

An unexpected new *Poropanchax*
(Cyprinodontiformes, Procatopodidae)
from the Kongo Central Province,
Democratic Republic of Congo

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ABSTRACT

A new procatopodid, assigned to the genus *Poropanchax*, is described from a wetland habitat located adjacent to the Inga Falls in Lower Congo. *Poropanchax pepo*, new species, is distinguished from all congeners by a combination of characters including a higher D/A ratio, rounded anal and dorsal fins, a humeral blotch in males, and the absence of a sharp ventral process on the basipterygium. The finding of a *Poropanchax* species in Lower Congo was unexpected, since the closest known congeneric population is located in northwestern Gabon, some 700 kilometers to the north. As recognized herein the genus *Poropanchax* is a clade comprised of five species geographically restricted to humid coastal regions of west and west-central Africa.

INTRODUCTION

Procatopodidae comprise about 100 oviparous killifish species distributed throughout Africa's freshwater environments (Ghedotti, 2000; Bragança and Costa, 2019). Despite high

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diversity and a widespread distribution, the African lampeyes, as they are commonly known due to the presence of a bright reflective dorsal region of the eyes, have been the subject of only a few taxonomic or systematic studies (Parenti, 1981; Huber, 1999a; Ghedotti, 2000). However, recent molecular and morphological studies are beginning to shed light on procatopodid internal relationships and classification (Bragança and Costa, 2019; Bragança in prep.).

Poropanchax was erected in 1967 by Stenholt Clausen⁴ with *Aplocheilichthys macrophthalmus* Meinken, 1932, now a synonym of *Poropanchax luxophthalmus* (Brüning, 1929), as type species. The genus was initially defined on the basis of the presence of a closed, anterior portion of the supraorbital canal system with three pores. In the same study, *Aplocheilichthys normani* Ahl, 1928, and *A. rancureli* Daget, 1965, were assigned to *Poropanchax* because, in addition to a closed anterior portion of the supraorbital, they also shared with *P. luxophthalmus* pronounced sexual dimorphism in body size, as well as the size, shape, and extension of the fins. According to Clausen (1967), *Poropanchax* species exhibit two distinct environmental preferences, with *P. normani* a savannah species occurring in the arid Sahel and having a typical Nilo-Sudanic distribution, while the other species are restricted to humid coastal plains in the upper and lower Guinean ichthyofaunal provinces.

Huber (1999a, 1999b) reported on populations of *Aplocheilichthys scheeli* Romand, 1970, from Gabon, and highlighted the presence of a closed anterior portion of the supraorbital system with two or three pores. He noted that this was in contrast to the supraorbital system in populations from Equatorial Guinea in which the anterior portion was open with three neuromasts exposed. Huber (1999a) argued that the number of pores, as well as the presence of an open or closed supraorbital system, is variable, and so placed *A. scheeli* in *Poropanchax* because of extreme sexual dimorphism and a presence of elongated fins in males in all populations of the species. However, Wildekamp and Malumbres (2004), after examining additional populations of *A. scheeli* from coastal Cameroon to northern Gabon, recognized two species: *A. scheeli* with an open supraorbital system (transferred to *Micropanchax*) and a new species, *Poropanchax stigmatopygus* Wildekamp and Malumbres, 2004, with a closed anterior supraorbital system with 2–3 pores (corresponding to Huber's northern Gabon populations of *P. scheeli*).

Recently, Bragança and Costa (2019) provided the first comprehensive, time-calibrated, molecular analysis of the Procatopodidae, establishing intrafamilial relationships and providing information on the origin and diversification patterns of procatopodid lineages. That study also revealed the paraphyly of some genera, including *Poropanchax*. “*Poropanchax*” *normani*, was recovered as sister to a large clade consisting of species belonging to *Lacustricola*, *Micropanchax*, *Rhexipanchax*, and the remaining *Poropanchax* species. All of these occur in arid savannah environments except for the species belonging to a restricted *Poropanchax*, then known only from coastal rainforests of the upper and lower Guinean provinces.

Despite the possession of an open supraorbital system with exposed neuromasts, Bragança and Costa (2019) reassigned *Micropanchax scheeli* to *Poropanchax*, a placement supported by

⁴ H. Stenholt Clausen is often referred to as H.S. Clausen. Stenholt, however, is not part of his first name but is part of his composite family name (M. Juhl, personal commun., 2018). Since almost all references in the literature to his work list him as Clausen, H.S., to avoid confusion in this paper we will continue to do so.

their initial molecular data, and by a more extensive molecular and morphological analysis (Bragança in prep.), in which additional taxonomic reassignments, generic diagnoses, and new generic names will be provided.

In 2002, during a biodiversity survey in the Democratic Republic of Congo, a new procatopodid species was collected just north of Inga in Lower Congo, but given the lack of available taxonomic information at the time it could not be assigned to genus and was left undescribed (Shumway et al., 2003). However, following Bragança and Costa (2019) and ongoing osteological research (Bragança in prep.), we herein assign the specimens to *Poropanchax* and provide justification for that assignment and a formal taxonomic description of the new species.

MATERIAL AND METHODS

Description of the new species is based on a collection made in September 2002 approximately 4.5 km northeast of the village of Inga, Kongo Central Province (formerly Bas-Congo), Democratic Republic of Congo. Preserved specimens are deposited in the collections of the American Museum of Natural History, New York (AMNH), Royal Museum for Central Africa, Tervuren, Belgium (MRAC), and Zoological State Collection, Munich, Germany (ZSM). Additional comparative material includes specimens deposited in the ichthyological collection of the Muséum National d'Histoire Naturelle, Paris, France (MNHN), South African Institute for Aquatic Biodiversity, Grahamstown, South Africa (SAIAB), and Federal University of Rio de Janeiro, Rio de Janeiro, Brazil (UFRJ). All institutional abbreviations follow Sabaj (2016).

Measurements were taken by photographing each specimen in an Ortech Professional Photobox Plus (Model 1419) on a platform with a Nikon D200 camera with a 60 mm f/2.8 AF Micro-Nikkor lens, and a 1 cm scale. Specimens were pinned to mark fins and caudal peduncle prior to photographing, and images uploaded into tpsDIG2 (Rolf, 2013). Measurements are presented as percentages of standard length (SL) rounded to the nearest 0.1 mm.

Measurements follow Amiet (1987) except for SL, which was taken from the anterior tip of the snout and not from the tip of the lower jaw. Scale counts along the midlongitudinal series include scales between the upper attachment of the opercular membrane and the caudal-fin base, and exclude scales beyond the hypural junction. The relative position of the first dorsal-fin ray to anal-fin rays (D/A) was estimated as in Sonnenberg and Schunke (2010). Pleural ribs and vertebrae were counted using a digital In-Vivo DSX Pro X-ray machine, and rays of unpaired fins were counted using a physical Faxitron X Ray Corporation Cabinet X-Ray System.

Nomenclature for the cephalic laterosensory system follows Clausen (1967) and Van Bergeijk and Alexander (1962), and that for the supraorbital (frontal) squamation follows Hoedeman (1958). Photos of the cephalic sensory system were taken using a Nikon SMZ800 microscope/camera connected to a computer and the NIS-Elements D computer application, with a 1× objective lens. Osteological studies were made on cleared and stained specimens (C&S) prepared according to Taylor and Van Dyke (1985). Osteological structures were photographed also using the Nikon SMZ800 microscope and illustrations were made with drawing tube or based on the high-quality photographs. We follow the pragmatic approach of Moritz et al. (2000) as a species concept.



FIGURE 1. *Poropanchax pepo*, new species in preservation: **A**, AMNH 267246, holotype (male); **B**, AMNH 267247, paratype (female). Scale bar = 1 cm.

Poropanchax pepo, new species

Figures 1–5; tables 1, 2

HOLOTYPE: AMNH 267246, male, 27.9 mm SL, Democratic Republic of Congo, Kongo Central Province, 4.5 km northeast of the village of Inga, Fwamalo river channel adjacent to the right bank of the Congo River (5°28'13" S, 13°35'01" E), R. Schelly et al, 25 September 2002.

PARATYPES: AMNH 267247, 8 males and 2 females, 23.9–30.1 mm SL, 2 are C&S, same data as holotype. — MRAC 2019-006-P-0001-0006, 5 males and 1 female, 25.4–26.4 mm SL, same data as holotype. — ZSM 47479, 3 males and 1 female, 24.3–28.0 mm SL, same data as holotype.

DIAGNOSIS: *Poropanchax pepo* is distinguished from all procatopodids (except other *Poropanchax*) by the presence of a slightly curved, posteriorly directed, distal maxillary process (vs. straight, anteromedially directed or deeply constricted); and the presence of a slender (vs. robust) dentary. It is distinguished from all congeners by a D/A of 11–14 (vs. 5–10), the presence of rounded anal and dorsal fins in males (vs. pointed); the presence of a dark humeral blotch in males (vs. absence); and the absence of a sharp ventral process on the basipterygium (vs. presence). *Poropanchax pepo* is further distinguished from all congeners except *P. scheeli*, by the presence of an open anterior supraorbital system (vs. closed), and by the absence of bright bluish flank bands in males. It is similar to *P. rancureli* and distinct from other congeners in lacking filamentous pelvic fins (vs. pelvic filaments present). Other features not unique but useful for identification of *P. pepo* are the absence of a dark brown blotch on the lower jaw and preorbital area and the presence of a dark marginal band on the caudal-fin lobes.

TABLE 1. Morphometrics measurements (as percentages of SL) for the holotype and 18 paratypes of *Poropanchax pepo*, new species. C&S paratypes excluded. SD = standard deviation.

	<u>Holotype</u>	<u>Holotype and male paratypes (n = 15)</u>		<u>Female paratypes (n = 4)</u>	
		Range	Mean (SD)	Range	Mean (SD)
Standard length	27.9	24.4–30.1	26.5 (4.0)	23.9–25.4	24.5 (0.4)
Body depth	27.2	25.4–28.7	26.9 (0.6)	25.1–26.4	25.9 (0.7)
Head length	25.1	22.2–26.9	24.5 (0.6)	23.0–24.0	23.4 (0.5)
Eye diameter	9.3	8.6–10.7	9.6 (1.2)	9.0–9.8	9.1 (0.1)
Predorsal length	72.8	69.7–77.2	74.1 (2.1)	72.4–75.0	74.2 (0.4)
Preanal length	56.3	53.8–59.1	56.3 (2.1)	59.0–60.7	59.8 (1.2)
Prepelvic length	38.4	38.0–41.3	39.5 (0.5)	40.6–42.8	41.7 (1.2)
Dorsal-fin base	7.2	4.9–8.9	6.5 (0.4)	5.7–8.6	6.8 (1.6)
Anal-fin base	20.8	18.7–23.6	20.3 (1.7)	14.6–16.7	15.7 (1.4)
Caudal peduncle length	20.4	17.2–24.5	19.7 (2.2)	17.7–21.3	18.8 (1.2)
Caudal peduncle depth	15.4	14.8–16.0	15.4 (0.7)	13.9–15.0	14.1 (0.2)
Caudal peduncle ratio	0.8	0.8–1.7	1.2 (0.2)	1.3–1.4	1.4 (0.1)

TABLE 2. Meristic counts of *Poropanchax pepo*, new species. D/A position = first dorsal fin ray inserted above anal-fin ray number D/A.

	<u>Holotype</u>	<u>Paratypes (n = 18)</u>	
		Range	Mode
Dorsal fin rays	6	5–6	6
Anal fin rays	15	14–17	15
D/A position	12	11–14	12
Longitudinal scale rows	26	25–27	26
Transverse scale rows	6	6–6.5	6
Circumpeduncular scale rows	10	10	10
Precaudal vertebrae	10	9–10	10
Caudal vertebrae	16	15–16	16
Total vertebrae	26	25–26	26

DESCRIPTION: A large, strongly laterally compressed *Poropanchax* species, attaining a maximum recorded size of 30.1 mm SL (male, AMNH 267247), with general appearance as in figure 1. Dorsal profile anterior to dorsal fin almost straight, ventral profile convex, greatest body depth approximately at distal tip of pelvic fin, caudal peduncle straight. Mouth directed upward, lower jaw protruding, much longer than upper jaw. Outer row teeth on both jaws large, conical and slightly recurved. Inner row teeth smaller, irregularly implanted. Distal maxillary process slightly curved and posteriorly directed, dentary slender (fig. 2A). No branchiostegal appendages in adult males.

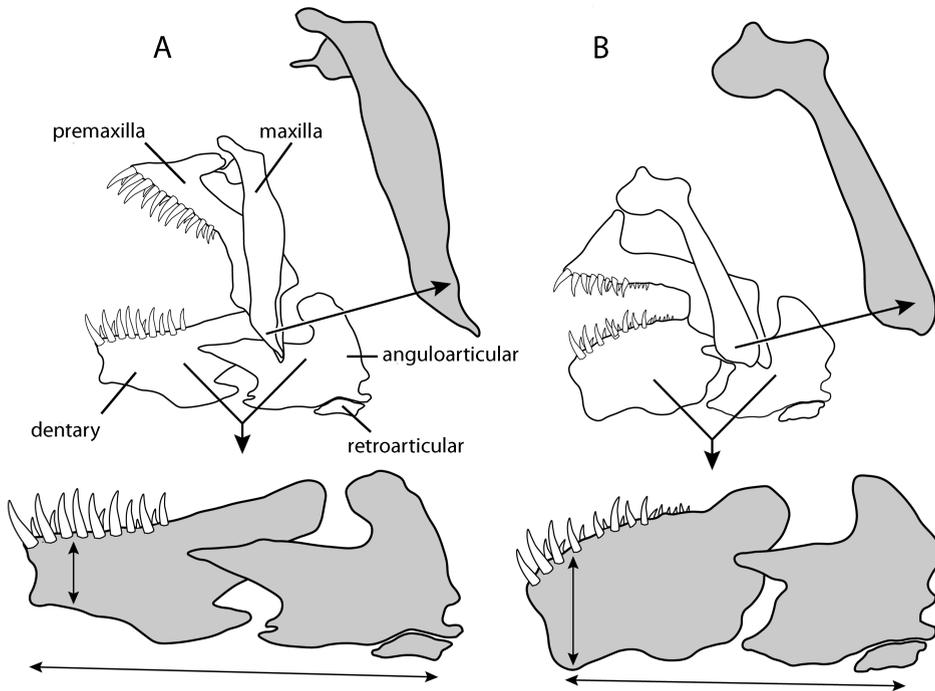


FIGURE 2. Oral jaws, with isolated maxillae and lower jaws highlighted: A, *Poropanchax pepo* (AMNH 267247); B, "*Lacustricola*" *johnstoni* (SAIAB 35820).

Dorsal-fin rays 5–6, anal-fin rays 14–17, first dorsal-fin ray above anal-fin ray (D/A) 11–14, caudal-fin rays 20–24. No dorsal, anal, or pelvic-fin extensions in males. Pelvic-fin rays 6, basipterygia lacking sharp ventral processes (fig. 3A).

Scales cycloid, body completely scaled except on ventral head surface. Frontal squamation of G-type, G-scale as long as wide, double E scale present, F scale present and H scales variably present (fig. 4A). No scales on dorsal- and anal-fin base, 2–3 scales over caudal-fin base. Longitudinal series 24–27, transverse series at dorsal-fin insertion 6, circumpeduncular scale rows 10. Pectoral fin reaching one third to mid-pelvic fin in females, in males from mid-fin almost to tip of pelvic fin; pelvic fin just reaching urogenital aperture.

Frontal neuromasts small. Preorbital sensory system in open groove with three neuromasts, postorbital canal with two pores, preopercular canal with six pores. Anterior supraorbital system in open groove with three exposed neuromasts; first neuromast anteriorly positioned; posterior portion in an open groove with three neuromasts (fig. 4A).

COLORATION IN LIFE (fig. 5, male): Snout brownish orange with scattered melanophores, iris silver. Dorsum bright orange, flanks pale orange with bluish silver iridescence. Ventrums from opercle to pelvic fins pale yellowish silver. Humeral blotch present, but weakly pigmented. Scales on flanks and dorsum reticulated. Pectoral fins hyaline, remaining fins pumpkin orange. Dorsal, anal, and pelvic fins with narrow white edge anteriorly, absent posteriorly. Dorsal fin with two elongate interradiial spots anteriorly, difficult to see in live specimens but prominent in preserved specimens. Caudal fin with a dark greyish-black distal margin, extended dorsally

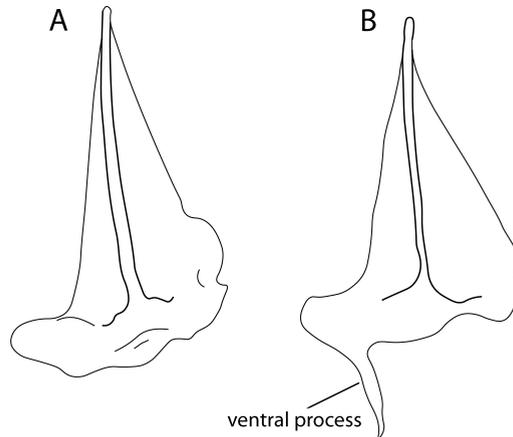


FIGURE 3. Isolated right basipterygium in ventral view: **A**, *Poropanchax pepo* (AMNH 267247); **B**, *P. stigmatopygus* (MRAC 77-17-P-934-936).

in posterior third of fin. Dorsally dark margin broad with light submarginal band, ventrally margin narrows and lacks submarginal band, giving caudal fin a characteristic asymmetrical patterning. Caudal interradials with small dark melanophores extending to midfin. Female coloration in life unknown. Preserved males (fig. 1A) with dorsum and flanks pale yellowish brown, scales reticulated. Head pale, especially on snout and below eye. Concentration of melanophores at third and/or fourth scale along midline forming humeral blotch (not well marked in all preserved specimens). Dorsal, anal, and caudal fins light grey. Interradials of dorsal and anal fin greyish black. In some males caudal interradials are dark only at base, in most interradials are dark to midfin, and in some dark interradials extend to posterior margin. Anal and dorsal fins with narrow light margin as in live specimens. Caudal fin with black distal margin, extended dorsally in posterior third of fin. Dark margin broad dorsally with light submarginal band, ventrally margin narrow and lacking a submarginal band. Anteriorly dorsal fin with two elongated dark interradial spots. In females (fig. 1B) head, dorsum, and flanks as in males, but scale reticulation less marked or absent, and no humeral blotch evident. All fins light grey and immaculate.

DISTRIBUTION AND HABITAT: *Poropanchax pepo* is currently known only from the type locality 4.5 km northeast of the village of Inga (fig. 6). Specimens were collected in a stagnant channel, with sand and boulders, located approximately 180 meters from the main channel of the Congo River (Shumway et al., 2003).

ETYMOLOGY: The name *pepo* refers to the orange color of the dorsum and unpaired fins in males, that resembles the color of the pumpkin *Cucurbita pepo* (Latin *pepo*, from Greek πέπων, meaning “ripe gourd”).

COMPARATIVE MATERIAL EXAMINED: “*Poropanchax*” *normani* (Ahl, 1928): MNHN 1965-0700, 106 specimens, Tchad, Lake Tchad, Stauch, 31 March 1962. — MNHN 1987-1429, 24 specimens (2 C&S), Guinea, affluent of Kolente, road Kolente-Madina-Oula, Lévêque, 9 February 1986. — MRAC 79-09-P-817-826, 10 specimens, Tchad, Bahr-Sara, Lambert, 11 November 1960. — MRAC 92-059-P-2039-2161, 126 specimens, Guinea, Ndyarendi, Kogon

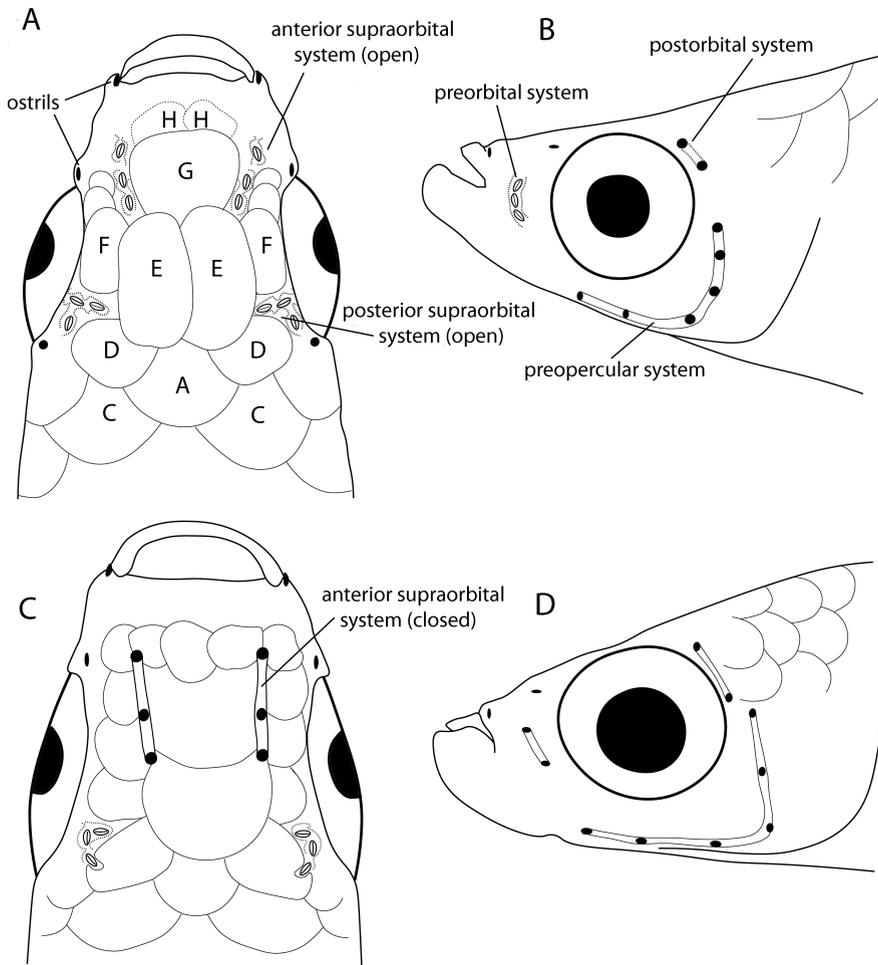


FIGURE 4. Cephalic laterosensory system and squamation: *Poropanchax pepo* (AMNH 267247), **A**, dorsal view, **B**, lateral view; *Poropanchax luxophthalmus* (MRAC 90-19-P-414-417), **C**, dorsal view, **D**, lateral view. Frontal squamation coding follows Hoedeman (1958).

River, Teugels et al., 09 April 1992. — MRAC 92-059-P-2162-2164, 3 specimens (C&S), Guinea, Ndyarendi, Kogon River, Teugels et al., 09 April 1992. — UFRJ 3882, 24 specimens, Guinea, Koumba River. — UFRJ 8136, 2 specimens (C&S), Guinea, Koumba River. — UFRJ 10907, 8 specimens, aquarium material.

Poropanchax luxophthalmus (Brüning, 1929): MRAC 88-35-P-300-318, 19 specimens, Nigeria, Chokocho, Otamiri River, Powell, 26 January 1988. — MRAC 88-35-P-319-321, 3 specimens (C&S), Nigeria, Chokocho, Otamiri River, Powell, 26 January 1988. — MRAC 90-19-P-320-413, 94 specimens, Nigeria, Port Harcourt, Powell, 30 May 1986. — MRAC 90-19-P-414-417, 4 specimens (C&S) Nigeria, Port Harcourt, Powell, 30 May 1986. — MRAC P-73039.2001-20, 20 specimens, W. Foersch, Aquarium, 1/01/1964-31/12/1965. Identified in MRAC as *Aplocheilichthys macrophthalmus* Meinken, 1932. — MRAC 73-39-P-1983-995, 16



FIGURE 5. *Poropanchax pepo*, new species: male coloration in life, picture taken prior to preservation at the type locality.

specimens Ijebu, S.W. Nigeria, H. S. Clausen, 16 June 1962. — MRAC 90-19-P-370-417, 48 specimens, Bori camp stream, Posrt Harcourt, Nigeria; C.B. Powell, 30 May 1986.

Poropanchax pepo new species: AMNH 239381, 12 specimens, Democratic Republic of Congo, Kongo Central Province, 4.5 km northeast of the village of Inga, Fwamalo river channel adjacent to the right bank of the Congo River (5°28'13" S, 13°35'01" E), R. Schelly et al., 25 September 2002.

Poropanchax rancureli (Daget, 1964): MRAC A0-044-P-0233-0245, 13 specimens, Ivory Coast, Mé River basin, secondary tributary of the Zo River, near Apiadji, Ryckewaert, 18 August 2000. — MRAC 86-13-P-752-766, 15 specimens, Ivory Coast, Blé River, affluent of the Dodo, about 2 km from bridge over the Dodo, route San Pedro-Tabou, Teugels, 07 April 1986. — MRAC 86-13-P-767-768, 2 cleared and stained specimens, Ivory Coast, Blé River, affluent of the Dodo, about 2 km from bridge over the Dodo, route San Pedro-Tabou, Teugels, 07 April 1986. — UFRJ 3886, 10 specimens, Ivory Coast, affluent of Dodo River. — UFRJ 8137, 2 specimens (C&S), Ivory Coast, affluent of Dodo River. — MNHN 1981-0648, 80 specimens (3 C&S), Ivory Coast, Agnébi River, near Akoupe, Lévêque, 30 January 1978.

Poropanchax aff. *rancureli* Lake Amansuri, village Nzulezo (Nzulenzu), southwest of Ghana, Keijman et al., 7 November 2018, J.R.Z. personal collection.

Poropanchax stigmatopygus Wildekamp and Malumbres, 2004: MRAC B2-039-P-0001-0002, 2 specimens, Cameroon, Kribi, Wildekamp, 12 February 1984. — MRAC A5-030-P-0050-0055, 6 specimens, Cameroon, Pongo village, Maguiou River, over bridge, Bogaerts et al., 23 February 2005. — MRAC 77-17-P-863-933, 72 specimens, Cameroon, Akok, 19 km SE of Kribi, Radda, 14 February 1972. — MRAC 77-17-P-934-936, 3 specimens (C&S), Cameroon, Akok, 19 km SE of Kribi, Radda, 14 February 1972.

Poropanchax scheeli: MNHN 1998-0483, 39 (4 C&S); Gabon; Auguste; 1997. — MNHN 1985-1096, 13 (2 C&S), 53 km à l'Ouest D'Edea, Cameroun; Birgi. — MRAC 73-02-P-2590-594, 5 specimens, km 15 route Bata-Rio Benito, rio Muni, Thys V.D. Audenaerde, 7 December 1964. — MRAC 164711-721, 11 paratypes, Fleuve Ekuko, km 9 de Bata, rio Muni, B. Roman, 21 June 1968. — MRAC A2-031-P-0001-0042, 42 specimens, Creek emptying in the Rio Ue, Equatorial Guinea; Malumbres et al., 27 February 2002.

"*Lacustricola*" *johnstoni*: SAIB 35820, 18 specimens (5 C&S), Upper Shire River, Mangochi, Malawi, 14°26'60"S 35°15'60"E; D. Tweddle and N. G. Willoughby; 19 September 1971.

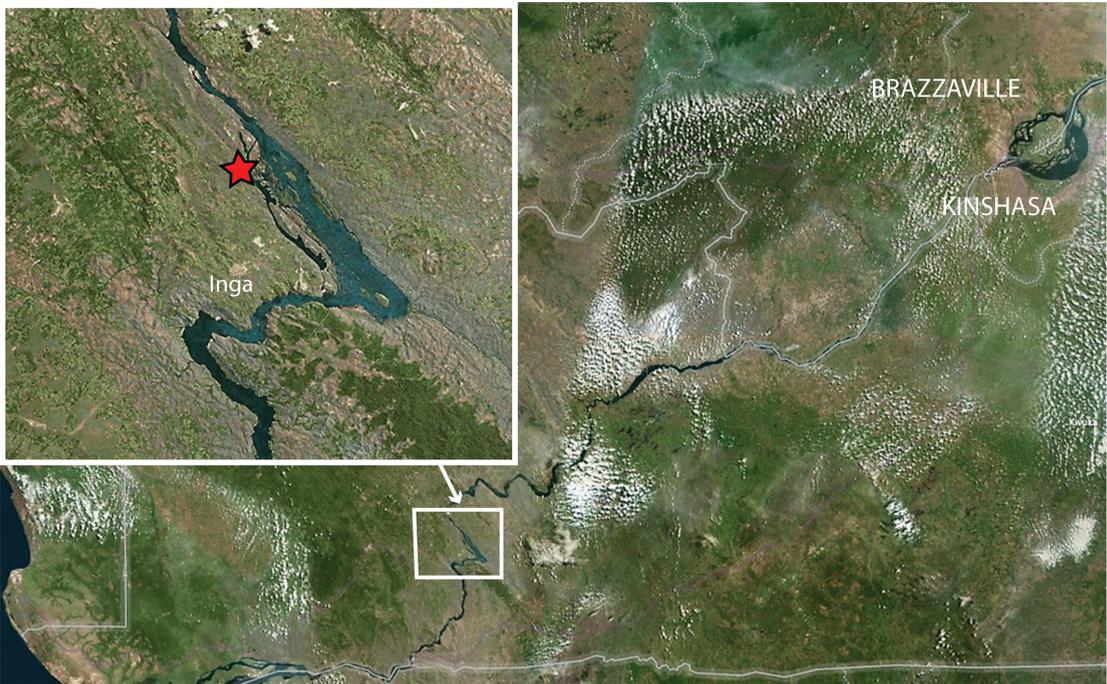


FIGURE 6. Map of Lower Congo, with region around Inga Falls inset. Star indicates type locality.

DISCUSSION

Despite high diversity and a continent-wide distribution, few studies have attempted to resolve procatopodid intrarelationships, and as a consequence considerable taxonomic confusion has persisted in the literature. Many currently recognized genera lack apomorphy-based diagnoses and are poorly differentiated by combinations of meristic, cephalic laterosensory, and coloration/pigmentation features that often display broad overlap or high variability. The recent molecule-based analysis of Bragança and Costa (2019), in addition to providing considerable resolution of intrafamilial relationships, indicated paraphyly of a number of procatopodid genera including *Poropanchax*. External morphological features traditionally used to define membership in *Poropanchax* (presence of a closed, anterior portion of supraorbital system with 2–3 pores, pronounced sexual dimorphism in body size and fin size and shape) are considered plesiomorphic and variable (Bragança and Costa 2019).

Based on osteological and additional molecular analyses (Bragança, in prep.) *Poropanchax* is herein diagnosed by two unique and unreversed apomorphic character states: the presence of a slightly curved ventral portion of maxilla in which its tip is directed backward, and by a slender dentary (fig. 2A). As recognized herein the genus *Poropanchax* sensu stricto includes the following five species: *P. luxophthalmus*, *P. pepo*, *P. rancureli*, *P. scheeli*, and *P. stigmatopygus*.

The finding of *P. pepo* near the Inga falls in Lower Congo, 700 km south of its nearest congener in the Ogowe River estuary, was surprising and represents the southernmost record for the genus. However, such a distributional gap could reflect undersampling in the region,

which is poorly explored due to limited accessibility (Mamonekene and Stiassny, 2012; Mamonekene et al., 2018). This is supported by the record of a putative *Poropanchax* recently reported from the Nyanga basin in the Republic of Congo, about 350 km northwest of Inga (Vreven, personal commun.). It is worth mention that with the placement of “*P.*” *normani* in a distinct “savannah/arid” lineage (Bragança and Costa, 2019) *Poropanchax* sensu stricto is now recognized as a clade restricted to humid coastal regions of west and west-central Africa.

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