

A new species of spiny driftwood catfish *Spinipterus* (Siluriformes: Auchenipteridae) from the Amazon basin

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Abstract

An expedition to the middle Rio Purus basin uncovered a remarkable new species of the genus *Spinipterus*. The new species has a very distinct and conspicuous colour pattern resembling a jaguar and it is almost four times larger than *Spinipterus acsi*, a small specimen (32 mm L_S) from Caño Santa Rita, a right bank tributary of Río Nanay in Peru and a second specimen was reported from Rio Juruá, Amazonas State, Brazil. Although the new species is more similar in size and colour pattern to *Liosomadoras*, it shares the synapomorphies for *Spinipterus*. The new species differs from the congener by the following characters: (a) colour pattern with large black rosette-like spots over a light yellow to brown background (v. brown background with small dark blotches over the body); (b) adult body size reaching 104.5 mm L_S (v. maximum known size 37.1 mm L_S); (c) posterior process of cleithrum short, never reaching vertical through the dorsal-fin origin (v. posterior process long, surpassing vertical through the dorsal-fin origin); (d) seven soft pectoral-fin rays (v. six); (e) caudal fin truncated (v. caudal fin rounded).

KEYWORDS

driftwood catfish, neotropical, otorongo woodcat, sexual dimorphism, *Spinipterus*, spiny jaguar catfish

1 | INTRODUCTION

The Neotropical catfish family Auchenipteridae currently comprises at least 124 valid species in 22 genera and two subfamilies (Calegari *et al.*, 2019). The genus *Spinipterus* Akama & Ferraris 2011 is a member of Auchenipterinae and was described based only on the holotype of *Spinipterus acsi* Akama & Ferraris 2011 from the Peruvian Amazon. A second specimen of this species was recognised from Rio Juruá, Brazil (Calegari *et al.*, 2018). *Spinipterus acsi* is a remarkable auchenipterid catfish characterised by external autapomorphic features, of which the most noteworthy is the presence of three rows of serrations along anterior and anterolateral margins of the pectoral and dorsal-fin spines. It can be further diagnosed by the presence of conspicuous spines on dorsal surface of cephalic bones, nasal and cleithrum; a groove on medial portion of dorsum of body just behind the dorsal fin (Akama & Ferraris, 2011; Calegari *et al.*, 2019). Specimens of the genus were also recorded in the Rio Madeira (Akama & Ribeiro, 2013) and Rio Branco basins (Ferreira *et al.*, 2007: cited as new genus of Auchenipteridae), but its taxonomic identity

is still uncertain. Also, *Spinipterus* has been found in the aquarium trade from Guyana, possibly from the Essequibo Basin and from the upper Amazon River in Peru, but no specimens are available in scientific collections.

More recently, an expedition to the middle Rio Purus basin revealed a new species of *Spinipterus*, with a very distinct and conspicuous colour pattern resembling a jaguar, head bones fully spiny and almost four times larger than *S. acsi*. Although the new species has a colour pattern and size more similar to *Liosomadoras* Fowler 1940 species (qv Birindelli & Zuanon, 2012), it shares the derived characters proposed for the genus by Akama & Ferraris (2011) and recently discussed in Calegari *et al.*, (2019). The new species is described here.

2 | MATERIALS AND METHODS

All fishes collected for this study were collected in accordance with Brazilian laws, under a permanent scientific collection licence (SISBIO 11561–1).

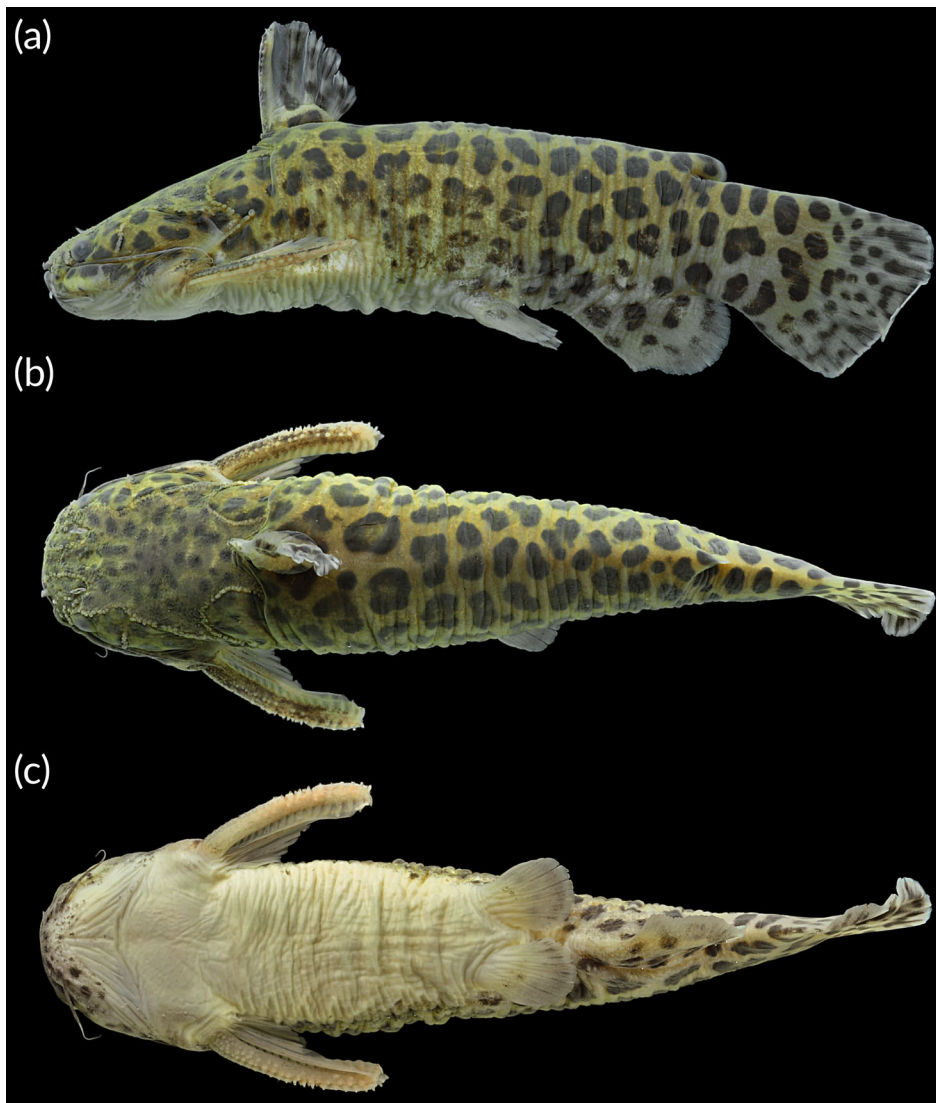


FIGURE 1 (a) Lateral, (b) dorsal and (c) ventral views of *Spinipterus moijiri* sp. nov., holotype, INPA 35625, 86.2 mm standard length, male, Brazil, Amazonas, Tapauá, Rio Tapauá, Rio Purus basin

After collection, fishes were anaesthetised with benzocaine, fixed in 10% formalin for 2 weeks and then transferred to 70% ethanol for permanent storage. Measurements are straight-line distances taken point-to-point with digital callipers on the left side of the specimen whenever possible and recorded to the nearest 0.1 mm. Measurements follow Lundberg and McDade (1986) and Akama and Ferraris (2011). All measurements are expressed as per cent of standard length (% L_S), except subunits of the head, which are expressed as per cent of head length (% L_H).

Fin rays and vertebral counts were based on radiographs, cleared and stained (c&s) and dry skeleton (sk) specimens. Gill rakers were counted on the first branchial arch. Vertebral counts included all elements in the Weberian complex. The compound caudal vertebra (PU1 + U1) was counted as a single element. In the description, counts for the holotype are indicated by an asterisk. The geographic distribution map was prepared using Quantum GIS 2.18.2 software following Calegari *et al.*, (2016).

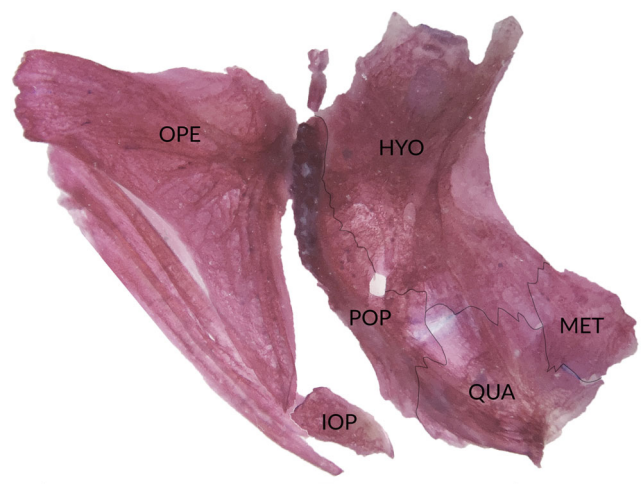
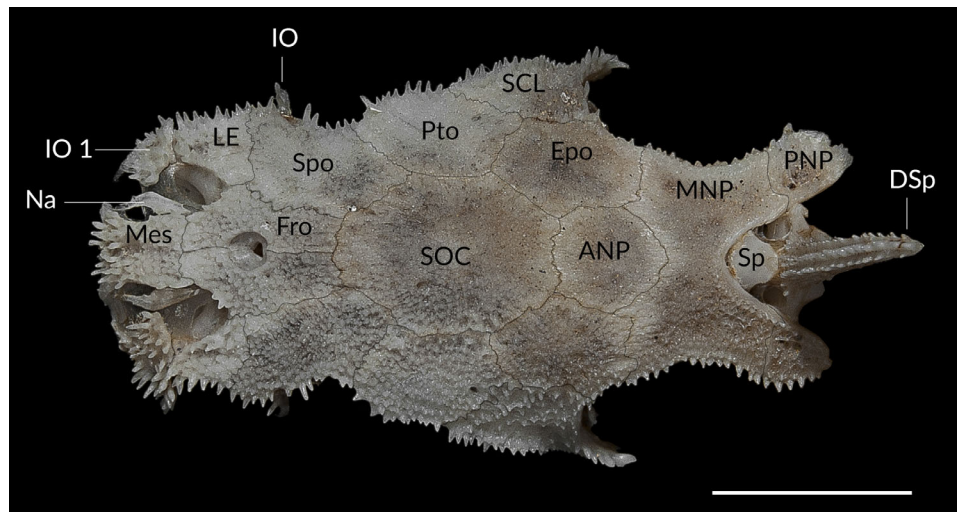


FIGURE 2 Lateral view (anterior to right) of right suspensorium of *Spinipterus moijiri* sp. nov., paratype, INPA 35411: HYO, hyomandibula; IOP, interopercle; MET, metapterygoid; OPE, opercle; POP, preopercle; QUA, quadrate. Scale, 10 mm

FIGURE 3 Dorsal view (anterior to left) of neurocranium of *Spinipterus mojiri* sp. nov., paratype, INPA 35411: ANP, anterior nuchal plate; DSp, dorsal-fin spine; Epo, epioccipital; Fro, frontal; IO, infra-orbital; IO1, infraorbital 1; LE, lateral ethmoid; Mes, mesethmoid; MNP, median nuchal plate; Na, nasal; PNP, posterior nuchal plate; Pto, pterotic; SCL, supra cleithrum; Sp, spinelet; Spo, sphenotic; SOC, supraoccipital. Scale, 10 mm



The specimens examined are deposited at Academy of Natural Sciences, Philadelphia (ANSP); Instituto Nacional de Pesquisas da Amazônia, Manaus (INPA); Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP); Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro (MNRJ); and Instituto de Desenvolvimento Sustentável Mamirauá, Tefé (IDSMLctio).

3 | RESULTS

3.1 | *Spinipterus mojiri* sp. nov.

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Figures 1–7 and Table 1.

Spinipterus sp. 'oncinha'; Calegari *et al.*, 2019: 89 (phylogeny).

3.1.1 | Holotype

INPA 35625, 86.2 mm L_S , male, Brazil, Amazonas, Tapauá, Rio Tapauá, Rio Purus basin, 05° 47' 22" S, 64° 33' 33" W, F. Rossoni, 12 November, 2010.

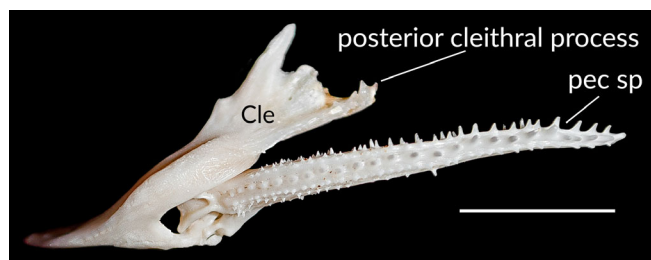


FIGURE 4 Lateral view of pectoral girdle *Spinipterus mojiri* sp. nov., paratype, INPA 35411: Cle, cleithrum; pec sp., pectoral spine. Scale, 10 mm

3.1.2 | Paratypes

INPA 35377, 2, 97.3–102.2 mm L_S , collected with holotype. INPA 35386, 90.3 mm L_S , Brazil, Amazonas, Tapauá, Rio Tapauá, Rio Purus basin, 05° 57' 10" S, 64° 50' 42" W, F. Rossoni, 18 November, 2010. INPA 35411, 5 (2 sk, 1 c&s), 95.5–104.5 mm L_S , Brazil, Amazonas, Tapauá, Rio Caniúá, Rio Purus basin, 06° 08' 18" S, 64° 53'

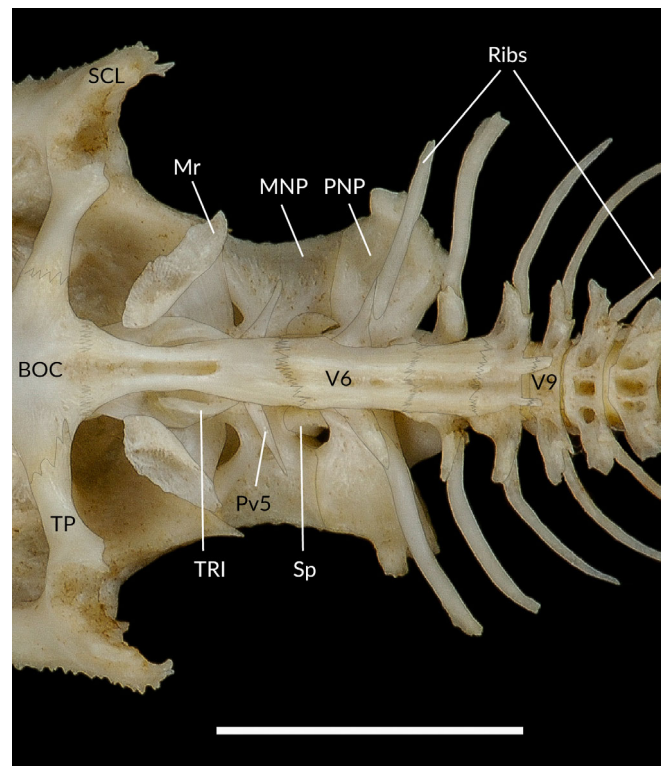


FIGURE 5 Ventral view of anterior vertebrae in *Spinipterus mojiri* sp. nov., paratype, INPA 35411: BOC, basioccipital; MNP, middle nuchal plate; Mr., Müllerian ramus; PNP, posterior nuchal plate; Pv5, parapophysis of fifth vertebra; SCL, posttemporal-supracleithrum; TP, transcapular process; TRI, tripus; v6 & v8, vertebrae 6 & 8. Scale bar equal 10 mm



FIGURE 6 (a) View of colour pattern in smallest (uncatalogued) live specimen from type locality of *Spinipterus mojiri* sp. nov. and (b) coloration in older, larger live example of the same species

33'' W, F. Rossoni, 16 November, 2010. IDSMIctio 1677, 2, 67.2–68.0 mm L_S , Brazil, Amazonas, Tefé, Igarapé Ubim, Rio Japurá basin, 02° 30,05' S, 64° 41,03' W, H. Lazzarotto & J. Oliveira, 10 October, 2007.

3.1.3 | Diagnosis

The new species differs from the single congener *Spinipterus acsi* by having the colour pattern with large black rosette-like spots over a light yellow to brown background (v. brown background with small dark blotches over the body; Figures 1, 6, and 7); adult body size reaching 104.5 mm L_S (mean 99.3 mm L_S ; v. maximum known size of body 37.1 mm L_S); posterior process of cleithrum short, not reaching the vertical through the dorsal fin spine (v. process long, almost reaching the vertical through first dorsal fin ray; Figures 1, 4, and 6); seven soft pectoral-fin rays (v. six soft pectoral-fin rays); caudal fin truncated (v. caudal fin rounded; Figure 1).

3.1.4 | Description

Morphometric data are presented in Table 1. General aspect of *Spinipterus mojiri* sp. nov. is shown in Figure 1. Body robust;

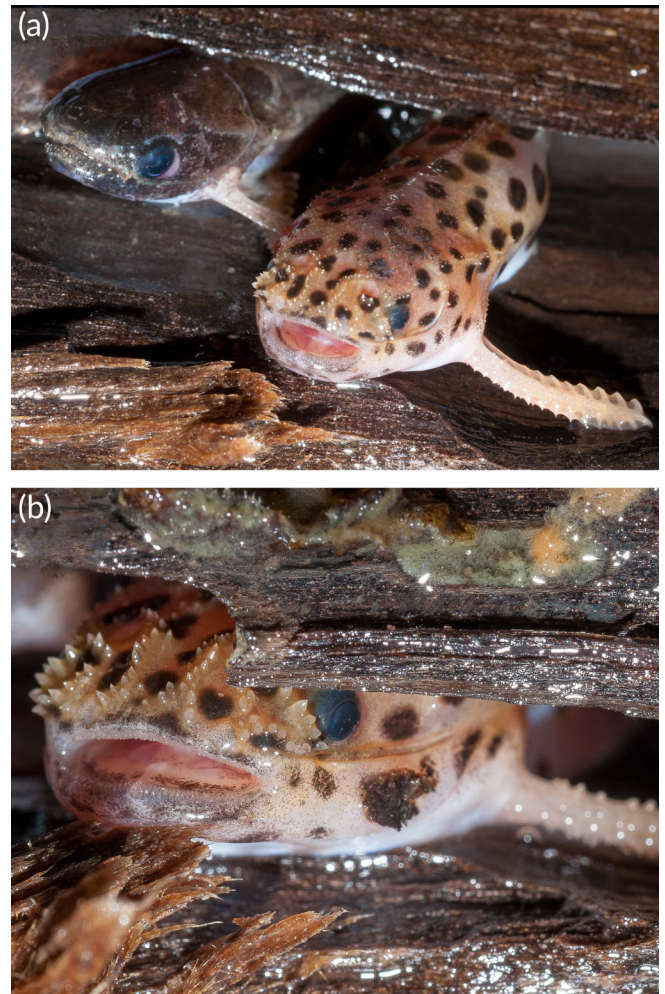


FIGURE 7 (a) Live specimens of *Spinipterus mojiri* sp. nov. and *Tatia* sp. inside a tree trunk and (b) close-up of head of a small specimen of *S. mojiri* sp. nov. inside a submerged tree trunk showing the spines along the anterior neurocranium bones. Specimen of *S. mojiri* sp. nov. photographed alive (uncatalogued) at type locality

greatest body depth at dorsal-fin origin 17.7%–22% L_S ; greatest body width at cleithrum 24.2%–28.4% L_S . Head and predorsal region depressed. Head short, 22.7%–25.4% L_S . Dorsal profile of head straight to slightly convex from anterior margin of snout to dorsal-fin origin. Snout length 1.8–2.5 times orbital diameter. Mouth terminal, dentary anteriorly projecting, slightly beyond upper jaw. Premaxillary teeth plate transversely elongate and rectangular, with 4 or 5 irregular villiform tooth rows. Palate without teeth. Dentary with five rows of teeth near symphysis, narrowing to one row posterolaterally. Tooth conical and slightly curved distally. Suspensorium composed of hyomandibula, preopercle, quadrate and metapterygoid. Metapterygoid in contact with hyomandibula via suture (Figure 2). Preopercle bearing spines on its laterodorsal region.

Three pairs of barbels. Maxillary barbel inserted midway between verticals through anterior nostril and anterior orbital margin; barbel laying in a sulcus right below orbital margin reaching to vertical through pectoral-fin origin. Anterior mental barbel reaching base of

TABLE 1 The morphological and meristic characteristics of *Spinipterus moijiri* sp. nov.

	Holotype	Paratypes (n = 5)			SD
		Mean	Minimum	Maximum	
Standard length (L_S , mm)	86.2	99.3	90.3	104.5	
% L_S					
Predorsal length	34.1	33.7	31.9	36.4	1.7
Prepectoral length	26.0	23.8	21.5	25.5	1.5
Head length (L_H)	24.7	23.8	22.7	25.4	1.0
Body depth	21.2	20.1	17.7	22.0	1.8
Body width	28.4	25.5	24.2	26.4	0.9
Upper gill membrane distance	21.4	19.5	18.6	20.3	0.7
Dorsal-fin base length	9.6	9.1	7.8	11.0	1.3
Dorsal-fin spine length	15.4	13.9	13.6	14.4	0.3
Cleithral process length	15.1	14.1	13.5	14.6	0.4
Pectoral-fin spine length	25.3	24.5	23.8	25.4	0.7
Anal-fin base	17.8	15.8	14.0	18.8	1.9
Caudal peduncle length	14.4	13.0	11.4	14.3	1.0
Caudal peduncle depth	15.0	13.4	11.8	15.1	1.2
% L_H					
Mouth width at rictus	47.4	56.0	50.9	59.7	4.1
Snout length	35.7	36.6	31.5	39.3	3.0
Eye diameter horizontal	16.0	16.7	15.6	17.7	0.9
Bony interorbital	57.8	56.9	53.9	59.1	2.6
Internarial length	24.4	21.5	20.2	23.2	1.1

posterior mental barbel. Posterior mental barbel not reaching base of pectoral-fin spine. Anterior nostril located near to snout margin, slightly tubular and directed anteriorly. Posterior nostril located dorsally to orbit; posterior nostril with an anterior folded membrane.

Eye laterodorsal, near snout tip; ocular rim circular. Margin of infraorbital 1 and lateral ethmoid bordered anteriorly and dorsally by strong spines (Figure 3). Eye relatively small: Eye diameter 15.6%–17.7% of L_H and 3.1–3.7 times in interorbital distance.

Skull roof not exposed, but visible through a thin skin. Cranial bones rough dorsally with spines or ridges distributed along external borders of lateral ethmoid, frontal, sphenotic, pterotic, supracleithrum, epiotic, preopercle and nuchal plates (Figures 3 and 7). Orbital margin of skull roof delimited dorsally by lateral ethmoid and anteriorly by infraorbital 1. Frontals excluded from orbital margin. Anterior cranial fontanel rounded, delimited by frontals only; its width almost equal to eye diameter (Figure 3).

Lateral line complete, midlaterally situated, extending onto caudal-fin base, but not bifurcated; lateral-line canals straight, with no branches. Posterior cleithral process narrow and short, directed posterodorsally. Lateral surface of posterior cleithral process ornamented with strong spines and tip with a strong hook-like spine (Figure 4).

Dorsal fin inserted near anterior $\frac{1}{3}$ L_S . Dorsal fin composed of spinelet, spine and five soft and branched rays. Dorsal-fin spine strong, smaller than first branched ray. Dorsal-fin spine with three rows of small spines along its anterior margin, oriented perpendicularly to spine axis (Figure 3); posterior margin of spine smooth.

Adipose fin elongate, with thick and short base, with free posterior lobe. Pectoral fin inserted at vertical through middle of predorsal distance. Pectoral fin composed of spine and four soft, branched rays. First branched ray longest, but shorter than pectoral-fin spine; pectoral-fin spine stout; posterior margin with retrorse, unicuspid, well-developed serrations; anterior and anterolateral margins with three rows of strong serrations (Figure 4). Pelvic fin inserted near vertical through middle of L_S ; fin with six soft rays; first ray simple, all others branched. Adducted fin reaches to base of anal fin. Anal-fin base short, with slightly-convex distal margin; fin with 18*–19 rays. Anal-fin origin posterior of middle of L_S . Caudal fin truncated, with dorsal rays slightly more elongated than ventral rays; principal caudal-fin rays i,7,9,i. Procurrent rays 18 on upper lobe and 13 on lower. Weberian apparatus including eight (1 c&s, 2 sk) attached vertebrae (Figure 5). First pleural rib on sixth vertebra. Nine* to ten pleural ribs. Total vertebrae 41–43 (42*).

3.1.5 | Sexual dimorphism

Males show an intromittent organ elongate and extending attached along the entire length of the anterior anal-fin margin. Females show a small urogenital opening anterior to anal-fin origin. The secondary sexually-dimorphic characters of the fins, barbels and epidermis, known to occur in other Auchenipteridae, were not observed in the new species.

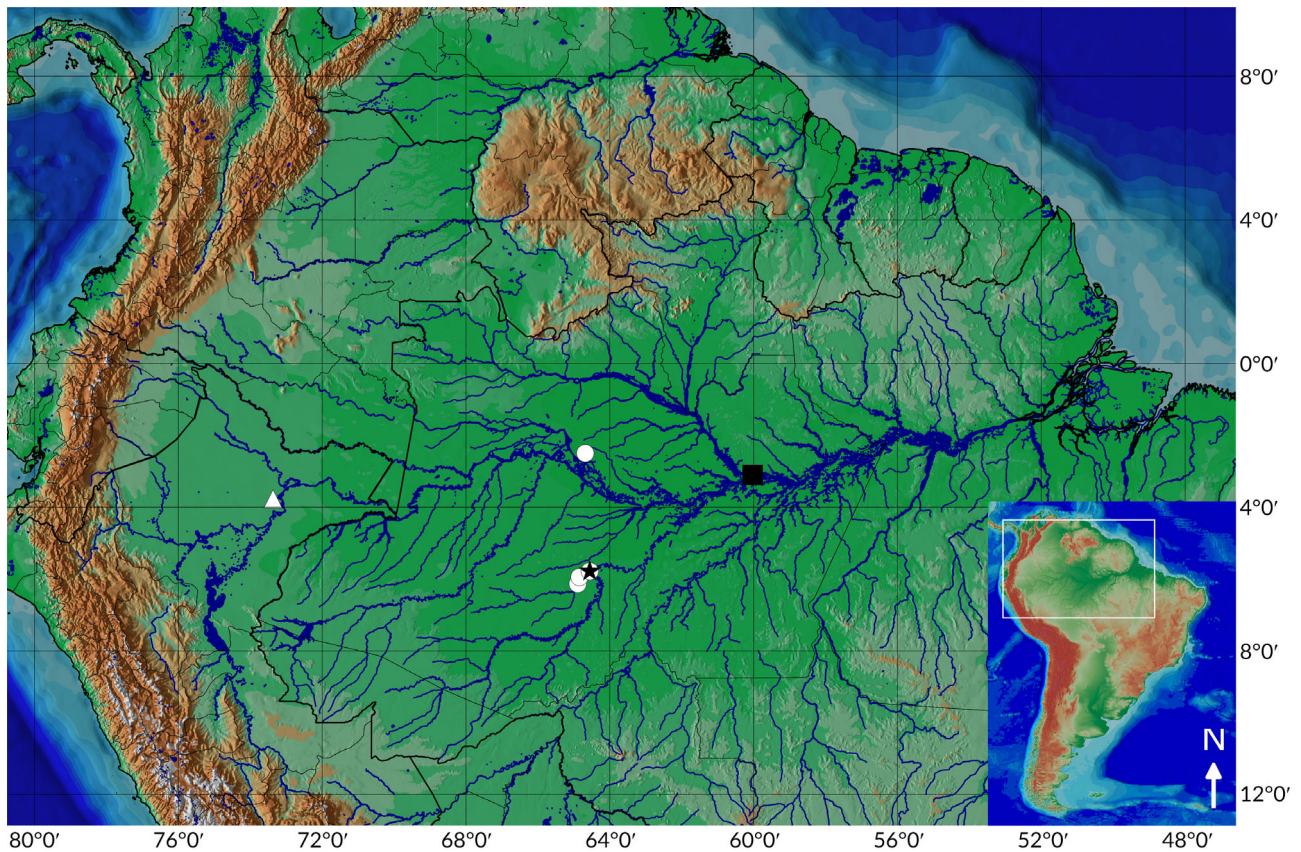


FIGURE 8 Partial map of South America showing the distribution of *Spinipterus mojiri*. ●, Manaus municipality; ○, paratypes of *S. mojiri*; △, record of *S. mojiri* from Peru; ★, type-locality

3.1.6 | Colour in life

The colour varies ontogenetically, with small specimens (c. 60 mm L_S) showing simple large black spots that gradually start to become rosette-like with growth (Figure 6). In large specimens (>90 mm L_S ; Figure 6) the rosettes are all over the body and some of them start to fragment in small black spots that are present over the body, head and all fins, but more conspicuous on the caudal and dorsal fins. Ventral surface of head densely pigmented with small spots on the branchiostegal membrane and around mental barbels. Ventral surface of body, from pectoral girdle to urogenital opening light brownish or yellowish, lacking spots. The background colour is light yellow or brown in small specimens and becomes brownish darker in large specimens.

3.1.7 | Colour in alcohol

The colour in preserved specimens shows the same pattern as the live specimens but the spots turn to dark brown over a light brown background.

3.1.8 | Etymology

The specific epithet *mojiri* comes from Mojiri, as this species is known among the Paumari natives that inhabit the Rio Tapauá, Purus

basin. The meaning of the word Mojiri is unknown so far. The Paumari language belongs to the Arawa linguistic group.

3.1.9 | Distribution and ecological remarks

The new species is from the Rio Tapauá (Rio Purus basin) and from Igarapé Ubim, a small tributary of Lago Amanã, Rio Japurá, both from Brazil. There is an additional record from Peru, from Depto. Loreto, Province Maynas, Río Nanay throughout Tarapoto village and confluence with Caño Tarapoto, 3° 46', 19.16" S, 73° 22' 08.56" W (S. Grant pers. comm.), which greatly increases the distribution range of the species (Figure 8). Although these specimens were not analysed here, the specimens can be attributed to *S. mojiri* based on the external morphology and colour pattern. A similar distribution pattern is also found for *Liosomadoras morrowi* Fowler 1940, which is known from the Río Ucayali basin, from Contamana to Iquitos, in eastern Peru and from the Rio Jutai, Rio Purus and Lago Amanã near Tefé, in north-western Brazil (Birindelli & Zuanon, 2012). This wide distribution is also recorded for *S. acsi* (Calegari *et al.*, 2018) and the few specimens and localities known to the species is probably due to the peculiar habit of these fishes to live inside submerged trunks and rocks. *Spinipterus mojiri* was collected inside submerged trunks together with the auchenipterids *Liosomadoras morrowi* and *Tatia* sp. (Figure 7) and *Pseudacanthicus* sp. and *Panaqolus* sp.

4 | DISCUSSION

The genus *Spinipterus* was proposed by Akama & Ferraris (2011) based on *S. acsi* including three derived characters: (a) pectoral and dorsal-fin spines with three anterior rows of serrations running from base to the tip of the spines; (b) lateral margins of skull roofing bones ornamented with a single row of spines; (c) groove along dorsal midline posterior to dorsal fin, in which the adducted dorsal fin rests. In the original description of *S. acsi* Akama & Ferraris (2011) stated the presence of a single row of nearly-imperceptible serrations on posterior margin of dorsal-fin spine. Based on new analyses Calegari *et al.*, 2019 found no serration on the posterior margin of dorsal-fin spine and this same condition is reported here for *Spinipterus moijiri*. Moreover, Calegari *et al.*, (2019) proposed 13 morphological synapomorphies for *Spinipterus*, all observed here in *S. moijiri*.

Spinipterus acsi was described based on a single specimen (32 mm L_S) from Caño Santa Rita, a right bank tributary of Río Nanay in Peru (Akama & Ferraris, 2011). Recently Calegari *et al.*, (2018) reported a second specimen (37.1 mm L_S) from Rio Juruá, Amazonas state, representing the first record of this species in Brazil. This specimen increased the distribution range for the species *c.*, 1900 km by river from the type locality. Akama & Ferraris (2011) and Akama & Ribeiro (2013) mention the existence of two additional undescribed small species from Negro (Ferreira *et al.*, 2007) and Madeira basins. The undescribed species from Madeira Basin reaches 31.7 mm L_S and it was collected in submerged trunks (Akama & Ribeiro, 2013). *Spinipterus moijiri* does not fit to *S. acsi* or the other undescribed species cited above, especially concerning its conspicuous jaguar-like pigmentation pattern. Moreover, adults of *S. moijiri* attains at least 90.0 mm L_S much larger than its congeners.

The coloration of the new species described here is strikingly different from *S. acsi* (and the two putatively new and undescribed species) and from most species of Auchenipteridae. The colour pattern found in *S. moijiri* superficially resembles species of *Liosomadoras*, consisting of a white to yellowish-brownish background with black spots scattered over the body. In *Liosomadoras oncinus* (Jardine 1841) there are two longitudinal rows of about seven large squarish dark-brown blotches on the body in small specimens (up to 60 mm L_S) that become fragmented into smaller spots (sometimes forming rosettes) in larger specimens (*c.* 100 mm L_S). However, the two rows of blotches are separated by a pale midlateral line in specimens of all sizes. In specimens of *L. morrowi* the spots are rounded, not fragmented and widespread over the body at all sizes, lacking the midlateral pale row (Birindelli & Zuanon, 2012). In *S. moijiri* the colour pattern varies ontogenetically, the background colour is light yellow-brown with dark and rounded spots in small specimens and the background becomes darker with spots fragmented and rosette-like in large specimens. There is no pale midlateral stripe in specimens of *S. moijiri* of any size (Figures 1, 6, and 7).

In Siluriformes the complex vertebra may include up to eight vertebrae (Chardon, 1968; Howes, 1983). The presence of four vertebrae in the compound centrum is recorded only in Diplomystidae and Nematogenyidae and is considered a plesiomorphic condition. Within Auchenipteridae the compound centrum may include five, six, seven

and eight vertebrae (Birindelli, 2014; Calegari *et al.*, 2019). Calegari *et al.*, 2019 reported the compound centrum including up to eighth vertebra in *Spinipterus*. We were unable to check this character in *Spinipterus acsi* but in *S. moijiri* the compound centrum includes eight vertebrae (Figure 5).

The new species has a high potential for use as an ornamental fish since it can be found in the aquarium market and indicates the need for detailed studies on its geographical distribution, population biology and ecology, in order to allow an adequate evaluation the suitability for its inclusion in the ornamental fish trade. The new species is occasionally consumed as food by native people in Rio Purus basin.

5 | COMPARATIVE MATERIAL EXAMINED

Liosomadoras morrowi: INPA 35415 (02 alc), INPA 53055 (02 sk). *Liosomadoras oncinus*: MNRJ 17640 (01 c&s). *Spinipterus acsi*: ANSP 178209 (01 alc). *Trachelyopterus galeatus*: MZUSP 52939 (01 c&s). *Trachelyopterus striatulus*: MZUSP 52627 (01 c&s). *Trachelyichthys decaradiatus*: MZUSP 6830 (185 alc, 03 c&s). *Trachelyichthys sp.*: MZUSP 30600 (02 alc, 02 c&s). *Trachelyopterichthys taeniatus*: MZUSP 8496 (38 alc, 1 c&s). *Trachelyopterus coriaceus*: MZUSP 52938 (01 c&s). *Trachelyopterus sp.*: MZUSP 45050 (01 c&s). *Trachycorystes trachycorystes*: MZUSP 7381 (01 c&s). *Trachycorystes trachycorystes*: MZUSP 752081 (02 alc). *Trachycorystes sp.*: MZUSP 37601 (02 c&s).

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CONTRIBUTIONS

M.S.R. data analysis and manuscript preparation; F.R. collection and manuscript preparation; A.A. discussion and manuscript preparation; J.Z. discussion and manuscript preparation.

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