Zootaxa 3666 (3): 337–344
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3666.3.4
http://zoobank.org/urn:lsid:zoobank.org:pub:CA6ED703-24FC-46B1-89A5-3F728BBC4B07

A new deep-water goatfish of the genus *Upeneus* (Mullidae) from Vanuatu, South Pacific

FRANZ UIBLEIN[1,2,4] & ROMAIN CAUSSE[3]

[1]*Institute of Marine Research, P.O. Box 1870 Nordnes, N-5817 Bergen, Norway. E-mail: franz@imr.no*
[2]*South African Institute of Aquatic Biodiversity, Grahamstown, South Africa*
[3]*UMR BOREA, MNHN, CNRS 7208, UPMC, IRD 207, 43 rue Cuvier, Muséum national d'Histoire naturelle, 75005, Paris, France*
[4]*Corresponding author*

Abstract

A new goatfish, *Upeneus vanuatu* (Mullidae), is described based on five specimens collected off two islands of Vanuatu (South Pacific), at depths of 191–321 m, and compared with five closely related species: *Upeneus davidaromi* (Red Sea), *U. mascareinsis* (Western Indian Ocean), *U. stenopsis* (northern Australia, Philippines, 127–275 m), and the more shallow-occurring Indo-West Pacific species *U. subvittatus* (26–120 m) and *U. vittatus* (<100 m). The new species can be distinguished from all other congeneric species by the combination of four characters: number of gill rakers on lower limb, caudal-peduncle depth, interorbital length, and interdorsal distance. Strong allometric variation in body form between the holotype and the four smaller paratypes was found. Based on the lack of lateral body stripes, a rather narrow caudal peduncle depth, and large eyes in adults as common characteristics for *U. subvittatus* and the four deep-water *Upeneus* species, the so-called "*stenopsis*" species group can be distinguished from four other species groups that were established in earlier studies in order to facilitate intrageneric comparisons. The ecological and evolutionary significance of deep-water goatfishes is briefly discussed.

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

Introduction

The goatfish genus *Upeneus* (Mullidae) consists of 30 recognized species (Uiblein & McGrouther, 2012), most of which typically occur in coastal waters less than 100 m (Uiblein & Heemstra, 2010). Three species, however, occur at deeper levels of the lower shelf and upper slope, the so-called ocean-margin (Huthnance 1995): *Upeneus davidaromi* Golani, 2001 of the Red Sea occurs at 150 to 600 m depth; *U. mascareinsis* Fourmanoir & Guézé, 1967 of the Western Indian Ocean proper at 100–400 m depth, and *U. stenopsis* Uiblein & McGrouther, 2012 from northern/northeastern Australia (Timor Sea, western Coral Sea) and the Philippines (Quezon) at 127–275 m depth. The fact that all three species have been described within the last 45 years only, points to the need for further fish-taxonomic exploration of ocean margin habitats (Uiblein & McGrouther, 2012).

During a visit at the Muséum National d'Histoire naturelle, Paris in March 2011, the first author encountered two specimens of a yet unidentified *Upeneus* collected at 254–321 m off Espiritu Santo Island, Vanuatu (South Pacific), that clearly differed from the recently described *U. stenopsis*, but appeared to be rather similar in morphometric, meristic and colour characters to *U. mascareinsis*. Shortly after the description of *U. stenopsis*, in November 2012, three more MNHN specimens from similar depths and adjacent areas off Vanuatu became available allowing detailed comparisons.

Based on examination of a large set of meristic, morphometric and colour characters a new species is described and compared with the closely related deep-water dwellers *Upeneus davidaromi*, *U. mascareinsis*, and *U. stenopsis*, and the shallow-water Indo-West Pacific species *U. subvittatus* and *U. vittatus* (Forsskål, 1775). Because goatfishes show considerable changes in body form during ontogeny, special attention to allometric relationships is paid. The occurrence of a distinct species group of *Upeneus* consisting of mostly deep-water fishes (see also

Accepted by Wouter Holleman: 23 Apr. 2013; published: 31 May 2013

Uiblein & McGrouther 2012) is confirmed and the ecological significance and possible evolutionary causes of the formation of deep-water goatfishes are briefly discussed.

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 & Heemstra (2010) and Uiblein & McGrouther (2012). The five *Upeneus vanuatu* **n. sp.** specimens available for this study were not in a condition good enough to check the gonads for their state of maturity. All exceed the size limit for juveniles (< 80 cm SL, Table 1) used by Uiblein & McGrouther (2012) and hence only specimens >79 mm SL were used for interspecific comparisons. Because most of the comparative data have been published in an earlier account (Uiblein & McGrouther 2012), tabular presentations of the entire data sets were restricted to the three most closely occurring species *U. stenopsis*, *U. subvittatus*, and *U. vittatus*.

Institutional codes: AMS, Australian Museum, Sydney; MNHN, Muséum National d'Histoire naturelle, Paris, France; SAIAB, South African Institute of Aquatic Biodiversity, Grahamstown; ZMUC, Zoological Museum, University of Copenhagen, Denmark.

Taxonomy

Genus *Upeneus* Cuvier, 1829

***Upeneus vanuatu* n. sp.**
Vanuatu goatfish
(Figs. 1–3; Tables 1, 2)

Holotype. MNHN 2001-3361, 100 mm SL, Espiritu Santo Island, Vanuatu, South Pacific, 15°7'1"S, 166°52'59"E, Musorstom 8 cruise, R/V *Alis*, station cp1120, 282–321 m, beam trawl, 9/Oct/1994.

Paratypes. 4 specimens (80–84 mm SL). MNHN 2002-0028, 84 mm SL, same area as holotype, 15°7'59"S, 166°52'59"E, Musorstom 8 cruise, R/V *Alis*, cp1119, 254-300 m, beam trawl, 9/Oct/1994; MNHN 2002-0103, 2 specimens, 80–83 mm SL, same area as holotype, 15°7'59"S, 166°52'59"E, Musorstom 8 cruise, R/V *Alis*, station cp1119, 191–284 m, beam trawl, 9/Oct/1994; MNHN 2008-1331, 83 mm SL, Malo Island, Vanuatu Archipelago, Coral Sea, South Pacific, 15°39'54"S, 167°1'59"E, Santo 06 cruise, R/V *Alis*, station at17, 267–270 m, beam trawl, 21/Sept/2006.

Diagnosis. Dorsal fins VIII + 9; pectoral fins 14–16; gill rakers 7–8 + 19–20 = 27–28; measurements in % SL: body depth at first dorsal-fin origin 21–25; body depth at anus 17–19; caudal-peduncle depth 7.9–8.4; maximum head depth 18–23; head depth through eye 14–18; interorbital length 7.0–7.6; head length 29–32; orbit length 7.4–10; upper jaw length 11–13; barbel length 16–22; interdorsal distance 13–15; caudal-fin length 27–28; anal-fin height 14–17; pelvic-fin length 17–19; pectoral-fin length 21–24; first dorsal-fin height 19–20; second dorsal-fin height 15–17; total number of oblique caudal-fin bars 7, with 4 dark bars on upper caudal-fin lobe (including one bar close to rear end of lateral line) and 3 dark bars on lower caudal-fin lobe; bars differ in colour intensity and width; barbels white; no lateral body stripes; head and body pale rose, dorsally reddish and belly whitish; preserved fish pale brown, caudal-fin bars and black dorsal-fin tips retained.

Description. Measurements as % 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[4.4–4.7]; body depth at anal-fin origin 5.3[5.3–5.8]; head depth through eye 5.6[5.8–7.1]; head length 3.1[3.2–3.5], clearly longer than maximum depth of body and caudal-fin length (3.8[3.6–3.7]); first dorsal-fin height 5.1[4.9–5.3]; second dorsal-fin height 5.9[6.3–6.7]; barbel length 4.5[5.3–6.4]; pectoral-fin length 4.3[4.2–4.8], longer than pelvic-fin length (5.4[5.2–6.1]); orbit length 10[11–14], subequal to caudal-peduncle depth (12[12–13]).

Fresh colour (based on holotype; Figure 1): Head and body pale-rose; fore- and uppermost part of head and dorsal margin of body slightly darker; reddish markings along snout and around dorsal-fin bases; belly white; no

lateral body stripes; barbels white; caudal fin with 7 dark oblique bars (the two distal-most bars covering the fin tips); 4 bars (including one bar close to rear end of lateral line and one at tip) on upper lobe, 3 bars on lower lobe (one at tip); colour of the three most anterior caudal-fin bars changing from pale brown proximally to dark grey or black towards rear caudal-fin margin, the other four bars uniformly dark grey or black; bars anterior to fin tips wider than all other bars; white interspaces between bars of subequal width; dorsal fins with two dark bands each, one band close to base and the other at and surrounding fin tip; paired fins hyaline or whitish, without dark pigmentation.

Preserved colour: Head, body and barbels uniformly pale brown, head with a dark patch on opercle; holotype with dark belly pigmentation; first and second dorsal-fin tip and caudal-fin bar pigmentation retained; colour of caudal-fin bars weaker than in fresh fish, but variation in colour and width similar as in fresh fish.

Size: Upeneus vanuatu **n. sp.** attains at least 10 cm SL.

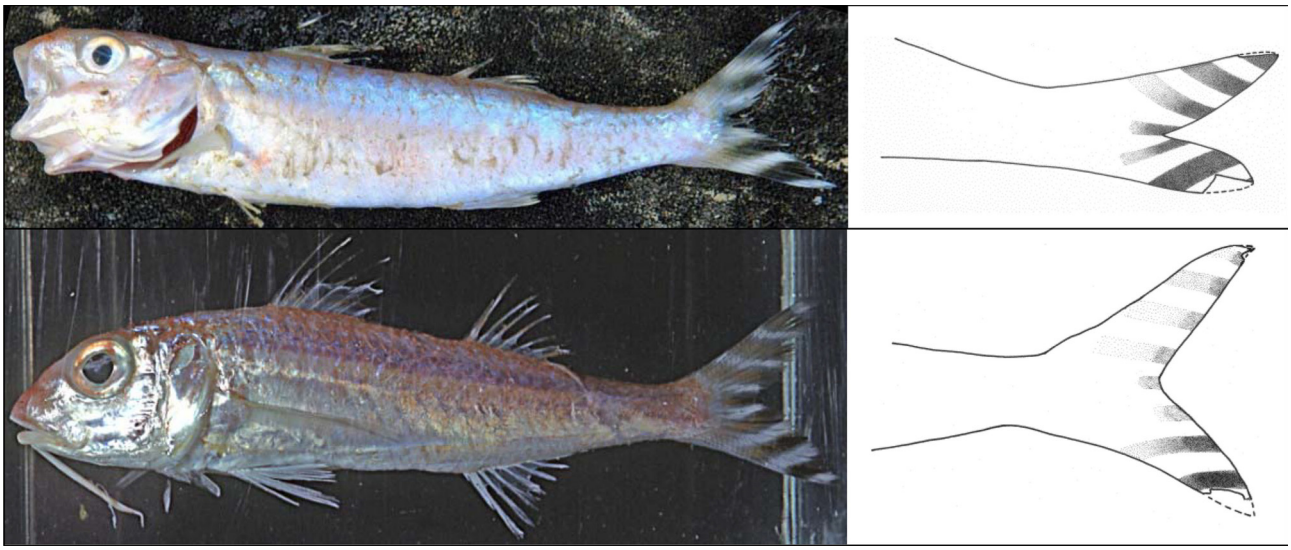

FIGURE 1. Top: *Upeneus vanuatu* **n. sp.**, left: Paratype (PT4 in Table 1), MNHN 2008-1331, 8.3 cm SL, off Malo island, Vanuatu Archipelago (C. Ferrara); right: Drawing of caudal fin of preserved paratype MNHN 2002-0028, 8.4 cm SL, off Espiritu Santo Island, Vanuatu. Bottom: *Upeneus stenopsis*, left: Holotype, AMS I.20918-017, 13.1 cm SL, NE Australia (D.F. Hoese); right: drawing of caudal fin of preserved holotype. The photograph of *U. stenopsis* is shown mirror-inverted to facilitate comparison.

Distribution. Only known from off Espiritu Santo and Malo Islands, Vanuatu, South Pacific; depth range 191–321 m.

Etymology. The name "*vanuatu*" is used as a noun in apposition and is based on the type locality, which is currently the only known locality for this species.

Comparisons. *Upeneus vanuatu* **n. sp.** differs from all other congeneric species by the combination of the following characteristics (Tables 1, 2): 19–20 (17–18 developed) gill rakers on lower limb, caudal-peduncle depth 7.8–8.4 % SL, interorbital length 7.0–7.6 % SL, and interdorsal distance 13–15 % SL.

Upeneus vanuatu **n. sp.** differs from the most closely related Pacific species as follows (Tables 1, 2): from *U. stenopsis* in a deeper and longer caudal peduncle, shallower, shorter and narrower head with narrower interorbital and shorter jaws, first dorsal fin lower, second dorsal fin shorter at base, more developed gill rakers on lower limb, and the caudal-fin bars more irregular in width; from *Upeneus subvittatus* it differs in shallower body, a shallower, narrower, and longer caudal peduncle, shallower, narrower and shorter head with shorter jaws, shorter interdorsal distance, shorter and narrower pectoral fins, lower first dorsal fin, and more developed gill rakers on lower limb; and from *U. vittatus* it differs in a shallower body, shallower and narrower caudal peduncle and head, shorter interdorsal distance, shorter pelvic fin, narrower pectoral fin, lower and shorter first dorsal fin, more developed gill rakers on lower limb, less lateral-line scales, and lateral body stripes absent.

TABLE 1. Morphometric and meristic characters in *Upeneus vanuatu* **n. sp.** and three closely related Pacific species, with the data revealing the most important distinctions from the new species emphasized in bold.

	Upeneus vanuatu sp. n.									*U. stenopsis*				*U. subvittatus*				*U. vittatus*			
	HT	PT1	PT2	PT3	PT4	Min	Mean	Max	*n*	Min	Mean	Max	*n*	Min	Mean	Max	*n*	Min	Mean	Max	*n*
SL (mm)	100	84	83	80	83	80	86,0	100	5	101	112.9	131	4	85	134.4	180	9	80	139,9	207	17
Body depth at first dorsal-fin origin	25	21	23	22	22	21	22,5	25	5	22	23.9	25	4	**25**	**26.6**	**28**	9	**24**	**27,4**	**30**	17
Body depth at anal-fin origin	19	17	19	17	19	17	18,2	19	5	18	19.6	21	4	**22**	**22.1**	**23**	9	**21**	**22,8**	**25**	17
Half body depth (from lateral line downwards) at first dorsal fin origin	20	17	18	16	18	16	17,9	20	5	-	-	-	-	**21**	**21.8**	**23**	9	**19**	**21,6**	**24**	17
Half body depth (from lateral line downwards) at anal fin origin	14	13	15	14	15	13	14,1	15	5	-	-	-	-	**15**	**16.5**	**18**	9	**15**	**17,2**	**18,7**	17
Caudal-peduncle depth	8,4	8,1	8,2	8,4	7,9	7,9	8,2	8,4	5	**7.4**	**7.7**	**7.8**	4	**9.2**	**9.5**	**10**	9	**9,4**	**10,7**	**11,6**	17
Caudal-peduncle width	2,6	2,9	2,7	2,9	2,9	2,6	2,8	2,9	5	2.6	2.7	2.9	4	**4.0**	**4.3**	**4.8**	9	**3,6**	**4,1**	**5,0**	17
Maximum head depth	23	20	19	18	20	18	20,0	23	5	**22**	**22.1**	**23**	4	**22**	**23.3**	**25**	9	21	23,4	26	17
Head depth across a vertical midline through eye	18	17	15	14	15	14	15,7	18	5	**18**	**18.7**	**19**	4	**18**	**18.9**	**20**	9	**17**	**18,7**	**20**	17
Suborbital depth	9,9	8,1	6,6	7,2	7,9	6,6	7,9	9,9	5	**9.1**	**9.8**	**11**	4	**10**	**10.8**	**12**	9	9,2	11,0	13	17
Interorbital length	7,4	7,0	7,5	7,2	7,6	7,0	7,3	7,6	5	**8.0**	**8.2**	**8.3**	4	**7.7**	**8.3**	**8.9**	9	**7,5**	**8,1**	**9,0**	17
Head length	32	31	30	29	29	29	30,4	32	5	**33**	**33.3**	**34**	4	**32**	**32.7**	**33**	9	29	30,8	32	17
Snout length	11	11	9,6	10	10	9,6	10,3	11	5	**11**	**11.2**	**12**	4	**11**	**12.0**	**13**	9	10	11,6	13	17
Postorbital length	13	13	12	12	13	12	12,5	13	5	**13**	**13.2**	**14**	4	**13**	**13.4**	**14**	9	11	12,8	14	17
Orbit length	10	9,2	8,1	7,9	7,4	7,4	8,5	10	5	9.2	9.5	9.9	4	7.8	8.3	8.8	9	6,6	7,6	8,8	17
Orbit depth	9,3	8,3	7,2	7,0	6,7	6,7	7,7	9,3	5	8.3	8.6	8.9	4	6.8	7.4	8.0	9	5,5	6,8	7,8	17
Upper-jaw length	13	12	12	12	11	11	12,0	13	5	**14**	**14.1**	**15**	4	**13**	**14.0**	**14**	9	11	12,2	13	17
Lower-jaw length	12	11	11	11	10	10	11,1	12	5	**13**	**13.5**	**14**	4	**13**	**13.2**	**14**	9	11	11,6	12	17
Snout width	-	-	8,5	7,1	8,0	7,1	7,9	8,5	3	8.3	8.9	9.7	4	8.8	10.3	11	9	7,5	9,5	12	16
Barbel length	22	19	17	17	16	16	18,1	22	5	20	20.8	22	4	19	21.3	24	9	16	18,1	21	16
Maximum barbel width	0,9	0,7	0,7	0,6	0,6	0,6	0,7	0,9	5	0.6	0.7	0.8	4	0.7	0.8	1.0	9	0,6	0,9	1,1	17
First pre-dorsal length	37	39	40	37	36	36	37,8	40	5	40	40.6	41	4	40	41.2	43	9	39	40,5	42	17
Second pre-dorsal length	66	63	65	62	65	62	64,1	66	5	64	67.0	70	4	66	68.2	71	9	65	67,7	70	17
Interdorsal distance	13	14	14	15	15	13	14,1	15	5	12	14.1	15	4	**14**	**15.8**	**18**	9	**14**	**16,1**	**20**	17
Caudal-peduncle length	23	24	25	22	24	22	23,4	25	5	21	20.9	21	4	**19**	**20.1**	**22**	9	18	20,8	24	17
Pre-anal length	64	66	64	63	66	63	64,7	66	5	66	69.2	72	4	66	68.5	71	9	65	68,0	71	17

.....continued on the next page

TABLE 1. (Continued)

	Upeneus vanuatu sp. n.									*U. stenopsis*				*U. subvittatus*				*U. vittatus*			
	HT	PT1	PT2	PT3	PT4	Min	Mean	Max	*n*	Min	Mean	Max	*n*	Min	Mean	Max	*n*	Min	Mean	Max	*n*
Pre-pelvic length	38	36	32	33	36	32	35,0	38	5	33	35.1	37	4	33	34.9	37	9	33	34,0	37	17
Pre-pectoral length	36	34	31	32	32	31	32,8	36	5	35	35.4	36	4	32	33.9	35	9	31	32,0	34	17
Second dorsal-fin depth (second dorsal-fin origin to anal-fin origin)	19	18	19	17	19	17	18,6	19	5	19	20.1	22	4	21	22.3	23	9	21	23,7	27	17
Pelvic-fin depth (first dorsal-fin origin to pelvic-fin origin)	25	21	23	22	22	21	22,7	25	5	23	24.1	25	4	25	26.6	28	9	25	27,3	30	17
Pectoral-fin depth (first dorsal-fin origin to dorsal origin of pectoral fin)	17	16	14	14	13	13	14,7	17	5	16	16.9	18	4	16	17.0	18	9	16	18,2	21	17
Length of first dorsal-fin base	14	13	14	13	14	13	13,3	14	5	13	13.9	15	4	13	14.3	16	9	**14**	**15,1**	**17**	17
Length of second dorsal-fin base	13	11	13	11	13	11	12,1	13	5	**13**	**13.1**	**14**	4	11	12.7	14	9	12	13,1	14	17
Caudal-fin length (dorsal caudal-fin origin to upper caudal-lobe tip)	27	28	27	27	-	27	27,2	28	4	26	27.1	28	3	26	27.9	29	8	26	29,7	32	17
Length of anal-fin base	11	10	10	11	9,7	9,7	10,4	11	5	10	10.6	12	4	9.5	10.3	11	9	9,3	10,3	11	17
Anal-fin height	17	-	14	16	15	14	15,7	17	4	15	15.4	16	4	14	15.6	18	8	15	15,8	18	17
Pelvic-fin length	19	19	17	18	-	17	18,0	19	4	18	18.7	19	4	17	18.5	19	9	**18**	**19,2**	**21**	17
Pectoral-fin length	23	24	21	21	21	21	22,1	24	5	23	24.1	25	4	**23**	**24.3**	**25**	9	21	22,8	26	17
Pectoral-fin width (width of pectoral-fin base)	3,8	3,1	3,7	3,5	3,6	3,1	3,5	3,8	5	3.9	4.1	4.3	4	**4.2**	**4.4**	**4.8**	9	**3,9**	**4,5**	**5,2**	17
First dorsal-fin height	20	20	19	20	19	19	19,6	20	5	**20**	**21.6**	**23**	3	**20**	**21.2**	**23**	9	**22**	**24,2**	**28**	16
Second dorsal-fin height	17	16	15	15	-	15	15,8	17	4	14	15.7	16	4	14	15.6	17	9	14	15,8	18	17
Pectoral-fin rays	15	14	16	16	15	14	15,2	16	5	15	15.8	16	4	16	16.1	17	9	15	15,9	17	17
Rudimentary gill rakers on upper limb	2	1	0	1	0	0	0,8	2	5	0	1.5	4	4	1	2.4	4	9	0	2,6	5	17
Developed gill rakers on upper limb	6	7	8	7	7	6	7,0	8	5	4	6.0	7	4	4	5.2	7	9	4	5,3	8	17
Developed gill rakers on lower limb	17	17	18	17	18	17	17,4	18	5	**14**	**15.5**	**17**	4	**14**	**14.8**	**16**	9	**13**	**14,9**	**17**	17
Rudimentary gill rakers on lower limb	3	3	2	2	2	2	2,4	3	5	2	4.0	6	4	4	4.4	6	9	4	4,9	6	17
Total gill rakers on upper limb	8	8	8	8	7	7	7,8	8	5	7	7.5	8	4	7	7.7	9	9	7	7,9	9	17
Total gill rakers on lower limb	20	20	20	19	20	19	19,8	20	5	18	19.5	20	4	19	19.2	20	9	19	19,8	21	17
Total gill rakers	28	28	28	27	27	27	27,6	28	5	25	27.0	28	4	26	26.9	28	9	27	27,7	29	17
Scales along lateral line to caudal-fin base	34	33	33	-	-	33	33,3	34	3	-	-	-	-	34	34.6	35	9	**35**	**35,9**	**38**	14
Oblique bars on upper caudal-fin lobe	4	4	4	4	4	4	4,0	4	5	4	4.3	5	3	4	4.6	6	8	4	4,5	5	17
Oblique bars on lower caudal-fin lobe	2+	3	2+	3	3	3	3,0	3	3	3	3.3	4	3	3	3.5	4	8	3	3,1	4	16
Total oblique bars on caudal fin	6+	7	6+	7	7	7	7,0	7	3	7	7.7	9	3	7	8.1	10	8	7	7,6	9	16

From the two deep-water *Upeneus* species of the Western Indian Ocean region, *U. vanuatu* **n. sp.** differs as follows (see also Uiblein & McGrouther 2012; Table 2; morphometric characters as % SL): from *U. davidaromi* in a shallower body (body depth at first dorsal-fin origin 21–25 vs 24–28; body depth at anal-fin origin 17–19 vs 20–23), shallower, narrower and longer caudal peduncle (caudal-peduncle depth 7.9–8.4 vs 8.5–9.7; caudal-peduncle width 2.6–2.9 vs 3.0–4.3; caudal-peduncle length 22–25 vs 18–22) shallower, narrower and shorter head (maximum head depth 18–23 vs 24–27; head depth through eye 14–18 vs 20–24; interorbital length 7.0–7.6 vs 7.9–8.9; head length 29–32 vs 32–35), shorter jaws (upper-jaw length 11–13 vs 14–15; lower-jaw length 10–12 vs 12–14), shorter barbels (barbel length 16–22 vs 20–25), shorter caudal fin (caudal-fin length 27–28 vs 28–30), shorter pelvic fins (pelvic-fin length 17–19 vs 18–20), narrower pectoral fins (pectoral-fin width 3.1–3.8 vs 4.1–5.3), shallower first dorsal fin (first dorsal-fin height 19–20 vs 20–24), and more developed gill rakers on lower limb (17–18 vs 13–16); and from *U. mascareinsis* it differs in narrower and longer caudal peduncle (caudal-peduncle width 2.6–2.9 vs 2.9–4.1; caudal-peduncle length 22–25 vs 19–23), shorter snout (snout length 9.6–11 vs 11–12), shorter jaws (upper-jaw length 11–13 vs 12–14; lower-jaw length 10–12 vs 11–14), shorter interdorsal distance (13–15 vs 15–18), slightly more gill rakers on lower limb (18–20 vs 20–22), and less lateral-line scales (33–34 vs 34–37).

Remarks. The larger holotype differs from the four smaller-sized paratypes clearly in several characters having a deeper body, larger head and larger eyes, longer jaws, and longer barbels (Table 1). When plotted against standard length, all these characters reveal allometric relationships (see example for body depth in Figure 2), while other characters such as caudal-peduncle depth and width, interorbital length, interdorsal distance, and pectoral-fin width do not (Table 1, Figure 2).

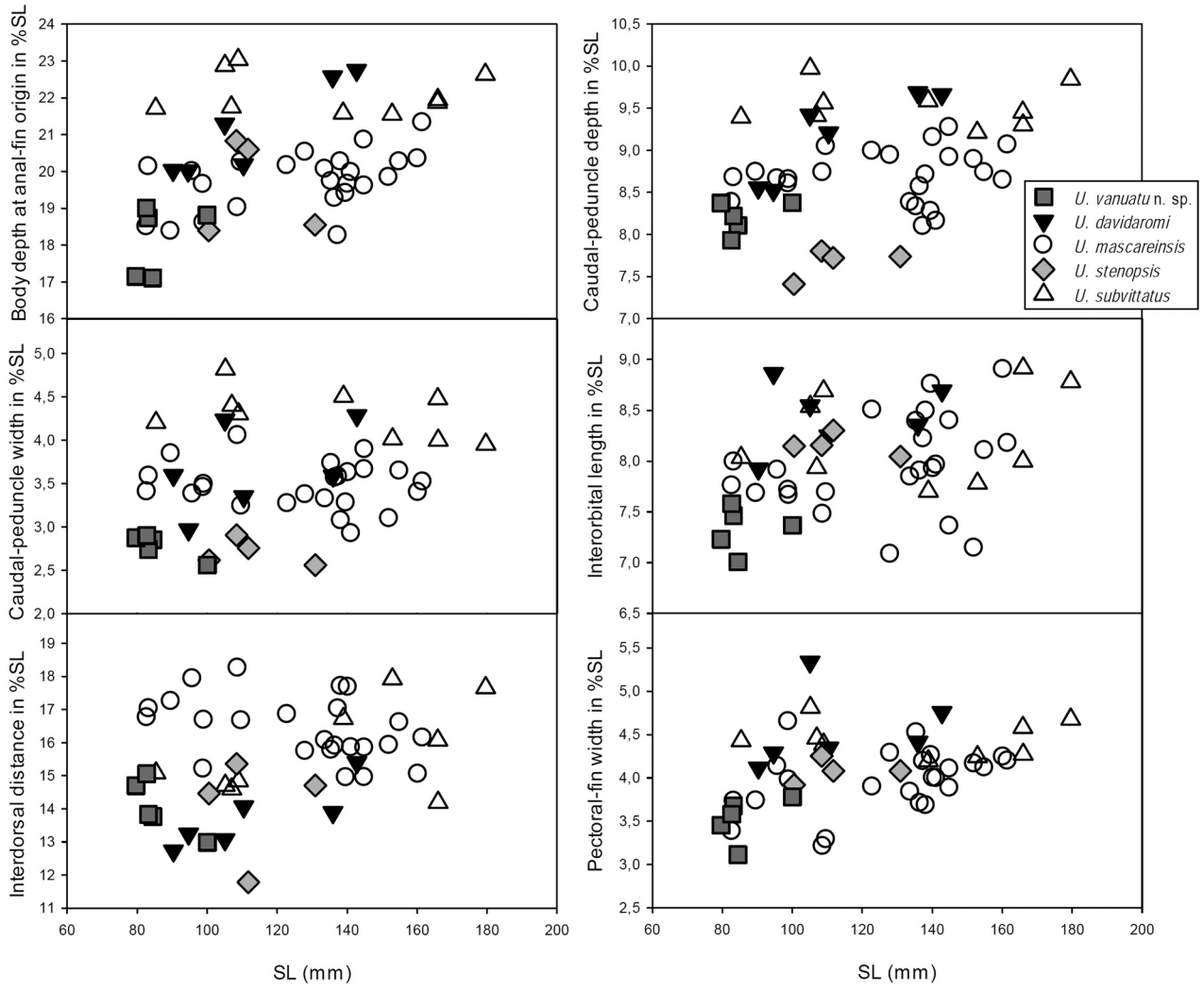

FIGURE 2. Relationships between SL and six morphometric characters (as % SL) in five closely related species of the *vittatus* group, *Upeneus vanuatu* **n. sp.**, *Upeneus davidaromi*, *U. mascareinsis*, *U. stenopsis*, and *U. subvittatus*.

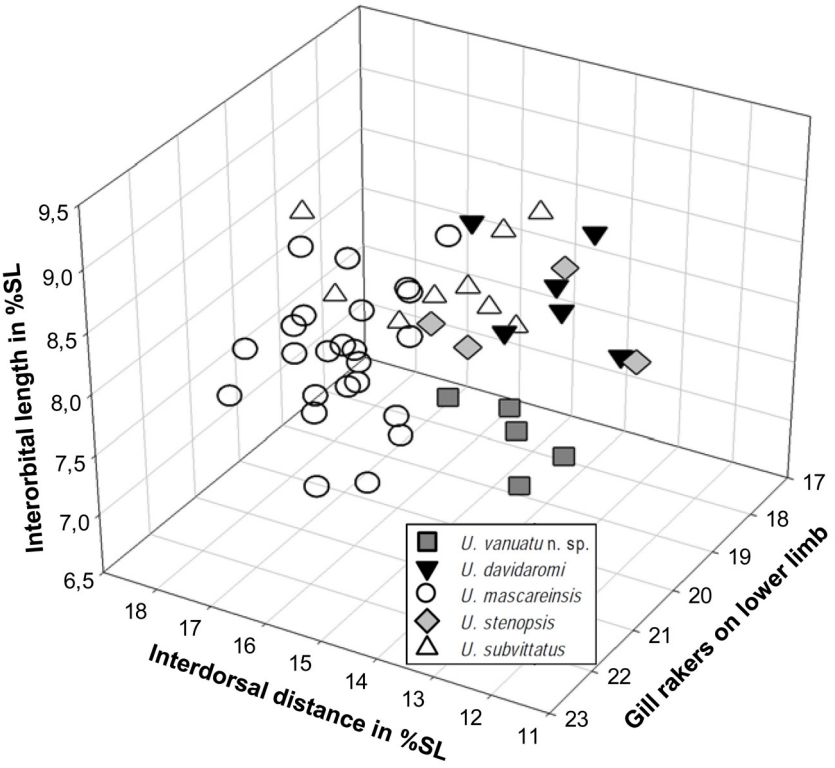

FIGURE 3. Relationship between total number of gill rakers on lower limb, interdorsal distance and interorbital length (morphometric characters as % SL) in five closely related species of the *vittatus* group, *Upeneus vanuatu* **n. sp.**, *Upeneus davidaromi*, *U. mascareinsis*, *U. stenopsis* and *U. subvittatus*.

TABLE 2. Number of gill rakers on lower limb for six *Upeneus* species.

	n	*n* undeveloped rakers							*n* developed rakers						total rakers				
		2	3	4	5	6	7	8	13	14	15	16	17	18	18	19	20	21	22
U. vanuatu **n. sp.**	5	3	2										3	2		1	4		
U. davidaromi	6		1	1	2	2			1	2	2	1				4	2		
U. mascareinsis	24		4	11	9						1	11	9	3			10	12	2
U. stenopsis	4	1	1		1	1				1	1	1	1		1		3		
U. subvittatus	9			6	2	1				3	5	1				7	2		
U. vittatus	17			5	5	5	1	1	2	3	8	2	2			5	10	2	

Discussion

The discovery of yet another new goatfish species from ocean margin depths further emphasizes how important it still is to explore the fish fauna of the zone ranging from the lower shelf downwards to the upper slope. The occurrence of deep-water goatfishes is not only restricted to the genus *Upeneus*, as there are also four species of *Parupeneus* known to occur well below 100 m. These are *Parupeneus chrysonemus* (Jordan & Evermann, 1903), from Hawaii and Johnston Island (20–183 m depth), *Parupeneus louise* Randall, 2004 from Tuamotu Archipelago (200–250 m); *Parupeneus moffitti* Randall & Myers, 1993 from Guam, Mariana Islands (120–230 m), and *Parupeneus posteli* Fourmanoir & Guézé, 1967 from Reunion (90–250 m). The three latter, deeper occurring *Parupeneus* species have also only been described within the last 45 years.

Upeneus vanuatu **n. sp.**, together with the other three deep-water *Upeneus* species, and *U. subvittatus* are characterized by a high number of gill rakers, shallow caudal peduncle, and lack of lateral body stripes. In particular the latter two characteristics separate them from *U. vittatus* and other species of the "*vittatus*" group

(Uiblein & Heemstra 2010). This confirms the existence of a distinct species group, as proposed by Uiblein & McGrouther (2012), which we term here the "*stenopsis*" group. As in *Upeneus*, the group of deeper-dwelling *Parupeneus* shares several characters such as a high gill-raker count, long barbels, and a uniform red colour rendering those four species distinct from all other congenerics (Randall, 2004). These findings may indicate the independent evolution of deep-water clades in both genera. However, those groupings so far have been primarily established for taxonomic purposes and phylogenetic analyses still remain to be done.

Many goatfish species show allometry in a number of morphometric characters when a wide range of size classes is compared (Uiblein & Heemstra, 2010, 2011; Uiblein, 2011) and this most certainly reflects considerable shifts in lifestyle throughout ontogeny (Uiblein, 1991, 2007). The here documented increase in head size, eye size, jaw and barbel length from smaller to larger *Upeneus vanuatu* **n. sp.** may, for instance, reflect a shift in foraging style and diet, but also in habitat, as well as adaptations that enhance survival in deeper and darker zones.

While there is ample evidence for goatfishes qualifying as ecological indicators of coastal habitats (Uiblein, 2007), it remains yet unclear what ecological significance and role this group may have in the light-reduced and often steep and rugged habitats surrounding the ocean margin. However, before these interesting questions can be satisfyingly tackled, more data and specimens from each of the deep-water species need to be collected and their habitats more entirely studied.

Comparative material examined. *Upeneus vittatus:* ZMUC 49433, 82 mm, Tahiti, South Pacific; ZMUC 49434, 112 mm, Tahiti, South Pacific; for all other comparative material see Uiblein & McGrouther, 2012.

Acknowledgements

We thank the following colleagues for hospitality and assistance during collection visits or for providing other collection-related favors: Roger Bills and the SAIAB fish collection staff, Elaine and Phil Heemstra, and Alan Whitfield (SAIAB); Mark McGrouther and Amanda Hay (AMS); Patrice Pruvost (MNHN); Peter R. Møller and Jørgen G. Nielsen (ZMUC). For photographs of fresh fish Claude Ferrara (MNHN) and Doug Hoese (AMS) and for drawings of the caudal fins of preserved specimens Elaine Heemstra (SAIAB) are thanked. The first author thanks the South African Institute for Aquatic Biodiversity and the Nansen Programme of the Center for Developmental Fisheries at the Institute of Marine Research (IMR), Bergen, Norway for travel support. Thanks to Wouter Holleman and two anonymous referees for valuable suggestions that have improved the manuscript.

References

Huthnance, M. (1995) Circulation, exchange and water masses at the ocean margin: the role of physical processes at the shelf edge. *Progress in Oceanography*, 35, 353–431.
http://dx.doi.org/10.1016/0079-6611(95)80003-C

Randall, J.E. (2004) Revision of the goatfish genus *Parupeneus* (Perciformes: Mullidae), with description of two new species. *Indo-Pacific Fishes*, 36, 64, 14 plates.

Uiblein, F. (1991) Ontogenetic shifts in resource use and shoaling tendency related to body size in Red Sea goatfish (*Parupeneus forsskali*, Mullidae). *Marine Ecology*, 12, 153–161.
http://dx.doi.org/10.1111/j.1439-0485.1991.tb00249.x

Uiblein, F. (2007) Goatfishes (Mullidae) as indicators in tropical and temperate coastal habitat monitoring and management. *Marine Biology Research*, 3, 275–288.
http://dx.doi.org/10.1080/17451000701687129

Uiblein, F. (2011) Taxonomic review of Western Indian Ocean goatfishes of the genus *Mulloidichthys* (Family Mullidae), with description of a new species and remarks on colour and body form variation in Indo-West Pacific species. *Smithiana*, Bulletin 13, 51–73.

Uiblein, F. & Heemstra, P.C. (2010) A taxonomic review of the Western Indian Ocean goatfishes of the genus *Upeneus* (Family Mullidae) with descriptions of four new species. *Smithiana*, Bulletin 11, 35–71.

Uiblein, F. & Heemstra, P.C. (2011) Description of a new goatfish species, *Upeneus randalli* n. sp. (Mullidae), from the Persian Gulf, with remarks and identification keys for the genus *Upeneus*. *Scientia Marina*, 75, 585–594.
http://dx.doi.org/10.3989/scimar.2011.75n3585

Uiblein, F. & McGrouther, M. (2012) 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*. *Zootaxa*, 3550, 61–70.