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Atelomycterus erdmanni, a new species of catshark (Scyliorhinidae: Carcharhiniformes) from Indonesia

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Abstract

A new species of catshark of the genus *Atelomycterus* is described from eastern Indonesia based on two type specimens. *Atelomycterus erdmanni* is closely related to *A. baliensis* and *A. marmoratus*, being sympatric with the latter. It differs from these two species in coloration, external morphology, meristics and clasper morphology. *Atelomycterus erdmanni* differs from *A. baliensis* in having white spots present over the body (vs. white spots absent), a larger first dorsal fin, paired fins closer together, and pelvic fin farther apart from the ventral caudal-fin origin. It differs from *A. marmoratus* in having far less numerous white spotting, a larger first dorsal fin, and the clasper glans about half length of clasper outer margin (vs. less than half length of outer margin). Its status was also confirmed by genetic analysis with comparison of the mitochondrial cytochrome c oxidase subunit 1 (CO1) genetic marker utilised in DNA barcoding producing a genetic divergence of 4.8% and 5.3% between the new species and its closest congeners, *A. baliensis* and *A. marmoratus*, respectively.

Key words: taxonomy, sharks, elasmobranch, Chondrichthyes, DNA barcoding, Indo-Pacific, fishes, ichthyology.

Introduction

The family Scyliorhinidae has long been considered to be the largest family of sharks with close to 150 species, almost 30% of all known shark species. However, Iglesias *et al*. (2005) provided strong evidence, using nuclear and mitochondrial genes, that the Scyliorhinidae is paraphyletic. This had also been suggested by Maisey (1984) using morphological cladistic analysis. As a result, it was suggested that the subfamily Pentanchinae (see Compagno 1988) be elevated to familial level. The resulting Pentanchidae contains *Apristurus*, *Asymbolus*, *Bythaelurus*, *Cephalurus*, *Figaro*, *Galeus*, *Halaelurus*, *Haploblepharus*, *Holohalaelurus*, *Parmaturus,* and *Pentanchus*. The Scyliorhinidae, under the new arrangement, contains the genera *Atelomycterus*, *Aulohalaelurus*, *Cephaloscyllium*, *Poroderma*, *Schroederichthys*, and *Scyliorhinus*. The main difference between these two families is the presence (Scyliorhinidae) or absence (Pentanchidae) of supraorbital crests on the chondrocranium (Iglesias *et al*. 2005). Under this new arrangement, the Scyliorhinidae contain 47 species. However, many authors still follow the original classification with only a single catshark family, the Scyliorhinidae (e.g. Kawauchi *et al*. 2014).

The genus *Atelomycterus* contains 5 currently recognised species: *A. baliensis* White, Last & Dharmadi 2005 from Bali, Indonesia; *A. fasciatus* Compagno & Stevens 1993 from northwestern Australia; *A. marnkalha* Jacobsen & Bennett 2007 from Queensland, Australia; *A. macleayi* Whitley 1939 from northern Australia, and *A. marmoratus* (Anonymous [Bennett] 1830) from Pakistan to Papua New Guinea and north to China. Allen & Erdmann (2012) included 4 species of atelomycterine catsharks from the East Indies, which included two potentially undescribed species, *Atelomycterus* species 1 and species 2. Specimens of one of these, *Atelomycterus* species 1, were subsequently collected by M.V. Erdmann from Manado in North Sulawesi. Herein this species is formally named and described based on two type specimens and several other records.

Materials and Methods

Numerical characters were selected to enable morphological and meristic comparisons with other *Atelomycterus* species. The holotype and paratype of the new species were measured in full (Table 1). For comparison, 10 Indonesian specimens and one Philippine specimen of *Atelomycterus marmoratus*, and the holotype and four paratypes of *Atelomycterus baliensis* were also measured. In the description, morphometric values for the holotype are given first followed in parentheses by that of the paratype. The morphometric measurements used follow the FAO system of Compagno (2001). Nostril length and internarial width measurements were made by lifting the nasal flap upwards to expose the entire nostril. Since there are only two known specimens of the new species, tooth counts were not taken as they require partial dissection to obtain accurate counts (White *et al*. 2005). Vertebral counts were obtained separately for trunk (monospondylous centra), precaudal (monospondylous + diplospondylous centra to origin of upper lobe of caudal fin), and caudal diplospondylous (from origin of upper caudal lobe to tip) regions.

Type specimens and comparative material are deposited in the ichthyological collections of the Commonwealth Scientific and Industrial Research Organisation, Hobart (CSIRO) and Research Centre for Oceanography, Indonesian Institute of Sciences (NCIP), Jakarta; their registration numbers are prefixed with these acronyms.

The holotype of the new species was sequenced for the cytochrome c oxidase I (CO1) DNA barcoding fragment (~650 base pairs) (see Hebert *et al*. 2003, Ward *et al*. 2005, Holmes *et al*. 2009). A sequence could not be successfully obtained from the paratype. This sequence was compared with corresponding sequences available for other *Atelomycterus* species using the BOLD database (www.boldsystems.org). DNA extractions, PCR reactions, and sequencing followed the protocols in Holmes *et al*. (2009). Kimura two-parameter pairwise genetic distances were also estimated for the CO1 datasets and these were subjected to neighbour-joining to generate trees for the genus *Atelomycterus* using the BOLD database. GenBank accession numbers of all CO1 sequences are provided in the phenetic tree.

Figure 1. *Atelomycterus erdmanni,* n.sp., holotype, adult male 501 mm TL (NCIP 6544), lateral view (upper), dorsal view (lower).

Atelomycterus erdmanni n. sp.

Spotted-belly Catshark

Figures 1–7, Table 1.

Atelomycterus species 1 Allen & Erdmann 2012: 55, figs (Waigeo Island, West Papua, Indonesia).

Holotype. NCIP 6544, adult male, 501 mm TL, 'Nudi Retreat' dive site, Lembeh Strait, Manado, North Sulawesi, Indonesia, 01°29.19' N, 125°14.46' E, 62 m depth, 4 January 2013 (COI sequence with GenBank accession KP769787).

Paratype. NCIP 6549, female, 508 mm TL, Bitung fish market, North Sulawesi, Indonesia, 26 July 2014.

Diagnosis. A medium-sized *Atelomycterus* species (to at least 508 mm TL) with the following combination of characters: a relatively short snout, 3.4–3.8% TL; head length 17.5–17.9% TL; precaudal length 76.6–79.1% TL; interdorsal space 13.4–13.7% TL; distance between pectoral and pelvic fins and pelvic to anal fins about equal, ratio of pectoral-pelvic and pelvic-anal 1.01–1.02; anal-fin length to anal-fin base ratio 1.29; dorsal fins moderately falcate, posterior margins sloping anteroventrally from fin apices; denticles strongly tricuspid with an elongate medial cusp; claspers of adult males relatively short, outer length 9% TL, clasper base width 15.5% of clasper outer length, not stubby, not tapering from base to tip; clasper glans extending about half of clasper outer length; cover rhipidion relatively narrow; rhipidion moderately large, partly concealed by cover rhipidion and exorhipidion; pseudosiphon about half length of cover rhipidion; clasper tip narrow and bluntly pointed. Colour pattern consisting of dark brown to black and white spots and blotches, and faint dark brown saddles; white spots

Figure 2. *Atelomycterus erdmanni,* n.sp., paratype, female 508 mm TL (NCIP 6549), lateral view (upper), dorsal view (lower).

surrounded by 2–4 dark spots; dark spots scattered along most of the ventral surface (less distinct in male); a distinct white stripe running through upper third of gill slits (Figs. 1–4).

Description. Body slender, trunk subcircular in section at first dorsal-fin base; length of trunk from fifth gill openings to vent 1.31 (1.25) times head length; no predorsal, interdorsal or postdorsal ridges on midline of back; no postanal ridge between anal fin base and lower caudal fin origin; no lateral ridges. Caudal peduncle short, moderately compressed, without lateral keels, height 1.59 (1.27) in width at second dorsal fin insertion, pelvic-anal space 2.20 (2.16) times anal-caudal space.

Head short, length 0.98 (0.99) to pectoral-pelvic space; narrow and moderately depressed; bluntly pointed in lateral view; dorsal profile in front of eye weakly concave; narrowly parabolic in dorsoventral view anterior to gill openings. Preoral length short, 0.56 (0.63) times mouth width; moderately rounded in dorsoventral view; not or very slightly indented adjacent to anterior of orbits. Eye small, length 5.57 (5.76) in head length, 3.22 (3.09) times eye height; dorsolaterally on head, with lower edges well medial to horizontal head rim in dorsal view, subocular ridges strong but not sharply defined. External eye openings with prominent anterior and posterior notches; posterior notch connected to spiracle. Nictitating lower eyelids of rudimentary type, with shallow, scaled subocular pouches and secondary lower eyelids free from upper eyelids.

Spiracles small, length 5.48 (5.27) in eye length, slightly below posterior margin of eye. First four gill slits substantially higher than fifth, height of fifth 0.75 (0.70) of third; height of third 5.57 (5.76) in head length, 0.62 (0.77) of eye length. Gill slits straight, slightly concave, not elevated on dorsolateral surface of head; upper ends about opposite lower edge of eyes or slightly below; gill filaments not visible from outside.

Nostrils almost reaching mouth, with small incurrent aperture lacking posterolateral keels, width 1.01 (1.08) in internarial space, 1.80 (1.76) in eye length. Anterior nasal flaps large, with narrowly rounded tips, directed posterolaterally, covering excurrent apertures, reaching lower jaw; united near symphysis of upper jaw, interspace between insertions of lobes covering upper lip, weakly concave; mesonarial flaps small and positioned laterally.

Mouth broadly angular, width 2.88 (2.97) in head length, length 2.78 (2.66) in its width; lower symphysis almost reaching upper symphysis; teeth adjacent to upper symphysis exposed in ventral view; tongue moderate-sized, flat and concave anteriorly, filling most of floor of mouth. No large buccal papillae in mouth, palate and floor of mouth covered by buccopharyngeal denticles, except just in front of tongue. Upper labial furrows long, reaching level of upper symphysis; lower labial furrows slightly longer than uppers; labial cartilage large.

Tooth counts not taken; 5/4 series functional; posterolateral teeth not arranged in diagonal files; no toothless

space at symphysis. Teeth not strongly differentiated in upper and lower jaws; tooth-row groups along upper and lower jaws weakly defined. Teeth tricuspid; central cusp strong, well developed, much longer than lateral cusps; cusps strongly erect to semi-oblique, more erect posteriorly; upper anterior symphysial teeth smaller than those adjacent; posterior teeth with lower central cusps, in several rows in both jaws distinctly smaller than anterior teeth; sexual heterodonty weak; tooth morphology not particularly enlarged or modified in adult males.

Lateral trunk denticles below first dorsal fin narrow, weakly tricuspid, tear-drop shaped; crowns with pair of strong medial ridges extending entire length onto long, narrow medial cusp; lateral cusps short, each with prominent lateral ridge extending onto cusp from crown about 1.7 times width; medial cusp about 0.6 times total length of crown; crowns somewhat elevated, weakly imbricate.

Pectoral fins broadly triangular and apices narrowly rounded, not falcate, length 1.68 (1.73) in head length; anterior margins moderately convex, 1.19 (1.22) times its length; bases narrow; apices narrowly rounded; posterior margins straight or weakly convex; free rear tips and inner margins broadly rounded; origins under interspace between third and fourth gill slits. Apex of pectoral fin slightly posterior to its free rear tip when fin is elevated and adpressed to body.

Pelvic fins broadly triangular; anterior margins nearly straight, 0.69 (0.71) of pectoral-fin anterior margins, 0.84 (0.88) times its length; apices narrowly rounded; posterior margins nearly straight; free rear tips angular and not attenuated; inner margins straight or weakly convex, forming a weak fold, connected to median dorsal surface of each clasper; fold not fused together over claspers of adult male.

Claspers of adult male holotype elongate; lateral margins nearly straight, not undulated; extending well behind pelvic-fin free rear tips, distance 1.2 times pelvic-fin inner margin; glans moderately elongate, length about half clasper outer margin; blunt distally with a small knob-like apex; covered dorsolaterally and ventrally with small clasper denticles; dorsomedial surfaces of glans (including rhipidion) and lateral strip adjacent clasper

Figure 3. *Atelomycterus erdmanni,* n.sp., holotype, adult male 501 mm TL (NCIP 6544), ventral view (upper); paratype, female 508 mm TL (NCIP 6549), ventral view (lower).

Figure 4. *Atelomycterus erdmanni,* n.sp., holotype, adult male 501 mm TL (NCIP 6544), ventral view of head.

groove naked; clasper denticles typical seed-like, much longer than broad, cusps indistinct; narrow band of low, semi-upright tricuspidate denticles near tip of glans; apopyle connected by long clasper groove, with its dorsal margins loosely fused over clasper canal; cover rhipidion elongate, formed as distally tapering wedge with narrow tab anteriorly, posterior and proximal to pseudopera, exorhipidion and rear end of the rhipidion; rhipidion enlarged, formed as a flat convex-shaped blade, extending across most of length of clasper glans, terminating below exorhipidion; pseudosiphon long, narrow and slitlike, extending opposite most of cover rhipidion base; pseudopera present below anterior end of exorhipidion and about opposite posterior end of cover rhipidion; exorhipidion well differentiated, originating well behind the cover rhipidion; no specialised clasper hooks.

First dorsal fin moderately high, anterior margin weakly convex, narrowly rounded apically, moderately falcate; posterior margin slightly sloping anteroventrally from apex, angular free rear tip; inner margin relatively short, straight; origin at about midpoint of pelvic-fin bases; insertion closer to pelvic-fin insertions than anal-fin origin; fin insertion anterior to fin apex; first dorsal-fin base 1.53 (1.47) in interdorsal space, 2.28 (2.24) in dorsal caudal-fin margin, height 1.22 (1.26) in base length, inner margin 2.60 (2.46) in height, 3.19 (3.09) in base length.

Second dorsal fin similar to first dorsal fin and about equal in area; height 0.74 (0.75) times first dorsal-fin height, base length 1.02 (1.00) times first dorsal-fin base length; moderately falcate; anterior margin slightly convex, apex narrowly rounded; posterior margin slightly sloping anteroventrally from apex; free rear tip angular;

TABLE 1

Morphometric data for the holotype and paratype of *Atelomycterus erdmanni,* n.sp. and ranges for *A. baliensis* (type specimens) and *A. marmoratus* (measurements expressed as percentage of the total length)

	A. erdmanni, n. sp.		*A. baliensis* types, n=5		*A. marmoratus* n=11	
	holotype NCIP 6544	paratype NCIP 6549	min	max	min	max
Total length (mm)	**501**	**508.0**	**397**	**443**	**343**	**618**
Pre-caudal length	76.6	79.1	78.4	79.7	78.4	81.3
Pre-second dorsal length	64.3	64.2	63.7	65.2	64.8	66.9
Pre-first dorsal length	41.1	41.7	44.0	45.2	42.2	45.2
Head length	17.5	17.9	19.4	19.8	17.9	21.1
Prebranchial length	12.7	13.3	13.9	14.6	13.0	16.0
Prespiracular length	7.6	7.6	9.0	9.8	7.9	9.9
Preorbital length (horizontal)	3.8	3.8	4.9	5.5	4.5	5.7
Preorbital length (direct)	4.9	5.1	5.9	6.3	5.4	6.4
Preoral length	3.4	3.8	4.0	4.6	3.8	4.6
Prenarial length	3.2	3.1	3.2	3.8	2.9	3.4
Prepectoral length	16.2	16.1	17.8	18.7	16.7	20.5
Prepelvic length	38.1	38.0	39.9	40.8	37.4	42.8
Snout-vent distance	40.5	40.3	42.7	43.6	40.0	43.8
Preanal length	61.0	61.2	60.5	61.8	61.0	63.9
Interdorsal distance	13.7	13.4	11.6	12.9	12.5	16.8
Dorsal-caudal space	6.0	5.8	5.8	6.7	4.9	8.1
Pectoral-pelvic space	17.8	18.0	19.7	20.7	16.7	19.9
Pelvic-anal space	17.3	17.7	14.8	15.5	15.9	19.7
Anal-caudal space	7.9	8.2	7.3	8.7	5.9	9.5
Eye length	3.1	3.1	2.7	3.0	2.5	3.2
Eye height	1.0	1.0	0.6	0.8	0.3	0.9
Interorbital width	5.7	5.7	5.8	6.3	5.0	6.4
Nostril width	1.7	1.8	2.1	2.3	1.7	2.3
Internarial space	1.8	1.9	2.0	2.6	1.7	2.3
Anterior nasal flap length	2.7	2.8	2.8	3.0	2.4	2.9
Spiracle length	0.6	0.6	0.6	0.7	0.5	0.8
Eye-spiracle distance	0.7	0.8	0.8	0.9	0.7	1.0
Mouth length	2.2	2.3	2.1	2.4	1.8	2.3
Mouth width	6.1	6.0	6.8	7.3	5.4	7.8
Upper labial furrow length	2.7	2.8	2.7	2.9	2.5	3.3
Lower labial furrow length	3.2	3.3	3.4	3.8	2.8	4.0
First gill slit height	1.9	2.4	1.7	2.6	1.8	2.5
Second gill slit height	1.9	2.4	1.8	2.7	1.8	2.6
Third gill slit height	1.9	2.4	1.8	2.4	1.8	2.7
Fourth gill slit height	1.6	2.3	1.6	2.1	1.8	2.4
Fifth gill slit height	1.5	1.7	1.3	1.8	1.3	1.9
Head height	6.7	7.1	7.2	7.8	5.9	8.9
Trunk height	7.6	7.9	7.8	9.0	6.3	10.1
Caudal peduncle height	3.4	3.6	3.5	3.8	3.5	4.0

TABLE 1 cont.

	A. erdmanni, n. sp.		*A. baliensis*		*A. marmoratus*	
	holotype	paratype	types, n=5		n=11	
	NCIP 6544	NCIP 6549	min	max	min	max
Head width	9.2	9.8	10.3	11.2	9.0	12.8
Trunk width	8.9	9.4	8.9	10.4	8.0	10.6
Caudal peduncle width	2.2	2.8	2.0	2.6	2.0	2.8
Pectoral fin - length	10.4	10.3	10.4	12.1	9.4	12.0
Pectoral fin - anterior margin length	12.4	12.6	11.8	12.4	10.7	12.6
Pectoral fin - base length	5.1	5.3	4.5	5.0	4.1	5.0
Pectoral fin - height	10.7	10.8	9.0	9.6	7.4	10.0
Pectoral fin - inner margin length	5.8	5.9	4.6	5.6	5.1	6.1
Pectoral fin - posterior margin length	8.4	8.4	7.9	8.6	6.2	8.7
Pelvic fin - length	10.2	10.2	9.5	10.5	8.9	10.6
Pelvic fin - anterior margin length	8.6	8.9	7.8	8.5	7.2	8.7
Pelvic fin - base length	5.8	5.9	6.6	7.4	5.6	7.0
Pelvic fin - height	6.2	7.0	5.2	6.7	5.0	6.8
Pelvic fin - inner margin length	4.1	3.9	2.9	4.1	3.0	4.5
Pelvic fin - posterior margin length	6.3	6.8	5.9	7.0	4.9	6.5
Clasper outer length	9.0	–	8.8	8.8	8.7	12.1
Clasper inner length	9.7	–	10.9	10.9	11.7	15.2
Clasper base width	1.4	–	1.4	1.4	1.1	1.3
First dorsal fin - length	11.9	12.2	9.8	10.4	9.2	11.1
First dorsal fin - anterior margin length	13.5	13.4	10.7	11.4	10.5	12.6
First dorsal fin - base length	8.9	9.1	7.5	8.2	6.3	8.1
First dorsal fin - height	7.3	7.2	5.5	5.9	5.3	6.6
First dorsal fin - inner margin length	2.8	2.9	2.2	2.8	2.9	3.5
First dorsal fin - posterior margin length	6.7	6.8	5.1	5.7	4.8	6.0
Second dorsal fin - length	11.3	11.5	10.6	11.9	9.3	11.1
Second dorsal fin - anterior margin length	12.6	12.9	11.0	11.9	10.2	12.0
Second dorsal fin - base length	9.1	9.1	8.3	9.1	7.0	8.7
Second dorsal fin - height	5.4	5.4	4.7	5.4	4.5	6.7
Second dorsal fin - inner margin length	2.7	2.8	2.1	2.8	2.4	3.3
Second dorsal fin - posterior margin length	4.8	5.0	4.2	5.0	4.5	5.3
Anal fin - length	10.3	10.5	9.5	10.6	8.7	10.2
Anal fin - anterior margin length	9.0	9.1	7.6	8.8	6.9	8.3
Anal fin - base length	8.0	8.1	7.5	8.5	6.6	7.9
Anal fin - height	3.0	3.1	3.0	3.7	2.7	3.8
Anal fin - inner margin length	2.4	2.4	1.9	2.2	1.9	2.5
Anal fin - posterior margin length	2.9	3.1	3.4	4.1	3.2	4.1
Caudal fin - dorsal margin length	20.4	20.4	20.1	21.2	18.0	20.9
Caudal fin - preventral margin length	8.8	8.9	7.9	9.2	7.3	9.2
Caudal fin - upper postventral margin length	10.6	9.9	11.3	12.9	9.7	12.7
Caudal fin - subterminal margin length	4.0	3.5	3.5	3.9	3.1	4.0
Caudal fin - terminal margin length	4.5	4.5	3.8	4.8	3.5	4.6
Caudal fin - terminal lobe length	5.5	5.0	4.7	5.5	4.6	6.0
Second dorsal fin origin-anal fin origin	2.8	2.9	2.6	3.8	2.0	3.3
Second dorsal fin insertion-anal fin insertion	4.0	4.1	3.3	4.3	2.9	3.7

origin in front of anal-fin midbase, insertion behind anal-fin free rear tip; free rear tip in front of upper caudal-fin origin by 1.28 (1.09) times the inner margin; second dorsal-fin base length 0.67 (0.64) in dorsocaudal space, height 1.68 (1.68) in base length, inner margin 2.03 (1.93) in height and 3.42 (3.25) in base length.

Anal fin low, not falcate, much smaller than second dorsal fin; anterior margin slightly convex to nearly straight, apex broadly rounded; posterior margin nearly straight, directed posterodorsally; inner margin short, nearly straight; origin slightly in front of second dorsal-fin origin; height 1.77 (1.75) in second dorsal-fin height and base 0.88 (0.90) times second dorsal-fin base; anal-fin base 0.98 (1.01) in anal-caudal space, height 2.63 (2.63) in base length, inner margin 1.29 (1.30) in height and 3.41 (3.41) in base length.

Caudal fin moderately elongate, narrow, asymetrical, with large terminal lobe, ventral lobe not developed; dorsal margin slightly undulating, 3.76 (3.83) in precaudal length; preventral margin length 2.31 (2.27) in dorsal caudal margin, almost straight, forming low, broadly rounded lobe with postventral margin; postventral margin

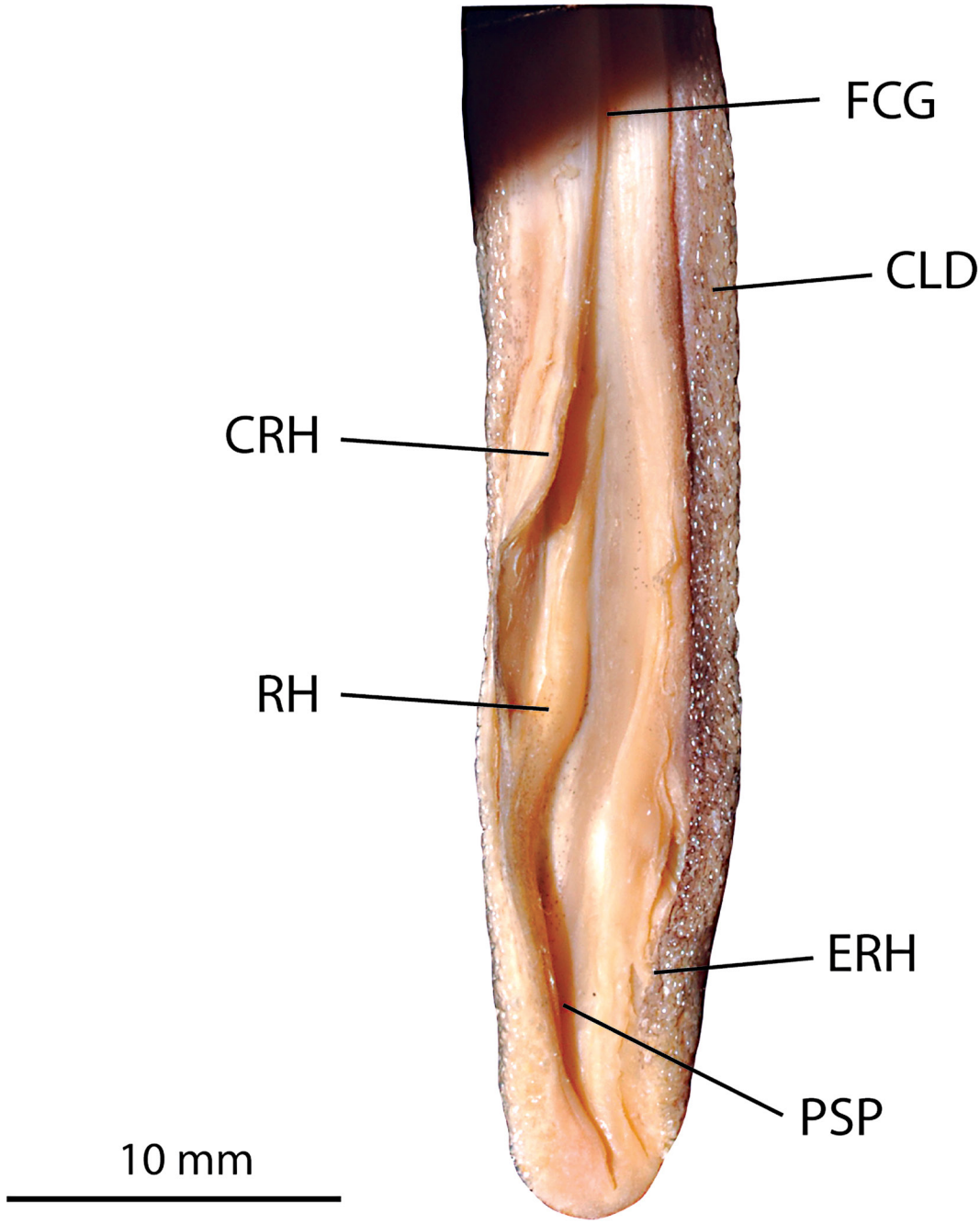

Figure 5. Right clasper of *Atelomycterus erdmanni,* n.sp., holotype, adult male, 501 mm TL (NCIP 6544) with glans spread. Abbreviations: CLD: clasper denticles; CRH: cover rhipidion; ERH: exorhipidion; FCG: fused clasper groove; PSP: pseudopera; RH: rhipidion.

straight to convex, not differentiated into upper and lower parts; origin of subterminal notch forming a deep, narrow slot, margin straight to concave, its length 1.14 (1.27) in terminal margin; terminal margin slightly convex and often notched, edges of lobe bluntly angular, its length 4.49 (4.54) times dorsal caudal margin.

Vertebral counts: 42 (42) monospondylous (MP) centra; 73 (74) diplospondylous trunk (DP) centra; 43 (42) diplospondylous caudal centra; 115 (116) precaudal (PC) centra; 158 (158) total centra. Transition between monospondylous (MP) and diplospondylous (DP) about 3 centra behind front of pelvic gildle. Monospondylous –diplospondylous transition hardly enlarged, not forming 'stutter zone' of alternating long and short centra.

Colour. (Figs. 1–7) Dorsal and lateral surfaces brownish grey with a pattern of white and dark brown to blackish and blotches and spots, and faint dark brown saddles; a faint, dark brown, narrow interorbital bar present; five dark brown saddles present, faint in dorsal view, barely visible in lateral view; first saddle situated anterior to and including second gill slit, second saddle just behind pectoral-fin insertions, third saddle midway between pectoral-fin free tips and pelvic-fin origins, fourth on mid-interdorsal region, and fifth on caudal peduncle (barely evident); numerous diffuse-edged, dark brown to blackish blotches and spots present on body and fins; white spots and blotches less numerous than dark blotches and spots, each usually surrounded by 2–4 black spots; a distinct white stripe running from below eye, across upper third of gill slits and terminating in a white spot posterior to fifth gill slit; white spots in pairs in dorsal view, mostly located immediately anterior to and posterior to saddles; a white spot pair also present below anterior dorsal-fin bases; dorsal and anal fins and upper and lower caudal-fin lobes prominently white tipped bordered by a dark bar; pectoral and pelvic fins with whitish posterior margin. Ventral surfaces pale greyish to whitish (yellowish when preserved) with scattered small dark brown to blackish spots (more evident in female than male type specimen); a row of small dark spots present on each side running from about level with first gill slit and extending onto pectoral-fin base; dark spots more numerous between pectoral and pelvic fins; larger but less numerous dark spots present on pelvic-anal and anal-caudal spaces; outer half of pectoral and pelvic fins dark brownish.

Size. Only known for several specimens, with accurate sizes for only the two type specimens, a 501 mm TL adult male and 508 mm TL female.

Distribution and habitat. *Atelomycterus erdmanni* is known from Lembeh Strait and Bunaken Islands in North Sulawesi, and from off Ambon in the Maluku Islands. The holotype was collected at 62 m depth on reef. Dive operators in North Sulawesi and Ambon have observed this species on night dives in depths of 3 to 15 m. The record from Allen & Erdmann (2012) was from Waigeo Island in the Raja Ampat Islands, West Papua. An additional specimen collected for the aquarium trade was collected from the Maluku Islands (C. Avila, pers. comm.).

Figure 6. *Atelomycterus erdmanni,* n.sp., Lembeh Strait, Indonesia, underwater photograph on coral by M.V. Erdmann.

Figure 7. *Atelomycterus erdmanni,* n.sp., Lembeh Strait, Indonesia, underwater photograph on rubble by M.V. Erdmann.

Etymology. The species is named after Mark V. Erdmann who first discovered and collected the type specimens of this species.

Comparisons. *Atelomycterus erdmanni* is most similar to *A. baliensis* (Fig. 8 upper) and *A. marmoratus* (Fig. 8 lower), but differs in coloration and morphology. Coloration is the strongest character differentiating these species. *Atelomycterus erdmanni* differs from *A. baliensis* in having white spots on the body (vs. white spots absent), fainter dark saddles (vs. obvious dark saddles), and a distinct white stripe through the gill slits (vs. no strongly defined white stripe through the gills). It differs from *A. marmoratus* in having far fewer white spots on the dorsal and lateral surfaces (vs. numerous white spots).

Atelomycterus erdmanni differs from *A. baliensis* and *A. marmoratus* in having: a larger first dorsal fin (height 7.2–7.3 vs. 5.5–5.9 and 5.3–6.6% TL, respectively; anterior margin 13.4–13.5 vs. 10.7–11.4 and 10.5–12.6% TL, respectively); a shorter snout (preorbital length 3.8 vs. 4.9–5.5 and 4.5–5.7% TL, respectively); a shorter prepectoral length (16.1–16.2 vs. 17.8–18.7 and 16.7–20.5% TL, respectively); a shorter predorsal length (41.1–41.7 vs. 44.0–45.2 and 42.2–45.2% TL, respectively); and slightly larger pectoral fins (10.7–10.8 vs. 9.0–9.6 and 7.4–10.0% TL, respectively). It can be further differentiated from *A. baliensis* in having: a shorter pectoral-pelvic space (17.8–18.0 vs. 19.7–20.7% TL); a longer pelvic-anal space (17.3–17.7 vs. 14.8–15.5% TL); a shorter snout-

Figure 8. *Atelomycterus baliensis* female 455 mm TL (MZB 12901), lateral view (upper); *Atelomycterus marmoratus* female 542 mm TL (CSIRO H 5876-01), lateral view (lower).

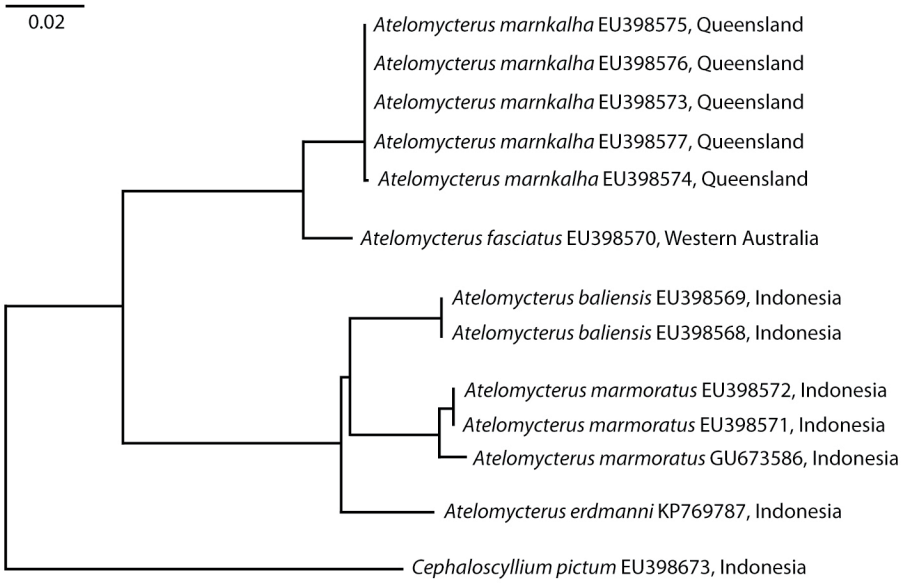

Figure 9. Neighbour-joining tree of nucleotide sequence divergence at the barcoding region of the COI gene following the Kimura two-parameter model (K2P) generated by BOLD (Barcode of Life Database) for *Atelomycterus* species. Scale bar represents 2% K2P distance. GenBank accession numbers are listed.

vent length (40.3–40.5 vs. 42.7–43.6% TL); a narrower mouth (mouth width 6.0–6.1 vs. 6.8–7.3% TL); a shorter preoral length (3.4–3.8 vs. 4.0–4.6% TL); and dorsal fins slightly farther apart (interdorsal space 13.4–13.7 vs. 11.6–12.9% TL).

The new species has more diplospondylous trunk (DP) vertebral centra than *A. baliensis* and *A. marmoratus* (73–74 vs. 57–63 and 63–68), but fewer diplospondylous caudal (DC) centra (42–43 vs. 52–59 and 49–61).

The claspers of the adult male holotype of *A. erdmanni* are shorter than those of adult male *A. marmoratus* (inner length 9.7 vs. 11.7–15.2% TL) and the glans is about half clasper outer length (vs. less than half outer length in *A. marmoratus*).

DNA barcoding results. DNA barcoding, coupled with classical taxonomic techniques, has proven to be extremely useful for highlighting where potential cryptic speciation may be present in sharks (Ward *et al*. 2008).

The single *A. erdmanni* sequence obtained grouped closest to *A. marmoratus* and *A. baliensis* from Indonesia using the CO1 marker (Fig. 9). The new species had an average sequence divergence from these two species of 4.8% and 5.3%, respectively (minimum interspecific divergence of 4.5% and 5.2%, respectively) based on those sequences (Table 2). *Atelomycterus erdmanni* also aligned closely to, but clearly distinct, from *A. marnkalha* and *A. fasciatus*, with average divergences from those two species of 13.5% and 13.9%, respectively (minimum interspecific divergence of 13.3% and 13.9%, respectively) (Table 2).

TABLE 2

Average K2P genetic divergences for 5 species of *Atelomycterus* based on the CO1 marker, interspecific and intraspecific (%)

	bal	*erd*	*fas*	*marm*	*marn*
A. baliensis	0.13				
A. erdmanni, n. sp.	5.3	-			
A. fasciatus	14.8	13.9	-		
A. marmoratus	5.4	4.8	15.0	0.48	
A. marnkalha	14.3	13.5	2.9	15.1	0.07

For comparison, the average sequence divergences from 11 species in the genus *Cephaloscyllium* ranged from 1.3% to 11.6% and those from 4 species in the genus *Scyliorhinus* ranged from 4.2% to 7.9%. Note that divergences for *Scyliorhinus torazame* were not included due to uncertainty about its generic placement.

Other material examined: *Atelomycterus baliensis*: CSIRO H 5868-03 (holotype), adult male 433 mm TL; CSIRO H 5868-04 (paratype), female 443 mm TL; CSIRO H 5868-05 (paratype), female 425 mm TL; CSIRO H 5868-01 (paratype), female 397 mm TL; CSIRO H 5868-02 (paratype), female 431 mm TL, Indonesia.

Atelomycterus marmoratus: CSIRO H 5889-05, female 433 mm TL, Indonesia; CSIRO H 5889-22, female 474 mm TL, Indonesia; CSIRO H 5889-23, adult male 554 mm TL, Indonesia; CSIRO H 5889-24, female 498 mm TL, Indonesia; CSIRO H 5876-01, female 535 mm TL; CSIRO H 5876-02, female 528 mm TL, Indonesia; CSIRO H 4132-01, adult male 618 mm TL, Philippines; NCIP 6550, adult male 475.5 mm TL, Indonesia; NCIP 6551, adult male 551.5 mm TL, Indonesia; NCIP 6552, female 437 mm TL, Indonesia; NCIP 6553, female 343 mm TL, Indonesia.

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