

Oxyeleotris colasi (Teleostei: Eleotridae), a new blind cave fish from Lengguru in West Papua, Indonesia

by

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ABSTRACT. - *Oxyeleotris colasi* is the first hypogean fish recorded from West Papua. The habitat consists of a freshwater pool in the cave of Jabuenggara located in the heart of Seraran anticline in the limestone karst of Lengguru. The new species is most closely related to the blind cave fish *O. caeca* described by Allen (1996) from eastern New Guinea. The two troglomorphic species are hypothesised to be related to *O. fimbriata*, an epigeal freshwater gudgeon that ranges widely in New Guinea and northern Australia (Allen, 1996). *Oxyeleotris colasi* differs from its congeners by the absence of eyes, its skin and fins being totally depigmented, the presence of a well developed sensory papillae system partly consisting of low raised fleshy ridges on each side of the head, a reduced number of cephalic sensory pores, a reduced number of scales on head and body, a long head with a short snout length, a narrow mouth width and a long upper jaw length, body shape with a shallow anterior body depth and narrow body width, a long and deep caudal peduncle, long predorsal and prepectoral lengths, and a long pectoral fin.

RÉSUMÉ. - *Oxyeleotris colasi*, une nouvelle espèce de poisson cavernicole de Lengguru en Papouasie occidentale (Teleostei : Eleotridae).

Oxyeleotris colasi est la première espèce de poisson hypogée décrite de Papouasie occidentale. Elle a été capturée dans un trou d'eau douce situé dans la grotte de Jabuenggara au cœur de l'anticlinal de Seraran dans le karst de Lengguru. Cette espèce présente beaucoup d'affinités avec l'espèce dépigmentée *O. caeca* décrite par Allen (1996) dans la partie orientale de la Nouvelle-Guinée. Ces deux espèces troglomorphes seraient probablement dérivées de *O. fimbriata*, une espèce épigée d'eau douce et largement distribuée en Nouvelle-Guinée et dans la partie nord de l'Australie. *Oxyeleotris colasi* se distingue de ses congénères par l'absence des yeux, une peau et des nageoires totalement dépigmentées, la présence d'un système développé de papilles sensorielles avec un relief marqué et notamment représenté par des crêtes verticales sur les côtés de la tête, un nombre réduit de pores sensoriels céphaliques, un nombre réduit d'écaillles sur la tête et le corps, une longue tête munie d'un museau court, d'une bouche étroite et d'une mâchoire inférieure relativement développée, une faible hauteur et largeur de corps dans sa partie antérieure, un pédoncule caudal allongé et relativement épais, de longues distances pré-dorsale et pré-pectorale, et une longue nageoire pectorale.

Key words. - Eleotridae - *Oxyeleotris colasi* - West Papua - Indonesia - Lengguru - Karst - Hypogean fish - New species.

Romero and Paulson (2001) presented a general review of blind cave fishes. There are approximately 90 species of troglomorphic fishes occurring worldwide and belonging to 18 families: Amblyopsidae, Astroblepidae, Balitoridae, Bythitidae, Characidae, Clariidae, Cobitidae, Cyprinidae, Eleotridae, Gobiidae, Ictaluridae, Loricariidae, Pimelodidae, Poeciliidae, Siluridae, Sternopygidae, Synbranchidae and Trichomycteridae. Most of these species are restricted

to the intertropical zone and are confined to phreatic waters or to karstic areas. Troglomorphic fishes are characterised by highly variable level of structural reduction in eye development and pigmentation and by reduction in number and complexity of scales (Romero and Paulson, 2001).

In Indonesia, three species of troglitic blind fish are recorded from various karst areas around Sulawesi Island: *Grammonus thielei* Nielsen & Cohen (2004) from Tioman

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Island (North Sulawesi), *Bostrychus microphthalmus* Hoese & Kottelat (2005) from Gua Tanete close to Maros karst (South Sulawesi), and *Diancistrus typhlops* Nielsen, Schwarzhan & Hadiaty (2009) from an anchialine cave in Muna Island (Southeast Sulawesi).

Only three hypogean fish species are known from Australia and are distributed in a geographically restricted area. The two blind cave gudgeons *Milyeringa veritas* Whitley, 1945 and *M. brooksi* Chakrabarty, 2010 were described from the Cape Range Peninsula and Barrow Island in north-western Australia. Humphreys (2001) and Chakrabarty (2010) state that the two species inhabit a vast subterranean karst wetland in anchialine systems and occur sympatrically with the blind cave eel *Ophisternon candidum* (Mees, 1962).

Oxyeleotris caeca was the first hypogean fish recorded from Papua New Guinea (Allen, 1996). The species inhabits a limestone subterranean drainage connected to the Upper Kikori River in eastern New Guinea and is closely related to *O. fimbriata*, an epigeic fish that ranges widely in New Guinea and in Cape York, Australia (Allen, 1996).

No specialised troglomorphic species have been reported previously from Western New Guinea in spite of the extensive karst topography known from the Lengguru Range and from the Bird's Head Peninsula.

With the aim to contribute to a rapid assessment of biodiversity in such unexplored and remote rugged ecosystems, the Lengguru-Kaimana Scientific Expedition was held in 2010 by the Lembaga Ilmu Pengetahuan Indonesia (LIPI), the Institut de Recherche pour le Développement (IRD), the Akademi Perikanan Sorong (APSOR), the Muséum national d'Histoire naturelle (MNHN), the Badan Penelitian dan Pengembangan Kelautan dan Perikanan (BALITBANGKIP) and the Dinas Kelautan dan Perikanan Kaimana (DKP-Kaimana). Several new species were discovered during the expedition including the first known hypogean blind fish from Indonesian Papua, described in the present paper.

Because cave communities including stygobites are known to display a high degree of morphological convergence, the increasing development of molecular phylogenetic techniques gives new insights for resolving their evolutionary relationships (Chakrabarty *et al.*, 2012; Trontelj *et al.*, 2012). The systematic status of the new species was therefore clarified with the sequencing of the partial COX-1 mitochondrial gene.

MATERIAL AND METHODS

Specimens of the new species are deposited at the Museum Zoologicum Bogoriense (MZB, Indonesia) and in the Muséum national d'Histoire naturelle de Paris (MNHN, France).

The methods of counting and measuring are derived from Allen (1996) and Keith *et al.* (2004) with some modifications and additions. Measurements were taken with digital dial callipers under a stereomicroscope (x4). Measurements were taken on the left side and are expressed to the nearest 0.1 mm. All proportions are expressed as percentage of the standard length.

Counts are as follow. - Lateral scales are the number of scales in horizontal row from the upper corner of the gill cover to the caudal-fin base, excluding the small scales posterior to the hypural junction. Transverse scales are the number of scales in a vertical row between the base of the second dorsal fin and the base of the anal fin origin. Predorsal scales are the number of scales along the midline of the nape in front of the first dorsal fin. Circumpeduncular scales are the number of scales on the narrowest region of the caudal peduncle counted from the dorsalmost scale to the ventralmost scale in zigzag manner. Dorsal rays are the number of spines in the first dorsal fin and the spine and soft rays in second dorsal fin. Anal rays are the single spine and number of soft rays. The last soft ray of the anal and second dorsal fins is divided at the base and counted as a single ray. Pectoral rays are the total number of rays. Pelvic rays are the single spine and number of soft rays. Caudal rays are the total number of rays including procurrent rays. Gillrakers are the total number on the first branchial arch. The alphabetical labeling of cephalic sensory pores follows the system for gobioid fishes used by Akihito and Meguro (1975).

Measurements are as follow. - Standard length is measured from the anteriormost tip of the upper lip to the posteriormost point of the hypural fold formed when the caudal peduncle is bent. Head length is measured from the tip of the upper lip to the upper rear edge of the gill opening. Snout length is measured from the tip of the upper lip to the posterior nostril. Snout width is the least distance between the posterior nostrils. Upper jaw length is measured from the tip of the snout to posterior margin of premaxilla. Mouth width is measured from each posterior corner of mouth. Anterior body depth is measured vertically from the belly to the dorsum at the pelvic fin origin. Posterior body depth is measured vertically from the belly to the dorsum at the anal fin origin. Body width is the maximal width measured posteriorly just behind the pectoral-fin base. Caudal peduncle depth is the minimum depth. Caudal peduncle length is measured from the base of the last anal fin ray to the vertebral-hypural junction at the caudal-fin base. Predorsal length is measured from the tip of the upper lip to the base of the spine at the origin of first dorsal fin. Prepelvic length is measured from the tip of the upper lip to the base of the spine at the origin of pelvic fin. Preanal length is measured from the tip of the upper lip to the base of the spine at the origin of anal fin. Prepectoral length is measured from the tip of the upper lip to the anteriormost part of pectoral-fin base. Pectoral fin

length is measured from the base to the tip of the longest soft ray. Pelvic fin length is measured from the anteriormost part of pelvic-fin base to the tip of the longest soft ray.

Comparative material

Three specimens of the New Guinean blind fish *Oxyeleotris caeca* housed in the Western Australian Museum in Perth: WAM P. 31208-001, a female, 85.3 mm SL, Kafa village at type locality, 6°35'S, 143°30'E, coll. Allen G.R., 2 Nov. 1996; WAM P. 31682-001, 2 spms, a male, 92.3 mm SL, a female, 82.6 mm SL, same data as previous registration number.

DNA sequencing

Genomic DNA was extracted from two specimens of the new species by using the Genomic DNA mini Kit (Tissue) of Geneaid Ltd according to manufacturer specifications. The complete cytochrome oxidase I gene (COI) was amplified using the primers FOXY-TCWTAGTTAACAGCTAAGCG and R2OXY-RAAGTGRCAGAGYGGTTATG defined from the alignment of the complete mitochondrial genome of *Beryx decadactylus* (NC_004393), *Rhyacichthys aspro* (NC_004414), *Eleotris acanthopoma* (NC_004415) and *Odontobutis platycephala* (NC_010199). Double-stranded DNA amplifications were performed with the FastStart PCR Master Kit from Roche Ltd in 26 μ L total reaction volume containing 13 μ L of 2X master mix, 2 μ L of each primer (stock solution 10 μ M), 5 μ L of template DNA (250-1000 ng) and 4 μ L of ddH₂O. Amplifications were made with an initial denaturation step at 95°C for 3 min followed by cycle of three steps (94°C for 1 min, 58°C for 2 min, 72°C for 2 min 30 sec) repeated 34 times and ended by a final extension at 72°C for 10 min. Both strands of purified PCR fragments were sequenced by GenoScreen (Lille, France) using BIGDYE 3.1 protocol on 3730 XL 96 capillary sequencers (Applied Biosystems) using the same primers as for amplifications. The sequences have been deposited in GenBank and BOLD (Ratnasingham & Hebert, 2007). Sequence relatedness was performed in the database Nucleotide Sequence collection (nr/nt) available in NCBI by using the Basic Local Alignment Search Tool (BLAST). The belonging of the new species to the genus *Oxyeleotris* was tested by assessing its phylogenetic relationships with the following Gobiiformes: *Oxyeleotris lineolata* (AY722165), *Oxyeleotris marmorata* (AY722177), *Bostrychus sinensis* (NC_017880), *Butis butis* (AY722180), *Eleotris acanthopoma* (NC_004415), *Eleotris fusca* (AY722172), *Kribia nana* (AY722150), *Milyeringa brooksi* (AY722169), *Odontobutis platycephala* (NC_010199), *Rhyacichthys aspro* (NC_004414). Sequence divergence was calculated using the Kimura 2-parameter (K2P) model and the mid-point rooted Neighbour-joining (NJ) tree of K2P distances was created to provide a graphic representation of the species divergence as implemented in

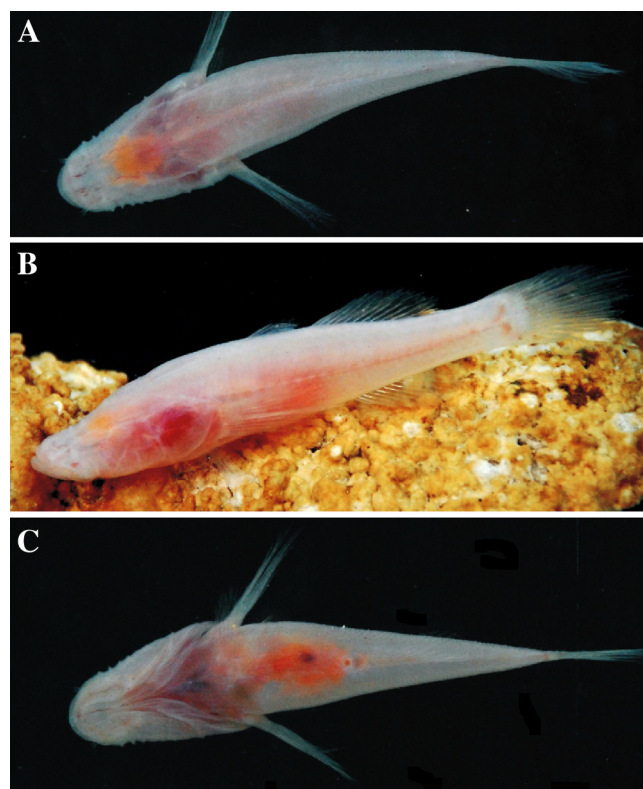


Figure 1. - Live coloration of *Oxyeleotris colasi*, MZB 20031 (holotype), male, 40.6 mm SL, Jabuenggara Cave near Sewiki Lake, Arguni Bawah, Kaimana, West Papua, Indonesia (A: Dorsal view; B: Lateral view; C: Ventral view).

Table I. - Measurements taken on the holotype and 8 paratypes of *Oxyeleotris colasi* sp. nov.

	Holotype	Paratypes				
SL (mm)	40.6	26.3-43.0				
<i>in % standard length</i>		n	min	max	mean	SD
Head length	39.3	8	38.1	39.7	38.7	0.7
Snout length	7.2	8	7.3	7.4	7.3	0.0
Snout width	8.4	8	8.3	9.0	8.7	0.3
Upper jaw length	13.6	8	13.4	14.0	13.7	0.3
Mouth width	10.5	8	8.5	11.4	9.6	1.3
Anterior body depth	17.0	8	16.0	18.8	17.7	1.3
Posterior body depth	17.0	8	15.6	18.4	16.9	1.2
Body width	18.0	8	17.0	18.1	17.7	0.5
Caudal peduncle depth	11.9	8	10.8	11.3	11.0	0.2
Caudal peduncle length	23.5	8	22.5	24.0	23.0	0.7
Predorsal length	47.1	8	46.1	46.9	46.5	0.4
Prepelvic length	34.0	8	34.6	35.8	35.1	0.5
Preanal length	66.1	8	63.8	65.7	64.6	0.8
Prepectoral length	40.3	8	39.2	41.3	40.1	0.9
Pectoral fin length	24.5	8	23.9	26.7	25.7	1.6
Pelvic fin length	17.1	8	16.8	18.4	17.3	0.8

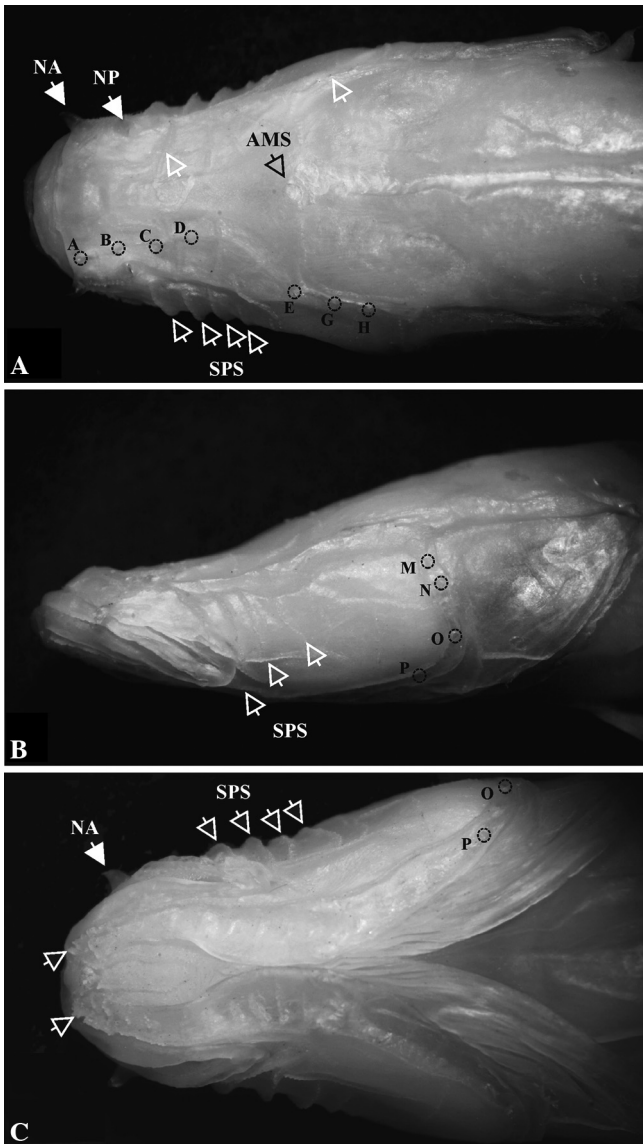


Figure 2. - *Oxyeleotris colasi*, holotype, close-up photograph of head (A: Dorsal view; B: Lateral view; C: Ventral view) showing tracks of cephalic sensory papillae system (SPS), position of sensory pores (alphabetical labelling as per Akihito and Meguro, 1975), position of anterior (NA) and posterior nostril (NP) and position of anteriormost predorsal scales (AMS).



Figure 4. - *Oxyeleotris colasi*, X-Ray lateral view (MNHN 2010-0034, 35.5 mm SL, photo MNHN).

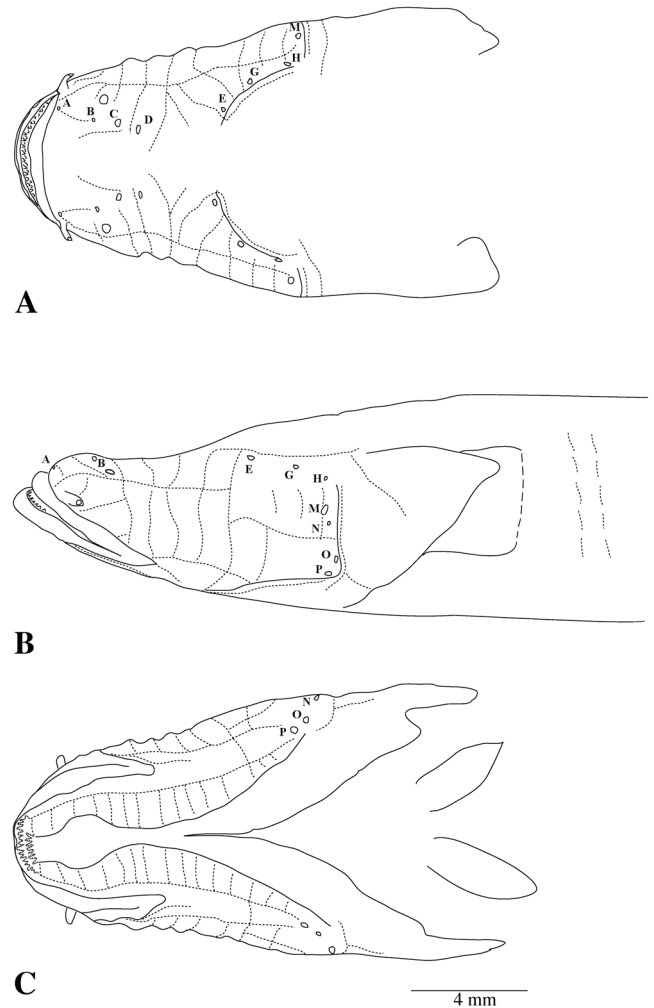


Figure 3. - *Oxyeleotris colasi*, composite drawing of sensory papillae (dotted line) and position of sensory pores, based on holotype and paratypes. (A: Dorsal view; B: Lateral view; C: Ventral view).

MEGA version 5. The reliability of the estimated tree was assessed with the bootstrap method (MEGA version 5) using 1000 replicates on the sequence dataset.

***Oxyeleotris colasi*, sp. nov. Pouyaud,
Kadariusman & Hadiaty
(Figs 1-4; Tab. I)**

Type material

Holotype. - MZB 20031, a male, 40.6 mm SL, 3°19.424'S-133°44.798'E, Jabuenggara Cave on the border of Sewiki Lake, 14 km south of Urisa village in Arguni Bay, northern edge of the anticline of Seraran in the limestone karst of Lengguru, Kaimana, West Papua Province, Indonesia; Coll. B. Fromento, A. Ajambua, N. Lemauk, L. Janoma, L. Pouyaud, 2 Nov. 2010 (Fig. 1).

Paratypes. - MZB 20032, a male (26.3 mm SL), 3 females (35.5-43.0 mm SL), same data as for holotype; MNHN 2010-0034, an immature (28.8 mm SL), a male (33.1 mm SL), 2 females (30.1-35.5 mm SL), same data as for holotype.

Type locality

A freshwater pool (Fig. 5) located at 50 m inside from the opening of Jabuenggara Cave and connected to an unexplored anchialine drainage in the karst of Seraran anticline (Fig. 6). Habitat in total darkness, water clear with around 1 m of tidal range, specimens caught with hand net in freshwater at about 23°C. The subterranean drainage is connected to the Sewiki Lake, which flows to Arguni Bay in front of Urisa village.

Etymology

The species is named *colasi*, in honour of the COLAS Companies in Indonesia which sponsored, among others, the Lengguru-Kaimana expedition in October-November 2010.

Distribution

The new species is currently known only from the type locality, which is connected to a vast subterranean drainage in the limestone anticline of Seraran, West Papua, lying in the western side of the Lengguru Range in West Papua (Fig. 7).

Diagnosis

Oxyeleotris colasi is distinguished from all of its congeners by the combination of the following characters: eyes absent; skin and fins totally depigmented; a well developed sensory papillae system, with a marked relief on snout, pre-orbital region, anteriormost part of chin and consisting of low fleshy ridges on each side of the head; sometimes one or two vertical rows of papilla on the body, laterally, behind the pectoral fins; cephalic sensory pores reduced, pores F, I, J, K, and L absent, no extra pores between D and E; pores A, B, C and D, always present as N, O, P; pores H and M absent on some specimens (M sometimes missing on one side of the fish but not on the other), pores E, G, rarely present; dorsal rays VI-I,9 to 11; anal rays I,8-9; cycloid scales dorsally, covering the belly and extending from the posterior part of the head to the flanks to the middle of first dorsal fin; ctenoid scales on flanks from the middle of first dorsal fin to caudal peduncle; lateral scales 47-49; transverse scales 19; predorsal scales 30-32; anteriormost predorsal scales extending until middle of head; circumpeduncular scales 23-25; gillrakers 13; vertebrae 10 + 16 = 26; head long, length 38.1-39.7% of SL; snout short, length 7.2-7.4% of SL; upper jaw long, length, 13.4-14.0% SL; mouth narrow, width 8.5-11.4% SL; body slender, anterior body depth 16.0-18.8% SL and body width 17.0-18.1% of SL; caudal peduncle long and deep (its

Table II. - Measurements taken on the three specimens of *Oxyeleotris caeca*.

SL (mm)	<i>Oxyeleotris caeca</i>				
	82.6-92.3				
<i>in % standard length</i>	n	min	max	mean	SD
Head length	3	34.2	35.6	34.9	0.7
Snout length	3	7.6	8.6	8.0	0.6
Snout width	3	8.7	10.6	9.7	1.0
Upper jaw length	3	12.2	13.2	12.6	0.5
Mouth width	3	11.5	13.3	12.2	1.0
Anterior body depth	3	19.3	20.6	19.8	0.7
Posterior body depth	3	16.8	18.3	17.5	0.7
Body width	3	18.7	21.6	20.3	1.5
Caudal peduncle depth	3	10.6	10.7	10.6	0.1
Caudal peduncle length	3	20.3	21.7	20.9	0.7
Predorsal length	3	43.6	45.9	44.6	1.2
Prepelvic length	3	33.1	35.4	34.1	1.2
Preanal length	3	63.9	65.5	64.7	0.8
Prepectoral length	3	36.5	38.4	37.7	1.1
Pectoral fin length	3	22.7	23.7	23.1	0.5
Pelvic fin length	3	17.5	18.5	18.0	0.5

Table III. - Counts taken on the three specimens of *Oxyeleotris caeca*.

	WAM	WAM	
	P. 31208.001	P. 31682.001	
	Female	Male	Female
Lateral scales	55	53	55
Transverse scales	17	16	17
Predorsal scales	40	40	40
Circumpeduncular scales	22	21	21
Dorsal rays	VI-I.11	VI-I.11	VI-I.11
Anal rays	I.9	I.9	I.9
Pectoral rays	16	16	16
Pelvic rays	I.5	I.5	I.5
Vertebrae	28		

length 22.5-24.0 and depth 10.8-11.9% of SL); predorsal length 46.1-47.1% of SL; prepectoral length 39.2-41.3% of SL; pectoral fin length 23.9-26.7% SL.

Description

Counts and proportions that appear in parentheses refer to the range for paratypes (8 specimens, 26.3-43.0 mm SL) if different from the holotype (given first). Morphometric data are given in table I.

Dorsal rays VI-I,11 (VI-I,9-10); anal rays I,9 (I,8-9); pectoral rays 16, all rays branched except upper and lowermost; pelvic rays I,5; segmented caudal rays 8 + 7; dorsal procurrent caudal rays 7, ventral procurrent rays 7; lateral scales 48 (47-49); transverse scales 19; predorsal scales 32 (30-32); anteriormost predorsal scales extending to middle of head

(Fig. 2); circumpeduncular scales 23 (23-25); total gillrakers on first arch 13; vertebrae $10 + 16 = 26$ (Fig. 4).

Body slender and relatively elongate, laterally compressed, its width similar to anterior and posterior body depth; head elongate with a concave profile and depressed frontal region where eyes would be; snout short and flattened; predorsal, preanal and prepelvic length elongate; caudal peduncle elongate and deep.

Mouth large, lower jaw protruding; dense band of villiform teeth on upper and lower jaw, those of outermost row slightly enlarged; vomer and palatine edentate; anterior nostril tubular overhanging upper lip; posterior nostril as an open pit on upper part of snout.

Cycloid scales dorsally, covering the belly and extending from the posterior part of the head to the flanks until the middle of first dorsal fin; ctenoid scales on flanks from the middle of first dorsal fin to caudal peduncle; top of head partially scaled with anteriormost predorsal scales ending in the middle of its length (Fig. 2A); no scales on snout, preorbital and orbital region, lower jaw, lips and chin; few scales on posterior margin of preoperculum; operculum partially scaled with embedded scales smaller than body scales.

Cephalic sensory pores reduced (Figs 2, 3). Pores F, I, J, K, and L absent; no extra pores between D and E; pores A, B, C and D, always present as N, O, P; pores H and M absent on some specimens (M sometimes missing on one side of the fish but not on the other); Pores E, G, rarely present.

Sensory papillae system well developed on head and snout (Figs 2, 3) and forming marked relief on preorbital region (4 to 5 vertical ridges) and on anteriormost part of chin; sometimes one or two vertical rows of cutaneous papilla on the body, laterally, behind the pectoral fins.

First dorsal fin rectangular and much shorter than second dorsal fin, situated at level about midway between pelvic and anal fins, the spines weak; posterior rays of first dorsal fin when depressed not reaching origin of second dorsal fin; posterior rays of second dorsal fin and anal fin elongated and extending when depressed to middle part of caudal peduncle; 4th spine of first dorsal fin tallest, 11.4% of SL; 5th spine of second dorsal fin tallest, 14.5% of SL; 7th ray of anal fin tallest, 16.2% of SL; pelvic fins short with rounded margin; pectoral fins long with rounded margin and extending to anal fin origin; caudal fin long and rounded.



Figure 6. - View of the anticlinal of Seraran from Arguni Bay near the village of Wanoma

Males with a triangular and flattened urogenital papilla with distal tip rounded; females with a broad and flattened urogenital papilla with fimbriate margin.

Comparisons

The complete COI gene (1554 bp) was sequenced for two specimens of *O. colasi* (MZB 20032, 35.5 mm SL and MNHN 2010-0034, 30.1 mm SL). No difference was observed between the two individuals. Compared to the sequence database available in NCBI, the COI sequence of the new species appears to be most closely related to *Oxyeleotris marmorata* (Bleeker, 1852) (type species of the genus



Figure 5. - B. Fromento, one of the collectors, visiting the subterranean habitat of *Oxyeleotris colasi* in Jabuenggara Cave.

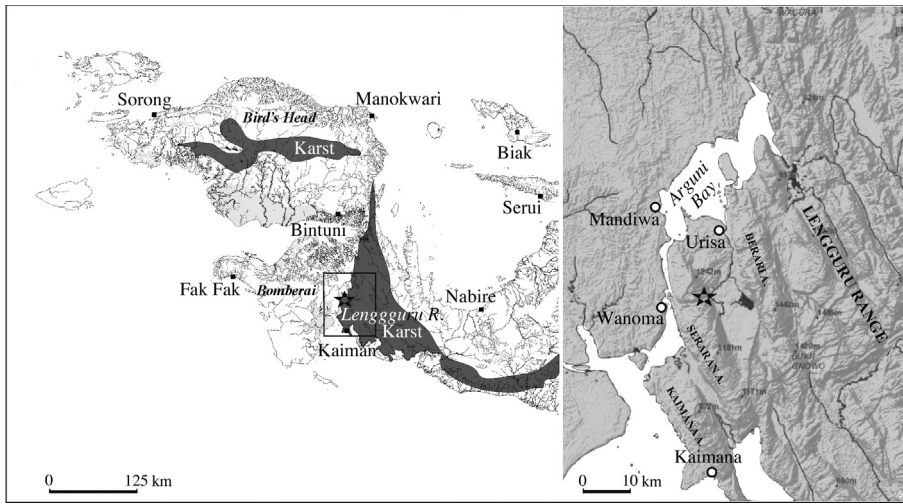


Figure 7. - Geographic localisation of the type locality of *Oxyeleotris colasi* (★).

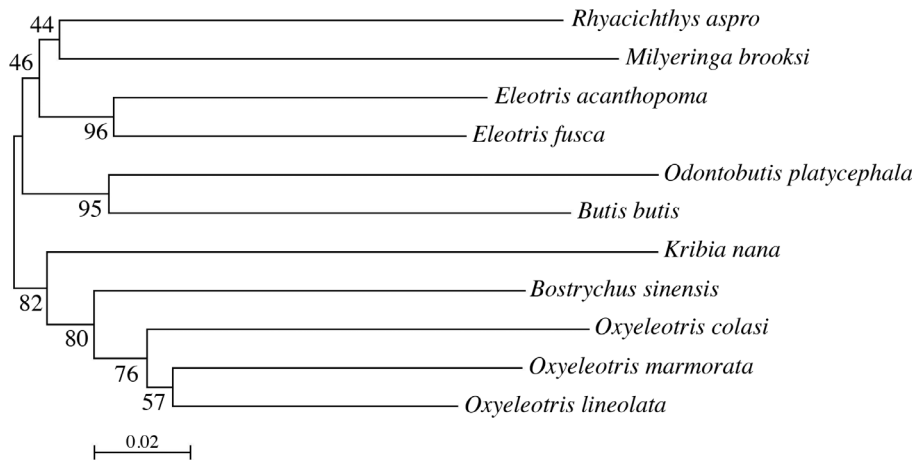


Figure 8. - Bootstrapped K2P-NJ tree including *Oxyeleotris colasi* and other gobioids based on COI haplotypes. Bootstrap values (in %) are indicated for each node.

cf. Bleeker, 1874) and also to *O. lineolata* (Steindachner, 1867), with a genetic divergence of 14%. The K2P-NJ tree (Fig. 8) confirms the monophyly of the new species with *O. marmorata* and *O. lineolata* compared to the other gobioids (bootstrap 76%), which therefore demonstrate its belonging to this genus.

Morphologically, *O. colasi* most closely resembles *O. caeca*, the blind cave fish from Papua New Guinea, described by Allen (1996). Following this author, *O. caeca* is most similar to the epigeal *O. fimbriata*, one of the most widespread gudgeons in New Guinea and one of the few purely freshwater fishes occurring on both sides of the central dividing range and on the Bird's Head Peninsula (Allen, 1991).

Oxyeleotris colasi (Figs 2, 3) seems to exhibit a higher degree of troglomorphism than *O. caeca* (Fig. 9), including a skin totally depigmented (*versus* skin pigmentation mainly absent, except on the dorsal portion of body; see diagnosis in Allen (1996)), absence of eyes (*versus* vestigial eyes not externally visible but still pigmented in orbit; see figure 1 in Allen (1996)), a very well developed sensory papillae sys-

tem with a marked relief on preorbital region and on anteriormost part of chin (*versus* papillae not raised on fleshy ridges on preorbital region and less marked on anteriormost part of chin), head partially scaled with anteriormost predorsal scales ending at middle of its length (*versus* anteriormost predorsal scales ending at level of posterior nostril), reduced number of cephalic pores with no extra pores between D and E, pores E and G rarely present, pores K and L absent, pore M sometimes missing on one side of the fish but not on the other (*versus* presence of 2 extra pores between D and E, pores E, G, K, L, M always present).

Oxyeleotris colasi (Tab. I) is distinguishable from *O. caeca* (Tabs II, III) by a longer head length (38.1-39.7 vs. 34.2-35.6% SL), a shorter snout length (7.2-7.4 vs. 7.6-8.6% SL), a longer upper jaw length (13.4-14.0 vs. 12.2-13.2% SL), a smaller mouth width (8.5-11.4 vs. 11.5-13.3% SL), a narrow anterior body depth (16.0-18.8 vs. 19.3-20.6% SL), a slender body width (17.0-18.1 vs. 18.7-21.6% SL), a deeper caudal peduncle depth (10.8-11.9 vs. 10.6-10.7% SL), a longer predorsal length (46.1-47.1 vs. 43.6-45.9% SL), a longer prepectoral length (39.2-41.3 vs. 36.5-38.4% SL),

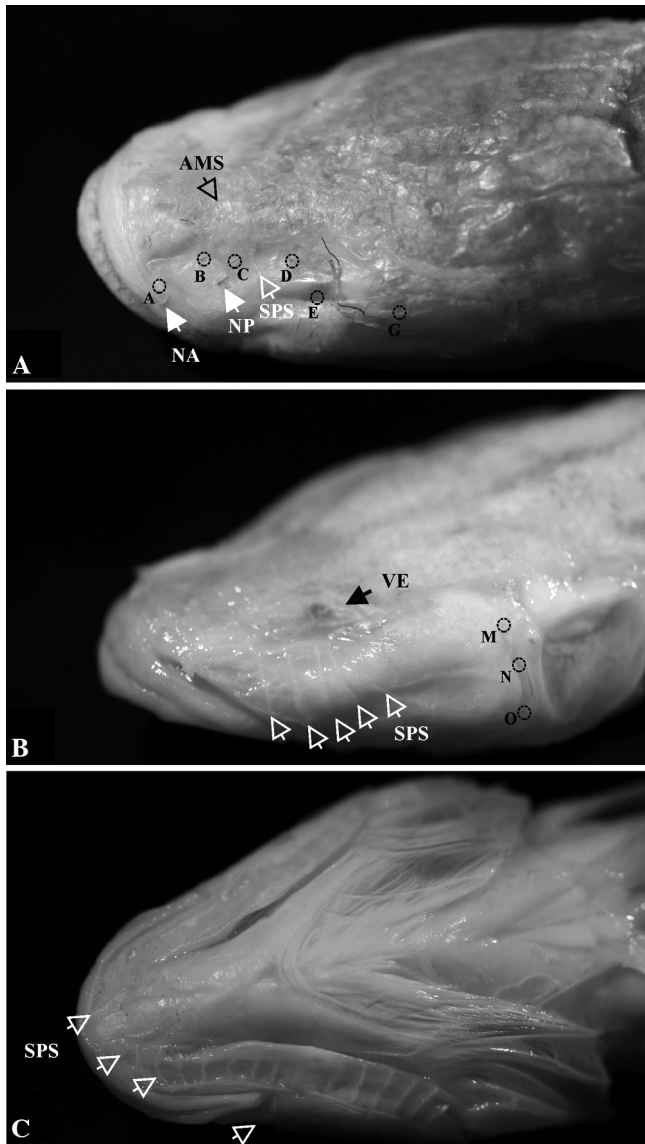


Figure 9. - *Oxyeleotris caeca*, close-up photograph of head (A: Dorsal view; B: Lateral view; C: Ventral view) showing tracks of cephalic sensory papillae system (SPS), position of sensory pores (alphabetical labelling as per Akihito and Meguro (1975)), position of anteriormost predorsal scales (AMS) and pigmentation of vestigial eye (VE).

a longer caudal peduncle length (22.5-24.0 vs. 20.3-21.7% SL), a longer pectoral fin length (23.9-26.7 vs. 22.7-23.7% SL), fewer lateral scales (47-49 vs. 53-55), more transversal scales (19 vs. 16-17), fewer predorsal scales (30-32 vs. 40), more circumpeduncular scales (23-25 vs. 21-22), more gill-rakers (13 vs. 10) and fewer vertebrae (26 vs. 27-28, Figs 4, 10).

Allen and Renyaan (1996) described five specimens of *Oxyeleotris fimbriata* from Kamaka region in the internal part of the limestone karst of Lengguru. We therefore used the meristic data provided by these authors for comparison

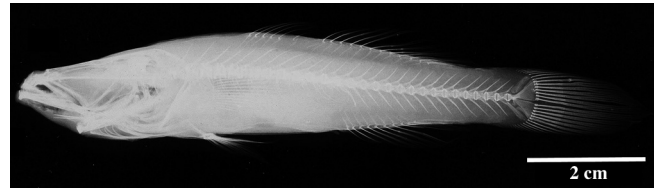


Figure 10. - *Oxyeleotris caeca*, X-Ray lateral view (WAM P31208-001, 85.3 mm SL, photo MNHN).

with the new species. Beside obvious differences involving the lack of eyes and absence of skin pigmentation, the new species differs from the specimens of *O. fimbriata* inhabiting the same geographic area by fewer lateral scales (47-49 vs. 52-57), fewer vertebrae and fewer predorsal scales (30-32 vs. 36-42). Following Allen (1991, 1996), the new species differs from *O. fimbriata* distributed throughout New Guinea by fewer circumpeduncular scales (23-25 vs. usually 26-28) and by the pattern of cephalic pores (pores F, I, J, K, and L missing in the new species vs. present on *O. fimbriata*).

CONCLUSION

In many areas of Southeast Asia, karst systems have formed “islands within islands” (Clements *et al.*, 2006). The high species diversity and endemism observed in karst landscapes is explained by a large array of ecosystems, complex and fragmented terrains, variable local climatic conditions, and also by tectonic and eustatic histories, variable degrees of isolation, and incidence of random events.

Karst covers large section of New Guinea but their exploration is the least advanced of any sector in the Australasian region.

The discovery of the first hypogean species in Western Papua emphasizes the role of limestone karsts on biological diversification and endemism and suggests that this vast unexplored area is probably home of many other undiscovered taxa.

Further zoological expeditions in the area will prioritize the discovering of additional hypogean species and will give new insights on their phylogenetic relationships with epigean species present in New Guinea for understanding the evolutionary processes that have contributed to these diverse endogean taxa.

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