–11; caudal fin length 28–32; pectoral fin length 19–21; pelvic fin length 20–24. Body grayish dorsally, white ventrally, with irregular reddish-brown spots and blotches, a brown stripe from snout through eye to caudal-fin base; tip of first dorsal fin dark; brownish or blackish bars on upper and lower caudal-fin lobes; 4–6 bars on upper caudal-fin lobe, 4–7 bars on lower lobe; barbels yellow (Uiblein and Heemstra 2010).

Material examined. Thailand, Andaman Sea: PMBC 6186, 118.3 mm SL, market in Phuket, 23 June 1972; PMBC 6192, 118.4 mm SL, market in Phuket, 21 Oct. 1973; PMBC 10439, 109.2 mm SL, Bang Rong, Phuket, mangrove area, push net, 30 June 1994; PMBC 20654, 15 specimens, 37.6–85.4 mm SL, Pa Klok Village, Phuket, 4 Sep. 2004; PMBC 25171, 150.4 mm SL, Phuket, sandy mud, trawl, 10 Nov. 1978; PMBC 25921, 8 specimens, 23.3–40.8 mm SL, Pa Klok Village, Phuket, 25 Sep. 2003; PMBC 34760, 122.3 mm SL, landed at trawler harbor, Phuket, 23 June 1972; PMBC 20186, 2 specimens, 26.0–30.5 mm SL, Prathong Island, Phang-nga, seagrass bed, 30 June 2003; PMBC 20916, 87.4 mm SL, Pa klok Village, Prathong Island, Phang-nga, beach seine, 3 July 2003; PMBC 30286, 2 specimens, 117.8–118.6 mm SL, Kao Isalnd-Surin Island fish market, Phang-nga, 4 Mar. 1997; PMBC 4803, 67.8 mm SL, Pu Island, Krabi, muddy sand, 5–6 m depth, hand spear, 29 Feb. 2000; PMBC 10438, 4 specimens, 62.8–133.6 mm SL, Yonglum Beach, Trang, seagrass bed, beach seine, 26 Nov. 1991; PMBC, 14435, 4 specimens, 37.8–103.0 mm

SL, Yonglum Beach, Trang, seagrass bed, 26 Nov. 1996; PMBC 21016, 15 specimens, 22.7–38.1 mm SL, Libong Island, Trang, seagrass bed, 1 m depth, beach seine, 25 Feb. 2004; PMBC 15974, 134.9 mm SL, BIOSHELF St. PB3–PB4 (7°51'N 98°37'E to 7°51'N 98°39'E), 21 m depth, otter trawl, 21 Feb. 1998; PMBC 15975, 3 specimens, 103.4–128.0 mm SL, BIOSHELF St. PB3 (7°48'N 98°29'E to 7°49'N 98°31'E), 22 m depth, otter trawl, 4 Dec. 1998; PMBC 15976, 3 specimens, 116.5–129.4 mm SL, BIOSHELF St. PB3 (7°48'N 98°28'E to 7°49'N 98°32'E), 21 m depth, otter trawl, 21 Apr. 1997.

Remarks. In Thai waters, *U. tragula* has been recorded from the Andaman Sea and the Gulf of Thailand based on voucher specimens (Sirimontaporn 1984; Satapoomin 2005b,2009b, 2011;Tafzilmeriam 2013d; this study). Satapoomin (2011) reported *U. asymmetricus* Lachner, 1954 based on a PMBC specimen without indicating the collection registration number. However, PMBC 6192, previously identified as *U. asymmetricus*, was identified as *U. tragula* in the present study. Furthermore, no other specimens in the PMBC collection were here identified as *U. asymmetricus*. Therefore, Satapoomin's (2011) record of *U. asymmetricus* is considered as a misidentification of *U. tragula.*

Upeneus vittatus (Forsskål, 1775)

Fig. 16

Diagnosis. Dorsal-fin spines 8, rays 9; pectoral-fin rays 15–17; gill rakers 5–9 + 18–21 = 25–29; lateral-line scales 35–37. As % of SL: body depth at first dorsal fin origin 24–30; body depth at anal fin origin 20–24; head depth 21–26; HL 29–32; barbel length 16–21; first dorsal fin height 22–28; anal fin height 14–18; caudal peduncle depth 10–12; caudal fin length 27–31; pectoral fin length 20–24; pelvic fin length 18–20. Body white to silvery, brownish above lateral line, white ventrally, 4 yellowish lateral stripes; tip of first dorsal fin dark; blackish bars on upper and lower caudal-fin lobes; upper caudal-fin lobe with 4–6 bars, lower lobe with 3–4 bars, one being extremely broad; barbels white (Uiblein and Randall 2022).

Material examined. Thailand, Andaman Sea: PMBC 5752, 184.7 mm SL, market in Phuket, 9 Apr. 1973; PMBC 5757, 175.8 mm SL, market in Phuket, 9 Nov. 1972; PMBC 26238, 56.6 mm SL, BIOSHELF St. K4 (7°00'N 98°21'E to 6°59'N 98°21'E), 101–104 m depth, Agassiz trawl, 23 Feb. 2000. Philippines: PMBC 34755, 151.0 mm SL, Manila Bay, Luzon (obtained at market in Manila), 9 Sep. 1972.

Remarks. In Thai waters, *U. vittatus* has been recorded from the Andaman Sea based on voucher specimens (Satapoomin 2011; this study).

Upeneus spp.

Material examined. Thailand, Andaman Sea: PMBC 10014, 2 specimens, 38.1–67.9 mm SL, Bang Rong, Phuket, mangrove area, 30 June 1993; PMBC 25898, 3 specimens, 71.6–75.6 mm SL, Phang-nga Bay, 29 m depth, trawl, 17 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25912, 2 specimens, 61.8–71.3 mm SL, Phang-nga Bay, 28 m depth, trawl, 23 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 25917, 32.2 mm SL, Loh Poh Bay, Yao Yai Island, Phang-nga, seagrass bed, trawl, 25 Nov. 2004; PMBC 25922, 2 specimens, 32.7–35.9 mm SL, Loh Poh Bay, Yao Yai Island, Phang-nga, 25 Nov. 2004; PMBC 34753, 2 specimens, 69.8–79.3 mm SL, Phang-nga Bay, 26 m depth, trawl, 23 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 34759, 76.9 mm SL, Phang-nga Bay, 29 m depth, trawl, 17 Dec. 2001, Biodiversity of Phang-nga Bay Project; PMBC 34762, 3 specimens, 36.4–72.8 mm SL, Phang-nga Bay, 10 m depth, trawl, 20 Dec. 2001, Biodiversity of Phang-nga Bay Project. Philippines: PMBC 6514, 90.9 mm SL, Calatrava, Negros, Occidental, Negros, 27 May 1954.

Remarks. These specimens could not be identified here due to damage and coloration loss. However, the following were included in the "*Upeneus japonicus*-group", determined by Uiblein and Heemstra (2010), by having 7 first dorsal-fin spines: PMBC 6514, PMBC 25898, PMBC 25912, PMBC 34753, PMBC 34759, and PMBC 34762.

Specimens previously registered and identified included *Mulloidichthys vanicolensis* (PMBC 25898 and PMBC 34753), *Upeneus sundaicus* (PMBC 6514 and PMBC 10014), *Upeneus sulphureus* (PMBC 25912 and PMBC 34759), *Upeneus* cf. *sulphureus* (PMBC 25917), and *Upeneus tragula* (PMBC 25922 and PMBC 34762).

Figure 15. *Upeneus tragula,* PMBC 10439, 109.2 mm SL. Scale bar 20 mm.

Figure 16. *Upeneus vittatus,* PMBC 5752, 184.7 mm SL. Scale bar 30 mm.

MULLID FISHES FROM THAI WATERS

The following goatfish species were found in the PMBC Reference Collection. The Andaman Sea (13 species): *Mulloidichthys vanicolensis, Parupeneus barberinus, P. cyclostomus, P. heptacanthus, P. macronemus, P. pleurostigma, Upeneus guttatus, U. luzonius, U. margarethae, U. sulphureus, U. sundaicus, U. tragula*, and *U. vittatus*. Both of the Gulf of Thailand and the Andaman Sea (1 species): *Parupeneus indicus.*

In addition, the following species previously recorded from Thailand were not found in the PMBC Reference Collectin. *Mulloidichthys flavolineatus* (Lacepède, 1801): Satapoomin (2011) reported this species from the Andaman Sea without voucher specimens. Sirimontaporn (1984: fig. 213) reported *M. flavolineatus* from Songkhla Lake based on a voucher specimen without a registration number. However, the specimen is identified as a species of the genus *Upeneus* because it has oblique bands on the upper caudal fin lobe, semi-transparent dorsal fins, and silverish body. Therefore, no specimen-based record of *M.flavolineatus* from Thai waters has been found during this study. *Parupeneus trifasciatus* (Lacepède 1801): The species has been recorded from the Andaman Sea based on an underwater photograph (Imamura 2009e). Satapoomin (2011) also reported the species from the Andaman Sea without voucher specimens. *Upeneus asymmetricus* Lachner, 1954: Although Satapoomin (2011) reported the species from the Andaman Sea based on voucher specimens without registration numbers, the PMBC specimen originally registered as *U. asymmetricus* is reidentified as *U. tragula* in this study (see the Remarks of *U. tragula*). Because no other records of *U. asymmetricus* from Thai waters are found, the species is thought not to be distributed in Thailand. *Upeneus moluccensis* (Bleeker, 1855): the species has been recorded from the Andaman Sea based on a voucher specimen (Imamura 2009f). Satapoomin

(2011) also reported the species from the Andaman Sea without voucher specimens.

Considering the previous literature and the PMBC Reference Collection, totally 18 species (including *M. flavolineatus*) of mullid fishes have been recorded from Thailand. Among of them, 17 and 7 species of mullid fishes have been observed from the Andaman Sea and the Gulf of Thailand, respectively.

SUMMARY

Two hundred and eighty goatfish specimens representing 16 species in three genera were found in the PMBC Reference Collection, including one species of *Mulloidichthys*, seven of *Parupeneus*, and eight of *Upeneus*. Listed PMBC specimens were caught from Thailand (14 species, except *U. heterospinus* and *P. multifasciatus*, from Philippines). The fourteen species were collected from the Andaman Sea and one of the fourteen species was also recorded from the Gulf of Thailand. In addition, listed specimens were caught from India (2 species), Myanmar (1 species), Malaysia (1 species), Indonesia (1 species) and Philippines (7 species).

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