

Description of a new species of miniature catfish of the genus *Ammoglanis* (Siluriformes: Trichomycteridae) from rio Tapajós basin, Brazil

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A new species of *Ammoglanis* is described from the rio Aruri Grande, rio Jamanxim drainage, a right bank tributary to the middle rio Tapajós, Pará State, Brazil. The new species is identified and defined through morphological characters such as color pattern, consisting of eight or nine transverse dark bars regularly spaced along the dorsum; skeletal morphology; numbers of premaxillary teeth, vertebrae, and dorsal- and pectoral-fin rays; presence of cranial fontanel and two small, finger-like papillae on chin anterior to the gular apex. The new species probably is an additional example of endemism in the rio Tapajós basin.

Keywords: Biodiversity, Freshwater fishes, Sarcoglanidinae, Taxonomy.

Uma nova espécie de *Ammoglanis* é descrita do rio Aruri Grande, drenagem do rio Jamanxim, um afluente da margem direita do médio rio Tapajós, Pará, Brasil. A nova espécie é identificada e definida por meio de caracteres morfológicos como padrão de colorido, constituído por oito ou nove barras escuras transversais regularmente espaçadas ao longo do dorso; morfologia de elementos esqueléticos; número de dentes no pré-maxilar, vértebras e raios da nadadeira dorsal e peitoral; presença de fontanela craniana e duas pequenas papilas em formato de dedo localizadas no queixo, anterior ao ápice gular. A nova espécie provavelmente é um exemplo adicional de endemismo na bacia do rio Tapajós.

Palavras-chave: Biodiversidade, Peixes de água doce, Sarcoglanidinae, Taxonomia.

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INTRODUCTION

Ammoglanis Costa, 1994 is a genus of trichomycterid catfish (Sarcoglanidinae) described by Costa (1994) to allocate *A. diaphanus* Costa, 1994 from the rio Araguaia basin. Subsequently, five species have been described in the genus: *Ammoglanis pulex* de Pinna & Winemiller, 2000 and *A. natgeorum* Henschel, Lujan & Baskin, 2020 from the rio Orinoco basin, *A. multidentatus* Costa, Mattos & Santos, 2019 from coastal rivers of Bahia State in northeastern Brazil, and two other species from the rio Amazonas basin: *Ammoglanis obliquus* Henschel, Bragança, Rangel-Pereira & Costa, 2020 from the rio Preto da Eva drainage and *A. amapaensis* Mattos, Costa & Gama, 2008 from the Amapari, Araguari, and Jari river basins (Ferraris Jr., 2007; Mattos *et al.*, 2008; Henschel *et al.*, 2020a).

Ammoglanis species are miniature fishes that inhabit river and stream ecosystems dominated by sandy substrates (Costa, 1994; de Pinna, Winemiller, 2000; Henschel *et al.*, 2020a). The genus was thus originally characterized by 1) a slender quadrate, greatest depth 30% of the length of its main axis; 2) an expanded anterior tip of interopercle, about 50% of the total length of the bone's upper margin; 3) premaxilla posterior to mesethmoid cornu; 4) ventral mouth; 5) a short lateral process on the premaxilla, about 50% of the length of the premaxilla without process; and 6) absence of separate ossification of the anterior cartilage of palatine (Costa, 1994). However, among these characteristics, only the quadrate morphology is present in all species of the genus (Costa *et al.*, 2019; Henschel *et al.*, 2020a,b).

The objective of this paper is to describe a new species of *Ammoglanis* collected during recent ichthyofaunal surveys throughout the rio Jamaxim drainage, a right bank tributary to the middle rio Tapajós, Pará State, Brazil.

MATERIAL AND METHODS

Osteological preparations were cleared and stained (CS) for cartilage and bone using the method described by Taylor, Van Dyke (1985). Osteological nomenclature follows that of Schultze, Arratia (1989) and Datovo, Bockmann (2010). Osteological illustrations were made using a Zeiss Stemi 305 stereomicroscope with a camera AxioCam ERc 5S.

Counts and measurements were made on the left side of the specimens whenever possible, according to Costa (1992) and Henschel *et al.* (2020b), excluding interopercular patch length. All measurements are expressed as percent of standard length (SL), except subunits of the head, which are expressed as percent of head length (HL). Straight-line measurements were taken with a digital dial caliper to the nearest 0.1 mm.

Counts of fin rays and bony elements were obtained from CS specimens. Fin-ray counts include unbranched rays (Roman numeral) and all subsequent branched rays (Arabic numeral). Caudal-fin ray counts include all principal rays (*i.e.*, all inner branched rays and the first unbranched ray of the dorsal and ventral lobes, also referred to as outer principal rays). Vertebral counts included all vertebrae except those in the Weberian apparatus; the compound caudal centrum was counted as a single element.

Institutional abbreviations follow Sabaj (2020). In the list of comparative material examined, the museum abbreviations and catalog numbers are followed by the total

number of specimens in that lot, cleared and stained specimens, and range of standard length.

RESULTS

Ammoglanis nheengatu, new species

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(Fig. 1; Tab. 1)

Holotype. INPA 59653, 14.8 mm SL, Brazil, Pará State, Itaituba Municipality, rio Tapajós basin, rio Jamanxim drainage, igarapé Branco, tributary to Aruri Grande, 05°24'9.07"S 55°52'59.01"W, 9 Oct 2019, A. P. Hercos.

Paratypes. All collected with holotype. IDSM 3063, 5, 13.1–14.9 mm SL; INPA 59654, 3, 12.8–12.9 mm SL; UFOPA-I 1357, 10, 5 CS, 10.9–16.8 mm SL.

Diagnosis. *Ammoglanis nheengatu* is distinguished from *A. diaphanus*, *A. amapaensis*, and *A. multidentatus* by the absence (*vs.* presence) of the metapterygoid; by the possession of eight or nine transverse dark bars regularly spaced on the dorsum, more visible in dorsal view (*vs.* three transversal dark bars regularly spaced along the dorsum in *A. diaphanus* and *A. amapaensis* and few dark chromatophores scattered on the body in *A. multidentatus*), and the presence (*vs.* absence) of two small, finger-like papillae on chin anterior to the gular apex. *Ammoglanis nheengatu* is distinguished from *A. pulex*, *A. natgeorum*, and *A. obliquus* by having 8–10 teeth in the premaxilla (*vs.* teeth absent in *A. pulex*, 3 in *A. obliquus*, and 4–6 in *A. natgeorum*) and presence (*vs.* absence) of a sesamoid supraorbital, and from *A. obliquus* and *A. natgeorum* by the presence (*vs.* absence) of a pelvic splint. *Ammoglanis nheengatu* further differs from *A. natgeorum* by having six or seven (*vs.* five) interopercular odontodes and five (*vs.* six) pectoral-fin rays; from *A. amapaensis* by the presence (*vs.* absence) of cranial fontanel and absence (*vs.* presence) of anterior autopalatine ossification; from *A. multidentatus* by having short posterolateral process of autopalatine (*vs.* slender and long) and 4 or 5 (*vs.* 6) pelvic-fin rays; and from *A. diaphanus* by having 8 (*vs.* 10) dorsal-fin rays and 31–32 (*vs.* 34) vertebrae (Tab. 2).

Description. Morphometric data in Tab. 1. Body elongate; dorsal profile of head and body straight to slightly convex from tip of snout to origin of dorsal fin; approximately straight from end of dorsal-fin base to caudal-fin base. Ventral profile of head slightly convex. Ventral profile of trunk approximately straight up to insertion of anal fin; slightly convex from end of anal-fin base to caudal-fin base. Caudal peduncle strongly compressed. Urogenital and anal openings on vertical through base of first or second branched dorsal-fin rays. Head wide and depressed, trapezoidal in dorsal view. Eye small, elliptical, or nearly rounded, located dorsolaterally at anterior half of head length. Anterior profile of snout rounded. Mouth subterminal and small, with thin lower lip. Teeth conical, 8–10 in premaxilla and dentary, respectively, and arranged in two regular



FIGURE 1 | *Ammoglanis nheengatu* in lateral and dorsal views, holotype, INPA 59653, 14.8 mm SL, igarapé Branco, tributary to rio Aruri Grande, rio Jamaxim drainage, rio Tapajós basin, Pará State, Brazil.

rows. Branchiostegal membranes attached to isthmus and branchial openings wide. Maxillary, rictal, and nasal barbels short, with thick base, tapered distally. Maxillary barbel extending to posterior border of interopercular patch of odontodes. Rictal barbel slightly shorter than maxillary barbel, reaching middle of interopercular patch of odontodes. Nasal barbel extending beyond posterior margin of eye, reaching vertical through base of interopercular patch of odontodes. Chin region with two finger-like projections, one on each side of midline. Opercular and interopercular patches of odontodes small, elliptical, and located dorsolaterally on head; 7–8 conical opercular odontodes; 6–7 conical interopercular odontodes. Opercular and interopercular odontodes gradually increasing in size posteriorly and with tips curved dorsomedially.

Pectoral-fin rays i,5. Fin subtriangular in dorsal view; first ray markedly longest. Pelvic fin with slightly rounded distal profile, reaching vertical through origin of dorsal-fin base. Pelvic-fin rays i,2,ii or i,3,i. Pelvic-fin origin at vertical through between haemal spine of 13th and 14th vertebra. Pelvic splint present. Dorsal fin with semicircular profile in lateral view. Dorsal-fin rays ii,4,ii or ii,5,i, with seven pterygiophores. First pterygiophore inserted posterior to neural spine of 15th (2) or 16th (3) vertebra; last pterygiophore anterior to neural spine of 19th (3) or 20th (2) vertebra. Anal fin with semicircular profile in lateral view, its origin at vertical through base of last rays of dorsal fin. Anal-fin rays ii,3,i or ii,4,i plus one rudimentary ray at fin origin. Six anal-fin pterygiophores, first pterygiophore posterior to haemal spine of 18th (2) or 19th (3) vertebra; last pterygiophore immediately anterior to haemal spine of 22nd (4) or 23rd (1) vertebra. Caudal fin moderately long, with rounded distal margin; principal caudal-fin rays ii,4+4,ii. Dorsal and ventral procurrent caudal-fin rays 7 or 8.

Osteology. Anterior margin of mesethmoid approximately straight to slightly concave in medial portion, mesethmoid cornua slender distally. Cranial fontanel lozenge-shaped,

TABLE 1 | Morphometric data of holotype and 18 paratypes of *Ammoglanis nheengatu*. Range includes the holotype. SD = standard deviation.

	Holotype	Range	Mean	SD
Standard length (mm)	14.8	10.9–16.8	14.4	–
Percent of standard length				
Body depth	13.0	12.0–14.8	13.2	0.7
Caudal peduncle depth	10.1	9.5–10.8	10.1	0.4
Body width	9.4	7.7–12.2	9.5	0.9
Caudal peduncle width	3.8	2.8–4.3	3.6	0.4
Predorsal length	65.2	61.8–67.5	64.8	1.3
Preanal length	73.1	69.0–75.0	72.8	1.4
Prepelvic length	55.3	49.4–58.1	54.4	2.1
Dorsal-fin base length	7.1	7.9–10.6	8.5	0.8
Anal-fin base length	6.9	5.9–9.2	7.4	0.8
Pectoral-fin length	10.1	9.7–19.8	11.9	2.8
First pectoral-fin ray length	17.9	14.0–30.5	18.0	3.3
Pelvic-fin length	7.6	5.0–9.5	7.9	1.1
Head length	18.1	15.5–19.5	17.7	1.1
Percent of head length				
Head depth	52.2	49.8–65.5	55.2	4.6
Head width	93.7	85.3–102.2	93.6	5.6
Snout length	35.4	29.6–40.0	34.6	2.4
Interorbital width	20.5	19.3–26.0	21.2	1.5
Eye diameter	11.2	8.9–13.0	11.8	1.0
Mouth width	36.2	30.3–46.1	37.3	4.9
Opercular patch length	21.3	18.9–26.8	22.2	2.0

TABLE 2 | Some diagnostic characteristics to *Ammoglanis* species.

Character	<i>A. diaphanus</i>	<i>A. pulex</i>	<i>A. amapaensis</i>	<i>A. multidentatus</i>	<i>A. obliquus</i>	<i>A. natgeorum</i>	<i>A. nheengatu</i>
Middorsal dark bars	absent	seven	absent	Absent	seven	eight	eight-nine
Premaxilla teeth	9–12	absent	08–11	10–11	3	4–6	8–10
Dentary teeth	8	absent	7–8	11–13	4	8–11	8–10
Number of dorsal-fin rays	iii,6,i	ii,6	iii,5,i	ii,6, i	ii,6	ii,4,i	ii,4,ii or ii,5,i
Number of anal-fin rays	iii,4,i	iii,5	iii,4,i	ii,4,i	ii,5	i,5,i	ii,3,i or ii,4,i
Number of pelvic-fin rays	i,4	i,2,i	i,4	i,5	i,2,i or i,2,ii	i,4	i,2,ii or i,3,i
Number of pectoral-fin rays	i,6	i,4 or i,5	i,4	i,6 or i,7	i,5	i,4	i,5
Vertebrae	34	30 or 31	30–32	31	34 or 35	31	32
Pelvic splint	present	present	present	not available	absent	absent	present
Supraorbital sesamoid	present	absent or reduced	present	Present	absent	absent	present
Autopalatine posterolateral process	long	short	short	Long	short	short	short
Metapterygoid	present	absent	present	Present	absent	absent	absent
Finger-like projections	absent	present	absent	Absent	present	present	present

extending from anterior third of frontal to middle portion of parieto-supraoccipital (Fig. 2). Antorbital anteriorly expanded scythe-shape. Sesamoid supraorbital present, approximately 70% of antorbital length (Fig. 2).

Premaxilla with relatively long and pointed lateral process, projecting approximately 80% of bone length. Ventral expansion of premaxilla absent. Maxilla narrow and elongated, with short process dorsolaterally in anterior third. Autopalatine with rectangular shape; lateral margin concave, medial margin slightly convex. Posterolateral process of autopalatine short, posteroventrally curved. Anterior autopalatine ossification absent; cartilaginous head of palatine moderately large, about one-third of bone length.

Quadrates long, slender, about same length as longitudinal axis of hyomandibula. Very small process extending lateroventrally from anterior tip of quadrate, articulating with lower jaw; metapterygoid absent. Hyomandibula with elongated and narrow anterior process; its tip reaching vertical through anterior tip of quadrate (Fig. 3). Anterior portion of interopercle anteriorly expanded. Three basibranchial elements, 2nd and 3rd ossified, 4th cartilaginous. First hypobranchial ossified, 2nd cartilaginous, with small osseous anterodistal process 3rd, cartilaginous. Branchiostegal rays 6.

Vertebrae 32 (5 precaudal and 27 caudal vertebrae). Three pairs of pleural ribs, one specimen with third pair of ribs greatly reduced. Caudal skeleton composed of compound centrum, pleurostyle, and hypurals 3–5 fused, forming triangular upper hypural plate. Parhypural and hypurals 1–2 fused, forming trapezoidal lower hypural plate. Neural arch of compound centrum incomplete.

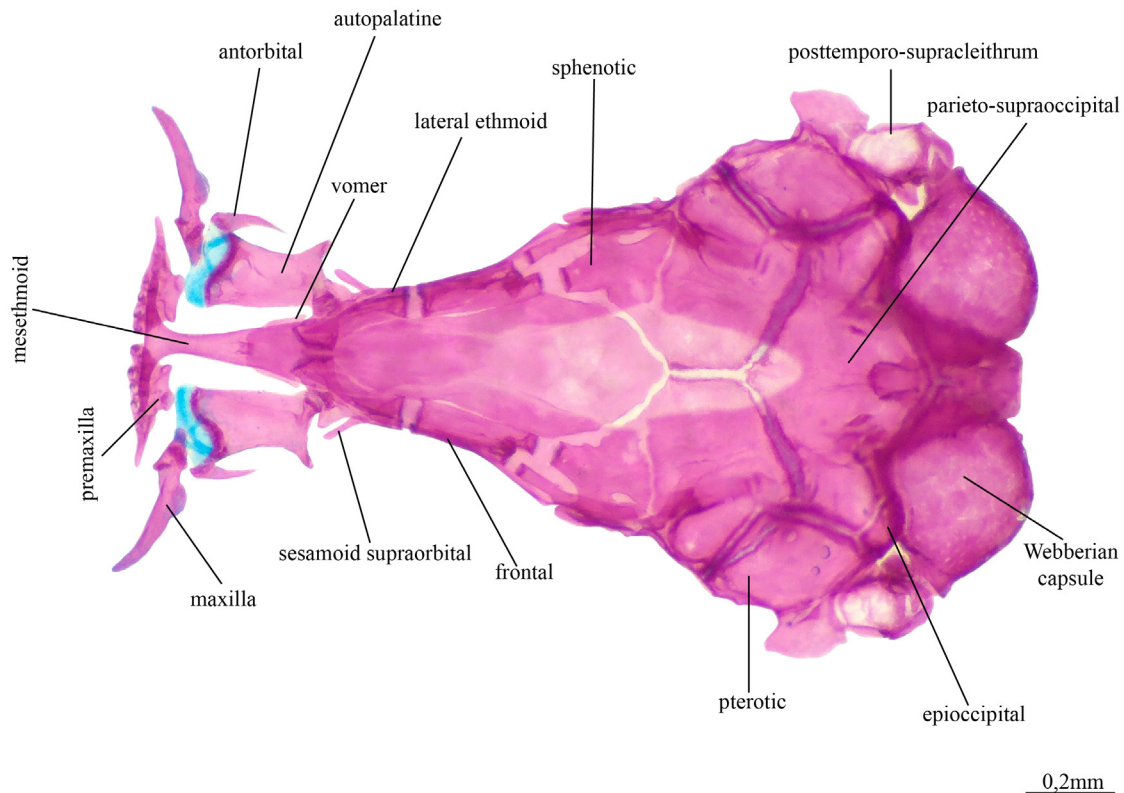


FIGURE 2 | Neurocranium of *Ammoglanis nheengatu*, paratype, UFOPA-I 1357, 15.2 mm SL, in dorsal view.

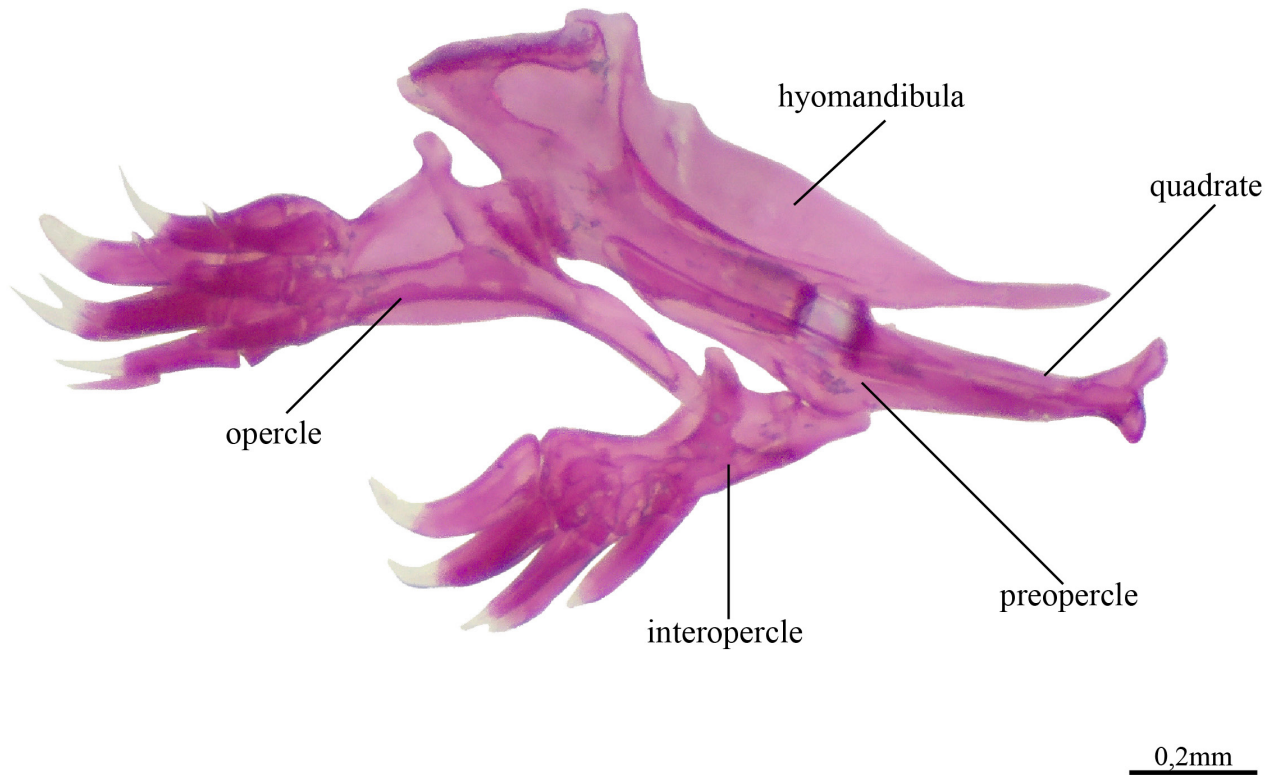


FIGURE 3 | Left suspensorium of *Ammoglanis nheengatu*, paratype, UFOPA-I 1357, 15.2 mm SL, in lateral view.

Coloration in alcohol. Body white to light yellow, darker dorsally. Dorsal region of head with patch of chromatophores, more concentrated on medial region, posterior to eye, extending up to nape and laterally to dorsal region of opercular odontodes. Ventral surface of head white, except for few sparse chromatophores on interopercular base. Barbels hyaline. Scattered dark chromatophores on sides of trunk, more concentrated along lateral midline. Chromatophores concentrated at regular intervals along dorsum, forming eight to nine dark bars, visible in dorsal view. Ventral region of caudal peduncle with chromatophores concentrated at regular intervals forming three bars. Dorsal-, caudal-, and anal-fins rays weakly pigmented by scattered chromatophores. Pelvic- and pectoral-fin rays hyaline. Some specimens with dark chromatophores concentrated on base of caudal-fin rays, forming two bands (Fig. 1).

Coloration in life. Body semi-translucent; ground color lightly yellow, with dark chromatophores scattered along sides, more concentrated on lateral midline. Dorsal region of head with dark blotches on post-orbital and nuchal portions, extending laterally to dorsal region of opercular odontodes. Concentrated chromatophores extend from lateral edge of anterior nostril to anterior margin of eye, forming a dark stripe. Ventral surface of head with few dispersed chromatophores on branchiostegal membrane and interopercular base. Maxillary, rictal, and nasal barbels hyaline. Eight or nine transverse dark-brown bands on dorsal surface of body, extending from behind nape to caudal-

fin base. Lateral surface of trunk with deeply set dark coloration, arranged at regular intervals, forming approximately seven dashes, only visible by transparency. Ventral surface of caudal peduncle with three transverse dark-brown bars. Dorsal-, caudal-, and anal-fin rays weakly pigmented by scattered chromatophores. Pelvic- and pectoral-fin rays hyaline. Dark chromatophores concentrated on base of caudal-fin rays, forming blotches (Fig. 4).

Geographical distribution. *Ammoglanis nheengatu* is known only from its type locality, the Igarapé Branco, a tributary to the rio Aruri Grande, rio Jamaxim drainage, a right bank tributary to the middle rio Tapajós, Pará State, Brazil (Fig. 5).

Etymology. The specific epithet, *nheengatu*, honors the indigenous people of the Amazon. Nheengatu is known as the general language of the Amazon that helped create the cultural identity of the largest Brazilian region. In the nineteenth century Nheengatu was the most commonly spoken language in the Amazon region, in both small and large cities (e.g., Belém, Manaus, Macapá, Santarém, Tefé, and Óbidos). Currently, Nheengatu is being rescued in indigenous schools of the lower rio Tapajós basin. A noun in apposition.

Ecological notes. Igarapé Branco, type locality of *Ammoglanis nheengatu*, is a “terra firme” clear water stream, approximately 9 m wide and 50 cm deep, with low flow speed. The collection site has large areas of riparian forest, with only part of the margins deforested for subsistence agriculture plantations. The specimens of *A. nheengatu* were captured only during the dry season, over sand banks (small beaches) located along the margin of the stream. The sand banks were composed of coarse yellow sand (Fig. 6). The following physico-chemical water parameters were obtained at the collection site during the dry season of 2020: water temperature 24.9°C; pH 5.9; conductivity 27.4 µS/cm³, and dissolved oxygen 5.88 mg/L. *Ammoglanis nheengatu* occurs syntopically with three other trichomycterids species: *Ochmacanthus reinhardtii* (Steindachner, 1882), *Stegophilus panzeri* (Ahl, 1931), and *Tridentopsis* sp.



FIGURE 4 | Live specimen of *Ammoglanis nheengatu*, paratype, UFOPA-I 1357, 16 mm SL.

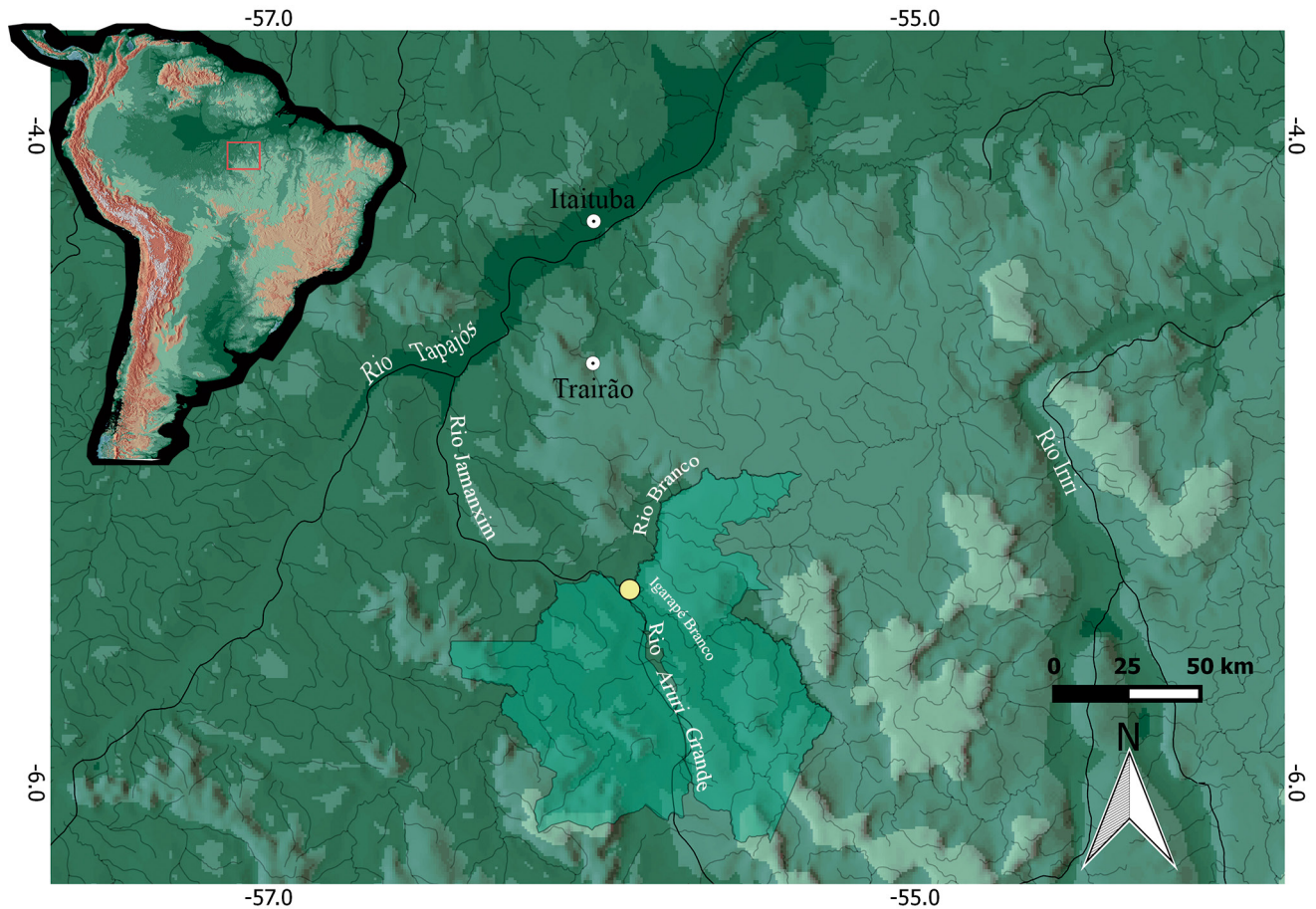


FIGURE 5 | Map indicating the known distribution of *Ammoglanis nheengatu* in the igarapé Branco, tributary to rio Aruri Grande, rio Jamaxim drainage, rio Tapajós basin, Pará State, Brazil. Delimitation of the Jamaxim National Park in light green.

Conservation status. The rio Jamaxim basin has been severely affected by anthropogenic pressures, including intense removal of native vegetation, mainly due to illegal logging, agricultural expansion, and gold mining activities (Fearnside, 2015; Lobo *et al.*, 2015). The type locality of the new species is located within an area impacted by the Cuiabá-Santarém highway (BR-163). However, the rio Aruri Grande basin drains into the Jamaxim National Park, an important protected biological reserve in western Pará. Along its margins, the rio Aruri Grande has many sandbanks, a favorable microhabitat for *Ammoglanis nheengatu*, suggesting that the species may occur inside the park. Therefore, following the International Union for Conservation of Nature (IUCN) categories and criteria (IUCN, 2019), we propose that *Ammoglanis nheengatu* be categorized as Least Concern (LC).



FIGURE 6 | Type-locality of *Ammoglanis nheengatu*, igarapé Branco, tributary to rio Aruri Grande, rio Jamaxim drainage, rio Tapajós basin, Itaituba municipality, Pará State, Brazil.

DISCUSSION

Ammoglanis nheengatu is assigned to the genus *Ammoglanis* based on the possession of a long and slender quadrate, with the greatest length representing approximately 75% of the length of the hyomandibula and greatest depth about 30% of its length (Fig. 3). According to Henschel *et al.* (2020b) this is the only character among the diagnostic character states originally proposed by Costa (1994) for the genus *Ammoglanis* that is notably shared by all species of the genus.

Henschel *et al.* (2020a,b) presented putatively informative features to elucidate internal relationships of *Ammoglanis*. According to Henschel *et al.* (2020b), *A. pulex*, *A. natgeorum*, and *A. obliquus* share the absence of the metapterygoid, the overall living color pattern (with poorly defined bars of chromatophores on middorsal portion of body and internal dark chromatophores forming a dash pattern along the flank), presence of two finger-like papillae in the gular region, and eight dorsal-fin rays. *Ammoglanis nheengatu* possess all the putative morphological synapomorphies assigned to this group. Nevertheless, *A. nheengatu* can be easily distinguished from *A. pulex*, *A. obliquus*, and *A. natgeorum* by possessing a higher number of premaxillary teeth and highly developed

sesamoid supraorbital, absent in *A. natgeorum* and *A. obliquus*, and, if present in *A. pulex*, significantly reduced, as previously stated by de Pinna, Winemiller (2000) and Henschel *et al.* (2020b) (Tab. 2). Additionally, *A. nheengatu* has a long anteroventral opercular process, with a length approximately equal to or slightly greater than the length of the main axis of the opercle, excluding the odontode patch. This condition is present in *A. multidentatus* and was considered a putative autapomorphy for this species by Costa *et al.* (2019: fig. 2b).

Ammoglanis nheengatu is known from the rio Jamamxim, a tributary situated on the limit between the middle and lower rio Tapajós, and probably is an additional example of endemism in the rio Tapajós basin (*e.g.*, Dagosta, de Pinna, 2017; Jézéquel *et al.*, 2020). *Ammoglanis nheengatu* is the third species of the genus reported within the limits of the rio Amazonas basin, where the greatest diversity of the genus is housed (MCC de Pinna, 2010, pers. comm.). Therefore, it is necessary to increase efforts, especially in the Amazon basin, to establish the actual diversity of this genus of trichomycterid catfish.

Comparative material examined. *Ammoglanis diaphanus*: Brazil. MZUSP 86249, 1 CS, 16.2 mm SL. *Ammoglanis pulex*: Venezuela. MZUSP 42471, paratypes (2 of 21, 1 CS). *Ammoglanis* aff. *pulex*: Brazil. INPA 27207, 2, 13.0–14.0 mm SL; INPA 27212, 6, 12.9–14.6 mm SL. *Ammoglanis obliquus*: Brazil. INPA 59277, paratypes, 2, 12.8–12.9 mm SL; INPA 30762, 52, 4 CS, 11.9–14.2 mm SL. *Ammoglanis* sp.: Brazil. INPA 34644, 18, 1CS, 10.6–2.8 mm SL. *Potamoglanis anhangá*: Brazil. INPA 25125, holotype, 10.0 mm SL.

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André L. Colares Canto: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Writing–original draft, Writing–review and editing.

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Not applicable.

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The authors declare no competing interests.

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