



***Mahidolia paucipora*, a new species of shrimpgoby (Teleostei: Gobiidae) from Papua New Guinea**

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Abstract

A new species of alpheid-shrimp-associated gobiid fish, *Mahidolia paucipora*, is described from Milne Bay Province, eastern Papua New Guinea, on the basis of 5 female specimens from 17.7–23.2 mm SL collected from a silty-sand and rubble bottom at 14.5–27 m depth. Diagnostic features that distinguish the new species from the widespread nominal *Mahidolia mystacina* include a reduced pattern of cephalic sensory-canal pores, with only pores B', D, E, F, and H present; a very small size at maturity (<20 mm SL); and a color pattern consisting of a whitish body with 5 widely spaced brown bars and the first dorsal fin with a prominent posterior white-edged black spot.

Key words: taxonomy, systematics, ichthyology, coral-reef fishes, gobies, alpheid shrimp, symbiosis, Pacific Ocean, biogeography, *Mahidolia mystacina*.

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Introduction

The alpheid-shrimp-associated goby, *Mahidolia mystacina* (Valenciennes, 1837), ranges widely in the Indo-Pacific region from East Africa to Micronesia (Pohnpei) and New Caledonia, and Australia northward to Japan (Allen & Erdmann 2012). It lives in burrows, constructed by its shrimp partner, on silty sand bottoms of estuaries, coastal bays, and in the vicinity of coral reefs. A number of nominal species have been assigned to *Mahidolia* in the past, although all are now considered junior synonyms (Hoese 1986, Myers 1999, Larson & Murdy 2001, Senou et al. 2004, Randall 2005, Hoese & Larson 2006, Shibukawa 2009, Allen & Erdmann 2012). Nevertheless, this species exhibits a wide range of variation in color pattern and dorsal-fin shape, some of which may be explained by gender differences, but the possibility remains that more than a single species is represented. Additional morphological and genetic analyses would be required to resolve the status of different populations.

We describe here a new species of *Mahidolia* from Papua New Guinea, which not only differs markedly from *M. mystacina* in color, but also has a distinctly different pattern of cephalic sensory-canal pores. *Mahidolia* is one of 13 gobiid genera, with at least 150 species, known to associate with alpheid shrimps (Greenfield & Allen 2018). The genus is characterized by a combination of a laterally compressed head, a large mouth with the maxilla reaching to the posterior eye or beyond, the gill opening extending forward to the level of the preoperculum, no anterior interorbital pore (C), the pelvic fins forming a disc, scales ctenoid posteriorly from the level of about the second dorsal-fin origin and cycloid anteriorly, and scales absent from the cheek and operculum. *Mahidolia* is very similar to *Cryptocentrus* Valenciennes, 1837, which differs in having smaller and more numerous scales and the presence of an anterior interorbital pore (Hoese 1986).

Materials and Methods

Type specimens are deposited at the National Museum of Natural History, Washington DC, USA (USNM), and Western Australian Museum, Perth, Australia (WAM).

Lengths are given as standard length (SL), measured from the median anterior point of the upper lip to the base of the caudal fin (posterior end of the hypural plate); body depth is measured at both the origin of the pelvic fins and the origin of the anal fin, and body width at the origin of the pectoral fins; head length (HL) is taken from the upper lip to the posterior end of the opercular membrane, and head width over the posterior margin of the preoperculum; orbit diameter is the greatest fleshy diameter, and interorbital width the least bony width; snout length is measured from the median anterior point of the upper lip to the nearest fleshy edge of the orbit; upper-jaw length from the same anterior point to the posterior end of the maxilla; cheek depth is the least depth measured perpendicular from the horizontal limb of the preopercle to the fleshy edge of the orbit; 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 the caudal-fin base; lengths of spines and rays are measured to their junction with the body; caudal- and pectoral-fin lengths are the length of the longest ray; pelvic-fin length is measured from the base of the pelvic-fin spine to the tip of the longest pelvic-fin soft ray.

Terminology and abbreviations for cephalic sensory-canal pores and papillae rows follow those presented by Akihito (1984). Cyanine Blue 5R (acid blue 113) stain and an airjet were used to make the cephalic sensory-canal pores and scales more obvious (Akihito et al. 1993, 2002, Saruwatari et al. 1991). Scales in the lateral series are counted from the scale above the pectoral-fin base, continuing in a longitudinal row to the posterior edge of the hypural plate; scales in the transverse series are counted from the origin of the anal fin anterodorsally to the base of the first dorsal fin; circumpeduncular scales are counted in a zigzag row around the narrowest portion of the caudal peduncle; gill rakers are counted on the first gill arch, those on the upper limb listed first; rudiments are included in the counts. Measurements were made to the nearest 0.1 mm using dial calipers. Morphometric data presented as percentages of the standard length are included in Table 1. The range of counts and measurements for paratypes is indicated in parentheses, if different from the holotype.

Mahidolia paucipora, n. sp.

Tiny Shrimpgoby

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Figures 1–4; Table 1.

Holotype. WAM P.34856-002, female, 23.0 mm SL, Papua New Guinea, Milne Bay Province, Sideia Island, small patch reef off southwestern tip, -10.5962°, 150.7667°, 24–27 m, rotenone, G.R. Allen, M.V. Erdmann & S. Tahing, 10 May 2018.

Paratypes. USNM 443802, female, 23.2 mm SL, Papua New Guinea, Milne Bay Province, Nuakata Island, Duduwali Bay, -10.2894°, 151.0044°, 14.5 m, clove oil & hand net, S. Tahing, 13 November 2018; WAM P.34856-003, 3 females, 17.7–22.5 mm SL, collected with holotype.

Diagnosis. Dorsal-fin elements IV-I,10; anal-fin elements I,8–9 (usually 9); pectoral-fin rays 15–16 (usually 16); lateral scales 35–37; body scales weakly ctenoid, except cycloid anteriorly, including side of nape, abdomen, pectoral-fin base, and prepelvic area; gill rakers 2–3+11–12; gill opening extending slightly forward of level of posterior margin of preopercle; dorsal fin without elongate spines, longest spine 1.9–2.8 in HL; caudal fin rounded, about equal to HL, 3.2 in SL; reduced pattern of cephalic sensory-canal pores consisting of only B', D, E, F, and H pores; body mostly whitish with 5 widely spaced brown bars, and first dorsal fin mainly whitish with a prominent posterior white-edged black spot; apparently small size, with mature females < 20 mm SL.

Description. Dorsal-fin elements VI-I,10; anal-fin elements I,9 (smallest paratype with 8); all dorsal- and anal-fin soft rays branched, last to base, both portions of last ray branched; pectoral-fin rays 16 (smallest paratype with 15), all branched except uppermost and lowermost one or two; pelvic-fin rays I,5, all soft rays branched, most with three branch points; pelvic fins joined medially with membrane and well developed, but thin frenum; segmented caudal-fin rays 17, branched rays 13 (one paratype with 12), 4 upper and 4 lower (smallest paratype with 3) unsegmented rays; lateral scales 37 (35–37); transverse scale rows 12; circumpeduncular scales 12; gill rakers 3+12 (smallest paratype with 2+11); vertebrae 26.



Figure 1. *Mahidolia paucipora*, freshly collected female holotype, 23.0 mm SL, Sideia Island, Milne Bay Province, Papua New Guinea (M.V. Erdmann).

Body elongate, depth at pelvic-fin origin 3.9 (3.6–4.2) and depth at anal-fin origin 4.3 (4.4–4.7), both in SL; body compressed, width at pectoral-fin origin 1.6 (1.3–1.9) in body depth; head length 3.1 (3.0–3.1) in SL; head compressed, width 1.4 (1.2–1.6) in body depth at pelvic-fin origin; snout short, length 3.6 (4.1–5.1) in HL; orbit diameter 3.7 (3.4–3.9) in HL; interorbital space narrow, 5.0 (4.2–5.9) in orbit diameter; caudal-peduncle depth 2.8 (2.7–3.0) in HL; caudal-peduncle length 1.7 (1.5–1.8) in HL.

Mouth terminal, oblique, and large, maxilla forming angle of about 48° to horizontal axis of head and body; maxilla reaching vertical near posterior edge of pupil, upper-jaw length 2.0 (2.0–2.2) in HL; gill opening extending slightly forward of level of posterior margin of preopercle; gill membranes attached only anteriorly to isthmus, with no free fold; upper and lower jaws with 3 or 4 rows (narrowing to 1 or 2 rows posteriorly) of slender, pointed, backward-slanting teeth, including about 12–15 larger teeth in outer row on each side, but none greatly enlarged and caniniform; teeth of both jaws mainly concealed among fleshy papillose lip folds; no teeth on vomer or palatines; outer edge of lips smooth; tongue tip broadly rounded; no distinct mental flap. Posterior naris a large, nearly round aperture in front of center of eye at fleshy edge of orbit; anterior naris a short membranous tube, anteroventral to posterior naris, just above edge of upper lip. Cephalic sensory-canal pores and papillae rows as shown in Fig. 2; reduced pattern of pores consisting of B', D, E, F, and H pores and no preopercular or supraopercular pores; chin tip with pair of short longitudinal lines of papillae.

Scales on body progressively larger posteriorly, scale rows irregular anteriorly, but forming regular transverse rows posteriorly; scales weakly ctenoid except becoming cycloid on anterior portion of body, including embedded scales on side of nape, abdomen, pectoral-fin base, and prepelvic area; scales absent on cheek, opercle, and predorsal midline; no scales on fins except about 2 or 3 rows at base of caudal fin, about same size or slightly smaller than caudal peduncle scales.

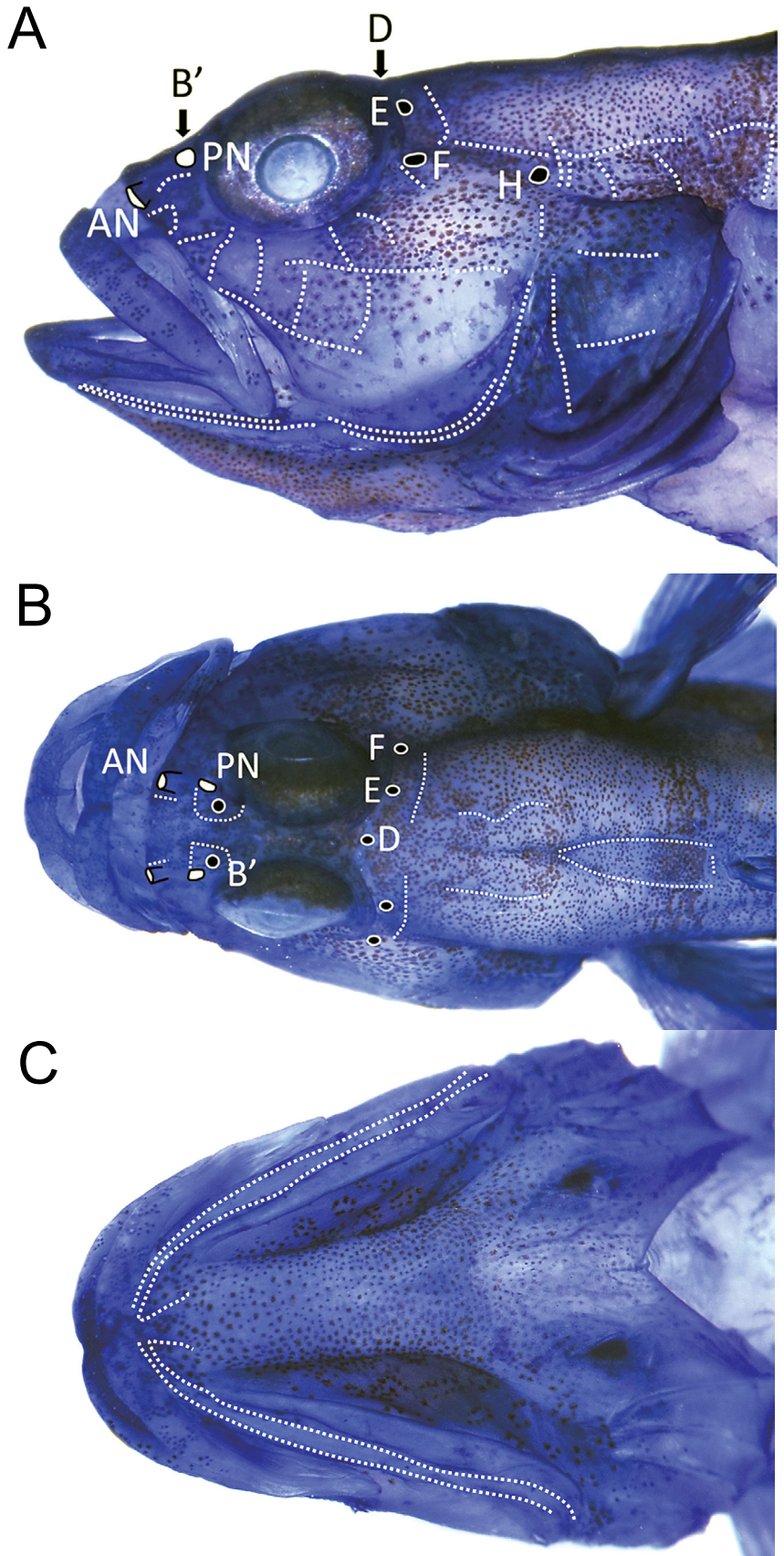


Figure 2. *Mahidolia paucipora*, female holotype, 23.0 mm SL; A) left lateral head view; B) dorsal head view; C) ventral head view; white-outlined black circles = cephalic sensory-canal pores; AN=anterior naris; PN=posterior naris; white dots=rows of papillae; specimen stained with Cyanine Blue (G.R. Allen).

TABLE 1

Proportional measurements of type specimens of *Mahidolia paucipora*, n. sp.
as percentages of the standard length

	holotype		paratypes		USNM 443802
	WAM P.34856-002		WAM P.34856-003		
Sex			all female		
Standard length (mm)	23.0	22.5	20.6	17.7	23.2
Body depth (pelvic origin)	25.9	28.0	28.0	24.8	23.8
Body depth (anal origin)	23.2	22.8	21.2	22.3	21.1
Body width	16.2	17.2	14.5	18.5	14.0
Head length	31.8	32.4	33.7	32.7	32.5
Head width	18.2	17.8	18.4	17.1	19.1
Snout length	8.8	7.1	8.1	6.4	7.8
Orbit diameter	8.6	9.5	8.6	9.6	8.5
Interorbital width	1.7	2.2	1.6	1.6	2.0
Cheek depth	10.0	9.9	8.4	7.7	10.4
Upper-jaw length	16.1	16.2	15.7	15.8	14.9
Caudal-peduncle depth	11.5	12.0	11.3	10.9	11.2
Caudal-peduncle length	18.6	21.4	19.9	21.0	18.0
Predorsal length	34.9	37.6	39.8	38.6	36.7
Preanal length	61.9	65.2	59.5	62.0	62.6
Prepelvic length	36.6	36.2	32.8	34.9	34.3
Base of first dorsal fin	45.8	48.1	49.3	48.5	48.5
First dorsal spine	24.1	26.3	23.9	21.9	23.1
Fourth dorsal spine	20.5	22.0	20.9	19.4	21.5
Fifth dorsal spine	15.8	17.4	18.5	16.6	16.2
Spine of second dorsal fin	15.4	14.5	14.3	14.0	14.6
Longest dorsal ray	21.2	19.7	20.8	21.0	22.9
Base of anal fin	21.4	18.6	19.9	18.5	20.5
Anal spine	11.2	12.4	12.1	9.3	11.2
Longest anal ray	23.4	22.3	21.4	19.5	23.7
Caudal-fin length	31.3	damaged	31.2	31.4	30.9
Pectoral-fin length	36.5	35.6	36.4	34.2	36.7
Pelvic-spine length	8.8	8.9	8.7	7.9	8.4
Pelvic-fin length	28.3	26.7	27.5	29.8	28.1

Origin of first dorsal fin slightly behind rear base of pelvic fins, predorsal length 2.9 (2.5–2.7) in SL; dorsal-fin spines slender and flexible, none filamentous; first dorsal-fin spine longest, 4.2 (3.8–4.6) in SL; third dorsal-fin spine 4.9 (4.5–5.1) in SL; sixth dorsal-fin spine 2.0 (1.8–2.0) in HL; membrane from tip of last dorsal-fin spine joined to base of spine of second dorsal fin, spine of second dorsal fin 2.1 (2.2–2.4) in HL; eighth segmented dorsal-fin ray longest, 1.5 (1.4–1.6) in HL; origin of anal fin below base of second segmented dorsal-fin ray, preanal length 1.6 (1.5–1.7) in SL; anal-fin spine 2.9 (2.6–3.5) in HL; seventh segmented anal-fin ray longest, 1.4 (1.4–1.7) in HL; caudal fin rounded, about equal to head length, 3.2 in SL; pectoral fins pointed, ninth ray longest, reaching beyond level of anal-fin origin, 2.7 (2.7–2.9) in SL; prepelvic length 2.7 (2.8–3.1) in SL; pelvic-fin tips falling well short of anal-fin origin, length of pelvic fin 3.5 (3.4–3.7) in SL; pelvic-fin spine about one-third length of longest ray; pelvic frenum thin, membrane nearly reaching tip of pelvic-fin spines.

Color in life. (Fig. 3) Generally white with brownish suffusion and 5 slightly oblique brown bands, first just anterior of first dorsal-fin origin to lower rear margin of operculum, second from base of posterior first dorsal fin to pelvic-fin base, third from base of third to fifth segmented dorsal-fin rays to rear abdomen, fourth from rear base of second dorsal fin to rear base of anal fin, and fifth at base of caudal fin (more indistinct than others); head mottled brown except white rear part of jaws, lower cheek, and adjacent portion of operculum; iris gray, darker on lower half with densely scattered melanophores around rim and narrow yellow ring around pupil; first dorsal fin white with large, black, vertically ovate ocellus with brown-to-yellowish outer margin (anteriorly and dorsally) and white inner margin, leading edge of fin with a pair of small black spots and several similar spots scattered on middle portion of fin; second dorsal fin translucent whitish with about 5 oblique brownish stripes; caudal fin translucent whitish with rows of small brown spots on membranes; anal and pelvic fins whitish; pectoral fins translucent with white base except for a cluster of small brown chromatophores on upper portion.

Color when fresh. (Fig. 1) Similar to color in life except anteriormost dark band consisting of close-set orange spots; also numerous small orange spots on cheek (including postorbital area), side of snout, and lips; fin markings similar except first-dorsal-fin ocellus more rounded and leading edge of fin with 6 small black spots.



Figure 3. *Mahidolia paucipora*, approx. 22 mm SL, Sideia Island, Milne Bay Province, Papua New Guinea (G.R. Allen).



Figure 4. *Mahidolia paucipora*, preserved female holotype, 23.0 mm SL, Sideia Island, Milne Bay Province, Papua New Guinea; lightly stained with Cyanine Blue (G.R. Allen).

Color in alcohol. (Fig. 4) Generally whitish with 5 brown bands as described in life, but first and last bands more diffuse, especially last; predorsal, side of nape, operculum, upper part of cheek, and ventral surface of head with dense covering of melanophores; lower cheek, snout, and lips with more widely-scattered melanophores; first dorsal fin with a vertically ovate, white-edged black spot posteriorly and dense melanophores on the membrane between the fourth and fifth spines, leading edge of fin with 6 small black spots (including two slightly larger ones) and about 6 similar black spots scattered on remainder of fin; remaining fins translucent whitish, second dorsal fin with 6 rows of small black spots and caudal fin with rows of small black spots on membranes; pectoral-fin base white with band of melanophores on upper half.

Etymology. The specific epithet is from the Latin *paucipora* for few pores, with reference to the reduced pattern of cephalic sensory-canal pores. It is treated as a feminine compound adjective.

Distribution and habitat. The new species is currently known only from two locations in Milne Bay Province, Papua New Guinea, separated by a distance of approximately 43 km. The type locality (Fig. 5) consists of a narrow isolated patch reef that rises to within 1 or 2 m of the surface from a depth of about 30 m and is situated about 800 m from Sideia Island, and about 10 km off the extreme eastern tip of the Papua New Guinea mainland. Approximately 8 solitary individuals were observed at this location on a silty-sand and rubble bottom at 24–27



Figure 5. Aerial view of the type locality of *Mahidolia paucipora*, situated slightly off the right side of the boat. Sideia Island is in the background (M.V. Erdmann).

m depth. It was invariably seen at the entrance of a burrow in company with an unidentified species of alpheid shrimp. Additionally, a single individual (USNM 443802) was collected at Nuakata Island in similar conditions at a depth of 14.5 m.

Comparisons. *Mahidolia paucipora* differs from the only currently recognized member of the genus, *Mahidolia mystacina*, on the basis of its reduced pattern of cephalic sensory-canal pores, color pattern, and apparent diminutive size. The contrasting pore patterns of the two species are particularly diagnostic, with *M. paucipora* possessing B', D, E, F, and H pores, in contrast to the relatively full complement of *M. mystacina* that includes all of these in addition to G, K, L, M', N, and O (Fig. 6). The color pattern of *M. mystacina* is highly variable and perhaps represents at least two species (as suggested by Senou et al. 2004), nevertheless, the color pattern for the new species differs from any documented pattern for *M. mystacina* (e.g. Fig. 7). The latter usually has 7 oblique brown bands that are much broader than the paler interspaces vs. 5 bands narrower than the pale interspaces in *M. paucipora*. Although the shape of the first dorsal fins and their markings are highly variable in *M. mystacina*, at least partly associated with gender, there is generally no isolated ocellus, which is characteristic of *M. paucipora*. The new species also lacks a broad dark stripe across the anal fin, which is usually present in *M. mystacina*. There also appears to be a great disparity with regards to adult size, with *M. mystacina* reaching at least 63 mm SL (about 80 mm TL). The largest known collected or observed specimen of *M. paucipora* is only 23.2 mm SL (about 30 mm TL). All 5 type specimens are mature females, based on their fully developed urogenital papillae and three (20.6–23.2 mm SL) contain ripe eggs.

Remarks. Junior synonyms of *M. mystacina* include the following species (type locality in parentheses): *Gobius maxillaris* Macleay, 1878 (Darwin, Australia); *Waitea parvida* Tanaka, 1915 (Nagasaki, Japan); *Mahidolia normani* Smith & Koumans, 1932 (Lem Sing, Thailand); *Mahidolia duque* Smith, 1947 (Inhaca, Mozambique); and *Oligolepis fasciatus* Wu & Lin, 1983 (Fukien, China). Although we have not examined type specimens of these species, we agree with Kottelat (2013: 412) and Fricke et al. (2019), who listed them as synonyms. Our opinion is based on a combination of the original descriptions, accompanying figures, and specimen photographs from the general area of the type locality.

Comparative material examined: (all WAM) *Mahidolia mystacina*: P.32028-007, 37 mm SL, Madagascar; P.30850-028, 5 specimens, 16–30 mm SL, Northwest Australia; P.33122-009, 2 specimens, 28–33 mm SL, Brunei; P.33594-003, 2 specimens, 36–45 mm SL, Woodlark Island, Papua New Guinea; P.33894-001, 27 mm SL, North Sulawesi, Indonesia; P.33964-002, 6 specimens, 27–63 mm SL, Yap, Federated States of Micronesia; P.34829, 31 mm SL, Fakfak Peninsula, West Papua Province, Indonesia.

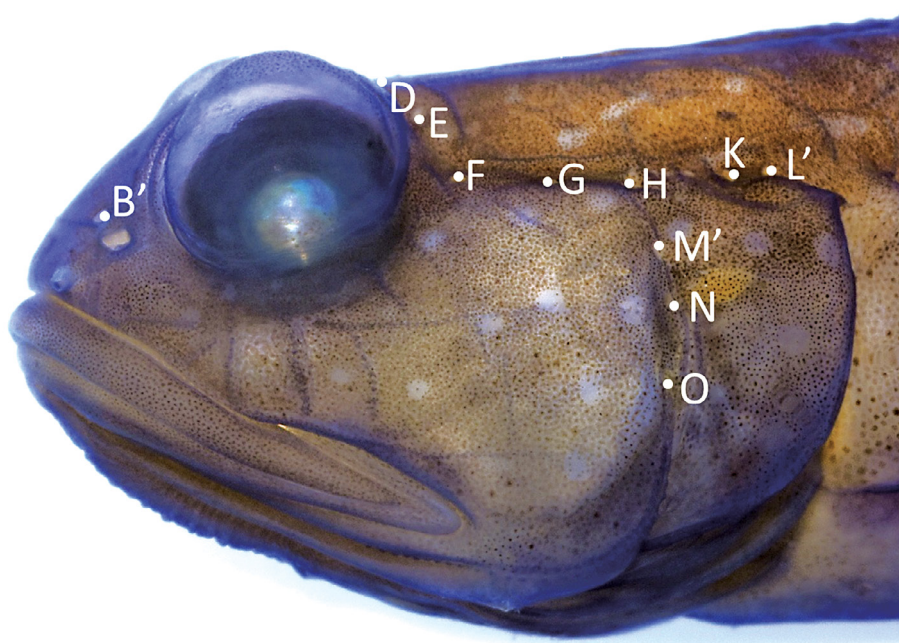


Figure 6. *Mahidolia mystacina*, preserved specimen, WAM P.33964-002, 63.0 mm SL, lateral view of head showing pattern of cephalic sensory-canal pores. Specimen stained with Cyanine Blue (G.R. Allen).



Figure 7. *Mahidolia mystacina*, variation in color patterns and first-dorsal-fin shape with size and location: (A) approx. 60 mm SL, Milne Bay, Papua New Guinea; (B) approx. 50 mm SL, Milne Bay, Papua New Guinea; (C) approx. 45 mm SL, Milne Bay, Papua New Guinea; (D) approx. 40 mm SL, Guadalcanal, Solomon Islands; (E) approx. 50 mm SL, Milne Bay Province, Papua New Guinea; (F) approx. 30 mm SL, Anilao, Philippines; (G) approx. 45 mm SL, Palawan, Philippines; and (H) approx. 60 mm SL, Yap, Federated States of Micronesia (G.R. Allen).

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