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A new genus for the Indo-Pacific goby species *Gobius baliurus* Valenciennes (Teleostei, Gobiidae, Gobiinae)

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ABSTRACT

A new genus, *Arcygobius*, is created to include the gobiid fish species previously known as *Gnatholepis baliurus* (Valenciennes) and *Gnatholepis calliurus* Jordan and Seale. It is a gobiine, not a gobionelline (as is *Gnatholepis*), resembles the genus *Acentrogobius* and is distinguished from other Indo-Pacific gobiines by having the gill opening wide and reaching to below mid-eye, cheeks fully scaled, opercle scaled dorsally and with transverse sensory papillae rows ventrally, papillae row *a* below eye formed by many short transverse rows, mouth large and oblique, chin prominent and a distinctive colour pattern. *Isthmogobius* Koumans, based on Bleeker's museum name for the genus, is not available. *Gnatholepis calliurus* is a junior synonym of *Arcygobius baliurus*.

KEYWORDS: new genus, *Arcygobius, Acentrogobius, Gnatholepis, Isthmogobius, Gobius baliurus, Gnatholepis calliurus*, Indo-Pacific.

INTRODUCTION

The gobiid taxon exemplified by the nominal species *Gobius baliurus* Valenciennes, 1837 (Fig. 1), and *Gnatholepis calliurus* Jordan and Seale, 1905 (Fig. 2), has since 1905 usually been placed under *Gnatholepis* Bleeker. It is not a *Gnatholepis*, as *Gobius baliurus* only possesses one anterior interorbital pore and a single epural (*Gnatholepis* has two of each), but this has been ignored by workers for convenience, because no other described genus applied to these names. Characters of *Gnatholepis* were recently reviewed by Randall and Greenfield (2001), and the genus clearly placed in the gobiid subfamily Gobionellinae. Randall and Greenfield refer to *Gobius baliurus* as "genus undetermined". Goren and Dor (1994) placed the species in the large genus *Acentrogobius* Bleeker.

Gobius baliurus belongs to the gobiid subfamily Gobiinae as defined by Pezold (1993), having a single anterior interorbital pore, a single epural, a first dorsal-fin pterygiophore pattern of 22110 (formula as in Birdsong *et al.* 1988), and 26 vertebrae. The species does not agree with the characters of *Gnatholepis*, or any other gobiid genus, although it does appear to be superficially close to genera such as *Asterropteryx* Rüppell, *Exyrias* Jordan and Seale, *Macrodontogobius* Herre and *Tryssogobius* Larson and Hoese by having scaled cheeks. Its wide gill opening, transverse papillae rows on the opercle and the scaled cheeks with papillae set in grooves separate it from these coral reef genera. Additionally, *Exyrias* and *Macrodontogobius* differ from *Gobius baliurus* in having the infraorbital canal extended under the eye, so that the infraorbital pore is widely separated from the pores in the lateral canal (this feature is also shared by *Istigobius* Whitley and *Fusigobius* Whitley). *Tryssogobius* comprises two very small species, which have cycloid scales on the head, a restricted gill opening and much-reduced sensory papillae pattern when compared with *Gobius baliurus*. *Asterropteryx* always has 1–8 spines on the posterior margin of the preopercle.

The genus *Aulopareia* Smith also resembles *Gobius baliurus* in having scaled cheeks and opercles in several species. The genus *Aulopareia* has never been reviewed or clearly defined, but it is presently considered to include only those species lacking an anterior interorbital pore (present in *Gobius baliurus*), having a longitudinally elongate (slit-like) infraorbital pore (which is rounded to oval in *Gobius baliurus*) and a longitudinal papillae pattern. Most *Aulopareia* species have large oblique mouths and live in soft-substrate coastal habitats, not coral reefs, and do resemble *Gobius baliurus* in these respects. There are about 12 nominal species of *Aulopareia* and the genus is in need of definition and review (as is the case for very many gobiids).

The taxon which most closely resembles *Gobius baliurus* is *Acentrogobius viridipunctatus*; the two taxa share several characters. This is discussed further under Remarks.

Early in this study, *Gnatholepis volcanus* Herre (1927) was considered as a possible species of *Arcygobius*. The type and only known specimen, described from Lake Taal in the Philippines, was destroyed during WWII, but it is very likely to have been an *Exyrias*, based on the original description (and see Koumans 1940: 184).

Isthmogobius is a "museum name" of Bleeker, and was first published by Koumans (1931) as a questionable synonym of *Gnatholepis*, with "*Gobius baliurus* C. & V." listed as type species. This is not an available name (IZCN Code Article 11.6). Bleeker (1983: pl. 434a) used the name *Isthmogobius baliurus*, with illustration and text, which would have made the name available if it had been published before 1961. The only other use of the name *Isthmogobius* is in Larson and Murdy (2001), who used the name in a list, in an attempt to place the genus elsewhere other than *Gnatholepis*. Therefore a new generic name is needed, as was earlier pointed out by Bauchot *et al.* (1991).

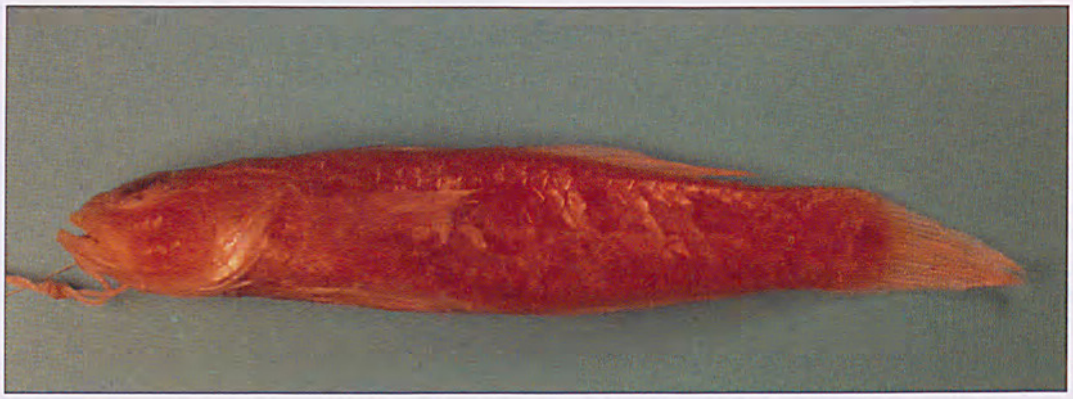

Fig. 1. Holotype of *Gobius baliurus*, MNHN 733, 67 mm SL female, from Java. Photograph by Rémi Ksas, Muséum National d'Histoire Naturelle, Paris.

Fig. 2. Holotype of *Gnatholepis calliurus*, USNM 51944, 51 mm SL male, from Negros, Philippines. Photograph by Sandra Raredon, National Museum of Natural History, Washington.

Fig. 3. Female, 59 mm SL (above), and 65 mm SL male (below) *Arcygobius baliurus* from Luzon, Philippines, NTM S.14226-010, showing colour pattern.

MATERIAL AND METHODS

Morphometrics and measurements. Measurements were taken using electronic callipers and dissecting stereomicroscope. Counts and methods generally follow Hubbs and Lagler (1970), except for transverse scale counts (TRB), taken by counting the number of scale rows from the anal fin origin diagonally upward and back toward the second dorsal fin base, and head length is taken to the upper attachment of the opercular membrane. Morphometrics are expressed as a percentage of standard length (SL) or head length (HL). In the description, numbers in parentheses after counts indicate the number of specimens with that count, or the range of counts. Pterygiophore formula follows Birdsong *et al.* (1988). Vertebral counts and other osteological information were obtained by clearing and double-staining, using the ethanol method of Springer and Johnson (2000). Terminology for lateral canals and sensory pores follows Hoese and Gill (1993) and Winterbottom (2002). Papillae rows are named based on Sanzo (1911).

Abbreviations. Abbreviations for institutions referred to are as in Leviton *et al.* (1985), with the exceptions of: RUSI – South African Institute for Aquatic Biodiversity (formerly J.L.B. Smith Institute of Ichthyology), Grahamstown; ZRC – Raffles Museum of Biodiversity Research (formerly Zoological Reference Collection), Singapore.

SYSTEMATICS

Arcygobius new genus

Isthmogobius Koumans, 1931 [ex Bleeker], type species *Gobius baliurus* Valenciennes, 1937, by original designation (genus name not available; listed in synonymy of *Gnatholepis*). – Koumans 1953: 168; Bleeker 1983: pls 434–434a; Eschmeyer 1998: 1980, 2489; Larson and Murdy 2001: 3586.

Type species. *Gobius baliurus* Valenciennes, 1937, by original designation.

Diagnosis. A gobiine distinguished by a combination of characters. Gill opening wide, membranes free of isthmus to below eye; predorsal with 8–11 scales, reaching to close behind eyes; cheek and opercle scaled; cheek scales divided into three rows by longitudinal rows of sensory papillae; distinctive transverse sensory papillae pattern on cheek and opercle; sensory pores on head with nasal pore near each posterior nostril, a single anterior interorbital pore, a posterior interorbital pore, a postorbital pore, an infraorbital pore on a short branch of the oculoscapular canal, a posterior otic and intertemporal pore in the anterior portion of the oculoscapular canal, and an anterior and posterior temporal pore in separate posterior portion of the oculoscapular canal; three preopercular pores present; eyes large, dorsolateral; snout pointed; jaws terminal, with chin tip anteriormost; jaws end below anterior half of eye; small, mostly evenly sized teeth in both jaws, outermost row larger but no large canine at side or front of jaw; first dorsal fin triangular, with first or second dorsal spine longest; caudal fin short, rounded; head and body yellowish with four elongate brown blotches along lateral mid-line of body and dense dark brown to black oval spot oriented longitudinally across bases of central caudal fin rays (Fig. 3).

Osteology. Osteology basically similar to gobiines such as *Glossogobius* and *Acentrogobius*. Dorsal pterygiophore formula 3–22110; one epural, two pre-anal pterygiophores; 10+16 vertebrae; 17 segmented caudal rays, in 9/8 pattern; 7/6 branched caudal rays; 8/7 or 8/8 procurrent rays set in broad cartilage plate. Five branchiostegal rays; posteriormost widely separated from rays 2–4; ceratohyal rectangular, longer than triangular epihyal. No infraorbital bones. No mesopterygoid. Metapterygoid slender, does not reach quadrate, not expanded dorsally (Fig. 4). Symplectic relatively slender, expanded posteroventrally, not in contact with preopercle. Preopercle crescent-shaped, with short groove (for sensory canal) posteriorly and with short dorsal process pointing toward symplectic. Palatine reaching at least halfway down pterygoid, does not reach quadrate. Premaxilla with moderately tall ascending and broad articular processes. Ceratobranchials 1–4 bear up to 12 patches of spined branchial teeth on inner faces; gill rakers ossified. Ceratobranchial 5 narrow, with fine pointed teeth; largest teeth near posterior edge. Lower post-cleithrum present, splint-like. Basihyal spatulate. All four pectoral radials ossified. Scapula foramen closed by strip of cartilage along posterior margin of scapula, which is mostly unossified. Neural spines on first three vertebrae slightly more robust than those immediately behind them; no flanges or bifurcation on these spines.

Etymology. From the Greek *arkys*, a net, as these gobies are usually collected as bycatch by trawl nets; pronounced with hard "c". Gender masculine.

Remarks. The monotypic *Macrodontogobius wilburi* Herre is similar to *Arcygobius* in that there are a number of transverse *a* rows under the eye and scattered transverse rows over the cheek, but it has only one longitudinal cheek row (row *d*). However, *Macrodontogobius* has a small subterminal mouth, a large curved canine tooth at the side of the lower jaw, no transverse papillae rows on the opercle, a gill opening ending just under the opercle, and all scales on the nape and side of head are ctenoid. It inhabits shallow sandy coral reef habitats (lagoonal), in depths of 0–20 m. It seems an unlikely relative of *Arcygobius*.

Exyrias is similar to *Arcygobius* in having scaled cheeks and opercles, but it has a basically longitudinal papillae pattern, a subterminal mouth, ctenoid scales

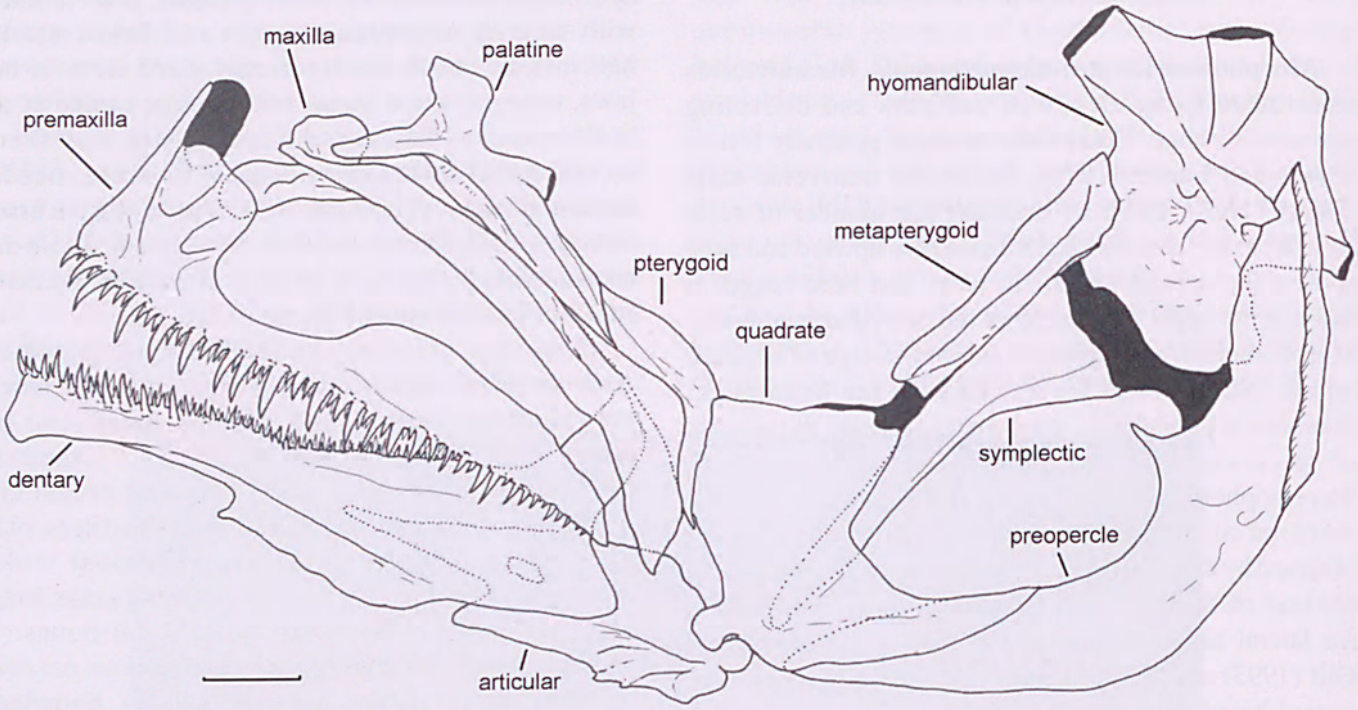

Fig. 4. Jaws and suspensorium of 60 mm SL female *Arcygobius baliurus*, ex AMS I.21901–004, Bolinao fishmarket, Philippines. Scale bar = 1 mm.

on the side of the head, cycloid nape scales, the gill opening restricted to the pectoral fin base, eyes placed close together and high on head, protruding well above body profile, and the first dorsal spines usually elongate and filamentous. Additionally, the mostly coral reef genera *Exyrias*, *Istigobius* and *Fusigobius* all share a variably long branch of the oculoscapular canal extending under the eye and ending in the infraorbital pore (e.g. see Fig. 3 in Murdy and Hoese 1985). *Arcygobius* has a very short branch to the infraorbital pore (Fig. 5).

The genus *Acentrogobius*, as exemplified by the type species *A. viridipunctatus* Valenciennes, shares a number of characters with *Arcygobius*. *Acentrogobius* is presently a catch-all genus which has never been reviewed or even adequately defined, but probably consists of several taxa (which may include species variously placed in *Amoya* Herre, *Arenigobius* Whitley, *Yoga* Whitley, *Yongeichthys* Whitley and a number of undescribed species). Zeehan Jaafar of the National University of Singapore has just commenced a review of the genus (PhD thesis). For purposes of this paper, *A. viridipunctatus* (Fig. 6) and four taxa of similar morphology and transverse sensory papillae (*A. dayi* Koumans, *A. decaryi* Pellegrin, *A. simplex* Sauvage, *A. therezieni* Kiener) are considered to be probably congeneric. These five *Acentrogobius viridipunctatus*-type species have gill membranes attached to the isthmus well behind the rear margin of the preopercle (except for *viridipunctatus*, in which the membranes attach just below or slightly anterior to the margin) versus wide gill opening free of isthmus to below the eye in *Arcygobius*; they have 2–5 rows of teeth, with the outer row teeth in both jaws enlarged and curved, and a large curved canine tooth at the side of the lower jaw versus all teeth small with no distinct canines; the opercle is variably covered with small scales and the cheek naked (*viridipunctatus* has a small patch of scales at the top of the cheek behind the eye) versus large scales covering the cheek and opercle; the predorsal is naked or has 19–31 scales reaching to above the preopercle (*viridipunctatus* has 25–31 predorsal scales which reach to close behind the eyes) versus 8–11 large scales reaching close up to behind the eyes; and the infraorbital pore opens more or less directly from the oculoscapular canal versus the pore opening at the end of a short infraorbital canal. *Acentrogobius viridipunctatus* also differs from other *Acentrogobius* species in having a somewhat horizontally elongate infraorbital pore, similar to the even more elongate pore in *Aulopareia* (*Acentrogobius cyanomos* Bleeker may have a somewhat elongate pore, but a longitudinal papillae pattern).

In summary, *Arcygobius* has a different set of characters from existing gobiine genera, and we consider that it is better to prevent the species from being maintained as a *Gnatholepis* or *Acentrogobius*, by assigning it to its own genus, until further work can be done to clarify relationships. This is not very satisfactory, given the size of the phylogenetic problem

waiting to be solved within the Gobiinae, but it is a beginning.

Arcygobius baliurus (Valenciennes, 1837)

(Figs 1–5)

Gobius baliurus Valenciennes, 1837: 61–62 (Java, Indonesia). – Bleeker 1849: 31; Bleeker 1851: 239, 242; Bleeker 1860: 43; Bleeker 1861: 32, 56; Gunther 1861: 18; Karoli 1882: 164; Weber 1913: 465; Bauchot *et al.* 1991: 26; Randall and Greenfield 2001: 1 [genus undetermined].

Gnatholepis calliurus Jordan and Seale, 1905: 796–797, fig. 14 (Negros, Philippine Islands). – Jordan and Richardson 1910: 47; Herre 1927: 130–131, plate 9, fig. 2; Chabanaud 1923: 559; Koumans 1931: 87; Herre 1933a: 5; Herre 1933b: 10; Herre 1934: 82; Herre and Myers 1937: 39; Koumans 1940: 123; Koumans 1953: 170–171; Herre 1953: 750; Böhlke 1953: 112; Eschmeyer *et al.* 1998: 311; Randall and Greenfield 2001: 1 [genus undetermined].

Gnatholipis callurus [*lapsus*] Seale 1910: 285.

Gnatholepis baliurus. – Koumans 1931: 86–87; Fowler 1938: 216; Koumans 1953: 169–170, fig. 41; Herre 1953: 750; Smith 1959: 213, pl. 11H; Smith and Smith 1969: 47, pl. 64H; Goren 1979: 42, fig. 26; Dor 1984: 245; Goren 1986: 650; Devi *et al.* 1993: 813; Lim and Larson 1994: 259; Eschmeyer *et al.* 1998: 189.

Isthmogobius baliurus. – Bleeker 1983: 9, 14, pl. 434a; Larson and Murdy 2001: 3598.

Acentrogobius baliurus. – Goren and Dor 1994: 62.

'Gnatholepis' baliurus. – Larson in Randall and Lim 2000: 638.

Material examined. 85 specimens, 21–69 mm SL. MOZAMBIQUE: RUSI 17280, 7(49–69), Nacala, 25 August 1950, coll. J.L.B. and M.M. Smith. KENYA: NTM S.12551–001, 1(33), Mombasa, June 1985, coll: P. Reay. THAILAND: NTM S.13839–001, 14(39–67), trawled offshore at Sriracha District, Cholburi Province, 20 January 1974, coll: P. Wongrat; NSMT–P55048, 1(57), klong at Pawang, 1 m depth, 24 October 1986, coll. K. Matsuura and R. Arai; NSMT–P55309, 1(62), klong at Pawang, mangroves, 1 m depth, 24 October 1986, coll. K. Matsuura and R. Arai. SINGAPORE: ZRC 31948, 1(59), dredged, Kallang Basin, 4 June 1993, coll. National University of Singapore; ZRC 41564, 1(45), Kallang Basin, 22 March 1990, coll. National University of Singapore; ZRC 41563, 1(49), Kallang Basin, 1989, coll. National University of Singapore; ZRC 19640, 1(62), mullet pond, Pulau Ubin, 30 April 1931, coll. H.W. Fowler; ZRC 19811–19812, 2(53.5–55), Sungei Seletar, 18 December 1968; ZRC 10547, 1(68), Sungei Punggol, 28 March 1967, coll. A. Drahman. INDONESIA: MNHN 733, holotype of *Gobius baliurus* Valenciennes, 67 mm female, Java, coll. Kuhl and van Hasselt. PHILIPPINES: USNM 51944, holotype of *Gnatholepis calliurus* Jordan and Seale, 51 mm male, Negros Island, 1901, coll. Bashford Dean; CAS/SU 26291, 15(40–56), Manila Bay, 11 May 1931, coll. A.W. Herre; AMS I.21901–004, 31(43–64), 2 of which are cleared and double-stained, Bolinao fish market, 16 April 1980, coll. D.F. Hoese; NTM S.14226–010, 5(60–66), Bolinao fish market, Luzon, 7 October 1995, coll: B.C. Russell. MICRONESIA: CAS 53902, 2(21–28.5), Yap Island, mud-bottomed lagoon behind police station, behind causeway, 15 December 1959, coll. Bronson and Sumang.

Other material examined (data not used). USNM 372624, 2, paratypes of *Gnatholepis calliurus*, Negros Island, Philippines; CAS 53925, 1, off Laem Mae Rampung, Gulf of Thailand; CAS 54761, 1, entrance to Trat Bay, Gulf of Thailand; CAS/SU 27849, 2, Sandakan, British North Borneo [Sabah]; CAS 53927, 2, Novotas Fish Landing, Manila Bay, Philippines; CAS 46083, 4, Manila Bay, Philippines; CAS/SU 29686, 2, Pontevedra, Negros Island, Philippines.

Description. Based on 55 specimens, 28.5–69 mm SL. An asterisk indicates the counts of the holotype of *Gobius baliurus* (Fig. 1).

First dorsal VI*; second dorsal I,9–I,10* (modally I,10); anal I,8–9* (modally I,9*), pectoral rays 15–19 (modally 17*), segmented caudal rays usually 17*; caudal ray pattern usually 9/8; branched caudal rays 6/5 to 7/7 (modally 7/6*); unsegmented (procurrent) caudal rays 8/7 or 8/8; longitudinal scale count 22*–26 (mode 24); TRB 7–9 (mode 9, 8 in holotype); predorsal scale count 8–11 (mode 9*); circumpeduncular scales 11–12 (mode 12) (Table 1). Gill rakers on outer face of first arch 2–4 + 11–15 (in 11). Pterygiophore formula 3–22110 (in 25). Vertebrae 10+16 (25), including urostyle. One epural (23). Two anal pterygiophores before haemal spine of first caudal vertebra (25).

Body compressed posteriorly, more rounded anteriorly. Head rounded to somewhat compressed, deeper than wide, HL 27.9–33.8% (mean 30.3) of SL; head depth at posterior preopercular margin 52.3–66.9% (mean 58.6) of HL; head width at posterior preopercular

Table 1. Counts of specimens of *Arcygobius baliurus*.

	Means	Max.	Min.	Mode
Second dorsal rays	9.9	10.0	9.0	10.0
Anal rays	9.0	10.0	8.0	9.0
Pectoral rays right	17.3	19.0	15.0	17.0
Pectoral rays left	17.2	18.0	16.0	17.0
Caudal segmented	17.0	17.0	16.0	17.0
Caudal branched	12.9	14.0	11.0	13.0
Longitudinal scales	24.4	26.0	22.0	24.0
Transverse rows back	8.5	9.5	7.0	9.0
Transv. rows forward	9.6	11.0	8.0	10.0
Predorsal scales	9.7	11.0	8.0	9.0
Caud. peduncle sc.	11.9	13.0	11.0	12.0

margin 50.3–70.5% (mean 56.7) of HL; head profile pointed. Mouth terminal, oblique, forming an angle of about 45° with body axis, chin tip anteriormost, often bony and prominent; jaws generally reaching below anterior half of eye; upper jaw length 37.6–48.8% (mean 44.0) of HL (Table 2). Lips smooth; lower lip thin, fused to underside of head on either side of sharp chin, in some specimens lip partly fused halfway along jaw. Eyes large, oval, dorsolateral, top forming part of dorsal profile, 23.2–29.5% (mean 26.1) of HL. Snout pointed, 22.5–32.2% (mean 26.0) of HL; posterior nostril in triangular to teardrop-shaped, placed almost halfway between eye and upper lip; anterior nostril in short tube, closer to upper lip. Interorbital narrow, 4.1–7.4% (mean 5.6) of HL. Body depth at anus 16.1–23.4% (mean 20.3) of SL. Caudal peduncle compressed, length 23.3–29.6% (mean 26.1) of SL; caudal peduncle depth 9.1–14.0% (mean 12.3) of SL (Table 2).

First dorsal fin triangular, first or second spine longest or equal in length, usually second spine longest; when depressed, spine tips reach second dorsal fin origin or just fall short of first fin element. First dorsal spine 15.4–19.2% (mean 17.5) of SL; second dorsal spine length 14.8–18.9% (mean 16.9) of SL. Second dorsal fin rather low, higher anteriorly than posteriorly, rounded to slightly pointed posteriorly. Anal fin low, anteriormost rays shorter than posterior few rays; fin slightly pointed posteriorly. Second dorsal and anal fin rays do not reach caudal fin when depressed. Pectoral fin pointed, central rays longest, 21.4–27.4% (mean 24.6) of SL; rays all branched but for upper and lowermost ray, fin reaches to at least above anus. Pelvic fins fused, with smooth-edged, deep frenum, fins oval, reaching to anus, 17.9–24.7% (mean 22.2) in SL. Caudal fin short, rounded, 23.3–31.3% (mean 26.6) of SL (Table 2).

Table 2. Measurements of specimens of *Arcygobius baliurus*, expressed as percentage of standard length (SL) or head length (HL).

	Means	Max.	Min.
Standard length	54.6	69.0	28.5
Head length in SL	30.3	33.8	27.9
Head depth in HL	58.5	66.9	52.3
Head width in HL	56.7	70.5	50.3
Body depth in SL	20.3	23.4	16.1
Body width in SL	12.6	14.9	9.5
Caud. ped. length in SL	26.1	29.6	23.3
Caud. ped. length in SL	12.3	14.0	9.1
Snout length in HL	26.0	32.2	22.5
Eye width in HL	26.1	29.5	23.2
Jaw length in HL	44.0	48.8	37.6
Interorbital in HL	5.6	7.4	4.1
Pectoral fin in SL	24.6	27.4	21.4
Pelvic fin in SL	22.2	24.7	17.9
Caudal fin in SL	26.6	31.3	23.3
First D1 fin spine in SL	17.5	19.2	15.4
Second D1 fin spine in SL	16.9	18.9	14.8

No mental fraenum, chin smooth and prominent. Anterior nostril in short round tube higher laterally than medially, placed closer to upper lip than eye. Posterior nostril oval, placed close behind anterior nostril. Gill opening very wide, extending forward to below mid-eye. Gill rakers on outer face of first arch long and slender, crowded near angle of arch; rakers on inner face of first arch short rounded knobs with several spines at tip; outer and inner rakers on all other arches similar to inner face rakers on first arch. Tongue large, tip blunt to bluntly rounded.

Teeth in upper jaw in 3–5 rows, outermost row teeth largest, widely spaced, curved and pointed; innermost row teeth small, sharp and evenly sized, oriented inward; 2–3 middle rows of teeth very small and finely pointed. Teeth in lower jaw similar, in 3–4 rows, but outermost row teeth smaller and slightly more upright than upper jaw outer row teeth. No teeth particularly enlarged; no symphysial or lateral caniniform teeth.

Predorsal scales large, cycloid, reaching close up to behind eyes. Ctenoid scales on side of body extend up to just above pectoral fin base. Dorsal part of operculum with cycloid scales (ventral part covered with complex sensory papillae pattern). Cheek covered with 3–4 rows of cycloid scales, dorsalmost row of largest scales just below eye; scale rows separated by sensory papillae rows *c* and *d* (Fig. 5), and one row of scales below papilla row *d*. No scales on branchiostegal membranes. Prepelvic area, isthmus and pectoral fin base covered with cycloid scales. Belly with ctenoid scales; may have cycloid scales along ventral midline.

Head pores in arrangement characteristic of the Gobiinae, with a nasal pore near each posterior nostril, single anterior interorbital pore, a single posterior interorbital pore (just anterior to first nape scale), a postorbital pore, an infraorbital (or anterior otic) pore on a very short but distinct branch of the oculoscapular canal, a posterior otic and intertemporal pore in the anterior portion of the oculoscapular canal, and an anterior and posterior temporal pore in a short separate posterior portion of the oculoscapular canal (over opercle); three preopercular pores present (Fig. 5).

Sensory papillae pattern in unique transverse pattern, illustrated in Figure 5. Papillae in row *a* proliferated into short transverse rows; opercular papillae also in distinctive pattern, with row *os* rising dorsoposteriorly and many transverse rows between rows *os* and *oi*; similar rows below row *oi*. No papillae in distinct groove on cheek below nostrils. Papillae on chin may be proliferated, obscuring the lines of papillae shown in Figure 5.

Coloration of fresh material. No information is available other than Smith's (1959) plate (reprinted in Smith and Smith 1969) and Bleeker's incomplete figure (1983). Smith (1959) shows a pale yellowish fish with red-brown markings on the head, most prominent being

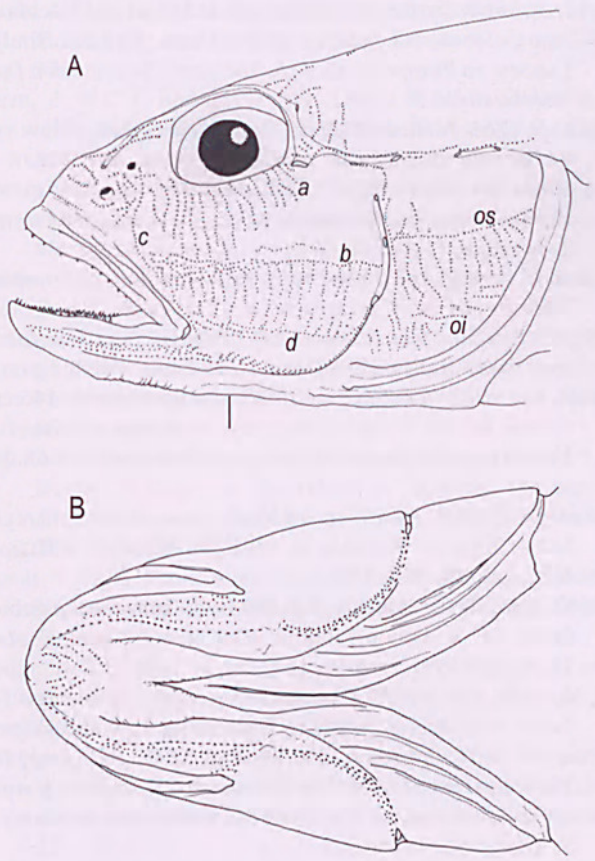

Fig. 5. Lateral line pores and composite sensory papillae pattern of *Arcygobius baliurus*, based on NSMT P–55048, 57 mm SL male, with some details from CAS 46083, 73.5 mm SL female: **A**, lateral view; **B**, ventral view, based on ZRC 31948, 59 mm male, with some details from CAS 46083, 73.5 mm SL female. Scales omitted for clarity. Vertical line shows extent of gill opening.

a broad streak from jaw across cheek and opercle, joining similarly coloured patch on pectoral base, blue spots on the body scales, black mid-body and mid-caudal fin base spots, the first dorsal, anal, pectoral and pelvic fins are plain yellow, the second dorsal fin has a red margin and black-bordered submarginal band, and the caudal fin is yellow barred with pinkish red.

Bleeker's (1983) colour illustration is clearly unfinished, but is quite similar to Smith's, but no blue spots on the body scales are shown, the anal fin is pinkish and there is no brown streak across the side of the head. The red barring on the caudal fin and the darker second dorsal fin margin agrees with Smith (1959). Devi *et al.* (1993) briefly stated that their specimen was "... reddish green above, greenish below ... Fins yellow."

Coloration of preserved material. Head and body whitish, yellowish or light brown (depending on preservation history), with scale margins broadly darkened, their centres paler, giving a mottled or reticulate appearance, four elongate to rectangular brown blotches along lateral mid-line of body and most conspicuously, a dense dark brown to black oval spot oriented longitudinally on base of central caudal fin rays (Fig. 3). Snout and area between eye and upper jaw darker than rest of head; in some specimens, dark brown blotch or short bar present below anterior nostril, reaching toward eye; blackish to dark brown spot or blotch over dorsal part of eye; iris pale (may have been golden or silvery gold in life, based on remnant colouring in some specimens), with dorsal portion of eye blackish, giving eye a "hooded" appearance; brownish to golden-brown triangular blotch on centre of opercle, lower part of opercle pale to pearly white. Pectoral fin base pale, slightly darker above and below; some specimens with indistinct brownish bar above and below central portion of fin base. Underside of head, breast and belly pale or whitish.

First dorsal fin dusky to blackish, with narrow darker margin, usually intensified posteriorly as blackish spot; second dorsal fin pale to dusky, margin slightly darker; anal fin dusky to brownish, margin white in some specimens; pectoral fin translucent to faintly dusky; caudal fin pale to brownish, with 5–6 indistinct wavy alternating dark and light bands, most distinct across centre of fin behind large oval dark blotch on central base of fin; pelvic fins whitish with dusky to

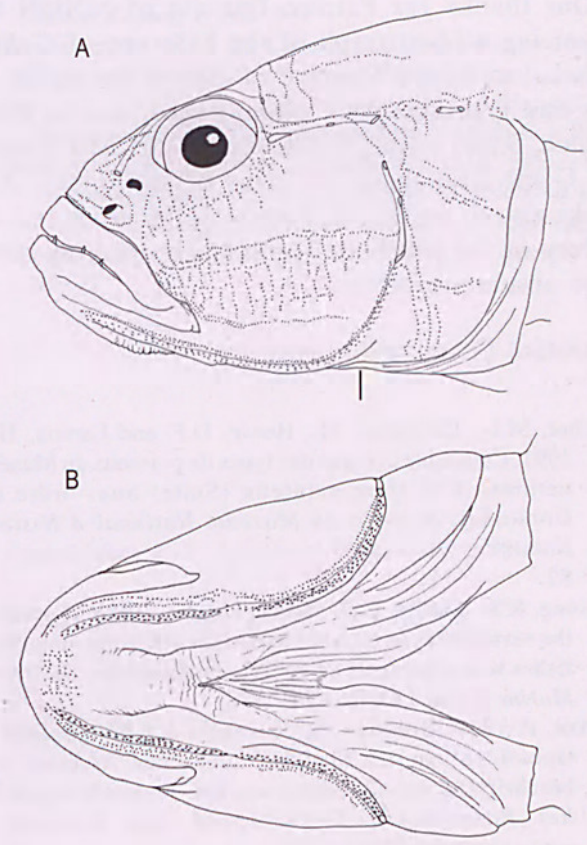

Fig. 6. Sensory papillae pattern and lateral line pores of *Acentrogobius viridipunctatus*, NTM S.11125–002, 78 mm SL female: **A**, lateral view; and **B**, ventral view. Scales omitted for clarity. Vertical line shows extent of gill opening.

brown pigment forming broad mid-line streak or band along fourth and fifth rays, fraenum pale.

Herre (1927: 131) gives a useful description of recently preserved specimens, indicating that the mark on the opercle is a "...dusky, iridescent silver spot" and that the cornea had "blue iridescence".

Distribution. Specimens are known from Micronesia, northern Australia, the Philippines, Singapore, Borneo, Indonesia, Thailand, Andaman Islands, Red Sea, Seychelles and the east coast of Africa. The two small specimens from Yap (Micronesia) are the only ones recorded from the Pacific Plate.

Ecology. Where data are available, it appears that specimens have been obtained by coastal trawling, over soft or mud substrate, in depths of 12–16 m. The species used to form large schools in the Gulf of Thailand, where it is now caught less often (P. Wongrat, pers. comm. 1993). The species is nowhere common in collections, and populations may have been reduced by habitat destruction due to shallow-water trawling. The most recently-collected material seems to be from Singapore, where the species has been found during faunal surveys of artificial boat basins (marinas).

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REFERENCES

Bauchot, M.L., Desoutter, M., Hoese, D.F. and Larson, H.K. 1991. Catalogue critique des types de poissons du Muséum national d'Histoire naturelle (Suite) Sous-ordre des Gobioidei. *Bulletin du Muséum National d'Histoire Naturelle, Paris* (4)13 (section A, 1–2, supplément): 1–82.

Birdsong, R.S., Murdy, E.O. and Pezold, F.L. 1988. A study of the vertebral column and median fin osteology in gobioid fishes with comments on gobioid relationships. *Bulletin of Marine Science* **42**(2): 174–214.

Bleeker, P. 1849. Bijdrage tot de kennis der Blennioïden en Gobioïden van den Soenda-Molukschen Archipel, met beschrijving van 42 nieuwe soorten. *Verhandelingen van het Bataviaasch Genootschap van kunsten en wetenschappen* **22**(6): 1–40.

Bleeker, P. 1851. Over eenige nieuwe soorten van Blennioïden en Gobioïden van den Indischen Archipel. *Natuurkundig Tijdschrift voor Nederlandsch-Indie* **1**: 236–258.

Bleeker, P. 1860. Dertiende bijdrage tot de kennis der vischfauna van Celebes, (visschen van Bonthain, Badjoa, Sindjai, Lagoesi en Pompenoea). *Acta Societatis Scientiarum Indo-Neérlandicae* **8**: 1–60.

Bleeker, P. 1861. Mededeeling omtrent vischsoorten, nieuw voor de kennis der fauna van Singpoera. *Verslagen en Mededeelingen der Koninklikje Akademie van Wetenschappen, Letterkunde, en Schoone Kunsten te Amsterdam* (1)**12**: 28–63.

Bleeker, P. 1983. *Atlas Ichthyologique des Indes Orientales Néêrlandaises, par M.- P. Bleeker. (Plates originally planned for planned tomes XI–XIV published here for the first time).* Smithsonian Institution Press: Washington.

Böhlke, J.E. 1953. A catalogue of the type specimens of Recent fishes in the Natural History Museum of Stanford University. *Stanford Ichthyological Bulletin* **5**: 1–168. [not seen]

Chabanaud, P. 1923. Sur divers vertébrés à sang froid de la région Indo-Chinoise. *Bulletin du Muséum National d'Histoire Naturelle* **29**: 558–559.

Devi, K., Rao, D.V. and Rajan, P.T. 1993. Additions to the gobioid fauna of Andaman Islands. *Environment and Ecology* **11**(4): 812–815.

Dor, M. 1984. *CLOFRES. Checklist of the fishes of the Red Sea.* Israel Academy of Sciences and Humanities, Jerusalem.

Eschmeyer, W.N., Ferraris, C.J., Hoang, M.D. and Long, D.J. 1998. Species of fishes. In: Eschmeyer, W.N. (ed.) *Catalog of fishes.* Vols 1–2. Pp 25–1820. California Academy of Sciences: San Francisco.

Eschmeyer, W.N. 1998. Genera of fishes. In: Eschmeyer, W.N. (ed.) *Catalog of fishes.* Vol. 3, pp. 1821–2174. California Academy of Sciences: San Francisco.

Fowler, H.W. 1938. A list of fishes from Malaya. *Fisheries Bulletin* **1**: 1–268.

Goren, M. 1979. The Gobiinae of the Red Sea (Pisces: Gobiidae). *Senckenbergiana Biologia* **60**(1/2): 13–64.

Goren, M. 1986. A suggested model for the recolonization process of the Red Sea at the post glacial period. In: Uyeno,T. *et al.* (eds) *Indo-Pacific Fish Biology, Proceedings of the 2nd International Conference on Indo-Pacific Fishes.* Pp 648–654. Ichthyological Society of Japan: Tokyo.

Goren, M. and Dor, M. 1994. *An updated checklist of the fishes of the Red Sea. CLOFRES II.* Israel Academy of Sciences and Humanities, and Interuniversity Institute for Marine Sciences: Elat.

Günther, A. 1861. *Catalogue of the acanthopterygian fishes in the collection of the British Museum.* Pp. 1–153. London : British Museum Vol. III.

Herre, A.W.C.T. 1927. Gobies of the Philippines and the China Sea. *Monographs of the Philippine Bureau of Science, Manila, Philippine Islands. Monograph* **23**: 1–352.

Herre, A.W.C.T. 1933a. A check list of fishes from Sandakan, British North Borneo. *Journal of the Pan-Pacific Research Institution* **8**: 2–5.

Herre, A.W.C.T. 1933b. A check list of fishes from Dumaguete, Oriental Negros, P.I., and its immediate vicinity. *Journal of the Pan-Pacific Research Institution* **8**: 6–11.

Herre, A.W.C.T. 1934. *Notes on fishes in the zoological museum of Stanford University. 1. The fishes of the Herre Philippines expedition of 1931. The fishes of the Herre 1931 Philippine expedition with descriptions of 17 new species.* Pp 1–106. Newspaper Enterprise Ltd: Hong Kong.

Herre, A.W.C.T. 1953. Check list of Philippine fishes. *United States Fish and Wildlife Service Research report* **20**: 1–977.

Herre, A.W.C.T. and Myers, G. 1937. A contribution to the ichthyology of the Malay Peninsula. *Bulletin of the Raffles Museum, Singapore* **13**: 5–75.

Hoese, D.F. and Gill, A.C. 1993. Phylogenetic relationships of eleotridid fishes (Perciformes: Gobioidei). *Bulletin of Marine Science* **52**(1): 415–440.

Hubbs, C.L. and Lagler, K.F. 1970. *Fishes of the Great Lakes Region*. University of Michigan Press: Ann Arbor.

Jordan, D.S. and Richardson, J.E. 1910. Check-list of the species of fishes known from the Philippine Archipelago. *Monographs of the Philippine Bureau of Science, Manila. Monograph* **1**: 1–78.

Jordan, D.S. and Seale, A. 1905. List of fishes collected by Dr Bashford Dean on the island of Negros, Philippines. *Proceedings of the United States National Museum* **28**(1407): 769–803.

Karoli, J. 1882. Prodromus piscium Asiae orientalis a Domine Xantus annis 1868–70 collectorum. *Termeszettudomanyi Fuzetek* **5**: 147–187.

Koumans, F.P. 1931. A preliminary revision of the genera of the gobioid fishes with united ventral fins. *Proefschrift Drukkerij Imperator N.V. Lisse*: 1–174.

Koumans, F.P. 1940. Results of a reexamination of types and specimens of gobioid fishes, with notes on the fishfauna of the surroundings of Batavia. *Zoologische Mededeelingen* **22**: 121–210.

Koumans, F.P. 1953. X. Gobioidea. In: Weber, M. and L.F. de Beaufort (eds). *The Fishes of the Indo-Australian Archipelago*. E.J. Brill: Leiden.

Larson, H.K. and Murdy, E.O. 2001. Gobiidae. Gobies. In: Carpenter, K.E. and Niem, V.H. (eds) Pp 3578–3603. *FAO species identification guide for fishery purposes. The living marine resources of the western Central Pacific. Volume 6. Bony fishes part 4 (Labridae to Latimeriidae)*. FAO, Rome.

Leviton, A.E., Gibbs, R.H., Heal, E. and Dawson, C.E. 1985. Standards in Herpetology and Ichthyology: Part 1. Standard symbolic codes for institutional resource collections in Herpetology and Ichthyology. *Copeia* **3**: 802–832.

Lim, K.K.P. and Larson, H.K. 1994. A preliminary checklist of the gobiid fishes of Singapore. In: Sudara, S., Wilkinson, C.R., and Chou, L.M. (eds) *Proceedings, Third ASEAN-Australian Symposium on Living Coastal Resources, Vol. 2: Research Papers*. Chulalongkorn University: Bangkok.

Murdy, E.O. and Hoese, D.F. 1985. Revision of the gobiid fish genus *Istigobius*. *Indo-Pacific Fishes* **4**: 1–41.

Pezold, F. 1993. Evidence for a monophyletic Gobiinae. *Copeia* **3**: 634–643.

Randall, J.E. and Lim, K.K.P. 2000. A checklist of the fishes of the South China Sea. *Raffles Bulletin of Zoology Supplement* **8**: 569–667.

Randall, J.E. and Greenfield, D.W. 2001. A preliminary review of the Indo-Pacific gobiid fishes of the genus *Gnatholepis*. *Ichthyological Bulletin of the J.L.B. Smith Institute of Ichthyology* **69**: 1–17.

Sanzo, L. 1911. Distribuzione delle papille cutanee (organi ciatiformi) e suo valore sistematico nei Gobi. *Mitteilungen aus der Zoologischen Station zu Neapel* **20**: 249–328.

Seale, A. 1910. Fishes of Borneo, with descriptions of four new species. *Philippine Journal of Science* **5**(4) section D: 263–289.

Smith, J.L.B. 1959. Gobioid fishes of the families Gobiidae, Periophthalmidae, Trypauchenidae, Taenioididae and Kraemeriidae of the western Indian Ocean. *Department of Ichthyology, Rhodes University, Grahamstown, Ichthyological Bulletin* **13**: 185–225.

Smith, J.L.B. and Smith, M.M. 1969. *The fishes of Seychelles*. J.L.B. Smith Institute of Ichthyology: Grahamstown.

Springer, V.G. and Johnson, G.D. 2000. Use and advantage of ethanol solution of alizarin red S dye for staining bone in fishes. *Copeia* **1**: 300–301.

Valenciennes, A. 1837. In: Cuvier, G.L. and Valenciennes, A. *Histoire Naturelle des Poissons*. Paris: Levrault. Vol. 12.

Weber, M. 1913. *Die Fische der Siboga-Expedition. Monographie LVII Siboga-Expeditie*. Leiden: E. J. Brill.

Winterbottom, R. 2002. A redescription of *Cryptocentrus crocatus* Wongratana, a redefinition of *Myersina* Herre (Acanthopterygii; Gobiidae), a key to species, and comments on relationships. *Ichthyological Research* **49**: 69–75.

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