



A new distinctively banded species of *Pseudolithoxus* (Siluriformes: Loricariidae) from the upper Orinoco River

NATHAN K. LUJAN¹ & JOSE L. O. BIRINDELLI²

¹Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258, USA

E-mail: nklujan@gmail.com

²Museu de Zoologia de Universidade de São Paulo. Av. Nazaré, 481, Caixa Postal 42494, 04218-970, São Paulo, SP, Brazil.

E-mail: josebirindelli@yahoo.com

Abstract

Pseudolithoxus kelsorum is described as a new species based on type material from the upper Orinoco in Amazonas State, Venezuela. *Pseudolithoxus kelsorum* is diagnosed from all other *Pseudolithoxus* by having dark brown to black base color with eight to 11 (usually nine) light yellow vertical or oblique transversal bands between orbits and caudal fin, bands wide and rarely but sometimes incomplete or contorted as swirls (vs. dark brown to black base color with 18 or more thin, light yellow, frequently contorted transversal bands between orbits and caudal fin in *P. tigris*; black base color with small white spots in *P. anthrax* and *P. nicoi*; and light brown base color with dark brown to black spots in *P. dumus*). Distributions of *P. kelsorum* and other Ancistrini taxa support the presence of a zoogeographic filter limiting fish distributions across a reach of the Orinoco River between the Ventuari-Orinoco confluence and the Maipures rapids.

Key words: Neotropics, Taxonomy, Ancistrini, Guiana Shield, Biogeography, Zoogeographic Filter

Resumen

Se describe una nueva especie, *Pseudolithoxus kelsorum*, con base en especímenes colectados en el alto río Orinoco, Estado de Amazonas, Venezuela. *Pseudolithoxus kelsorum* sp. nov. se diferencia de las demás especies de *Pseudolithoxus* por presentar un color de fondo de marrón oscuro a negro con ocho a 11 (generalmente nueve), franjas anchas (en ocasiones incompletas) de color amarillo claro entre las órbitas y la aleta caudal, que pueden ser verticales, transversalmente inclinadas, o retorcidas arremolinadas, (vs. color de fondo marrón oscuro a negro con 18 o más franjas delgadas de color amarillo claro entre las órbitas y la aleta caudal que pueden ser verticales, inclinadas hacia adelante, o transversalmente retorcidas en *P. tigris*; color de fondo negro con pequeñas manchas blancas en *P. anthrax* y *P. nicoi*; y color de fondo marrón claro con puntos de color marrón oscuro a negro en *P. dumus*). Las distribuciones de *Pseudolithoxus* y otros Ancistrini soportan la presencia de un filtro zoogeográfico de carácter fisicoquímico que limita diferencialmente las distribuciones de peces a través de una sección del río Orinoco entre la confluencia Ventuari-Orinoco y los raudales Maipures.

Palabras clave: Neotrópico, Taxonomía, Ancistrini, Escudo Guyanés, Biogeografía, Filtro Zoogeográfico

Introduction

Isbrücker and Werner (Isbrücker *et al.*, 2001) erected *Pseudolithoxus* and designated *Lasiancistrus tigris* as the type species and *L. anthrax*, *L. dumus*, and *L. nicoi* as congeners. Although Isbrücker and Werner provided only a brief description and no diagnosis for *Pseudolithoxus*, those species form a monophyletic group previously diagnosed by Armbruster and Provenzano (2000). Characters given by Armbruster and Provenzano (2000) as diagnostic for this group include evertible cheek plates, a dorsoventrally flattened body, extremely hypertrophied odontodes on elongated pectoral-fin spines and along the snout margin, and three rows of plates on the caudal peduncle. Phylogenetic analysis of osteological characters inclusive of all Ancistrini genera (Armbruster, 2008)

recovered *Pseudolithoxus anthrax* and *P. dumus* as a clade sister to *Ancistrus* + *Lasiancistrus*. Armbruster (2008) identified three homoplastic synapomorphies for *Pseudolithoxus*: posteromedial invagination of ceratobranchial 5 present (vs. absent), dorsomedial process on pterotic-supracleithrum present (vs. absent), and three to eight vertebrae from the first normal neural spine behind dorsal fin to spine under preadipose plate (vs. nine or more).

Pseudolithoxus is currently known only from rocky main channel habitats in the Casiquiare Canal and tributaries of the Orinoco River draining the western and northern versants of the Guiana Shield highlands. Within that range, species of *Pseudolithoxus* exhibit both allopatric and sympatric distributions. *Pseudolithoxus nicoi* is the only *Pseudolithoxus* species known from the Casiquiare Canal, whereas the ranges of *P. anthrax*, *P. dumus* and *P. tigris* overlap broadly in the upper Orinoco River and its tributaries between the Atures rapids and the Casiquiare Canal. Of these, only the range of *P. anthrax* is known to extend downstream of the Atures rapids as far as the Caura and Aro Rivers. Although extensively surveyed by the first author and colleagues in 2003, 2004, and 2005, the upper Orinoco and its tributaries yielded many specimens of only the three nominal species of *Pseudolithoxus* previously known from the region. However, during a more recent, 2010 expedition to the upper Orinoco sponsored by National Geographic, six specimens of a new, distinctively banded *Pseudolithoxus* species were collected. The new species is described herein as *Pseudolithoxus kelsorum*.

Methods

Counts and measurements follow Armbruster (2003). Standard length (SL) is expressed in mm and other measurements are expressed as either percentages of standard length or, for subunits of head, percentages of head length. Measurements and counts were taken on left side of specimens when possible. Meristic data are given in the description followed in parentheses by the mode or mean and range of all examined specimens and the count of the holotype. Dorsal-fin spinelet is counted as a spine. Lateral trunk plate row terminology follows Schaefer (1997). Institutional abbreviations follow Sabaj Pérez (2010). ‘Ancistrini new genus 1’ refers to new genus 1 of Armbruster (2008).

Pseudolithoxus kelsorum, new species

Figure 1. Table 1.

Holotype. MCNG 55357, 66.0 mm SL, Venezuela, Amazonas State, Orinoco River drainage, Orinoco River at Merey, 97.6 km N of San Fernando de Atabapo, 4°55'04"N, 67°49'58"W, J. Birindelli, N. K. Lujan & V. Meza, 18 April 2010.

Paratypes. Five specimens, collected with holotype. ANSP 182813, 1: 36.6 mm SL, AUM 51644, 2: 40.0, 52.4 mm SL; MCNG 55358, 1: 44.0 mm SL; MZUSP 108090, 1: 52.7 mm SL.

Diagnosis. *Pseudolithoxus kelsorum* is diagnosed from all other *Pseudolithoxus* by having dark brown to black base color with eight to 11 (usually nine) light yellowish vertical or oblique (tilted dorsoanteriorly) transversal bands between orbits and caudal fin, bands wide and rarely but sometimes incomplete or contorted as swirls (Fig. 1; vs. dark brown to black base color with 18 or more thin, light yellow, frequently contorted transversal bands between orbits and caudal fin in *P. tigris*, Fig. 2; black base color with small white spots in *P. anthrax* and *P. nicoi*; and light brown base color with dark brown to black spots in *P. dumus*, Fig. 3).

Description. Morphometrics in Table 1. Largest specimen 66.0 mm SL. Head and body dorsoventrally flattened with body depth greatest at supraoccipital; dorsal and ventral profiles only slightly convergent caudally. Snout surface and body flanks armored with ossified dermal plates, each covered with small odontodes; plates absent from small region at posteroventral corner of pterotic and entire abdomen. Cheek plates bearing moderately to highly hypertrophied, distally-hooked odontodes (mean 35, range 27–42, holotype 42) evertible to approximately 90° from sagittal plane; longest odontodes extending to posterior exposed margin of opercle. Orbit positioned dorsally on head with opening sloped ventrolaterally at approximately 45° from sagittal plane in anterior view.

Oral disk occupying most of ventral surface of head anterior of cleithrum. Interpremaxillary and intermandibular tooth row angle greater than 110°; premaxillary teeth 55–64 (average 61, holotype = 64); dentary teeth 47–57

(average 53, holotype 54). All teeth with gracile, flexible shafts and bicuspid heads bent inward at right angle to shaft. Maxillary barbel short and attached to lower lip along most of length; ventral surface of labial disk with hemispherical papillae decreasing in size distally and toward rictus; posterior margin of labial disk lacking fimbriae.

TABLE 1. Selected morphometric characters for *Pseudolithoxus kelsorum* n. sp. Interlandmarks (ILM) are the two points between which measurements were taken (from Armbruster, 2003). $N = 6$.

ILM	Measurement	Holotype	Mean	SD	Min	Max
1–20	Standard length	66.0	48.6	10.7	36.6	66.0
	Percents of standard length					
1–10	Predorsal length	43.0	43.6	0.6	43.0	44.6
1–7	Head length	34.0	35.8	0.9	34.0	36.6
7–10	Head—dorsal length	7.6	7.1	0.8	6.2	8.0
8–9	Cleithral width	30.9	30.7	0.6	29.8	31.5
1–12	Head—pectoral length	30.6	31.0	0.8	30.2	32.4
12–13	Thorax length	21.2	21.9	0.9	20.9	23.0
12–29	Pectoral-fin spine length	33.5	32.2	1.1	30.6	33.5
13–14	Abdominal length	24.3	24.7	1.5	23.0	26.6
13–30	Pelvic-fin spine length	23.9	24.3	0.8	23.5	25.2
14–15	Postanal length	31.6	32.2	1.3	30.3	33.7
14–31	Anal-fin spine length	9.0	8.1	1.0	6.9	9.2
10–12	Dorsal—pectoral distance	24.9	25.5	0.5	24.8	26.0
10–11	Dorsal spine length	24.3	23.2	0.9	22.0	24.3
10–13	Dorsal—pelvic depth	14.9	15.1	0.8	13.8	15.9
10–16	Dorsal-fin base length	23.1	23.8	0.9	23.1	25.4
16–17	Dorsal—adipose distance	16.9	17.6	1.2	16.5	19.4
17–18	Adipose spine length	8.1	7.7	0.4	7.0	8.2
17–19	Adipose—upper caudal distance	14.2	14.1	1.2	11.9	15.3
15–19	Caudal peduncle depth	7.6	7.3	0.9	5.9	8.2
15–17	Adipose—lower caudal distance	19.3	19.2	1.2	17.4	20.8
14–17	Adipose—anal distance	19.3	19.0	1.3	17.0	20.3
14–16	Dorsal-anal distance	8.5	9.0	0.4	8.5	9.5
13–16	Pelvic—dorsal distance	24.1	23.8	0.9	22.3	25.1
	Percents of head length					
5–7	Head—eye length	35.4	36.0	0.8	35.4	37.3
4–5	Orbit diameter	21.1	22.0	1.4	19.9	23.7
1–4	Snout length	60.2	55.4	2.5	53.2	60.2
2–3	Internares width	11.1	9.8	0.8	8.8	11.1
5–6	Interorbital width	42.3	39.2	7.0	25.1	43.2
7–12	Head depth	59.9	58.9	2.2	55.0	61.3
1–24	Mouth length	48.7	48.7	1.8	46.4	51.9
21–22	Mouth width	62.5	61.5	1.1	59.7	62.6
22–23	Barbel length	10.1	8.3	1.3	6.9	10.1
25–26	Dentary tooth cup length	18.9	17.5	1.7	15.8	19.9
27–28	Premaxillary tooth cup length	18.5	17.3	2.1	14.9	20.0



FIGURE 1. Holotype of *Pseudolithoxus kelsorum* n. sp., 66.0 mm SL, MCNG 55357, Venezuela, Amazonas State, Orinoco River at Merey, 97.6 km N of San Fernando de Atabapo, 4°55'04"N, 67°49'58"W, J. Birindelli, N. K. Lujan, & V. Meza, 18 April 2010 (photographed alive).

Dorsal fin II,7; dorsal-fin spinelet small but visible, V-shaped; dorsal-fin lock functional; posteriormost dorsal-fin ray free from body. Pectoral fin I,6; adpressed pectoral-fin spine reaching approximately halfway between anus and pelvic-fin origin; anterodorsal surfaces of spine with many hypertrophied odontodes increasing in length distally; odontodes longer and more numerous in larger specimens. Pelvic fin I,5; pelvic-fin spine extending to or past

insertion of anal fin when adpressed. Anal fin I,4; second unbranched ray longest. Adipose-fin spine straight; adnate to caudal peduncle via fleshy membrane with concave or convex posterior margin. Caudal fin I,14,I; dorsal procurrent caudal-fin rays four; ventral procurrent caudal-fin rays four; caudal fin obliquely and asymmetrically emarginated, with ventral lobe longer than dorsal lobe.



FIGURE 2. *Pseudolithoxus tigris*, 70.4 mm SL, AUM 42110, Venezuela, Amazonas State, Orinoco River, 50 km E of San Fernando de Atabapo, 4°55'04"N, 67°49'58"W, N. K. Lujan *et al.*, 3 March 2005 (photographed alive by M. Sabaj Pérez).

Body broadest at cleithrum; posterior margin of exposed posterior process of cleithrum squared or tapering to a point. Lateral median plates 23–25 (mode 23, holotype 24), middorsal plates 20–23 (mode 23, holotype 20), midventral plates 22–25 (mode 23, holotype 23); anteriormost midventral plate strongly bent. Caudal peduncle plate rows three. One or two azygous preadipose plates (mode one, holotype one); predorsal plate rows two not including nuchal plate; interdorsal plate rows four or five (mode five, holotype four).

Color. Body with dark brown to black base color with eight to 11 (usually nine) light yellow vertical or oblique (tilted dorsoanteriorly) transversal bands between orbits and caudal fin; bands wide and rarely but sometimes incomplete or contorted as swirls (Fig. 1). Paired, dorsal, adipose, and caudal fins light with dark bands. Snout with light yellow longitudinal bands, small spots, or contortions. Abdomen pale; lower lip, ventral plated surfaces, ventral paired-fin spine surfaces, and anal fin uniformly light yellow to tan.

Distribution and habitat. Known only from a single site on the Orinoco River just above the Maipures rapids and approximately 60 km south of the Atures rapids (Fig. 4). Type material collected via rotenone and castnet from a single shoreline granite outcrop. Anecdotal reports (O. Lucanus pers comm. to NKL) suggest that the range of *Pseudolithoxus kelsorum* extends downstream into the Atures rapids. However, extensive ichthyological surveys of the Orinoco River further upstream by the first author and colleagues have failed to yield specimens of *P. kelsorum*,

suggesting that its distribution is limited to only more downstream reaches, possibly including the nearby and still poorly surveyed lower reaches of western tributaries of the Orinoco in Colombia.

Etymology. Named in honor of George and Carolyn Kelso whose generous contribution to Texas A&M University and to the Winemiller Aquatic Ecology Lab has facilitated important ichthyological discoveries, including this new species.

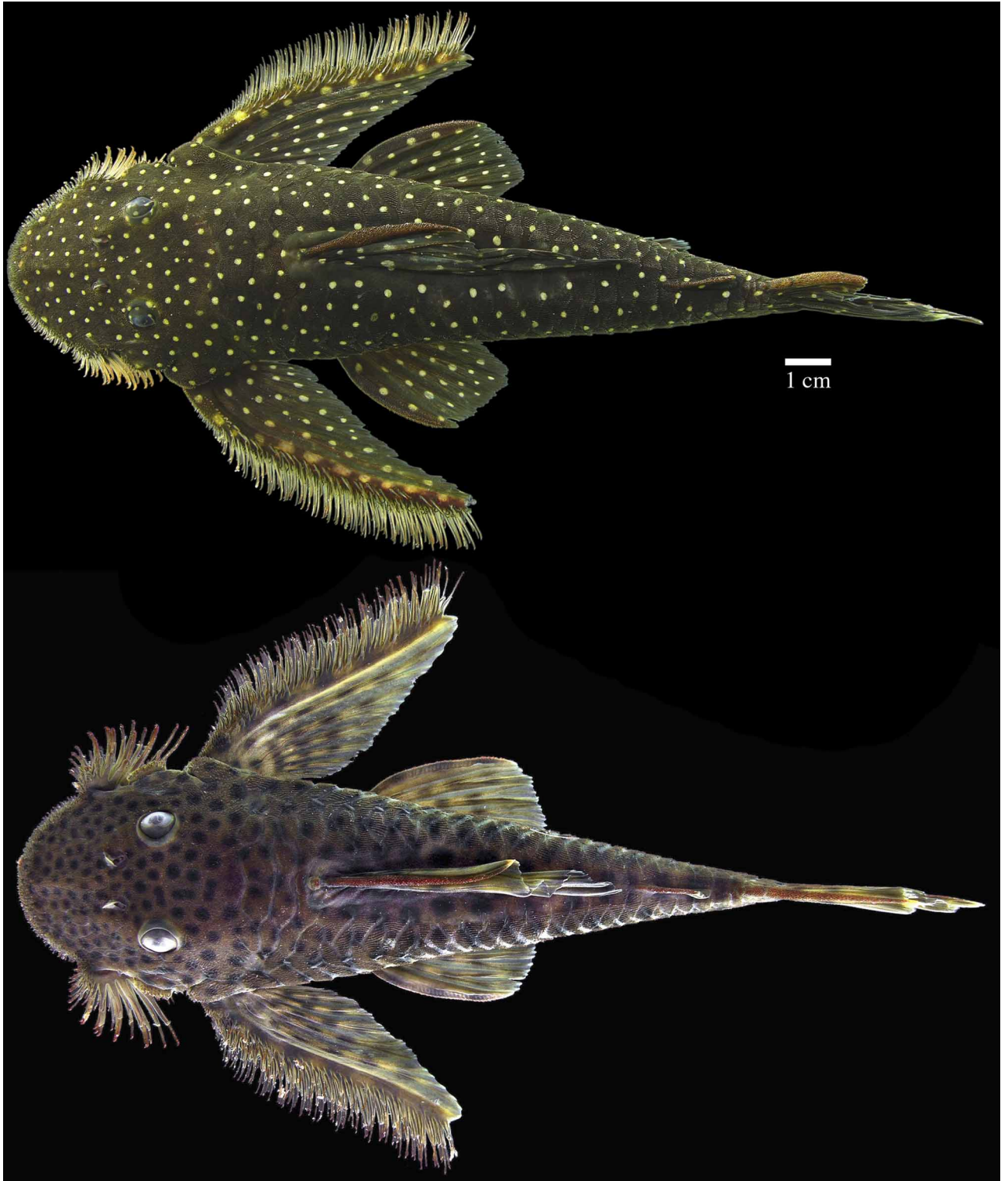


FIGURE 3. Above: *Pseudolithoxus anthrax*, uncatalogued specimen from the Ventuari River mouth, 3°58'42"N, 67°03'37"W, N. K. Lujan *et al.*, 29 March 2010. Below: *P. dumus*, AUM 43267, Venezuela, Amazonas State, Orinoco River 3°18'23"N, 66°36'12"W, N. K. Lujan *et al.*, 4 March 2005 (live photos by M. Sabaj Pérez).

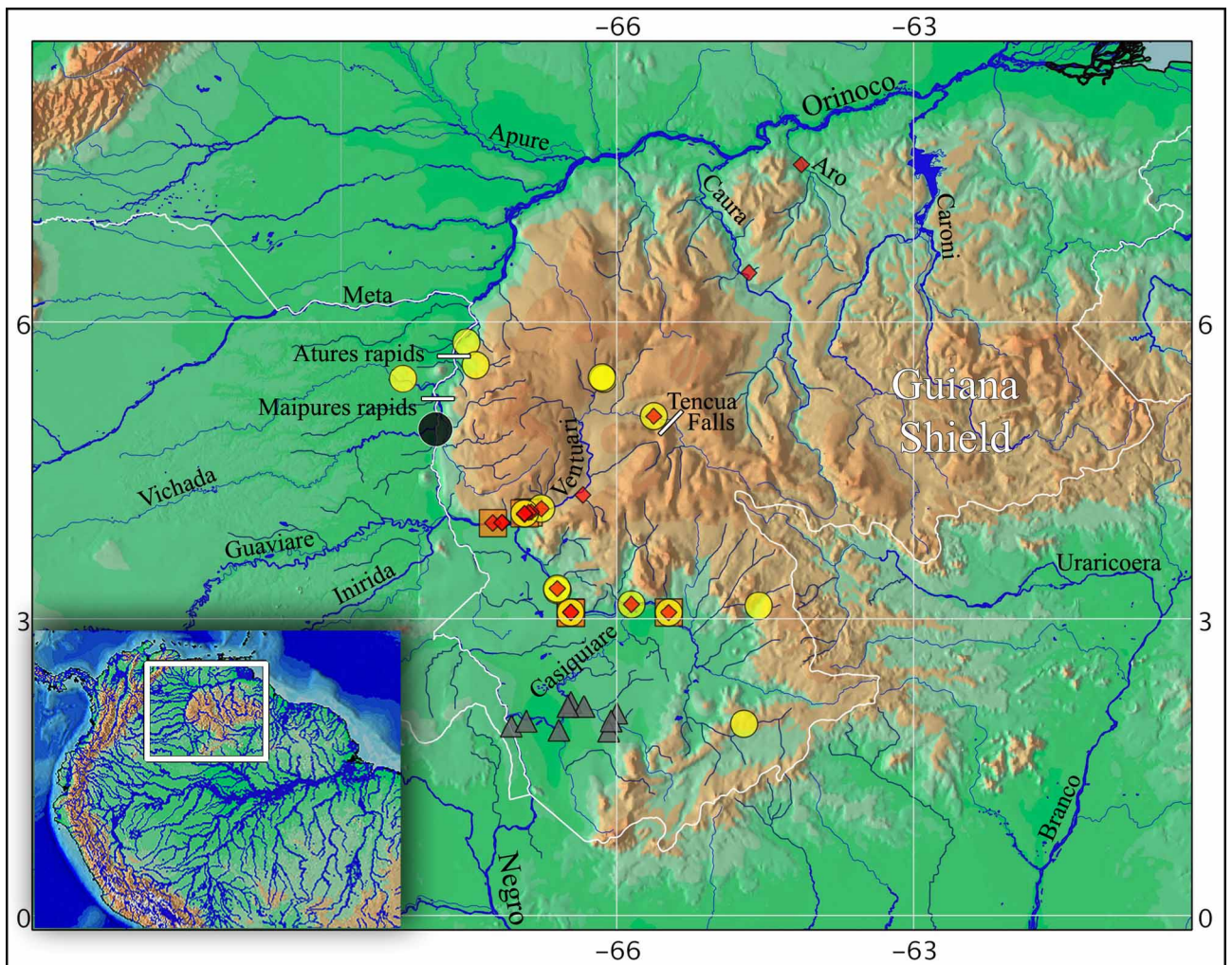


FIGURE 4. Map of the upper Orinoco showing the known distributions of *Pseudolithoxus anthrax* (red diamonds), *P. dumus* (yellow circles), *P. kelsorum* (black circle), *P. nicoi* (gray triangles), and *P. tigris* (orange squares).

Discussion

Pseudolithoxus is readily distinguished from most Ancistrini genera by having three rows of plates on the caudal peduncle, whereas most genera have five (Armbruster, 2004); other exceptions include *Ancistrus*, *Lasiancistrus*, *Dekeyseria*, *Lithoxus* and *Exastilithoxus*. In addition to their very dorsoventrally flattened head and body and large numbers of hypertrophied odontodes on the pectoral-fin spine, *Pseudolithoxus* differs from *Ancistrus* by having plates almost completely covering the snout, and from *Lasiancistrus* by lacking whisker-like odontodes on cheek plates. *Pseudolithoxus* differs from *Dekeyseria* by lacking well-keeled lateral trunk plates. *Lithoxus* and *Exastilithoxus* are sister taxa that are similar to *Pseudolithoxus* in being dorsoventrally flattened and having large numbers of hypertrophied odontodes on the pectoral-fin spine, but all *Lithoxus* and *Exastilithoxus* are small bodied (approximate maximum = 70 mm SL) and have few teeth (up to 10 on each jaw) with small tooth cups. Also, *Exastilithoxus* is diagnosed by having fimbriate papillae along the posterior margin of the oral disk.

Within *Pseudolithoxus*, species can be distinguished based on color pattern. *Pseudolithoxus anthrax* and *P. nicoi* have black body base color with small white spots, whereas *P. dumus* has a light brown body base color with dark black spots or blotches (Fig. 3). Based on color characters and body size, the new species is most similar to *Pseudolithoxus tigris*, which also attains a relatively small maximum body size (< 75 mm SL; vs. > 100 mm SL for *P. anthrax*, *P. dumus* and *P. nicoi*) and has a dark brown to black body base color with pale yellowish transversal bands; only the number and size of the bands differ (Figs. 1, 2).

Pseudolithoxus is one of four Ancistrini genera endemic to rivers draining the Guiana Shield highlands; others being *Exastilithoxus*, *Lithoxus*, and *Neblinichthys*. *Pseudolithoxus* is restricted to relatively large, mainstem river channels, whereas *Exastilithoxus* and *Neblinichthys* are known only from the uppermost reaches of mainstem rivers or from relatively low order tributaries; *Lithoxus* is largely restricted to the eastern Guiana Shield and is limited in the Orinoco Basin to the Ventuari River above Tencua Falls (Lujan, 2008). All of these taxa occupy relatively clear water habitats with rocky substrates where many other ancistrin genera and species are also encountered (Lujan and Armbruster, 2011).

Mounting evidence from recent surveys of loricariid assemblages in the upper Orinoco (Orinoco River above the Atures and Maipures rapids) and its tributaries suggests that within this region, the rocky, deltaic confluence of the Ventuari and Orinoco rivers (Fig. 4) is an epicenter of species diversity, and that loricariid species richness declines both upstream and downstream from this confluence. Several congruent distributional patterns are evident for the loricariid fauna inhabiting the Ventuari-Orinoco confluence: species narrowly endemic to habitats in or immediately adjacent to the confluence (e.g., *Baryancistrus demantoides*, *Leporacanthicus triactis*, Ancistrini new genus 1), species ranging more broadly across the upper Orinoco but with a downstream limit between the Ventuari-Orinoco confluence and the Maipures rapids (e.g., *Baryancistrus beggini*, *Hypancistrus contradens*, *H. lunaorum*, *Lasiancistrus schomburgkii*, *Leporacanthicus* cf. *galaxias*, *Peckoltia lineola*, *P. vittata*, *Pseudancistrus pectegenitor*, *P. sidereus*, *Pseudolithoxus tigris*), and species more broadly distributed in the Orinoco above and below the Maipures rapids (e.g., *Ancistrus macrophthalmus*, *Hemiancistrus guahiborum*, *H. sabaji*, *H. subviridis*, *Lasiancistrus tentaculatus*, *Panaque nigrolineatus*, *Pseudancistrus orinoco*, *Pseudolithoxus anthrax*, *P. dumus*; Werneke *et al.*, 2005; Armbruster *et al.*, 2007; Lujan *et al.*, 2007; 2009; 2010; Lujan and Armbruster, 2011; Fig. 4).

Pseudolithoxus kelsorum is not known from the Ventuari-Orinoco confluence and may be restricted to the portions of the Orinoco Basin in, near, or downstream of the Maipures and Atures rapids. This distribution is parapatric to the distribution of its likely sister species *P. tigris*, which is known only from localities near or upstream of the Ventuari-Orinoco confluence. Similar distributional transitions are evident in several other loricariid species, suggesting that a zoogeographic filter exists within the upper Orinoco between the Maipures rapids and the Ventuari-Orinoco confluence. This transitional zone appears to be the downstream distributional limit for at least 13 other loricariid species in addition to *P. tigris*: *Baryancistrus beggini*, *B. demantoides*, *Hypancistrus contradens*, *H. furunculus*, *H. lunaorum*, *Lasiancistrus schomburgkii*, *Leporacanthicus* cf. *galaxias*, *L. triactis*, *Peckoltia lineola*, *P. vittata*, *Pseudancistrus pectegenitor*, *P. sidereus*, and Ancistrini new genus 1. All of these species are known from localities upstream of the Ventuari River mouth, but none are known from the Maipures or Atures Rapids or any locality further downstream.

In addition to *Pseudolithoxus kelsorum*, at least two other loricariid species are known from localities in or near the Atures and Maipures rapids, but are unknown from the Ventuari River mouth or any localities upstream thereof: *Hypancistrus debilitera*, and an undescribed species of *Hemiancistrus* also discovered during the 2010 National Geographic expedition. Furthermore, although *Hemiancistrus subviridis* is known from throughout this region, specimens from localities downstream of the Ventuari River mouth differ slightly in coloration relative to those from the Ventuari-Orinoco confluence and reaches further upstream by having yellow spots extending caudally past the dorsal fin to the caudal peduncle and caudal fin (vs. rows of yellow spots terminating at or before the dorsal fin in more upstream populations; NKL pers. obs.).

At the southern end of the *Pseudolithoxus* range, the Casiquiare Canal constitutes a zoogeographic filter that appears to block dispersal of many species, including species of *Pseudolithoxus* (Winemiller *et al.*, 2008). Within Ancistrini, *Hypancistrus inspector* and *Pseudolithoxus nicoi* (Fig. 4) appear to be restricted to the Casiquiare Canal and its tributaries, whereas the likely sister species of *H. inspector* (*H. contradens*) and of *P. nicoi* (*P. anthrax*) are only known from the Orinoco and its tributaries draining the western Guiana Shield. Winemiller *et al.* (2008) implicate water chemistry (mainly pH) as the principle driver of shifts in fish community structure along the length of the Casiquiare Canal, which originates as a clearwater, moderately acidic bifurcation from the upper Orinoco then receives several blackwater tributaries before ending as a blackwater, highly acidic tributary to the Negro River. In a similar pattern, a series of strongly blackwater tributaries—the Atabapo, Guaviare, and Vichada rivers—enter the Orinoco River between the Ventuari-Orinoco confluence and the Maipures rapids. Blackwater input from those large tributaries may contribute to a physicochemical and zoogeographical phenomenon similar to that observed in the Casiquiare Canal.

Comparative material examined. *Pseudolithoxus* sp. MCNG 38525, Venezuela, Amazonas State, Siapa River in Caño Negro rapid, L. Nico, S. Walsh, A. Arrington, & L. Fitzgerald, 12 January 1998. *P. dumus*, AUM 43267, Venezuela, Amazonas State, Orinoco River 3°18'23"N, 66°36'12"W, N. K. Lujan *et al.*, 4 March 2005. *P. cf. kelsorum*, MBUCV-V-17557, Venezuela, Amazonas State, Orinoco River, creek between island and beach just downstream from Quiritare (Quiritare: 03°02'N, 66°04'W), B. Chernoff, H. Lopez, J. Fernandez, & W. G. Saul, 11 March 1987. *P. tigris*, AUM 42110, Venezuela, Amazonas State, Orinoco River, 50 km E of San Fernando de Atabapo, 4°55'04"N, 67°49'58"W, N. K. Lujan *et al.*, 3 March 2005.

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