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***Pempheris bexillon*, a new species of sweeper (Teleostei: Pempheridae) from the Western Indian Ocean**

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Abstract

Pempheris bexillon new species is described from the 129 mm SL holotype and 11 paratypes (119–141 mm SL) from the Comoro Islands. Twelve other specimens have been examined from the Agaléga Islands, Mascarene Islands, and Bassas da India (Madagascar). It is differentiated from other *Pempheris* by the following combination of characters: a yellow dorsal fin with a black, distal margin along its full length, broadest on anterior rays (pupil-diameter width) and gradually narrowing posteriorly, the last ray with only a black tip; large, deciduous cycloid scales on the flank; dark, oblong spot on the pectoral-fin base; anal fin with a dark margin; segmented anal-fin rays 38–45 (usually >40); lateral-line scales 56–65; and total gill rakers on the first arch 31–35; iris reddish-brown. Tables of standard meristic and color data for type material of all nominal species of cycloid-scaled *Pempheris* in the Indo-Pacific are provided.

Key words: taxonomy, Comoro Islands, meristics, comparative type data, *Pempheris nesogallica* Cuvier

Introduction

The genus *Pempheris* Cuvier comprises 44 nominal species of which perhaps 25 are valid, although a complete revision has yet to be undertaken (43 as listed in Eschmeyer 2014 with the addition of *P. flavicycla* Randall *et al.* 2013). The species are found on rocky and coral reefs of the tropical and temperate Indo-Pacific and western Atlantic Oceans to depths of about 100 m. They are medium-sized fishes (<200 mm SL) characterized by large eyes, strongly compressed body, a single, short dorsal fin, a long anal fin (>27 segmented rays), and a lateral line extending to the end of the middle rays of the caudal fin. During the day they are frequently found in aggregations under ledges or in caves. Despite their ubiquity, the taxonomy of this genus has long been problematic. Species are superficially very similar and are not easily separable by traditional counts; early workers produced copious synonyms or descriptions that lacked sufficient detail to differentiate species. For these reasons, along with poor quality type material and no modern revision available, later workers (including ourselves) have made identifications or suggested synonymies based on very little evidence and/or on previous literature (e.g. Fowler 1928, 1931, 1949; Herre 1953, Randall 1983, Heemstra 1986, Randall 1995, Mooi & Jubb 1996). As a result, faunal reviews are unlikely to accurately reflect the *Pempheris* species actually present.

Although specific identification is frequently difficult, several species groups can be recognized by morphology and color. There are two general groupings based on the presence of either adherent ctenoid or deciduous cycloid (or very weakly ctenoid) scales on the flank; these are phenetic groupings, as the ctenoid-scaled group is likely paraphyletic (unpublished data, RDM). Of the ctenoid-scaled taxa, only a few western Australian species range into the Eastern Indian Ocean (Mooi & Jubb 1996); none are known to occur in the Western Indian Ocean. The remaining cycloid-scaled species can be grouped by the presence or absence of a distinct, roughly oval, black spot covering the base of the pectoral fin. Among those with a basal pectoral-fin spot, we have found specimens from the Comoro and Mascarene Islands of the Western Indian Ocean that exhibit a distinctive dorsal-fin color. We describe this species and provide some basic descriptive characters for available types of the nominal species of cycloid-scaled *Pempheris* of the Indo-Pacific for future reference (Tables 1, 2).

TABLE 1. Selected meristic data for types of nominal species of *Pempheris* with cycloid flank scales occurring in the Indo-Pacific. Australian endemics (*P. affinis* McCulloch, *P. multiradiata* Klunzinger, *P. ornata* Mooi & Jubb and their synonyms) excluded. Locality listed once if all types collected together. Letters following catalogue numbers: H – holotype; P – paratype; S – syntype. L and R indicate counts for left and right side; — indicates data not available due to specimen damage. All counts taken from specimens except for *P. mangula* from interpretation of the description and figure by Russell (1803) and *P. ufiagari* taken from Koeda *et al.* (2013).

Species	Cat. No.	SL (mm)	Locality	LL scales	Scales above LL	Scales below LL	Circum-ped. scales	Gill rakers	Dorsal fin	Anal fin	Pectoral fin
<i>P. adusta</i> Bleeker, 1877	RMNH.PISC.6161 H	128.5	Ambon Is., Moluccas	56L, 53R	5	13	21	9+22L	VI,9	III,42	18LR
<i>P. flavicycla</i> Randall <i>et al.</i> , 2013	BPBM 17663 H	138	Mafia Is., Tanzania	56	4	12	—	9+20	VI,10	III,42	18LR
<i>P. itoi</i> Fowler, 1931	USNM 089994 H	103.3	Tanakeke Is., Indonesia	69LR	7	15	24	8+19	VI,9	III,44	18LR
<i>P. malabarica</i> Cuvier, 1831	MNHN A219 S MNHN A417 S MNHN B2511 S	121.9 130.4 120.1	Mahé, Malabar, western India	68LR 69LR 72L,68R	7 ~7 7	16 15 —	— ~20 ~24	8+19 8+18 8+19LR	VI,10 VI,9 VI,9	III,44 III,44 III,43	18 19L,18R 17LR
<i>P. mangula</i> Cuvier, 1829	No type material, from Russell (1803)	~135	Vizagatapuram eastern India	~65	5	~15	—	—	VI,10	III,39	18
<i>P. molucca</i> Cuvier, 1829	MNHN A220 H MNHN A217 P RMNH.PISC.1483 P	112.6 98.6 121.7	Moluccas Batavia Moluccas	68L,67R 74L,72R 70L,68R	7 7 6-7	14 15 14	23 ~21 ~21	8+20LR 8+19 8+20	VI,9 VI,9 VI,9	III,43 III,45 III,45	18LR 18LR 18LR
<i>P. nesogallica</i> Cuvier, 1831	MNHN A222 S MNHN B2514 S	136.7 126.8	Mauritius	58 57	5 ~6	14 ~15	—	9+22 9+22	VI,9 VI,10	III,38 III,39	18LR 18LR
<i>P. myctereutes</i> Jordan & Evermann, 1902	ZUMT 42902 H	159.3	Hokuto, Taipei City, Taiwan	81L,77R	6	~16	~21	8+20L,8+21R	VI,9	III,44	19L,18R
<i>P. otaitensis</i> Cuvier, 1831	MNHN A927 H	131.3	Tahiti, Society Is.	72L,71R	~7	~16	23	9+22L,9+23R	VI,9	III,41	18
<i>P. oualensis</i> Cuvier, 1831	MNHN A221 H	169.5	Kosrae, Caroline Is.	64LR	6	15	24	8+20LR	VI,9	III,41	17LR
<i>P. rhomboidea</i> Kossmann & Räuber, 1877	ZMB 9850 S	104.2	Red Sea	57L,55R	5-6	15	—	8+22L,9+21R	VI,9	III,39	17LR
<i>P. sasakii</i> (Jordan & Hubbs, 1925)	FMNH 58751 H	90.8	Toba (market), Japan	72L,74R	~6	~17	—	8+20	VI,9	III,41	19LR
<i>P. schwenkii</i> Bleeker, 1855	RMNH.PISC.6160 S RMNH.PISC.6160 S	89.6 86.8	Batu, Is., off west Sumatra	50LR 50LR	— ~3	~14 ~12	~18 ~19	7+19L 8+19L	VI,9 VI,9	III,36 III,35	18LR 17LR
<i>P. ufiagari</i> Koeda <i>et al.</i> , 2013	NSMT-P 108633 H	168.7	Daito Is., Japan	66LR	7.5	17	20	8+21	VI,9	III,42	17
<i>P. vanicolensis</i> Cuvier, 1831	MNHN A224 S MNHN A418 S MNHN B2512 S MNHN B2513 S	130.8 135.1 65.5 115.3	Vanikoro, Santa Cruz Is.	64 63 ~63 63L,64R	~6 ~6 — ~7	~15 ~15 — —	— — — —	8+20LR 8+20LR 7+20 8+20L,9+20R	VI,9 VI,9 VI,9 VI,8	III,41 III,41 III,41 III,41	18LR 18 18L,19R 18
<i>P. xanthopterus</i> Tomimaga, 1963	ZUMT 51967 H	115.1	Manazuru, Japan	50L,48R	3-4	10	—	9+21L	VI,9	III,38	18LR

TABLE 2. Selected color data for types of nominal species of *Pempheris* with cycloid flank scales occurring in the Indo-Pacific. Australian endemics (*P. affinis*, *P. multiradiata*, *P. ornata* and their synonyms) excluded. Type localities listed in Table 1. Observations taken directly from specimens except for *P. mangula* taken from interpretation of the figure by Russell (1803) and *P. ifugari* taken from Koeda *et al.* (2013; fig. 1). Letters following catalogue numbers: H – holotype; P – paratype; S – syntype; ? for *P. molucca*, *P. nesogallica* and *P. vanicolensis* indicates that original description specifies there is no pectoral-fin basal spot, but specimens now appear darkish at base (perhaps due to darkening of musculature under thinning skin).

Species	Cat. No.	SL (mm)	Pectoral-fin base spot	Dorsal fin	Anal fin
<i>P. adusta</i> Bleeker, 1877	RMNH.PISC.6161	H 128.5	Yes	Dark leading margin and tips of first few rays.	Dusky, particularly anteriorly and near the base.
<i>P. flavicycla</i> Randall <i>et al.</i> , 2013	BPBM 17633	138	Yes	Usually darker leading margin and distal blotch at tips of rays 1–4; occasionally a suffuse distal margin to ray 8.	Dark distal margin.
<i>P. itoi</i> Fowler, 1931	USNM 089994	H 103.3	No	Trace of darker tips to anterior rays.	Dusky base, pale distal margin.
<i>P. malabarica</i> Cuvier, 1831	MNHN A219 S MNHN A417 S MNHN B2511 S	121.9 130.4 120.1	No No No	All specimens poor, but no obvious markings on any.	Unmarked. Unmarked, somewhat dusky.
<i>P. mangula</i> Cuvier, 1829	No type material, from Russell (1803)	~135	Cross-hatching might represent spot or only shading.	No markings indicated; apparent dark distal band due to representation of ray branching.	No markings indicated; apparent dark distal margin due to representation of ray branching.
<i>P. molucca</i> Cuvier, 1829	MNHN A220 H MNHN A217 P RMNH.PISC.1483 P MNHN A222 S	112.6 98.6 121.7 136.7	? No ? ?	No markings. Trace of darker tips to rays 1–3. No markings. Distal blotch at tips of rays 1–4 or 5.	Dusky base, dark anterior rays. Dusky base, dark anterior rays. Dusky base, dark anterior rays. Dusky without distal marginal band, dark tips on very anterior rays.
<i>P. nesogallica</i> Cuvier, 1831	MNHN B2514 S	126.8	?	Distal blotch at tips of rays 1–5 or 6.	Dusky without distal marginal band, dark tips on very anterior rays.
<i>P. nyctereutes</i> Jordan & Evermann, 1902	ZUMT 42902 H	159.3	No	Specimen poor; perhaps darker distal tips to anterior rays.	Dusky base, pale distal margin.
<i>P. otaitensis</i> Cuvier, 1831	MNHN A927 H	131.3	Yes	Dark leading margin continuous with dark tips on rays 1–4.	Trace of dark, distal marginal band.
<i>P. ovalensis</i> Cuvier, 1831	MNHN A221 H	169.5	Yes	Dark leading margin.	Unmarked.
<i>P. rhomboidea</i> Kossmann & Rüber, 1877	ZMB 9850 S	104.2	No	Distal blotch at tips of rays 1–4; trace of narrow dark leading edge.	Dusky base, dark anterior rays.
<i>P. sasakii</i> (Jordan & Hubbs, 1925)	FMINH 58751 H	90.8	No	Distal blotch at tips of rays 1–4 or 5.	Anterior tips dark; dark distal margin.
<i>P. schwenkii</i> Bleeker, 1855	RMNH.PISC.6160 S RNMH.PISC.6160 S	89.6 86.8	No No	Trace of distal blotch at tips of rays 1–4. Trace of distal blotch at tips of rays 1–4.	Clear with dusky base. Clear with dusky base.
<i>P. ifugari</i> Koeda <i>et al.</i> , 2013	NSMT-P 108633 H	168.7	Yes	Yellowish with distal blotch at tips of rays 1–4; narrow dark leading margin.	Clear with dark, distal marginal band.
<i>P. vanicolensis</i> Cuvier, 1831	MNHN A224 S MNHN A418 S MNHN B2512 S MNHN B2513 S	130.8 135.1 65.5 115.3	? No ? ?	Distal blotch at tips of rays 1–4 or 5. Specimen poor; appears unmarked. Distal blotch at tips of rays 1–4 or 5. Dark leading margin continuous with distal blotch on rays 1–4.	Dusky; anterior rays darker. Anterior tips dark; dark distal band. Specimen poor; appears unmarked. Perhaps dusky, anterior tips dark. Unmarked with a dark base.
<i>P. xanthopterus</i> Tominaga, 1963	ZUMT 51967 H	115.1	No	Dark leading margin continuous with distal blotch on rays 1–4.	Unmarked with a dark base.

Material and methods

Abbreviations for institutional codes follow Fricke and Eschmeyer (2014) and/or Sabaj Pérez (2010). Materials of *Pempheris bexillon* are listed in the species description. Comparisons to other described species are based, in part, on the type material as listed in Tables 1 and 2.

In the description, data are reported first as in the holotype followed in parentheses by the range in remaining specimens.

Meristics. X-radiographs were used for meristics when available for the new species and exclusively for comparative type material listed in Table 1. The last segmented ray in the dorsal and anal fins is divided at its base and was counted as a single ray. Counts of pectoral-fin rays contain the rudimentary upper ray and are provided for both sides when available. Caudal-fin rays are provided as counts of segmented rays on the upper+lower hypural plates. Procurrent caudal rays are provided as upper+lower counts; the posteriormost procurrent ray was frequently segmented distally. Lateral-line scale counts were taken from the dorsalmost extent of the opercular opening to the mid-posterior edge of the hypural plate. Scale counts were taken on both sides when possible. Transverse scale rows were counted diagonally from the origin of the dorsal fin, downward and backward, to the ventral midline at or near the anal-fin base. Gill raker counts are from the first arch and include rudiments, recorded as upper arch + lower arch = total.

Morphometrics. Measurements were taken with dial callipers and recorded to three significant figures. Percentages are also recorded to three significant figures (tenths of a percent). Proportional measurements are rounded to the nearest 0.05. Standard length (SL) was taken from the anterior tip of the upper jaw (snout) to the mid-posterior edge of the hypural plate (as identified by folding the caudal fin to find the hypural crease). Head length (HL) is measured from the same anterior point to the posterior end of the opercular flap, and upper-jaw length from the same anterior point to the posterior end of the maxilla. Body depth is taken from the origin of the anal fin vertically to the base of the dorsal fin. Body width is measured just posterior to the opercular flap; orbit diameter is the horizontal bony diameter, and interorbital width the least bony width; caudal-peduncle depth is the least depth, and caudal-peduncle length the horizontal distance between verticals at the rear base of the anal fin and base of caudal fin; lengths of spines and rays of median fins are measured to their extreme bases; caudal-fin length is measured horizontally from the base to a perpendicular at the end of the longest ray, and caudal concavity the horizontal distance between tips of the shortest and longest rays; pectoral-fin length is the length of the longest ray; pelvic-fin length is measured from the base of the pelvic spine to the tip of the longest ray.

Pempheris bexillon new species

(Figures 1, 2; Tables 3–7)

Holotype. SAIAB 30861, male, 129 mm, Comoro Islands, Grande Comore, 0.5 km north of the Coelacanth Hotel, 11.8167°S, 43.0167°E, 50–100 m offshore, volcanic rock and coral reef with caves and ledges, 5–10 m, rotenone, P.C. Heemstra, M. Smale, and J. Wright, Oct. 26, 1986.

Paratypes (11 specimens). BPBM 41165, 122 mm, same data as holotype; CAS 33012, male, 121 mm, Grande Comore, rock reef in front of Hotel Coelacanth, rotenone, J.E. McCosker & M.D. Lagios, Mar. 1, 1975; CAS 33403, 8: 119–141 mm, Grande Comore, N'Gouni Reef, about ½ km north of Iconi, surge channel at far end of small cove, outgoing tide, rotenone, J.E. McCosker, S. Mead, D. Powell, & J. Breeden, Feb. 1975; USNM 402278, male, 123 mm, Comoro Islands, NW of Anjouan, 12°10'S, 44°23'E, cave in coral reef, 0–10 m, ichthyocide, *Te Vêga* Cruise 4, R. Bolin *et al.*, Aug. 21, 1964.

Other material (12 specimens). SAIAB 68413, 2: 140–151 mm, Mascarene Islands, Rodrigues, Grand Baie, 19.6503°S, 63.4403°E, reef, 5–10 m, ichthyocide, P.C. & E. Heemstra, M. Smale, and J. Wright, Oct. 13, 2001; USNM 343783, 155 mm, Mascarene Islands, Mauritius, west coast, Baie de La Petite Rivière, southwest of Albion Fisheries Research Centre, 10–11 m, P.C. Heemstra, A.C. Gill, D.G. Smith, & M.J. Smale, Apr. 28, 1995; USNM 343808, 3:127–148 mm, Agaléga Islands, North Island, about half mile southwest of tip, 10°19'S, 56°35'E, 0–8 m rotenone, V.G. Springer, T.H. Fraser, C.L. Smith *et al.*, Apr. 17, 1976; USNM 344241, 4:140–145 mm, Mascarene Islands, Cargados Carajos Bank, Raphael Island, 16.43°S 59.60°E, 100 yds off west side in coral patch in surge channel, 0–8m, rotenone, T.H. Fraser, V.G. Springer, C.L. Smith *et al.*, Apr. 2, 1976; MPM uncatalogued, 2:132–

133 mm, Madagascar, Bassas da India (21.5°S 39.7°E), south side of atoll, low tide gully on reef top, rotenone, S. Chater, June 30, 1991.

Diagnosis. A species of *Pempheris* that is unique in having a yellow or yellowish dorsal fin with a black, distal margin along its full length, broadest on anterior rays (pupil-diameter width) and gradually narrowing posteriorly, the last ray with only a black tip. It can also be differentiated from congeners by the combination of the following characters: large, deciduous cycloid scales on the flank; dark, oblong spot on the pectoral-fin base; anal fin with a dark margin along its length; segmented anal-fin rays 38–45; lateral-line scales 56–65; and total gill rakers on the first arch 31–35.



FIGURE 1. Left lateral view of the holotype of *Pempheris bexillon* n. sp. shortly after capture, SAIAB 30861, male, 129 mm SL, 0.5 km north of the Coelacanth Hotel, Grande Comore, Comoro Islands. Photo by P.C. Heemstra, used with permission.



FIGURE 2. Left lateral view of *Pempheris bexillon* Mooi & Randall n. sp. shortly after capture, SAIAB 68413, 140 mm SL, Grand Baie, Rodrigues, Mascarene Islands. Photo by P.C. Heemstra, used with permission.

Description. Dorsal rays VI,9 (VI,9–10), the spines slender, all segmented rays branched; anal rays III,41 (38–45), the spines stout, all segmented rays branched; pectoral rays 17 (16–19), the first rudimentary, second unbranched, remaining rays branched; pelvic rays I,5; principal caudal rays 9+8, the median 15 branched; upper + lower procurent caudal rays 5 + 5 (4–5 + 3–5), the most posterior of each segmented distally; lateral-line scales 59 (56–65) to base of caudal fin, pored scales continuing to end of fin; gill rakers 9 + 24 = 33 (8–10 + 22–25 = 31–35); branchiostegal rays 7; vertebrae 25.

Body moderately deep, the depth 2.3 (2.2–2.4) in SL, and compressed, the width 3.0 (2.45–3.05) in body depth; head length 3.6 (3.5–3.6) in SL; dorsal profile of head smoothly convex; snout short 4.5 (4.0–4.6) in HL; eye relatively small, the orbit diameter 2.3 (2.25–2.35) in HL; interorbital slightly convex, the width 3.2 (3.15–3.3) in HL; caudal-peduncle depth 2.9 (2.95–3.1) in HL; caudal-peduncle length 3.8 (3.3–3.9) in HL.

TABLE 3. Frequency of anal segmented ray counts for *Pempheris bexillon* n. sp. from six localities. All type material is from the Comoro Islands; holotype value marked by asterisk.

	38	39	40	41	42	43	44	45
Comoro Islands			2	5*	4	1		
Bassas da India				2				
Agaléga Islands			1	1		1		
Cargados Carajos	1	1	2					
Mauritius					1			
Rodrigues				1				1

TABLE 4. Frequency of pectoral-fin ray counts for *Pempheris bexillon* n. sp. from three localities. All type material is from the Comoro Islands; holotype value marked by asterisk. Counts are provided for both sides.

	16	17	18	19
Comoro Islands	1	11*	10*	2
Bassas da India			2	
Rodrigues			4	

TABLE 5. Frequency of lateral-line scale counts for *Pempheris bexillon* n. sp. from six localities. All type material is from the Comoro Islands; holotype value marked by an asterisk. Some counts provided from both sides.

	56	57	58	59	60	61	62	63	64	65
Comoro Islands	1	1	3	3*	2	1	3			
Bassas da India						1		1		
Agaléga Islands							1	1		1
Cargados Carajos	2	1	1							
Mauritius					1					
Rodrigues			2	2						

TABLE 6. Total gill-raker counts on the first arch for *Pempheris bexillon* n. sp. from six localities. All type material is from the Comoro Islands; holotype value marked by asterisk. Rodrigues specimen counts provided from both sides.

	31	32	33	34	35
Comoro Islands	2	3	4*	3	
Bassas da India				1	1
Agaléga Islands		1	2		
Cargados Carajos		1	3		
Mauritius			1		
Rodrigues		2	1	1	

TABLE 7. Measurements of selected type specimens of *Pempheris bexillon* n. sp. as percentages of standard length. Caudal concavity not available for specimens with damaged caudal fins (—). Paratypes listed in order of increasing size.

	Holotype	Paratypes				
	SAIAB 30861	CAS 33403	CAS 33012	BPBM 41165	USNM 402278	CAS 33403
Standard length (mm)	129	119	121	122	123	137
Body depth	43.0	42.5	42.2	43.5	42.8	45.2
Body width	14.4	14.3	14.2	17.8	14.0	15.0
Head length	27.7	27.9	28.4	28.2	28.4	27.7
Snout length	6.2	6.1	6.6	6.1	6.3	6.9
Orbit diameter	12.0	12.0	12.6	12.3	12.3	11.8
Interorbital width	8.7	8.8	9.0	8.9	8.9	8.4
Caudal-peduncle depth	9.6	9.0	9.4	9.6	9.7	9.3
Caudal-peduncle length	7.3	8.3	8.2	7.2	7.3	8.5
Predorsal length	36.6	36.3	36.8	37.5	37.6	38.0
Preanal length	51.5	51.0	50.7	52.8	52.0	51.0
Prepelvic length	37.8	36.2	37.9	37.0	36.4	36.5
Base of dorsal fin	20.2	18.0	18.2	19.7	19.1	18.1
First dorsal spine	6.8	8.1	8.9	6.9	7.1	7.8
Sixth dorsal spine	22.9	23.3	22.7	23.8	23.7	23.3
Longest dorsal ray	26.5	25.5	broken	26.2	26.6	25.7
Base of anal fin	54.7	54.1	54.3	54.6	54.9	53.7
First anal spine	4.4	4.5	3.5	5.4	4.2	4.2
Third anal spine	12.3	10.4	11.2	11.8	11.9	11.3
Longest anal ray	17.7	14.7	14.9	17.5	17.9	broken
Caudal-fin length	25.1	28.5	broken	24.3	broken	27.2
Caudal concavity	4.2	6.4	—	3.7	—	5.0
Pectoral-fin length	28.2	29.0	25.9	27.7	28.4	27.0
Pelvic-spine length	12.4	13.9	13.6	13.0	13.2	12.9
Pelvic-fin length	17.8	17.6	broken	18.1	17.8	17.5

Mouth strongly oblique, forming an angle of about 60° to horizontal axis of head and body, the slender lower jaw slightly protruding when mouth fully closed; maxilla slender anteriorly, expanding posteriorly to a width two-thirds to three-fourths pupil diameter, usually reaching slightly posterior to a vertical through center of eye; upper and lower margins of maxilla inwardly curved, the posterior edge straight with rounded corners; very small, sharp, incurved teeth in two irregular rows anteriorly in upper jaw, narrowing to a single row posteriorly; teeth on each side of nodular symphysis of lower jaw in a patch with at most six irregular rows of small teeth, the outer one or two rows sharply nodular, the inner three or four rows strongly recurved and narrowly sharp; teeth to side of lower jaw narrowing to two rows for most of length of jaw; all teeth of upper jaw exposed when mouth fully closed, but none of lower jaw; vomer with an expanded V-shaped patch of very small nodular teeth in three to four irregular rows; palatines with a long narrow patch of very small, medially curved teeth in three to four irregular rows anteriorly, narrowing to one or two rows posteriorly; tongue narrowly triangular, the upper surface with small papillae; gill rakers long, the longest gill filaments three-fourths length of longest gill raker.

Gill opening extending dorsally nearly to level of upper edge of orbit, and anteriorly nearly to a vertical at anterior edge of orbit. Opercular membrane ending posteriorly in a obtuse angle; margin of preopercle free only ventrally with two flat spines, the dorsoposterior spine acutely triangular, 2 mm long in holotype, separated by 3 mm from end of lower, asymmetrical, more rounded spine; a slight ridge midventrally on anterior two-thirds of chest.

Anterior and posterior nostrils in front of dorsal edge of pupil, one-third distance to median front of upper lip, the apertures vertically oval and subequal, separated by a septum nearly equal to nostril width; anterior nostril with a membranous flap on posterior edge that just reaches edge of posterior nostril when laid back.

Scales thin, deciduous, and cycloid, except finely ctenoid in posterior interorbital, on nape, dorsally on body posterior to dorsal fin and above lateral line; also ctenoid on chest, strongest ventrally, except a naked vertical zone directly ventral to base of pectoral fin; small scales on anal fin extending more than half way to margin and nearly half way to margin on caudal fin (farthest on membranes). The flank scales are in two layers, the outer layer larger and very deciduous. The lateral-line scales are in the second layer, but not completely covered (the narrow middle zone of the scale bearing the sensory canal and pore remains exposed).

Origin of dorsal fin in vertical alignment with rear base of pectoral fin, the predorsal length 2.75 (2.65–2.75) in SL; dorsal-fin base 4.95 (5.1–5.55) in SL; first dorsal spine short, 4.05 (3.2–4.1) in HL; sixth dorsal spine longest, 1.2 (1.2–1.25) in HL; first or second dorsal segmented rays longest, 1.05 (1.05–1.1) in HL; origin of anal fin below middle of dorsal fin, the preanal length 1.95 (1.9–2.0) in SL; anal-fin base 1.85 (1.8–1.85) in SL; first anal spine 6.3 (5.2–8.1) in HL; third anal spine 2.25 (2.4–2.45) in HL; longest anal segmented ray 1.55 (1.6–1.9) in HL; caudal fin length 4.0 (3.5–4.1) in SL; caudal concavity 6.6 (4.35–7.6) in HL; second or third branched pectoral ray usually longest, 3.55 (3.45–3.85) in SL; origin of pelvic fins below rear base of pectoral fins, the prepelvic length 2.65 (2.65–2.75) in SL; pelvic spine 2.25 (2.0–2.15) in HL; pelvic-fin length 1.55 (1.55–1.6) in HL.

Color of holotype in alcohol brown, the edges of scales narrowly pale yellowish; lateral line whitish; iris dark bluish gray, pupil pale yellowish, and lens dark orange-brown; dorsal fin with translucent greenish membranes, orange-yellow rays, and a black outer border on segmented-ray portion of fin, wide anteriorly (one-fourth fin length), progressively narrower posteriorly; scaled basal part of dorsal fin darker brown than body; anal fin with a dark brown band at base, a broad middle translucent zone and a blackish border; caudal fin dark brown on basal half, the rays pale yellow in outer half of this zone, followed by a zone about one-fourth length of fin with rays brownish-yellow and membranes translucent pale yellow; outer fourth of fin black, the demarcation of black and yellow paralleling incurved posterior margin of fin; upper and lower edges of caudal fin narrowly dark brown; pectoral fins yellow with a semicircular black spot as wide as pupil at base of fin; pelvic fins brownish yellow.

Color when fresh silvery with iridescence, the scale edges brown; dorsal fin lemon-yellow or merely yellowish with a black outer margin on segmented-ray portion, broadest on anterior rays and gradually narrower posteriorly; anal and caudal fins with a broad middle translucent zone, blackish margins, and broadly blackish at base (Figs. 1 and 2). We are not aware of any underwater photographs.

Etymology. The species name *bexillon* is from the Greek meaning banner or flag, in reference to the bright yellow and black dorsal fin.

Distribution and habitat. *Pempheris bexillon* has been found in the Mozambique Channel (Bassas da India, Anjouan, Grande Comore) and on or near the Mascarene Plateau (Agaléga Islands, Cargados Carajos, Mauritius, and Rodrigues). Collections were made with ichthyocide on coral or rocky reefs at depths less than 10 m in areas with ledges, caves, and surge channels.

Comparisons. Most species of *Pempheris* have some dark markings on the dorsal fin, but this is either restricted to a narrow anterior margin or is a distal blotch restricted to the first four or five segmented rays; occasionally the dark margin and distal blotch occur in tandem (Table 2). *Pempheris bexillon* is unusual in having a dorsal fin with a black, distal margin along its full length with the remainder of the fin yellow. Only one other species, *P. flavicycla* Randall *et al.* 2013 from the Red Sea, northern Western Indian Ocean, and eastward to Indonesia, has occasional specimens that have a dorsal-fin color approaching that of *P. bexillon*. The distal margin of the dorsal can be black almost to the penultimate dorsal ray, but the remainder of the fin is not yellow (Randall *et al.* 2013, figs. 3–4); in more typical specimens the dorsal fin has only a dark anterior margin and black distal blotch on fin-rays 1–4 (Randall *et al.* 2013, figs. 5–9). In addition, when a dorsal-fin marginal band is present in *P. flavicycla*, it is less sharply defined; the eye of this species also has a distinctive yellow iris ring around the pupil. Meristic data are very similar between these two species.

Among remaining described species of deciduous cycloid-scaled *Pempheris*, only two share the simultaneous presence of a distinct, dark spot on the base of the pectoral fin and dark, distal margin along the length of the anal fin: *P. otaitensis* Cuvier 1831 and *P. ufuagari* Koeda *et al.* 2013 (Table 2). *Pempheris otaitensis* differs from *P. bexillon* in having a higher lateral-line scale count (> 70) (Table 1) and has not been reliably recorded in the Western Indian Ocean; *P. ufuagari* has lower gill-raker counts (< 31) and is known only from the Daito and Ogasawara Islands southeast of Japan (Koeda *et al.* 2013).

Excluding *P. flavicycla*, the most similar species using meristics alone is *P. nesogallica* Cuvier 1831 described from Mauritius; both lateral-line scale counts and high gill-raker counts overlap (Table 1). The present condition of the type material of *P. nesogallica* suggests that the specimens might have a basal pectoral spot as there is some duskiness visible, but the dorsal fin exhibits only a large, distal blotch on anterior rays and there is no trace of a dark, distal margin on the anal fin (Figs. 3, 4). The original description (Cuvier 1831: 506) is somewhat vague regarding color in that it begins by noting *P. nesogallica* resembles *P. vanicolensis* in having black on the tip of the dorsal fin, but remains silent on the presence or absence of either a pectoral-fin basal spot or black margin on the anal fin. However, Cuvier (1831) seems consistent in mentioning these features when they occur in other species and emphasizes that the dark pectoral spot is very noticeable and remains in both wet and taxidermied specimens (p. 305: "...la tache très-noire de la base de la pectorale, qui est si remarquable et se conserve dans la liqueur et dans le sec"). Given this emphasis, it seems reasonable to assume that Cuvier would have made special note of a dark pectoral-fin base spot and dark distal margin on the anal fin in *P. nesogallica* if they had been present. Having neither of these features, nor a dorsal fin with a black distal margin over its entire length, would distinguish *P. nesogallica* from *P. bexillon*.



FIGURE 3. Left lateral view of a syntype of *Pempheris nesogallica* Cuvier, MNHN A.222, 138 mm SL, Mauritius (Isle de France), Dussumier? (collector after Bauchot 1963).



FIGURE 4. Left lateral view of a syntype of *Pempheris nesogallica* Cuvier, MNHN B.2514, 127 mm SL, Mauritius (Isle de France), Dussumier? (collector after Bauchot 1963).

Remarks. The cycloid-scaled species of the genus *Pempheris* have proven a challenge taxonomically. It is enormously difficult to assign original names to modern specimens because most of the type material is in relatively poor condition and the descriptions are generally brief and do not take note of features considered important for identification today. Traditional meristics can be useful in dividing taxa into species groups, but tend not to be informative at the species level because they are at either of the extremes of being too variable (e.g., anal-fin ray and lateral-line scale counts) or too conservative (e.g. pectoral-fin ray and dorsal-fin ray counts). Gill-raker counts on the first arch are useful, but have not been reported consistently. Color patterns can be useful, but are not always maintained in preserved specimens. As a result, most faunal compilations are not reliable for determining species distributions. Tables 1 and 2 provide summaries of some of the meristic and color features of the types of nominal species of Indo-Pacific cycloid-scaled species. This will prove to be a useful reference for future taxonomic work. Discovering a species such as *P. bexillon* that exhibits both meristic and color characteristics that are so clearly diagnostic is an exception within this genus.

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References

- Bauchot, M.-L. (1963) Catalogue critique des types de poissons du Muséum National d'Histoire Naturelle. II.--Familles des Chaetodontidae, Scatophagidae, Toxotidae, Monodactylidae, Ephippidae, Scorpidae, Pempheridae, Kyphosidae, Girellidae. *Publications of the National Museum of Natural History*, 20, 115–195.
- Bleeker, P. (1855) Bijdrage tot de kennis der ichthyologische fauna van de Batoe Eilanden. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 8, 305–328.
- Bleeker, P. (1877) Révision des espèces de *Pempheris* de l'Inde archipélagique. *Archives néerlandaises des sciences exactes et naturelles*, 12, 42–54.
- Cuvier, G. (1829) *Le Règne Animal, distribué d'après son organisation, pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée*. Vol. 2. 2nd Edition. Mem. Mus. Hist. Nat, Paris, xv + 406 pp.
- Cuvier, G. (1831) Des Pemphérides (*Pempheris*, nob.). In: Cuvier, G. & Valenciennes, A. (Eds.), *Histoire naturelle des poissons*. Tome septième. Livre septième. F.G. Levrault, Paris, pp. 296–309.
- Eschmeyer, W.N. (Ed.) (2014) *Catalog of Fishes*, California Academy of Sciences. Available from: <http://research.calacademy.org/research/ichthyology/catalog/fishcatmain.asp> (accessed 15 January 2014).
- Fowler, H.W. (1928) The fishes of Oceania. *Memoirs of the Bernice P. Bishop Museum*, 10, i-iii + 1–540, Pls. 1–49.
- Fowler, H.W. (1931) Contributions to the biology of the Philippine Archipelago and adjacent regions. The fishes of the families Pseudochromidae, Lobotidae, Pempheridae, Priacanthidae, Lutjanidae, Pomadasyidae, and Teraponidae, collected by the United States Bureau of Fisheries Steamer "Albatross," chiefly in Philippine seas and adjacent waters. *Bulletin of the United States National Museum*, 100 (11), i–xi + 1–388.
- Fowler, H.W. (1949) The fishes of Oceania—Supplement 3. *Memoirs of the Bernice P. Bishop Museum*, 12, 37–186.
- Fricke, R. & Eschmeyer, W.N. (2014) Guide to Fish Collections. Available from: <http://researcharchive.calacademy.org/research/ichthyology/catalog/collections.asp> (accessed 31 May 2012)
- Heemstra, P.C. (1986) Family No. 216: Pempheridae. In: Smith, M.M & Heemstra, P.C. (Eds.), *Smith's Sea Fishes*. Macmillan South Africa, Johannesburg, pp. 668–669.
- Herre, A.W. (1953) Check list of Philippine fishes. *United States Fish and Wildlife Service Research Report*, 20, 1–977.
- Jordan, D.S. & Evermann, B.W. (1902) Notes on a collection of fishes from the island of Formosa. *Proceedings of the United States National Museum*, 25, 315–368.
- Jordan, D.S. & Hubbs, C.L. (1925) Record of fishes obtained by David Starr Jordan in Japan, 1922. *Memoirs of the Carnegie Museum*, 10, 93–346, pls. 5–12.
- Koeda, K., Yoshino, T. & Tachihara, K. (2013) *Pempheris ufuagari* sp. nov., a new species in the genus *Pempheris* (Perciformes, Pempheridae) from the oceanic islands of Japan. *Zootaxa*, 3609 (2), 231–238. <http://dx.doi.org/10.11646/zootaxa.3609.2.9>

- Kossmann, R. & Räuber, H. (1877) Fische. Wissenschaftliche Reise in die Küstengebiete des Rothen Meeres. *Verhandlungen des Naturhistorisch-Medizinischen Vereins zu Heidelberg*, 1, 378–420, pls. 3–4.
- Mooi, R.D. & Jubb, R.N. (1996) Descriptions of two new species of the genus *Pempheris* (Pisces: Pempheridae) from Australia, with a provisional key to Australian species. *Records of the Australian Museum*, 48, 117–130.
<http://dx.doi.org/10.3853/j.0067-1975.48.1996.284>
- Randall, J.E. (1983) *Red Sea Reef Fishes*. Immel Publishing, London, 192 pp.
- Randall, J.E. (1995) *Coastal Fishes of Oman*. University of Hawai'i Press, Honolulu, 439 pp.
- Randall, J.E., Bogorodsky, S.V., Alpermann, T.J., Satapoomin, U., Mooi, R.D. & Mal, A.O. (2013) *Pempheris flavicycla*, a new pempherid fish from the Indian Ocean, previously identified as *P. vanicolensis* Cuvier. *Journal of the Ocean Science Foundation*, 9, 1–23.
- Russell, P. (1803) *Descriptions and figures of two hundred fishes; collected at Vizagapatam on the coast of Coromandel. Vol. 1–2*. London, i–vii + 78 pp. + 85 pls., 197 pls.
- Tominaga, Y. (1963) A revision of the fishes of the family Pempheridae of Japan. *Journal of the Faculty of Science, University of Tokyo*, 10 (1), 269–290.
- Sabaj Pérez, M.H. (Ed.) (2010) Standard symbolic codes for institutional resource collections in herpetology and ichthyology: an online reference. Version 2.0. American Society of Ichthyologists and Herpetologists, Washington, DC. Available from: <http://www.asih.org/> (accessed 8 November 2010)