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PENSOFT

Range extension of a small livebearer fish, *Poecilia scalpridens* (Garman, 1895) (Cyprinodontiformes, Poeciliidae): a new record for the Jari river drainage, Amapá, Brazilian Amazon

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Abstract

Recent field expeditions in the Jari river drainage, in addition to examination of uncatalogued poeciliids, allowed the identification of specimens as *Poecilia* (*Pamphorichthys*) *scalpridens* (Garman, 1895). The known range of this species includes lakes and igarapés in the lower reaches of tributaries near the main channel of the Amazon River between Parintins and the mouth of the Tapajós River. Here, we expand the range of *P. scalpridens* by about 300 km. We provide the main diagnostic characters of *P. scalpridens* to facilitate identification of specimens collected in future field surveys.

Keywords

Cyprinodontoidei, freshwater, geographic distribution, ichthyology, Neotropical region, poeciliids, South America

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Introduction

The family Poeciliidae comprises 275 valid species (Fricke et al. 2021) and is distributed throughout the main fresh- and brackish-water environments in the Americas, with a high level of species diversity in Middle America (Rosen and Bailey 1963; Lucinda 2005; Reznick et al. 2017). Poeciliids can be easily recognized by the presence of the male's gonopodium, a copulatory organ that consists of a modification of anal-fin rays 3, 4, and 5 (Regan 1913; Rosen and Gordon 1953) and by the presence of viviparity or ovoviviparity (Rosen and

Bailey 1963). Livebearers, as they are popularly known, are widely used as experimental organisms in embryological, behavioral, ecological, and evolutionary studies, in addition to being very popular among aquarium enthusiasts (Lucinda 2005). Recently, molecular-based phylogenetic studies have contributed greatly to the taxonomy and systematics of the family, especially in the genus *Poecilia* Bloch & Schneider, 1801. Many lineages previously considered as poeciliid genera, such as *Pamphorichthys* Regan, 1913, are now recognized as valid subgenera of a more comprehensive *Poecilia* (Meredith et al. 2011; Palacios et al. 2016; Reznick et al. 2017).

The subgenus *Pamphorichthys* currently includes seven species: *Poecilia akroa* Figueiredo & Moreira, 2018, *P. araguaiensis* (Costa, 1991), *P. hasemani* (Henn, 1916), *P. hollandi* (Henn, 1916), *P. minor* (Garman, 1895), *P. pertapeh* (Figueiredo, 2008), and *P. scalpridens* (Garman, 1895). All species are found exclusively in river systems in Brazil, with the exception of *P. hasemani*, which also occurs Bolivia in the Paraná–Paraguay river system (Lucinda 2003; Figueiredo and Moreira 2018). Species of *Pamphorichthys* are easily distinguished from one another by the unique microanatomy of the modified pelvic-fin rays, position of the gonapophysis, absence of gonactinosts 8 and 9, and distinct, zigzag colour pattern along the flank (Costa 1991). The microanatomy of the modified pelvic fin and of gonopodium structure are also highly informative for species level taxonomy (Costa 1991; Figueiredo 1997, 2008; Figueiredo and Moreira 2018).

The Amazon basin is the northern distribution limit for *Pamphorichthys* species. *Poecilia* (*Pamphorichthys*) *araguaiensis* occurs in the upper and middle portions of the Araguaia–Tocantins and Xingu rivers (Lucinda 2003; Figueiredo and Moreira 2018). Whereas *Poecilia* (*Pamphorichthys*) *minor* and *P.* (*Pamphorichthys*) *scalpridens* are found further north than their congeners. Both of these species occur in lakes and igarapés (the local name for rivers and tributaries) in the lower Amazon River between the municipality of Parintins (Amazonas state), and the mouth of the Tapajós River (Pará state) (Figueiredo 1997; Lucinda 2003). They inhabit shallow areas along the margin of lakes and igarapés and usually form large shoals close to marginal vegetation near the surface. Here, we report the first record of *P. scalpridens* from the lower Jari river drainage in the state of Amapá, northern Brazil.

Methods

Specimens were collected during ichthyological surveys conducted by the Instituto de Pesquisas Científicas e Tecnológicas do Estado do Amapá (IEPA) and the Universidade Federal do Rio de Janeiro (UFRJ) under SISBIO permit number 32955-3. Individuals were euthanized in a clove oil solution and then transferred to 10% formalin or to pure ethanol for tissue preservation. After 10–12 days, formalin-fixed specimens were transferred to 70% ethanol for long-term storage. Species identification was based on diagnostic osteological characters provided by Costa (1991) and Figueiredo (1997). Osteological preparations were made according to Taylor and Van Dyke (1985). Nomenclature for gonopodial structures follows Rosen and Gordon (1953). Sampled specimens were deposited at the ichthyological collections of aforementioned institutions. An updated distribution map for *P. scalpridens* is prepared based on records from UFRJ, IEPA, Global Biodiversity Information Facility (GBIF), and Species Link (http://splink.cria.org.br/) databases covering distribution information from other ichthyological collections.

Results

Family Poeciliidae

***Poecilia* (*Pamphorichthys*) *scalpridens* (Garman, 1895)**
Figures 1–4

New records. BRAZIL – **Amapá** • Laranjal do Jari Municipality, igarapé in the Jari river drainage, between Laranjal do Jari and Cachoeira de Santo Antônio; 00°44′23.9″S, 052°30′07.5″W; 25.VII. 2012; P. Bragança and E. Henschel leg.; 5 ♂, 11.4–15.8 mm SL; 4 ♀, 12.7–17.2 mm SL; UFRJ 8834 • Laranjal do Jari Municipality, Jari river margin; 00°42′48″S, 052°30′41″W; 27.X. 2007; C. Gama leg; 1♂, 15.2 mm SL (cleared and stained); 1 ♀, 20.5 mm SL (cleared and stained); UFRJ 8493 • Laranjal do Jari Municipality, Jari river margin; 00°51′16″S, 052°32′50″W; 27.X. 2007; C. Gama leg; 1♂, 16.5 mm SL (cleared and stained); 1 ♀,17.9 mm SL (cleared and stained); UFRJ 8494 • Laranjal do Jari Municipality, Balneário Riacho Doce on the right bank of the Jari River; 00°50′3.4″S, 052°32′33.7″W; 13.V.2012; C. Gama; 4 ♀, 21.0–23.8 mm SL; IEPA 2945 • Laranjal do Jari Municipality, Jari river margin; 00°50′25’08″S, 052°27′44″W; 02.IV. 2008; C. Gama leg; 1 ♂, 15.4 mm SL; 1 ♀, 16.5 mm SL; IEPA 2946 • Laranjal do Jari Municipality, Igarapé tributary of the Jari River; 00°50′09.6″S, 052°32′03.4″W; 12.VI. 2010; C. Gama leg; 1 ♂ 12.7 mm SL, 1 ♀ 11.4 mm SL; IEPA 2947.

Additional material examined. BRAZIL – **Pará** • Santarém Municipality, left side of main beach in Alter do Chão, Tapajós River; 31. VIII. 1996; C. Figueiredo and C. Codeço leg.; 38 sex indet.; UFRJ 3872 • Santarém Municipality, Tapajós River, beach close to start of Morro do Tauá trail, Alter do Chão; 01.IX.1996; C. Figueiredo and C. Codeço leg.; 362 sex indet.; UFRJ 3913 • Óbidos Municipality, Pauxis Lake, close to the Pauxis Igarapé outlet; 07.IX.1996; C. Figueiredo and C. Codeço leg.; 239 sex indet.; UFRJ 3862 – **Amazonas** • Parintins Municipality, Zé-Açu Lake margin, close to Bom Socorro community; 13.IX.1996; C. Figueiredo and C. Codeço leg.; 354 sex indet.; UFRJ 3914.

Identification. The specimens sampled in the lower Jari River were determined to belong to *P. scalpridens*

Figure 1. *Poecilia scalpridens* from the lower Jari River, Amapá, Brazil. **A.** Male, 15.4 mm SL (UFRJ 8834). **B.** Female, 17.2 mm SL (UFRJ 8834).

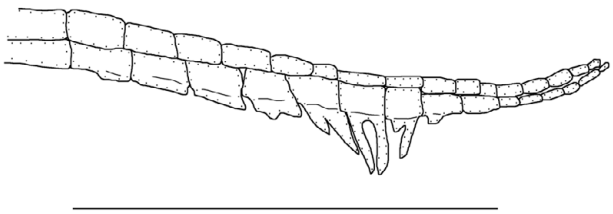

Figure 2. Left pelvic-fin tip of *Poecilia scalpridens*, ventral view. Scale bar = 1 mm.

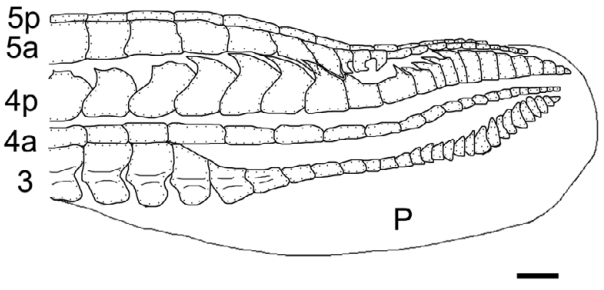

Figure 3. Gonopodium tip of *Poecilia scalpridens* (UFRJ 8494), lateral view. Abbreviations: p, gonopodial palp; 3, ray 3; 4a and 4p, anterior and posterior branches of ray 4; 5a and 5p, anterior and posterior branches of ray 5. Scale bar = 1 µm.

because they have of all the five autapomorphies proposed by Figueiredo (1997): (1) serrae adjacent to the short and deep elements from gonopodial ray 4p tip, projecting posteriorly and fitting into the adjacent elements; (2) 5 or 6 narrow ventral projections in the gonopodial ray 5a elements towards gonopodial ray 4p; (3) proximal serrae of the gonopodial ray 4p not distinguishable from the element itself; (4) initial serrae from the gonopodium ray 4p frequently with two tips; and (5) teeth from the external row of dentary and premaxilla incisive.

Description. Meristic data are presented in Table I. Adult maximum size 16.5 mm SL for male (UFRJ 8494) and 23.8 mm SL for female (IEPA 2945). Dorsal profile gently convex between snout and origin of dorsal-fin base, about straight on caudal peduncle. Ventral profile in male slightly convex between lower jaw and gonopodium insertion, approximately straight on caudal peduncle. In female, due to viviparity, pregnancy results in a prominent convexity of ventral profile, between lower jaw and anal-fin base. Caudal peduncle straight in females.

Dorsal fin rounded in males and females, about the same length as the anal fin in females. Caudal fin elliptical in males and females. Pectoral fin approximately elliptical. Pelvic fin of male long and modified; second pelvic fin ray longest almost reaching gonopodial ray 6, with its subdistal portion bearing lateral comb-like osseous prolongations (Fig. 2); pelvic fin of female short, tip reaching base of 1st or 2nd anal-fin ray. Anal fin in males modified as an intromittent organ, the gonopodium; rounded and short in females. Pelvic and anal fin (gonopodium) insertion in males anteriorly displaced relative to the more posterior positioned fins in females. Dorsal fin rays 6 or 7. Caudal fin rays 21 or 22. Female's anal fin rays nine. Pelvic fin rays five. Longitudinal series of scales 26 or 27. Transversal series of scales seven. Circumpeduncular scales 16.

Gonopodial ray 3 robust, abruptly narrowing in distal half; 10–12 distal segments with T-shaped processes (Fig. 3). No dorsal processes on gonopodial ray 4a segments. Gonopodial ray 4p, with serrae on 14–16 segments; serrae adjacent to the short and deep elements from ray tip, projecting posteriorly and fitting into

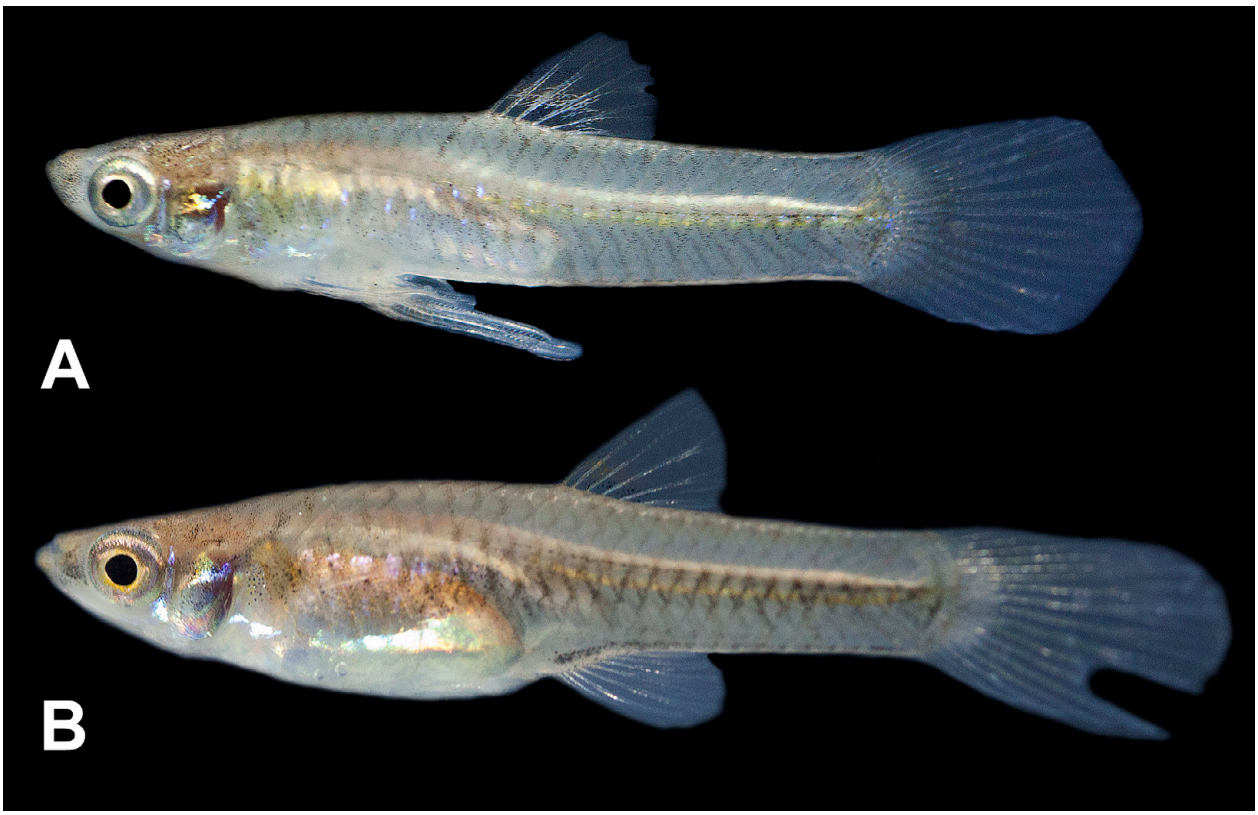

Figure 4. *Poecilia scalpridens* colouration in life. **A.** Male, about 15 mm SL (UFRJ 8834). **B.** Female, about 17 mm SL (UFRJ 8834).

adjacent elements; proximal serrae not distinguishable from the element itself; frequently with two tips. Ventral border of subdistal portion of gonopodial ray 5a with 4 or 5 narrow ventral projections towards gonopodial ray 4p.

Vertebrae 28 or 29. Gonapophyses of vertebrae 14 and 15 at angle of approximately 30° to vertebral column. Ligastyle absent. Proximal radial of dorsal fin in a vertical to neural spine of vertebrae 10 and 11.

Colouration of preserved specimens (Fig. 1). Overall body colour pale brownish yellow with minute, sparsely distributed chromatophores and some organized chromatophores forming a brown reticulate pattern along flank; zig-zag pattern inconspicuous on lower half of flank and not easily distinguishable from body zig-zag pattern. Black minute chromatophores forming a conspicuous, narrow line along mid-body line of flank and extending from the region just before dorsal fin insertion to the end of the caudal peduncle. Ventral surface from infraorbital region to about mid-half of body scarcely pigmented, bearing a line of dark brown chromatophores from this point to the end of caudal peduncle. Head overall yellowish brown. Dark brown chromatophores on dorsum of head. Minute chromatophores concentrated in the lower jaw, snout, and pre-orbital region, forming a distinct darker region. Infraorbital region white, without pigmentation; postorbital region predominantly white with few scattered chromatophores. Iris black. All fins hyaline in females, with melanophores sparsely concentrated only on fins membranes and along fin rays; high concentration of melanophores on dorsal fin in males, with two distinct dark brown to black zones separated by a hyaline band, one at the fin base and the other at the tip of the first three rays.

Colouration in life. Males (Fig. 4A). Side of body light gray to transparent, with an inconspicuous, light brown reticulate pattern; scattered with blue metallic dots in the anterior portion of the flank and along the flank midline. Dorsum grayish brown. Ventral surface white from below eye to mid-body, then with a dark brown line of chromatophores from this point to the end of caudal peduncle. Head predominantly light brown in post-orbital and dorsal region, with conspicuous chromatophores; light gray to white in anterorbital region, with conspicuous dark brown chromatophores on the snout and lower jaw forming a distinct grayish brown preorbital blotch. Opercular region with bright metallic blue blotches. Iris bright silver. Pectoral, pelvic fins and gonopodium hyaline with small chromatophores scattered along fin rays; dorsal fin with dark chromatophores on fin base and on the tip of the first three rays, forming two distinct dark brown to black zones, separated by a light yellow to hyaline band.

Females (Fig. 4B). Overall colouration similar to males. Side of body with a conspicuous zig-zag pattern along the lower half of flank; anterior region of flank with a purplish metallic colouration. Iris silver, bright yellow close to pupil. All fins hyaline.

Distribution and habitat. *Poecilia scalpridens* is known to occur along the lower reaches of tributaries close to the Amazon main channel, in the lakes and igarapés near Parintins (Amazonas state) and at the mouth of the Tapajós River (Pará state) (Figueiredo 1997; Lucinda

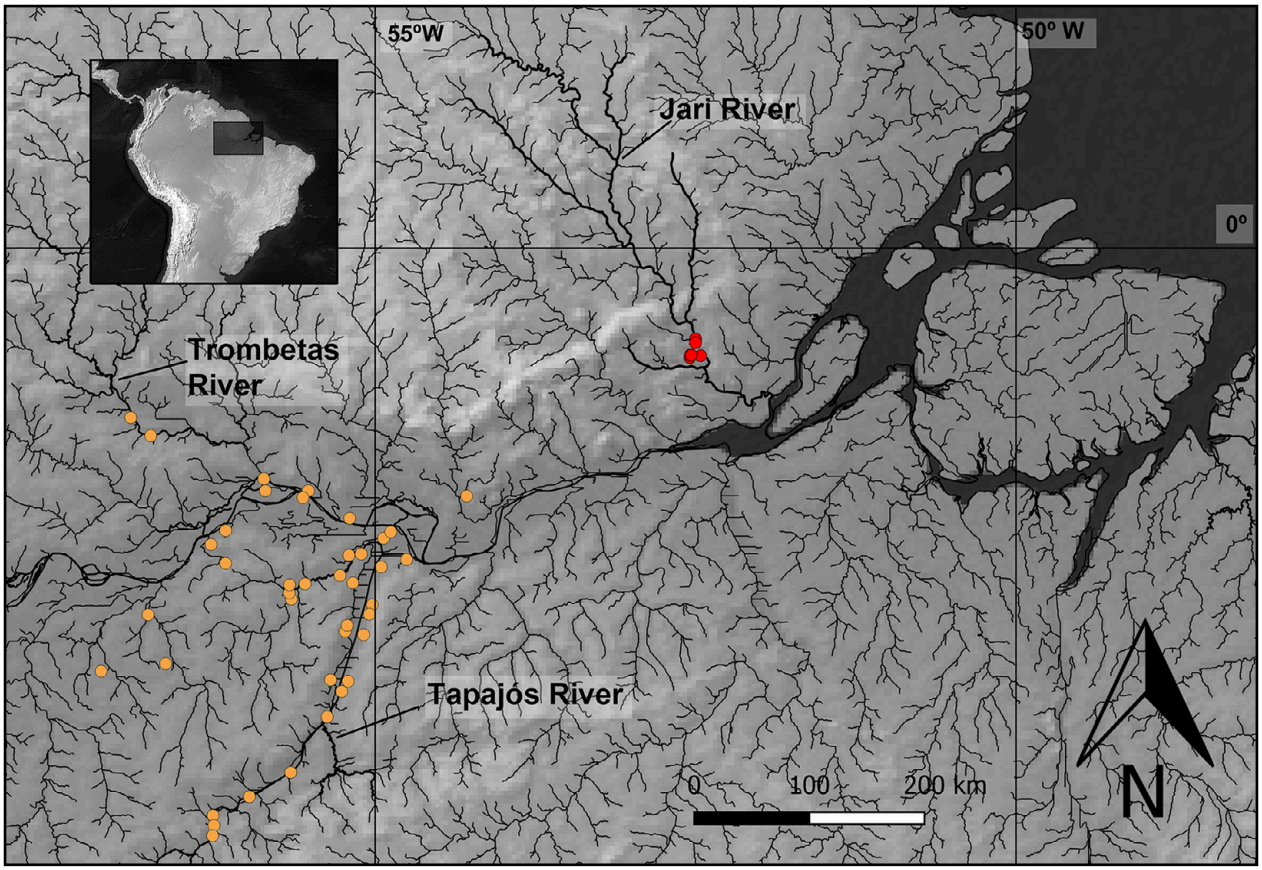

Figure 5. Distribution of *Poecilia scalpridens*. The orange dots represent UFRJ, GBIF, and SpeciesLink records for *P. scalpridens*, depicting its known distribution; red dots represent the new records for the Jari River, Amapá, Brazil.

2003). Here, we confirm that this species also occurs in the lower Jari River, a natural limit between the Amapá and Pará states. Our new record represents the easternmost record for the species (Fig. 5). Similar to its congeners, *P. scalpridens* inhabits shallows along the margins of lakes and igarapés, and it is also commonly found forming large shoals close to floating vegetation near the shore (Fig. 6).

Discussion

The Jari River ichthyofauna remains poorly known, with the Jari River being the only main drainage in Amapá not sampled by Melo's et al. (2016). This and other recent ichthyological surveys in the region (e.g., Dutra et al. 2020) failed to sample poeciliids.

In contrast, fieldwork led by UFRJ and IEPA researchers in Amapá state coastal river drainages and in the lower Jari river drainage in the past decade was successful in finding other Cyprinodontiformes, many of them new to science. The poeciliids *Poecilia* (*Micropoecilia*) *parae* Eigenmann, 1894 and *Poecilia* (*Poecilia*) *vivipara* Bloch & Schneider, 1801 were sampled in lower portions of coastal rivers of Amapá. In the Jari River, *Poecilia* (*Micropoecilia*) *waiapi* Bragança & Costa, 2012 and two rivulids, *Anablepsoides gamae* Costa, Bragança & Amorim, 2013 and *A. jari* Costa, Bragança & Amorim, 2013, were found. In addition to the aforementioned species, *Fluviphylax palikur* Costa & Le Bail, 1999 is also known to occur in the lower Jari River. Thus, there is evidence of a high diversity of Cyprinodontiformes in this area which is usually not found in large ichthyofaunal surveys. As such, we consider that fieldwork needs to focus on the collection of small fish species in order to properly investigate the diversity of the ichthyofauna of a particular area.

The Jari River drains the eastern border of the Guiana Shield and is the easternmost tributary of the Amazon before reaching the Atlantic Ocean. The occurrence of *P. scalpridens* is limited to the lower Jari River drainage, below Cachoeira de Santo Antônio (Santo Antônio Falls). The falls represent a major physical barrier that delimits the border between the lower and upper reaches of the Jari River. Our new records, therefore, delimit the easternmost extent of this species' range and extends its known distribution by about 300 km. *Poecilia scalpridens* was found in shallow and slow flowing water, but also in flooded areas near the river margin and in associated lakes within floating aquatic vegetation. Our new records represent a considerable range extension for *P. scalpridens*, and given the morphological congruence between populations, a broad distribution and connectivity between populations is expected despite the small size of the species. A similar distribution scenario is also seen among other fish species along the Lower Amazon main channel, as defined by Dagosta and de Pinna (2017).

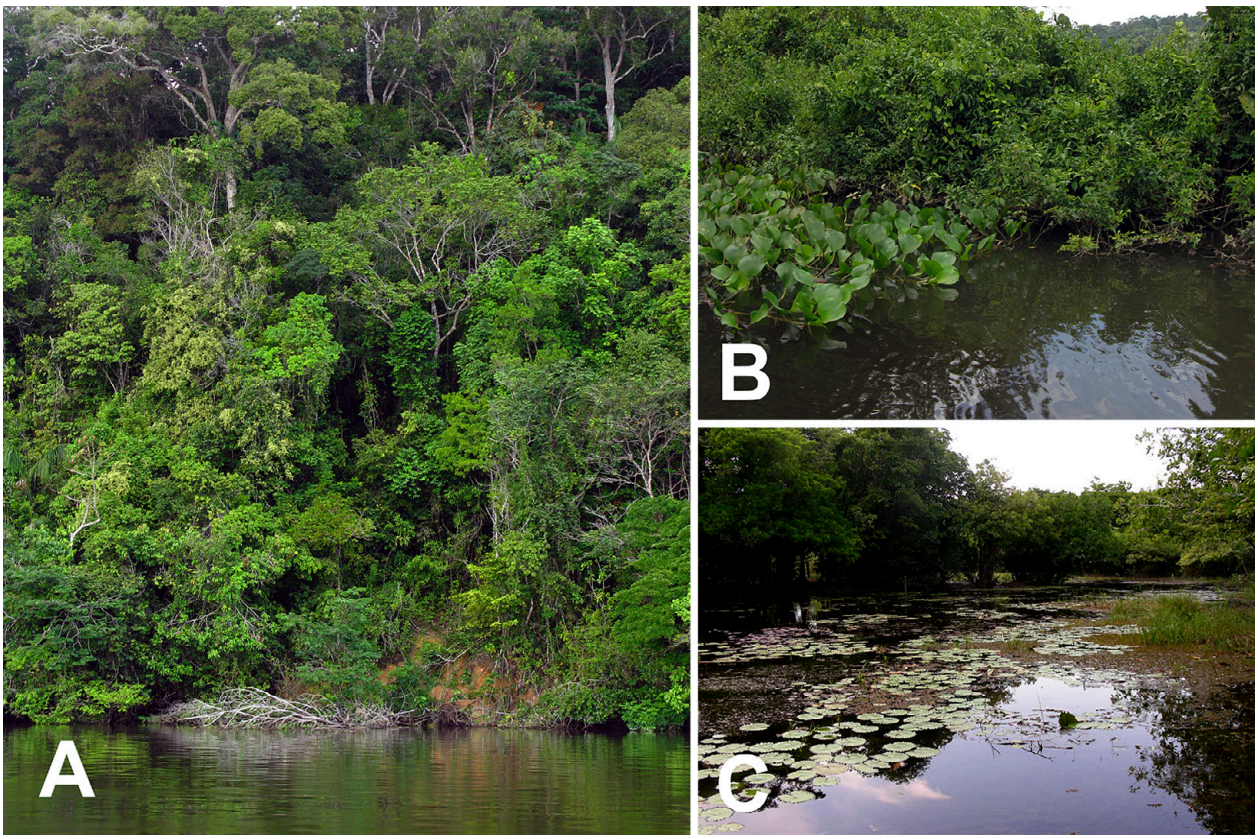

Figure 6. *Poecilia scalpridens* habitats in the lower Jari River, Amapá, Brazil. **A.** Jari River margin. **B.** Floating vegetation just below Cachoeira de Santo Antônio. **C.** Lake with aquatic vegetation close to the Jari River margin. Photographs by Pedro Bragança (A and B) and Cecile Gama (C).

Five autapomorphies of *Pamphorichthys* were recognized by Costa (1991) while describing *P. araguaiensis*. These relate to the microanatomy of the modified pelvic fin in males, the gonopodium, and colour pattern. According to Costa (1991), *Pamphorichthys* species are easily recognized by the following: presence of the second pelvic fin ray of males separated from rays 3–5 by a deep notch; second pelvic fin ray of males with lateral osseous prolongations over subdistal segments; gonapophysis almost parallel to the vertebral column; absence of gonactinosts 8 and 9, and presence of a zigzag colour pattern over the flank between the pectoral fin base posterior region and the end of the caudal peduncle. In our study, the examined specimens from the Jari river drainage exhibit all these diagnostic features.

Figueiredo (1997) in his unpublished revision of *Pamphorichthys* established five autapomorphies for *P. scalpridens*: serrae adjacent to the short and deep elements from gonopodial ray 4p tip, projecting posteriorly and fitting into the adjacent elements; 5 or 6 narrow ventral projections in the gonopodial ray 5a elements towards gonopodial ray 4p; proximal serrae of the gonopodial ray 4p not distinguishable from the element itself; initial serrae from the gonopodium ray 4p frequently with two tips; and teeth from the external raw of dentary and premaxilla incisive (Fig. 3). Our specimens present all these diagnostic characters, allowing for their identification as *P. scalpridens*.

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