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A new deep-water goatfish of the genus *Upeneus* (Mullidae) from northern Australia and the Philippines, with a taxonomic account of *U. subvittatus* and remarks on *U. mascareinsis*

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Abstract

Upeneus stenopsis n. sp. is described based on four specimens collected off northern Australia and Quezon Island, Philippines, at depths between 165 to 275 m and compared with four closely related species: the deep-water dwelling *Upeneus davidaromi* (Red Sea) and *U. mascareinsis* (Western Indian Ocean) and the shallow Indo-West Pacific species, *U. subvittatus* and *U. vittatus*. The new species can be distinguished from all other *Upeneus* species by a narrow caudal peduncle and a combination of morphometric and meristic characters. This is the first record of a deep-water goatfish of the genus *Upeneus* from the Pacific. A juvenile *Upeneus* collected off Quezon at 127–142 m depth was also assigned to the new species and compared to four similar-sized (69–79 mm SL) specimens of *U. mascareinsis*. A diagnosis is provided for *U. subvittatus*, along with evidence of its occurrence in the Eastern Indian Ocean and interspecific comparisons. The continued need to screen scientific fish collections for the occurrence of undescribed species that have successfully colonized and adapted to the depth zone surrounding the ocean margin is outlined.

Key words: *Upeneus stenopsis*, new species, ocean margin habitats, ontogeny

Introduction

The depth zone surrounding the ocean margin (Huthnance 1995) extending from the lower shelf to the slope below the shelf edge (ca. 100–400 m) deserves enhanced attention by fish systematists. Characterized by low light levels and an often rugged and/or steep topography this zone is inhabited by a rather transitive demersal fish assemblage composed of both shallow-water and deep-sea dwellers that overlap in depth ranges (Uiblein *et al.* 1998), but also by species with rather narrow bathymetric ranges occurring mostly within this zone. The latter applies for many cuskeel species of the genus *Neobythites* (Ophidiidae), of which several have been discovered and described recently (e.g., Nielsen & Uiblein 1993; Nielsen 2002; Nielsen *et al.* 2009; Ohashi *et al.* 2012). Two goatfish species in the genus *Upeneus* (Mullidae) occur in this depth zone: Darom's goatfish *Upeneus davidaromi* Golani, 2001 and the Mascarene goatfish *Upeneus mascareinsis* Fourmanoir & Guézé, 1967 (Uiblein & Heemstra 2010).

The genus *Upeneus* consists of 29 hitherto recognized species (Uiblein & Heemstra 2011; Yamashita *et al.* 2011), most of which typically occur in shallow coastal waters above 100 m. In contrast, *U. davidaromi* of the Red Sea occurs at 150 to 600 m depth, while the closely related species *U. mascareinsis* from the Indian Ocean proper has been reported from 100 to 400 m depth (Uiblein & Heemstra 2010). These two species resemble in morphology and colour patterns several other congeneric species with which they were assigned to a distinct species group, the so called *vittatus* group (Uiblein & Heemstra 2010, 2011).

In their taxonomic review of Western Indian Ocean (WIO) species of the genus *Upeneus*, Uiblein and Heemstra (2010) distinguished *U. mascareinsis* from the silver goatfish *Upeneus subvittatus* (Temminck & Schlegel, 1843) based on body colouration and a multivariate analysis of morphometric characters. The latter allowed a clear separation between WIO *U. mascareinsis* and W Pacific *U. subvittatus*. A single specimen from

Western Indonesia (Eastern Indian Ocean) was positioned intermediately (Uiblein & Heemstra, 2010; Figure 1) and was attributed to *U. mascareinsis*. One conclusion of this review was also that *U. subvittatus* for which type material is lacking (Golani 2001), requires more detailed taxonomic studies.

During recent visits at the Australian Museum, Sydney, and the Muséum national d'Histoire naturelle, Paris, the senior author examined four specimens of the genus *Upeneus* collected at depths between 165 and 275 m off northern Australia and the Philippines. Subsequent studies of comparative material from a number of fish collections and localities in the Indo-West Pacific revealed a juvenile *Upeneus* specimen from 127–142 m off Quezon, Philippines, which was examined at the fish collection of the California Academy of Sciences, San Francisco.

Based on the foregoing studies, we describe here the deep-water goatfish *Upeneus stenopsis* **n. sp.** and provide a diagnosis for *U. subvittatus*. Comparisons with the most closely related and/or co-occurring species are made, and distribution information is given. In addition, juveniles of the new species and *U. mascareinsis* are identified using a large set of morphometric, meristic and colour characters and distributional information.

Material and methods

Methods for measuring and counting as well as descriptions of colour based on preserved specimens and photographs of fresh fish follow Uiblein and Heemstra (2010). In all comparisons, attention was paid to the most diagnostic characters, taking sample size and intraspecific variation into consideration. Institutional codes followed Sabaj Pérez (2012).

Taxonomy

Genus *Upeneus* Cuvier, 1829

Upeneus Cuvier, 1829: 157.

Type species *Mullus vittatus* (Forsskål, 1775) by subsequent designation of Desmarest (1856).

Diagnosis. Dorsal fins VII or VIII + 9; anal fin I, 6; pectoral-fin rays 12–17; principal caudal-fin rays 7 + 8 (median 13 branched); gill rakers 4–9 + 13–24 = 18–33; lateral-line scales 28–39, lateral line complete; small scales present basally on second dorsal, anal and caudal fins; small teeth present on vomer, palatines and jaws, multiserial and villiform on jaws; body oblong, slightly compressed; barbel length in adults 4–7 times in SL; snout length 7–11 times in SL, subequal to postorbital length (7–10 times in SL); in fresh fish lateral body stripes and/or caudal-fin bars of differing colours, dark caudal-fin bars frequently retained on preserved fish.

Distribution. In all major oceans, tropical to subtropical, only a single species in the Atlantic and two in the Mediterranean, both immigrants from the Red Sea (Ben Tuvia 1966).

Remarks. We recognize 30 species as valid. One single species, *Upeneus filifer*, and four species groups can be distinguished based on number of dorsal spines and gill rakers, length of longest dorsal-fin spine, length of pelvic and pectoral fins, and presence or absence of caudal-fin bars and mid-lateral body stripes (Uiblein & Heemstra 2010). Here, *Upeneus stenopsis* **n. sp.** is added to the *vittatus* group which includes *U. davidaromi* Golani, 2001 (Red Sea), *U. indicus* Uiblein & Heemstra, 2010 (SW India), *U. mascareinsis* Fourmanoir & Guézé, 1967 (Mascarenes to Mozambique), *U. parvus* Poey, 1852 (Western Central Atlantic), *U. suahelicus* Uiblein & Heemstra, 2010 (Red Sea to South Africa), *U. subvittatus* (Temminck & Schlegel, 1843) (Indonesia to Japan), *U. supravittatus* Uiblein & Heemstra, 2010 (southern India) and *U. vittatus* (Forsskål, 1775) (Indopacific). This group can be distinguished by the following combination of characteristics: oblique dark bars on both caudal-fin lobes in fresh and preserved fish, 25–33 total gill rakers, 14–17 pectoral-fin rays, and pelvic-fin length 1.1–1.5 times in pectoral fin.

The three other species groups are the *japonicus* group (which includes *U. asymmetricus* Lachner, 1954, *U. australiae* Kim & Nakaya, 2002, *U. francisi* Randall & Guézé, 1992, *U. guttatus* (Day, 1868), *U. itoui* Yamashita, Golani & Motomura, 2011, *U. japonicus* (Houttuyn, 1782), *U. pori* Ben-Tuvia & Golani, 1989, and *U. seychellensis* Uiblein & Heemstra 2011), the *moluccensis* group (*U. doriae* (Günther, 1869), *U. moluccensis*

(Bleeker, 1855), *U. quadrilineatus* Cheng & Wang, 1963, *U. sulphureus* Cuvier in Cuvier & Valenciennes, 1829), and the *tragula* group (*U. luzonius* Jordan & Seale, 1907, *U. margarethae* Uiblein & Heemstra, 2010, *U. mouthami* Randall & Kulbicki, 2006, *U. oligospilus* Lachner, 1954, *Upeneus randalli* Uiblein & Heemstra, 2011, *U. sundaicus* (Bleeker, 1855), *U. taeniopterus* Cuvier in Cuvier & Valenciennes, 1829, *U. tragula* Richardson, 1846).

***Upeneus stenopsis* n. sp.**

Narrow-tail goatfish

(Figs. 1–2; Table 1)

Holotype. AMS I.20918-017, 131 mm, NE Australia, Queensland, Coral Sea, off Raine Island, 11° 35' S, 144° 02' E, 270–275 m, prawn trawl.

Paratypes. 3 specimens (101–112 mm) from northern Australia and the Philippines. AMS I.21628-001, 108 mm, Northern Territory, Timor Sea, 09° 46' S, 128° 57' E, 165–190 m, bottom trawl; MNHN 2012-0212, 112 mm, Philippines, off Quezon Island, 13°58'59" N, 120°18'00" E, 186–187 m, beam trawl; MNHN 1984-0802, 101 mm, same station data.

Non-type. CAS 33367, 71 mm (juvenile), Philippines, Quezon Island, Catanauan, Sandoval Point, 127–142 m.

Diagnosis. Dorsal fins VIII + 9; pectoral fins 15 or 16; gill rakers 7–8 + 18–20 = 25–28; measurements in % SL: body depth at first dorsal-fin origin 22–25; body depth at anus 18–21; caudal-peduncle depth 7.4–7.8; maximum head depth 22–23; head depth through eye 18–19; head length 33–34; orbit length 9.2–9.9; upper jaw length 14–15; barbel length 21–22; caudal-fin length 26–28; anal-fin height 15–16; pelvic-fin length 18–19; pectoral-fin length 23–25; first dorsal-fin height 20–23; second dorsal-fin height 14–16; total number of oblique caudal-fin bars 7–9, colour of bars changing from pale brown proximally to dark brown towards rear caudal-fin margin; 4–5 dark bars on upper caudal-fin lobe (including one bar close to rear end of lateral line), slightly increasing in width distally; 3–4 bars on lower caudal-fin lobe, of similar width as white interspaces between bars; first dorsal-fin tip black; caudal-fin bars and black dorsal-fin tip retained on preserved fish; barbels white; no lateral body stripes; head and body silvery laterally and reddish dorsally, belly and ventral side of peduncle white; preserved fish dorsally or entirely pale brown or brown, with ventral part of body and head covered by white or silvery pigment.

Description. Measurements in % SL and counts are given in Table 1; morphometric data as ratios of SL for holotype, data for paratypes in brackets: body moderately deep, its depth at first dorsal-fin origin 4.1[3.9–4.5]; body depth at anal-fin origin 5.4[4.8–5.4]; head depth through eye 5.2[5.2–5.6]; head length 2.9[3.0], clearly longer than maximum depth of body and caudal-fin length (3.6[3.6–3.8]); height of second dorsal fin 7.0[6.1–6.3], clearly less than barbel length (4.6[4.7–5.0]); pectoral-fin length 4.0[4.1–4.4], longer than pelvic-fin length (5.3[5.2–5.7]); orbit length 10[10–11], larger than caudal-peduncle depth (13[13]).

Fresh colour (based on holotype; Figure 1a): Head and anterior part of body silvery laterally, the posterior and dorsal third of body as well as the dorsal head margin starting from upper jaw reddish; belly to ventral caudal peduncle white; no lateral body stripes; barbels white; both dorsal fins hyaline at base with white rays overlain by two horizontal pale red stripes and black tips (only the spiny dorsal-fin tip well visible in photograph of holotype); paired fins and anal fin hyaline, caudal fin with 9 oblique bars (the two distal-most bars covering the fin tips); 5 bars (including one bar close to rear end of lateral line) on upper lobe, 4 bars on lower lobe, with hyaline-whitish interspaces between bars; the five anterior-most caudal-fin bars changing from pale brown proximally to dark brown at rear caudal-fin margin; the distal-most bars (including fin tip) on lower caudal-fin lobe entirely dark brown; the bars on the upper caudal-fin lobe slightly increasing in width distally, the interspaces of lesser width as interspaces on lower lobe.

Preserved colour: Head and body uniformly brown in holotype with white pigmentation patches behind jaws, on opercle, ventrally from belly to caudal peduncle, and some tiny white markings along lateral line at mid body; first dorsal-fin tip and caudal-fin bar pigmentation partly retained at or close to distal fin margins; paratypes with large whitish or silvery patches on head below eye and/or surrounding the lower half of orbit, and on posterior opercle (reduced on preopercle); Body entirely whitish or silvery at ventral side, brown dorsally, with dark pigmentation on both dorsal-fin tips, and bars on lower caudal-fin lobe well retained, much weaker on upper lobe (upper caudal-fin lobe almost entirely broken in one specimen).

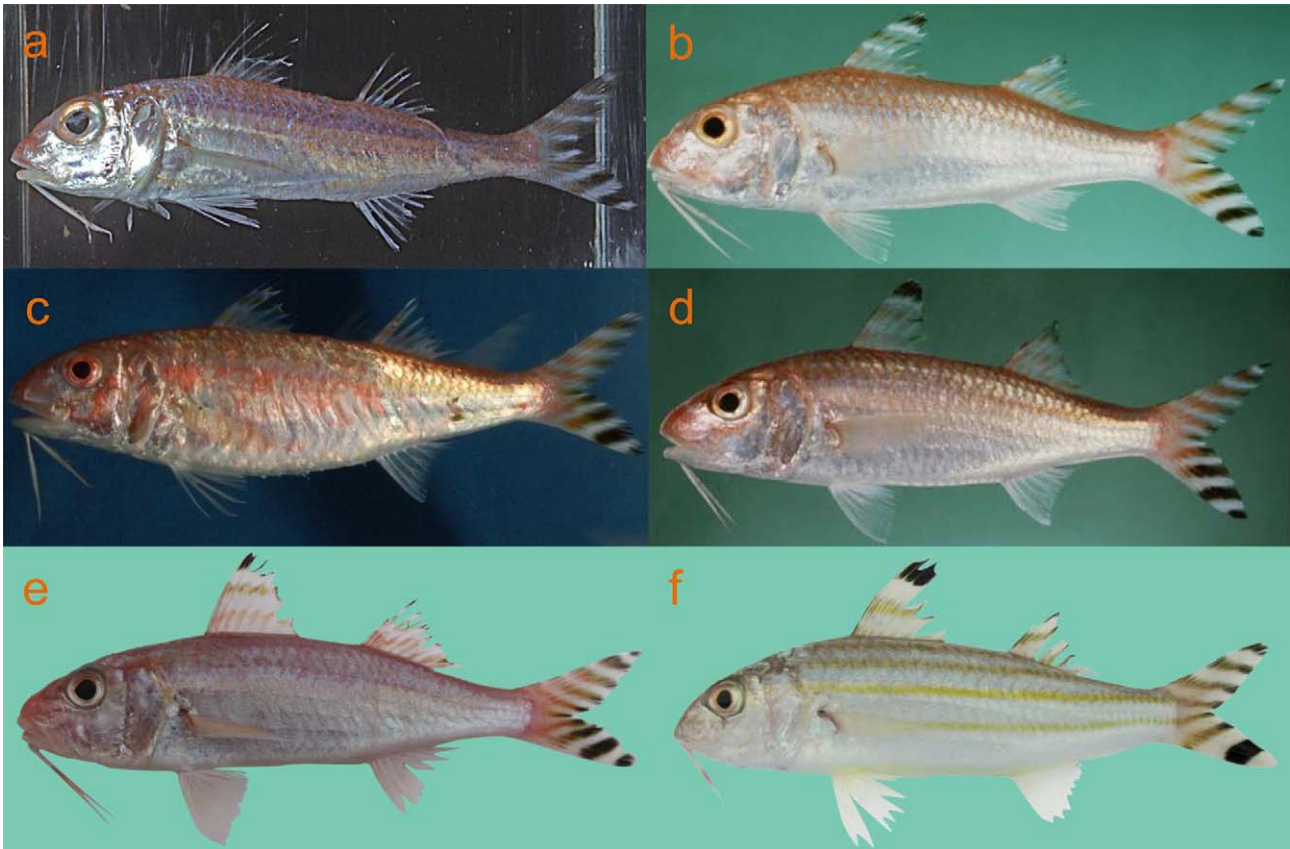


FIGURE 1. (a) *Upeneus stenopsis*, AMS I.20918-017, 13.1 cm SL, NE Australia (D. F. Hoese); (b) *U. davidaromi*, SL16.5 cm, Gulf of Aqaba (J. E. Randall), (c) *U. mascareinsis*, SAIAB 81951, SL 16.2 cm, Mozambique (P. C. Heemstra), (d) *U. subvittatus*, BPBM 32266, SL 20.5 cm, Moluccas, Indonesia (J. E. Randall); (e) *U. subvittatus*, MZB PB389, SL 16.6 cm, Java, Indonesia (W. White); (f) *U. vittatus*, CSIRO KD395, SL14.1 cm, Bali, Indonesia (W. White). The photographs of *U. stenopsis* and *U. vittatus* are shown mirror-inverted in order to facilitate comparison.

Distribution. N to NE Australia; Quezon, Philippines; first record of a deep-water goatfish of the genus *Upeneus* for the Pacific.

Etymology. The name “*stenopsis*” derives from the greek word “stenos”, meaning “narrow”, to refer to the rather narrow (both in depth and width) caudal peduncle of *Upeneus stenopsis* **n. sp.**

Comparisons (see also Table 1): *Upeneus stenopsis* **n. sp.** differs from all other congeneric species by its thinner caudal peduncle (peduncle depth and width in combination) and from the most closely related and/or co-occurring species of the *vittatus* group as follows: from *U. davidaromi* by lesser body depth (body depth at dorsal-fin origin 22–25 vs 24–28 %SL; body depth at anal-fin origin 18–21 vs 20–23 %SL), shallower head (maximum head depth 22–23 vs 24–27 %SL; head depth through eye 18–19 vs 20–24 %SL), and shorter caudal fin (caudal-fin length 26–28 vs 28–30 %SL); from *U. mascareinsis* in shorter interdorsal distance (12–15 vs 15–18 %SL), longer pectoral fins (pectoral-fin length 23–25 vs 21–24 %SL), and lower number of gill rakers (25–28 vs 27–30 total number of gill rakers); from *U. subvittatus* in lesser body depth (body depth at dorsal-fin origin 22–25 vs 25–28 %SL; body depth at anal-fin origin 18–21 vs 22–23 %SL), larger eyes (orbit length 9.2–9.9 vs 7.8–8.8 %SL), and shorter interdorsal distance (12–15 vs 14–18 %SL); and from *U. vittatus* in lesser body depth (body depth at dorsal-fin origin 22–25 vs 24–30 %SL; body depth at anal-fin origin 18–21 vs 21–24 %SL), longer head (head length 33–34 vs 29–32 %SL, larger eyes (orbit length 9.2–9.9 vs 6.6–8.8 %SL), longer jaws (upper-jaw length 14–15 vs 11–13 %SL, lower-jaw length (13–14 vs 11–12 %SL), longer barbels (barbel length 20–22 vs 16–21 %SL), lesser first dorsal-fin height (20–23 vs 22–28 %SL), lower caudal-fin bars and white interspaces not varying in width, first dorsal black tip smaller, and lateral body stripes absent.

Remarks. *Upeneus stenopsis* **n. sp.** shares with the three most closely related species *U. davidaromi*, *U. mascareinsis*, and *U. subvittatus* the following features: no lateral body stripes in life, a shallow caudal peduncle, and a long head with long jaws and large eyes. Sufficient distinction among those species is reached when

comparing the following characters in combination (Fig. 2): Number of gill rakers on lower limb, body depth at anal-fin origin, caudal-peduncle depth and width, and maximum head depth. While *U. subvittatus* occurs above 120 m depth, the other three species can all be characterized as lower-shelf and upper-slope dwellers, occurring mostly below 100 m depth.

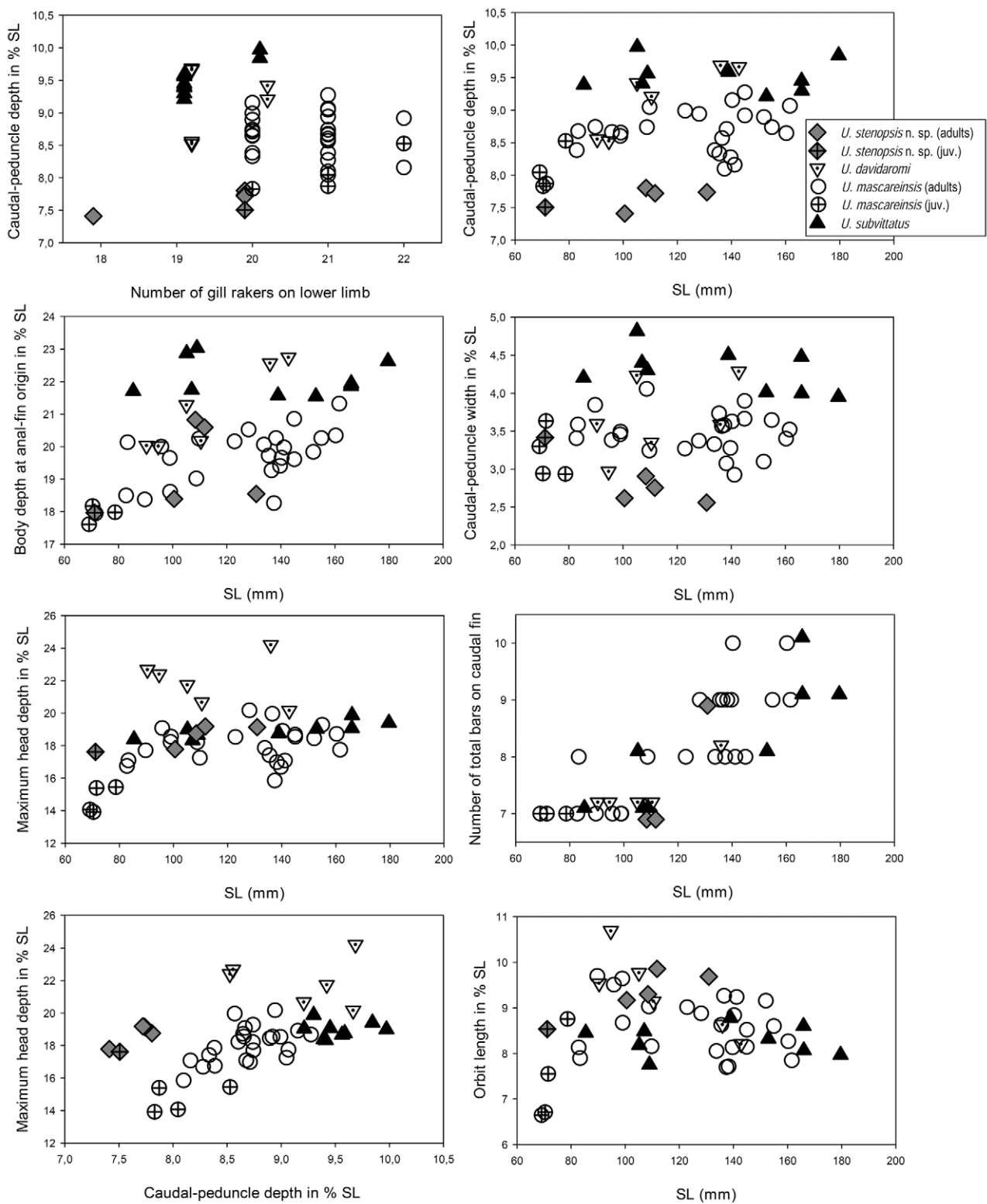


FIGURE 2. Relationships among morphometric and meristic characters in four closely related species of the *vittatus* group, *Upeneus davidaromi*, *U. mascareinsis*, *U. stenopsis* n. sp., and *U. subvittatus*. Specimens < 80 mm SL are distinguished as juveniles by crossed symbols.

The single juvenile specimen from Quezon largely overlaps in most morphometric and meristic characters with the four adult *U. stenopsis* n. sp. (Table 1, Fig. 2) and hence has been assigned to this species. Among the few minor deviations (Table 1, Fig. 2) the shallower head through eye, the smaller orbit, and the shorter jaws in the juvenile may reflect developmental changes. Other differences like the wider caudal peduncle (Table 1, Fig. 2) will need further studies to understand the overall intraspecific variability of this character.

Among the four juveniles of *U. mascareinsis* one specimen (SAIAB 82328) was earlier referred to as cf. *mascareinsis* in Uiblein and Heemstra (2010). Here, the full assignment to this species is based on the documented co-occurrence of 6 adults (> 79 mm SL) with 3 juveniles at two collecting stations off La Reunion (MNHN 1965-79, RMNH 24949), the close overlap in geographical and depth distribution, the general similarity among the four juveniles, and the consistency of deviations in morphometric but not meristic characters from adult conspecifics. The major deviations are a shallower body, a smaller head with shorter jaws, shorter barbels, and shorter anal and paired fins in the four juvenile *U. mascareinsis* compared to the adults (Table 1, Fig. 2). The eyes are only smaller in the initial stages of the ontogeny (Fig. 2).

Upeneus stenopsis n. sp. attains 13 cm SL; depth range 127–275 m.

***Upeneus subvittatus* (Temminck & Schlegel, 1843)**

Silver goatfish

(Figs. 1–2; Table 1)

Upeneus subvittatus (Temminck & Schlegel, 1843); Snyder (1907); Boeseman 1947 (incorrect assignment of lectotype and paralectotype); Masuda *et al.* (1984); Golani (2001); Randall 2001 (in part); Uiblein & Heemstra (2010, 2011)

Diagnosis. Dorsal fins VIII + 9; pectoral fins 16–17; gill rakers 7–9 + 19–21 = 26–30; measurements in % SL: body depth at first dorsal-fin origin 25–28; body depth at anus 22–23; caudal-peduncle depth 9.2–10; maximum head depth 22–25; head depth through eye 18–20; head length 32–33; orbit length 7.8–8.8; upper jaw length 13–14; barbel length 19–24; caudal-fin length 26–29; anal-fin height 14–18; pelvic-fin length 17–19; pectoral-fin length 23–25; first dorsal-fin height 20–23; second dorsal-fin height 14–17; total number of oblique caudal-fin bars 7–10, colour of bars changing from pale brown proximally to brown towards rear caudal-fin margin; 4–6 bars on upper caudal-fin lobe (including one bar close to rear end of lateral line), white interspaces between bars slightly narrower than bars; 3–4 darker bars on lower caudal-fin lobe, of similar width as white interspaces between bars and becoming darker towards lobe tip; first dorsal-fin tip black; caudal-fin bars and black dorsal-fin tip retained on preserved fish; barbels white; no lateral body stripes; head and body silvery laterally and pale rose dorsally; belly and ventral side of peduncle white; preserved fish dorsally pale brown and ventrally pale, with ventral part of head covered by differently sized patches of white pigment below eye and on opercle.

Distribution. Western Indonesia to Japan

Comparisons (see also Table 1). *Upeneus subvittatus* differs from the most closely related and/or co-occurring species of the *vittatus* group as follows: from *U. davidaromi* in lesser head depth (maximum head depth 22–25 vs 24–27 % SL; head depth through eye 18–20 vs 20–24 %SL) and longer interdorsal distance (14–18 vs 13–15 %SL); from *U. mascareinsis* in deeper body (body depth at first dorsal-fin origin 25–28 vs 21–26 %SL; body depth at anal-fin origin 22–23 vs 18–21 %SL), deeper caudal peduncle (caudal-peduncle depth 9.2–10 vs 8.1–9.3 %SL), longer pectoral fins (pectoral-fin length 23–25 vs 21–24 %SL), and less gill rakers (26–28 vs 27–30 total gill rakers); and from *U. vittatus* by a longer head (head length 32–33 vs 29–32 %SL), longer jaws (upper-jaw length 13–14 vs 11–13; lower-jaw length 13–14 vs 11–12 %SL), lesser first dorsal-fin height (20–23 vs 22–28 %SL), slightly fewer gill rakers (26–28 vs 27–29 total gill rakers), lower caudal-fin bars and white interspaces not varying in width, and lateral body stripes absent. For comparisons with *U. stenopsis* sp. n. see the account for this species above.

Remarks. While Temminck and Schlegel (1843) did not designate types in their description of *Upeneus subvittatus*, the type material designated by Boeseman (1947) agrees neither with the original description nor with the diagnosis provided here. After examination of the two lectotypes we agree with Golani (2001) that they belong most probably to *U. sulphureus*.

TABLE 1. Morphometric and meristic characters in *Upeneus stenopsis* n. sp. and four other species of the *vittatus* group

	<i>Upeneus stenopsis</i> n. sp.						<i>U. davidarumi</i>						<i>U. muscarevianus</i>						<i>U. subvittatus</i>						<i>U. vittatus</i>					
	Australia		Philippines		All types		Philippines		Red Sea		WTO (adults)		WTO (juveniles)		EIO and W-Pacific		Indian Ocean													
	HT	PT1	PT2	PT3	Min	Max	n	Min	Max	n	Min	Max	n	Min	Max	n	Min	Max	n											
SL (mm)	131	108	101	112	101	112	131	4	71	90	113.2	143	6	83	126.7	162	24	69	72.4	79	4	85	134.4	180	15	80	145.7	207	15	
Body depth at first dorsal-fin origin	24	25	22	24	22	23.9	25	4	23	24	26.4	28	6	21	24.0	26	24	19	19.7	21	4	25	26.6	28	9	24	27.4	30	15	
Body depth at anal-fin origin	19	21	18	21	18	19.6	21	4	18	20	21.5	23	6	17	20.1	22	19	16	17.2	18	3	21	21.8	23	9	19	21.7	24	15	
Half body depth (from lateral line downwards) at first dorsal fin origin	-	-	-	-	-	-	-	-	-	15	16.5	18	6	14	15.2	16	19	14	14.4	15	2	15	16.5	18	9	15	17.3	19	15	
Half body depth (from lateral line downwards) at anal fin origin	-	-	-	-	-	-	-	-	-	8.5	9.2	9.7	4	8.1	8.7	9.3	24	7.8	8.1	8.5	4	9.2	9.5	10	9	9.8	10.7	12	15	
Caudal-pectuncle depth	2.6	2.9	2.6	2.8	2.6	2.7	2.9	4	3.4	3.0	3.7	4.3	6	2.9	3.5	4.1	24	2.9	3.2	3.6	4	4.0	4.3	4.8	9	3.7	4.2	5.0	15	
Maximum head depth	22	23	22	22	22	22.1	23	4	21	24	25.1	27	6	20	21.7	24	24	17	18.2	19	4	22	23.3	25	9	21	23.5	26	15	
Head depth across a vertical midline through eye	19	19	18	19	18	18.7	19	4	18	20	22.0	24	6	16	18.1	20	24	14	14.7	15	4	18	18.9	20	9	17	18.8	20	15	
Suborbital depth	9.5	9.1	9.4	11	9.1	9.8	11	4	9.1	11	13.4	14	6	8.4	10.0	12	24	6.3	7.0	7.4	4	10	10.8	12	9	9.2	11.2	13	15	
Interorbital length	8.0	8.2	8.1	8.3	8.0	8.2	8.3	4	8.2	7.9	8.4	8.9	6	7.1	8.0	8.9	24	7.5	7.7	8.0	4	7.7	8.3	8.9	9	7.5	8.1	9.0	15	
Head length	34	33	33	33	33	33.3	34	4	31	32	34.0	35	6	30	31.9	35	24	27	29.1	30	4	32	32.7	33	9	29	30.8	32	15	
Snout length	11	12	11	11	11	11.2	12	4	12	11	12.0	13	6	11	11.5	12	24	8.5	9.5	11	4	11	12.0	13	9	10	11.6	13	15	
Postorbital length	13	13	13	14	13	13.2	14	4	14	13	14.3	15	6	11	12.4	14	24	12	12.7	14	4	13	13.4	14	9	11	12.7	14	15	
Orbit length	9.7	9.3	9.9	9.2	9.2	9.5	9.9	4	8.5	8.2	9.3	11	6	7.7	8.6	9.7	24	6.6	7.4	8.8	4	7.8	8.3	8.8	9	6.6	7.5	8.8	15	
Orbit depth	8.9	8.6	8.7	8.3	8.3	8.6	8.9	4	7.5	7.3	8.3	9.6	6	6.7	7.6	9.0	24	5.7	6.5	7.6	4	6.8	7.4	8.0	9	5.5	6.6	7.8	15	
Upper-jaw length	15	14	14	14	14	14.1	15	4	13	14	14.7	15	6	12	13.4	14	24	10	11.4	12	4	13	14.0	14	9	11	12.2	13	15	
Lower-jaw length	14	13	13	14	13	13.5	14	4	12	12	13.2	14	6	11	12.6	14	24	9.3	10.6	12	4	8.8	10.3	11	9	8.6	9.8	12	14	
Snout width	9.3	8.3	8.3	9.7	8.3	8.9	9.7	4	9.7	9.7	10.4	11	3	7.5	9.1	10	21	6.0	6.6	7.2	4	8.8	10.3	11	9	8.6	9.8	12	14	
Barbel length	22	21	20	20	20	20.8	22	4	20	20	21.7	25	6	18	20.7	24	23	12	15.8	18	4	19	21.3	24	9	16	18.2	21	14	
Maximum barbel width	0.8	0.6	0.8	0.8	0.6	0.7	0.8	4	0.7	0.7	0.8	1.0	6	0.6	0.8	1.0	24	0.4	0.6	0.7	4	0.7	0.8	1.0	9	0.6	0.9	1.1	15	
First pre-dorsal length	41	41	41	40	40	40.6	41	4	41	40	41.9	44	6	38	40.8	43	24	34	37.0	40	4	40	41.2	43	9	39	40.5	42	15	
Second pre-dorsal length	67	70	67	64	64	67.0	70	4	64	66	67.9	71	6	65	68.1	71	24	64	65.7	68	4	66	68.2	71	9	65	67.8	70	15	
Interdorsal distance	15	15	14	12	12	14.1	15	4	14	13	13.7	15	6	15	16.4	18	24	13	14.6	16	4	16	17.0	18	9	16	18.1	21	15	
Caudal-pectuncle length	21	21	21	21	21	20.9	21	4	21	18	19.9	22	6	19	20.8	23	24	22	23.9	25	4	22	23.1	25	4	19	20.3	22	15	
Pre-anal length	66	68	72	72	66	69.2	72	4	67	67	69.7	73	6	66	68.2	72	24	65	65.9	67	4	66	68.5	71	9	65	67.9	71	15	
Pre-pectoral length	35	35	36	37	33	35.1	37	4	34	36	39.1	42	6	33	34.6	39	24	30	32.1	33	4	33	34.9	37	9	33	35.9	37	15	
Second dorsal-fin depth (second dorsal-fin origin to anal-fin origin)	35	35	36	36	35	35.4	36	4	35	34	36.5	39	6	31	33.6	36	24	29	30.9	33	4	32	33.9	35	9	31	31.8	33	15	
Pelvic-fin depth (first dorsal-fin origin to pelvic-fin origin)	19	20	20	22	19	20.1	22	4	20	20	21.9	24	6	18	20.2	21	24	17	18.3	19	4	21	22.3	23	9	21	23.6	27	15	
Pectoral-fin depth (first dorsal-fin origin to pectoral-fin base)	25	25	23	24	23	24.1	25	4	23	25	27.0	29	6	22	24.3	26	24	20	20.5	22	4	25	26.6	28	9	25	27.4	30	15	
Length of first dorsal-fin base	17	16	17	18	16	16.9	18	4	16	17	17.5	18	6	14	16.1	18	24	13	14.6	16	4	16	17.0	18	9	16	18.1	21	15	
Length of second dorsal-fin base	14	15	14	13	13	13.1	14	4	14	13	13.7	15	6	12	14.1	16	24	11	12.5	13	4	13	14.3	16	9	12	13.0	14	15	
Caudal-fin length (dorsal caudal-fin origin to upper caudal-lobe tip)	28	26	-	28	26	27.1	28	3	27	28	28.8	30	6	26	27.4	29	19	26	26.9	28	2	26	27.9	29	8	26	29.5	31	15	
Length of anal-fin base	10	12	10	10	10	10.6	12	4	11	9.3	10.8	12	6	9.5	10.8	13	24	7.9	9.5	11	4	9.5	10.3	11	9	9.3	10.3	11	15	
Anal-fin height	15	15	16	16	15	15.4	16	4	17	15	15.7	17	6	13	15.1	16	24	12	12.9	13	4	14	15.6	18	8	15	15.7	18	15	
Pelvic-fin length	19	19	19	18	18	18.7	19	4	19	18	19.4	20	6	17	18.6	20	24	15	16.9	18	4	17	18.5	19	9	18	19.0	21	15	
Pectoral-fin length	25	23	24	24	23	24.1	25	4	24	23	24.7	26	6	21	22.5	24	24	18	20.8	23	4	23	24.3	25	9	21	22.6	24	15	
Pectoral-fin width (width of pectoral-fin base)	4.1	4.3	3.9	4.1	3.9	4.1	4.3	4	4.2	4.1	4.5	5.3	6	3.2	4.0	4.7	24	3.1	3.3	3.7	4	4.2	4.4	4.8	9	3.9	4.5	5.2	15	
First dorsal-fin height	-	20	23	22	20	21.6	23	3	22	20	22.3	24	5	19	20.6	23	20	19	19.4	20	3	20	21.2	23	9	22	23.9	28	14	
Second dorsal-fin height	14	16	16	16	14	15.7	16	4	15	16	16.6	17	6	14	15.5	17	23	14	14.9	16	3	14	15.6	17	9	14	15.7	18	15	
Pectoral-fin rays	16	15	16	16	15	15.8	16	4	15	15	15.7	17	6	15	16.2	17	24	15	15.5	16	4	16	16.1	17	9	15	15.9	17	15	
Rudimentary gill rakers on upper limb	1	4	0	1	0	1.5	4	4	2	0	1.0	3	6	0	1.2	3	24	0	0.5	1	4	1	2.4	4	9	1	2.8	5	15	
Developed gill rakers on upper limb	7	4	7	6	4	6.0	7	4	6	4	6.0	7	6	4	6.6	8	24	7	7.5	8	4	4	5.2	7	9	4	5.1	7	15	
Developed gill rakers on lower limb	17	15	16	14	14	15.5	17	4	16	13	14.5	16	6	15	16.6	18	24	17	18.5	21	4	14	14.8	16	9	13	14.7	17	15	
Rudimentary gill rakers on lower limb	3	5	2	6	2	4.0	6	4	4	3	4.8	6	6	3	4.8	6	24	0	2.8	5	4	4	4.4	6	9	4	5.0	6	15	
Total gill rakers on upper limb	8	8	7	6	7	7.5	8	4	8	7	7.0	7	6	7	7.8	9	24	8	8.0	8	4	7	7.7	9	9	7	7.9	9	15	
Total gill rakers on lower limb	20	20	18	20	18	19.5	20	4	20	19	19.3	20	6	20	20.7	22	24	20	21.0	22	4	19	19.2	20	9	19	19.7	21		

The geographic distribution of *U. subvittatus* between Japan and western Indonesia seems clearly distinct from the occurrence of *U. mascarensis*, the latter being restricted to the Western Indian Ocean proper. One specimen from the Eastern Indian Ocean previously identified as *U. mascarensis* (BMNH 1986.10.1.38) by Uiblein and Heemstra (2010) was here reassigned to *U. subvittatus*, as it falls clearly into the latter taxon based on the combination of three diagnostic characters: number of gill rakers on lower limb, body depth at anal-fin origin, and caudal-peduncle depth (Table 1, Fig. 2). No detailed locality information is available from this station deriving from the Jetindofish cruise (Lohmeyer 1982) which was carried out close to the western Indonesian Islands and hence in vicinity of the two *U. subvittatus* specimens from Java (CSIRO-PB389).

Uiblein and Heemstra (2010) indicated possible colour variations based on inspection of various photographs of fresh specimens of *U. subvittatus* from Japan and Indonesia. There are also rather different common names used in the different areas, such as “silver goatfish” in Indonesia (applied here) and “deep-water goatfish” in Japan (see www.fishbase.com). The latter name implies occurrence at deeper depths, but does not agree with the currently available bathymetric data that indicates a depth range of 26 m to a maximum of 120 m, while the three species specified here as deep-water goatfishes occur between 73 and 550 m and mostly between 100 and 400 m depth (Fourmanoir & Guézé 1967; Golani 2001; Uiblein & Heemstra 2010; present study).

Upeneus subvittatus attains 24 cm SL.

Discussion

Our finding of a new deep-water *Upeneus* species from off Australia provides evidence for the need to further explore deep-water habitats close to the ocean margin. The research method used in the current approach was to screen scientific fish collections for unidentified goatfish specimens collected at deep shelf to mid-slope depths followed by comparative studies using a large set of morphometric, meristic and colour data from all currently known *Upeneus* species. This approach appears of primary importance given the large number of expeditions which have already supplied collection material from more remote areas, the relatively high probability that goatfishes appear amongst catches with traditional fishing gear, and the still apparent need for dedicated work in order to fully unravel the diversity of this genus. It also provides a good basis to plan more focused field investigations of ocean margin habitats in the future.

The results of the present study provide the first evidence for a deep-water species of *Upeneus* from the Pacific. Given this large area, one may expect additional species to occur at deeper levels, or at least a wider distribution of *U. stenopsis* **n. sp.** The deviations in morphometric characters of the single juvenile from the Philippines compared with the four adult specimens reflect mostly developmental differentiation. When compared to the four similarly sized *U. mascarensis* juveniles, the differences from the adults appeared rather minor in the juvenile *U. stenopsis*. The wider caudal peduncle in the juvenile is however difficult to explain by ontogeny. Certainly more fish samples from both areas would need to be examined in order to better understand intraspecific differentiation processes in this species. Also, genetic information should be integrated, requiring most probably additional sampling.

The common phenotypic characteristics of the three deep-water species with *U. subvittatus* may indicate a close relationship and the occurrence of a distinct clade within the *vittatus* group which has successfully colonized the habitats close to the ocean margin. Long jaws and large eyes should have adaptive significance for enhancing food search and handling capacities at weakly illuminated depth levels (Klausewitz & Uiblein 1994; Uiblein 1995). The dorsally darker and ventrally silvery body common to these species may result in camouflage by obscuring the body when seen from above or countershading when seen from below. The caudal-fin colouration with distally darkened oblique bars interrupted by white interspaces has been retained in the three deep-water species. Contrasting colour patterns positioned at less vital body parts such as distal fin regions may have adaptive significance for predator avoidance or social communication especially when light is reduced (Uiblein & Nielsen 2005).

Comparative material examined

Upeneus davidaromi (6 specimens, 90–143 mm): **Israel, Red Sea:** MNHN1987-1195, 160 mm, Gulf of Aqaba, 550 m; SAIAB 42630, 105–110 mm, off Eilat; **Egypt, Red Sea:** MNHN 2000-1157, 143 mm, Gulf of Aqaba, Nuweiba, 28°58' N, 34°38' E, 300 m; **Central Red Sea:** MNHN 1984-456, 90–95 mm, 20°00' N, 39°00' E.

Upeneus mascarensis (28 specimens, 69–162 mm): **La Réunion:** holotype: MNHN65-0072, 152 mm, La Réunion, 21°07' S, 55°35' E; BMNH 1968.11.5.79, 99 mm, 140 m; MNHN1965-73, 90–97 mm, 21°07'0" S, 55°35'00" E; MNHN1965-79, 7: 72–145 mm; 21°07'0" S, 55°35'00" E; MNHN 1989-0090, 140 mm; 21°00' S, 55°15' E; MNHN 1975-0701, 137 mm, 21°0'0" S, 55°15'0" E, 100 m; MNHN 2008-1771, 128 mm, 73–77 m; RMNH 24945, 99 mm; RMNH 24949, 70–123 mm, 140 m; USNM 204033, 155 mm, 366 m; **Madagascar:** MNHN 1989-0202, 145 mm, 21°47' S, 43°10' E, 250 m; **Mozambique:** SAIAB 74603, 5: 135–160 mm, 18°02'06" S, 37°37'12" E, 162–200 m; SAIAB 81951, 3: 134–162 mm, 34°46.57' S, 25°07.31' E, 99 m; SAIAB 82328, 69 mm, 38°89.43' S, 17°27.83' E, 114 m.

Upeneus subvittatus (9 specimens, 85–180 mm): **Indonesia, Indian Ocean:** BMNH 1986.10.1.38, Western Indonesia, 88 mm; MZB PB389, 166 mm, West Java, Pelabuhanratu; CSIRO H 7371-01, 139 mm, same locality; **Indonesia, Pacific:** BPBM 32266, 166–180 mm, Molucca Islands, Ambon, 120 m; **Philippines:** BPBM 32724, 3: 105–109 mm, Samar Sea, Carigara Bay, 83–88 m; CAS 29422, 153 mm, Mindanao, Agusan Province, Nasipit.

Upeneus cf. sulphureus: **Japan:** RMNH 4700, purported lectotype and paralectotype of *Upeneus subvittatus* (as incorrectly designated by Boeseman 1947), 105–106 mm, Nagasaki.

Upeneus vittatus (15 specimens, 80–207 mm): **Red Sea:** SMF 1185, 163 mm, Central Red Sea; **La Réunion:** MNHN 1965-76, 168 mm, 21°07'0" S, 55°35'00" E; MNHN 1965-77, 149 mm, 21°07'0" S, 55°35'00" E; **Mauritius:** SAIAB 31413, 144 mm; **Mozambique:** SAIAB 82327, 146 mm, 38°21.44' S, 17°42.77' E, 25 m; **South Africa, Indian Ocean:** SAIAB 40593, 161 mm, Natal, Sodwana; **Thailand, Indian Ocean:** ZMUC 49380, 3, 140–186 mm, Phuket; **Indonesia, Indian Ocean:** BMNH 1986.10.1.39, 156 mm, Western Indonesia; MZB KD395, 141 mm, Bali, Kendongan; CSIRO H 7363-02, 207 mm, Tanjung Luar; CSIRO H 7370-01, 81 mm, West Java, Pelabuhanratu; MZB PB291, 2: 80 mm, same locality.

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