

# Redescription of the endangered hypoptopomatine catfish *Parotocinclus spilurus* (Fowler, 1941) (Siluriformes: Loricariidae) from the upper rio Jaguaribe basin, northeastern Brazil

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*Parotocinclus spilurus* (Fowler) was originally described as a species of *Plecostomus* based on six specimens collected in the rio Salgado, Icó Municipality, Ceará State, northeastern Brazil. Because the original description of *P. spilurus* is brief and uninformative, a detailed redescription of this endangered species based on the type series and on freshly collected topotypes was made. Data on osteology, intraspecific variation, sexual dimorphism and color pattern in life are presented for the first time, aiming at providing the necessary characters to differentiate the species from its congeners, as well as providing data on the distribution, habitat and conservation.

*Parotocinclus spilurus* (Fowler) foi descrita originalmente como uma espécie do gênero *Plecostomus* com base em seis espécimes coletados no rio Salgado, Município de Icó, Estado do Ceará. Devido à descrição original de *P. spilurus* ser breve e pouco informativa, uma redescricao detalhada desta espécie ameaçada com base na série tipo e em topótipos recentemente coletados foi feita. Dados de osteologia, variação ontogenética, dimorfismo sexual e padrão de coloração em vida são apresentados pela primeira vez, com o objetivo de fornecer caracteres necessários para distinguir a espécie das suas demais congêneres, assim como fornecer dados de distribuição, habitat e conservação.

**Keywords:** Freshwater fish conservation, Mid-Northeastern Caatinga ecoregion, Ontogenetic variation, Rio São Francisco transposition, Temporary rivers.

## Introduction

A sample of 823 specimens, representing 104 species of freshwater fishes from northeastern Brazil, was collected by Rodolpho von Ihering (Fowler, 1941). In 1937, this valuable material was sent to the curator of fishes, Henry W. Fowler, at the Academy of Natural Sciences of Philadelphia (ANSP), who described 36 new species from the rio Parnaíba in Piauí State, rio São Francisco in Pernambuco State, rio Jaguaribe and other small coastal basins of Ceará, Rio Grande do Norte and Paraíba States (Fowler, 1941). However, that study, as others involving the freshwater fish fauna from northeastern Brazil, presents succinct descriptions, erroneous identification,

and confused taxonomy, with some taxa probably being synonyms to species previously described (Rosa *et al.*, 2003; Barros *et al.*, 2011). Among those, is the original description of *Plecostomus spilurus*, based on six specimens collected in the rio Salgado, a tributary of the upper rio Jaguaribe basin, at Icó Municipality, Ceará State, with the holotype deposited under catalog number ANSP 69403 and five paratypes catalogued as ANSP 69404 to 69408.

*Parotocinclus* was raised to generic level by Eigenmann & Eigenmann (1890), and it was previously considered as a monotypic subgenus of *Hisonotus* Eigenmann & Eigenmann (Eigenmann & Eigenmann, 1889). Garavello (1977) revised *Parotocinclus* and placed

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*Plecostomus spilurus* in this genus. Although Garavello (1977) presented redescrptions of several *Parotocinclus* species known at that time, based on the type series. However, the morphological information is still brief for modern standard procedures and he did not present any osteological information, live color pattern, or habitat data.

Currently, *Parotocinclus* comprises 29 valid nominal species (Ramos *et al.*, 2013; Lehmann *et al.*, 2013, 2014, 2015), but it is recognized as a polyphyletic assemblage (Gauger & Buckup, 2005; Lehmann, 2006; Lehmann *et al.*, 2013; Martins *et al.*, 2014). The genus *Parotocinclus* has a high species richness in northeastern Brazil, being represented by twelve species (Ramos *et al.*, 2013). Despite this high diversity, the knowledge about the fish fauna of northeastern Brazil is rather scarce, usually restricted to original descriptions.

During recent ichthyological surveys in the drainages involved in the project of the artificial watershed transposition of the rio São Francisco (Lima, 2005), including the rio Jaguaribe, rio Piranhas-Açu, rio Apodi-Mossoró and rio Paraíba do Norte basins, some species of *Parotocinclus* were collected. Thus, a detailed redescription of *P. spilurus* based on the type series and on freshly collected topotypes, including intraspecific variation, live color pattern, and osteologic information is provided, in order to make available details necessary to distinguish that species from congeners, sometimes occurring in sympatry, as well as new data on geographic distribution, habitat and conservation.

### Material and Methods

Specimens were collected from the putative type locality and other nearby localities, and preserved both in formalin and ethanol for molecular studies. Specimens were deposited in the ichthyological collection of the Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCP), Universidade Federal da Paraíba (UFPB) and Universidade Federal do Rio Grande do Norte (UFRN). Measurements and counts follow Carvalho & Reis (2009), and counts of longitudinal plate series follow Schaefer (1997) and Lehmann *et al.* (2013). Measurements were taken with digital calipers and recorded to tenths of a millimeter. Measurements are presented as percents of standard length (SL) or head length (HL). Meristic data ranges include all specimens available for study. Osteological examinations were performed on specimens cleared and double-stained for bone and cartilage (c&s) according to the procedures proposed by Taylor & Van Dyke (1985). The vertebral counts included the five central of the Weberian apparatus, and the compound caudal centrum was counted as a single element. Descriptions of color pattern were based on photographs of live individuals kept in aquaria just after collection.

### Results

#### *Parotocinclus spilurus* (Fowler, 1941)

#### Figs. 1-7, Tables 1-2

*Plecostomus spilurus* Fowler, 1941: 148-150, figs. 47-49. Type locality: Rio Salgade, Icó, Ceara (rio Salgado, Icó, Ceará, Brazil), holotype ANSP 69403.

*Parotocinclus spilurus*: Garavello, 1977: 8-9, figs. 17-18 [redescription]; Isbrücker, 1980: 81 [checklist]; Böhlke, 1984: 127 [checklist]; Burgess, 1989: 438 [checklist]; Lacerda & Evers, 1996: 88 [illustration]; Isbrücker, 2001: 31 [literature compilation]; Britski & Garavello, 2002: 286 [literature compilation]; Isbrücker, 2002: 25 [literature compilation]; Reis *et al.*, 2003: 327 [checklist]; Rosa *et al.*, 2003 [checklist]; Gauger & Buckup, 2005: 516 [literature compilation]; Ferraris, Jr., 2007: 283 [checklist]; Reis & Carvalho, 2007: 86 [checklist]; Lehmann & Reis, 2012: 62 [comparative material]; Ramos *et al.*, 2013: 788 [comparative material]; Brasil, 2014: 127 [conservation status].

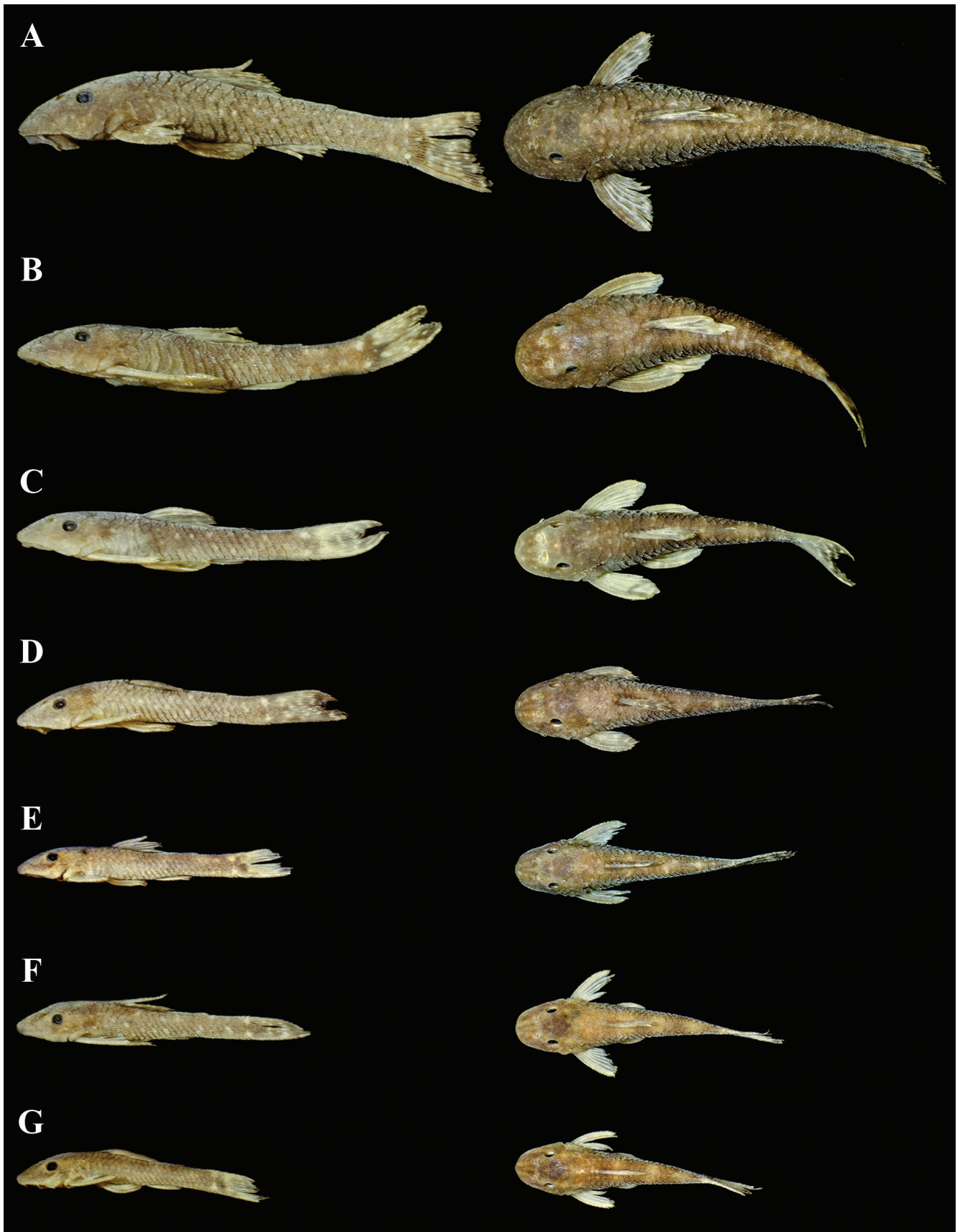
**Diagnosis.** *Parotocinclus spilurus* differs from all its congeners, except *Parotocinclus bidentatus*, *P. habolthi*, *P. muriaensis* and *P. seridoensis* by having the adipose fin rudimentary (a vestigial ridge composed by two small unpaired plates) or absent. *Parotocinclus spilurus* differs from *P. bidentatus*, *P. habolthi* and *P. muriaensis* by having numerous small bright spots, scattered on body and head (*vs.* body without spots); the pectoral girdle covered by skin medially and exposed only laterally supporting odontodes (*vs.* pectoral girdle completely exposed), and by the absence of accessory teeth on the premaxilla and dentary of juvenile and adults stages (*vs.* presence of accessory dentition). *Parotocinclus spilurus* also differs from *P. seridoensis* and other species of northeastern Brazil (*P. cearensis*, *P. cesarpinto* and *P. spilosoma*), except *P. haroldoi*, by having the abdomen mostly covered by rounded dermal plates arranged in T-shape between the pectoral girdle and the anus (*vs.* abdomen almost naked, with a single row of elongate reduced plates on each side and a group of small rounded plates irregularly distributed in the preanal region); and by the absence of the small area of naked skin on the snout tip without odontodes (*vs.* snout tip completely covered by odontodes). It also differs from *P. haroldoi* by presence of pectoral girdle medially covered by skin and laterally exposed, supporting odontodes only laterally (*vs.* pectoral girdle completely exposed). Finally, *P. spilurus* differs from all species of *Parotocinclus* that inhabit the Amazon, Orinoco, and Guianas coastal basins by the canal plate of the cheek not elongated posteriorly and not contacting the pectoral girdle (*vs.* the canal plate elongated posteriorly on the ventral surface of head and contacting the cleithrum).



**Fig. 1.** Lateral, dorsal, and ventral views of *Parotocinclus spilurus*, holotype ANSP 69403, 28.6 mm SL female; Brazil, Ceará State, Icó Municipality, rio Salgado, rio Jaguaribe basin.



**Fig. 2.** Lateral, dorsal, and ventral views of *Parotocinclus spilurus*, topotype UFRN 1255, 37.2 mm SL, female; Brazil, Ceará State, Icó Municipality, rio Salgado, rio Jaguaribe basin.



**Fig. 3.** Ontogenetic variation in *Parotocinclus spilurus* topotypes, UFRN 0321, 0389, UFPB 9989, specimens A to C between 46.5-30.5 mm SL, D to G between 26.9-21.6 mm SL. Specimens represented in scale.

**Description.** Morphometric and meristic data of holotype and topotypes presented in Tables 1-2, respectively (largest examined specimen 46.1 mm SL). Body moderately short and slightly depressed. Greatest body width at cleithrum, progressively tapering to end of caudal peduncle. Dorsal profile slightly convex from snout to dorsal fin origin; straight at dorsal-fin base; approximately straight from dorsal-fin origin to rudimentary adipose fin; slightly concave from this point to base of uppermost caudal-fin rays. Greatest body depth at dorsal-fin origin. Ventral profile of head straight or slightly concave; ventral profile of trunk somewhat straight or convex from pectoral girdle to anus; somewhat concave at anus region, straight between the anus and anterior margin of the anal-fin and slightly concave at anal-fin base and straight from anal-fin end to lowermost caudal-fin rays. Head depressed and round in dorsal view; two depressions on snout in front of each nostril separated by median keel; inferior rostral margin of snout with posteriorly directed odontodes, similar in size to those on dorsal portion of snout. Odontodes on upper portion of head arranged in indistinct rows. Eyes small, positioned midway between snout tip and posterior margin of parieto-supraoccipital; distance between margin of orbit and ventral surface of head greater than orbital diameter. Dorsal iris operculum present. Interorbital space slightly convex. Mouth small; oral disk approximately round, papillose; maxillary barbels slightly smaller than orbital diameter. All teeth slender and bifid. Accessory patch of unisupid teeth absent in dentary and premaxilla in juvenile and adults. Trunk depressed on insertion of dorsal and anal fins; caudal peduncle rounded in cross section. Pectoral girdle exposed only laterally, covered by odontodes; median region covered by skin (Fig. 5); arrector fossae of pectoral girdle ellipsoid, small, extending laterally, almost meeting in at midline (Fig. 6).

**Table 1.** Morphometric data of *Parotocinclus spilurus* (n=30). SD, standard deviation.

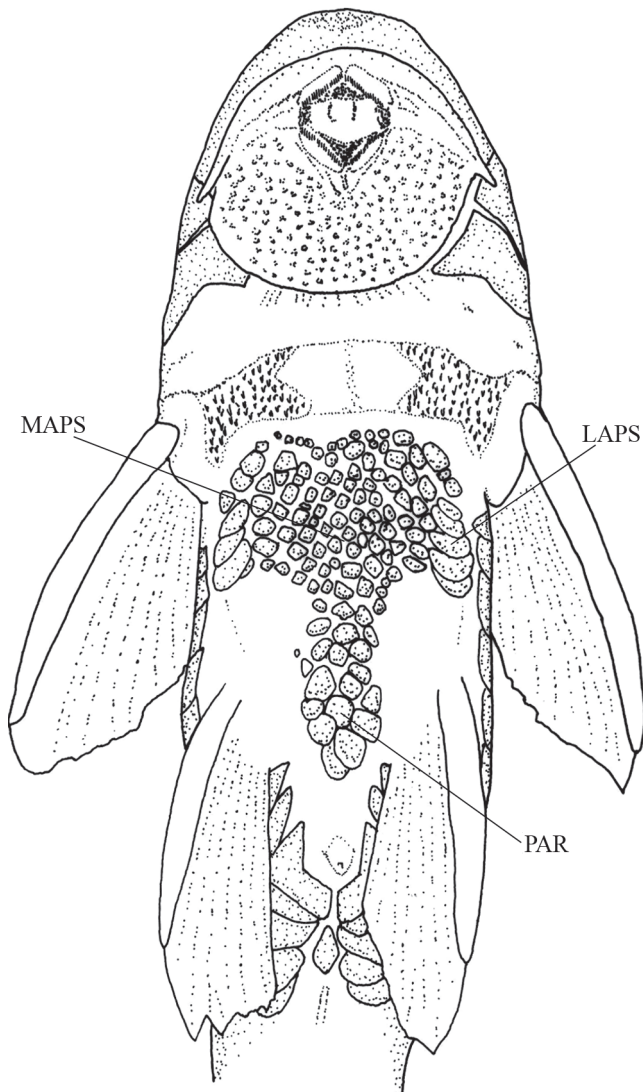
	Holotype	Paratypes/Topotypes		
		Mean	Range	SD
Standard length (mm)	28.6	34.8	24.4-46.1	5.3
Percent of standard length				
Body depth	18.6	17.1	14.0-19.3	1.5
Head length	38.2	35.0	32.0-38.2	1.4
Cleithral width	27.6	27.0	24.9-28.8	0.9
Thoracic length	15.8	18.2	15.2-24.6	1.9
Abdominal length	21.1	21.4	19.8-23.7	0.9
Pectoral-fin spine length	22.0	24.2	21.5-27.2	1.4
Caudal-peduncle depth	10.4	10.4	9.1-11.4	0.5
Caudal-peduncle length	26.9	30.0	26.3-33.6	1.9
Predorsal length	48.7	44.4	34.4-51.2	3.2
Percent of head length				
Head depth	40.8	47.2	40.8-52.6	2.9
Snout length	53.1	53.9	50.4-60.7	2.8
Horizontal eye diameter	15.7	14.4	12.7-18.5	1.1
Interorbital width	35.8	37.6	34.4-41.0	1.5

**Table 2.** Meristic data of *Parotocinclus spilurus*.

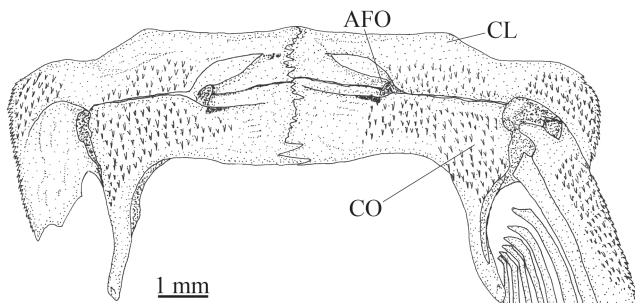
	Holotype	Paratypes/Topotypes	
		Range (n=29)	Mode
Premaxillary teeth right	17	14-24	15
Premaxillary teeth left	16	13-24	18
Dentary teeth right	17	14-28	17
Dentary teeth left	17	12-26	17
Plates in median series	23	22-25	23
Plates lateral to dorsal-fin base	5	5-6	5
Plates lateral to anal-fin base	3	3-3	3
Plates between anal and caudal fins	11	9-11	10



**Fig. 4.** *Parotocinclus spilurus*, live (UFRN 1255, 37.2 mm SL) specimen just after collection from rio Salgado (type locality), Icó, Ceará.



**Fig. 5.** Ventral view of abdominal region showing the lateral plates and preanal platelets arranged in T-shape in *Parotocinclus spilurus*. Abbreviations: LAPS, lateral abdominal plates series; MAPS, median abdominal plate series; PAR, pre-anal region.

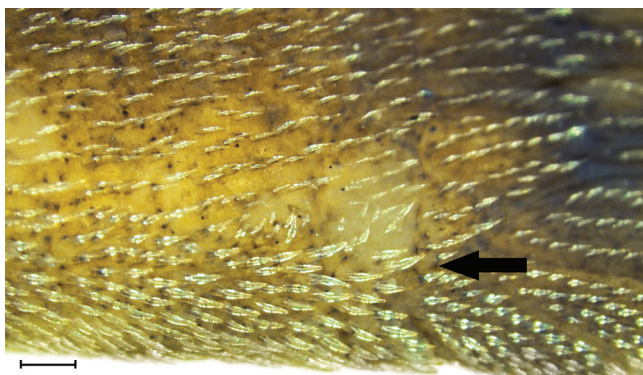


**Fig. 6.** Ventral view of pectoral girdle of *Parotocinclus spilurus*, UFRN 0321, 34.9 mm SL, female. Abbreviations: AFO, arrector fossa opening; CL, cleithrum; CO, coracoid.

Dorsal fin i,7; its origin in vertical line to pelvic-fin origin; when adpressed, extending to vertical through beyond anal-fin base. Dorsal-fin first unbranched ray flexible, followed by seven branched rays. Dorsal-fin spinelet present, trapezoid-shaped, wider than base of dorsal-fin unbranched ray. Dorsal-fin locking mechanism non-functional. Nuchal plate exposed, not covered by skin. Adipose fin rudimentary or vestigial. Pectoral fin i,6; pectoral-fin unbranched ray reaching nearly half length of unbranched pelvic-fin ray. Pelvic fin i,5; unbranched ray curved, covered with small odontodes; pelvic fin reaching beyond anus, ending in anal-fin origin. Anal-fin i,5; anal-fin base flanked by three plates. Caudal fin slightly notched, emarginated, with lower lobe slightly pointed and longer than the upper lobe; principal caudal-fin rays i,14,i. Lateral-line canal in median series complete, pore tube visible from parieto-supraoccipital to caudal peduncle. Body covered by dermal plates, except region between pectoral girdle and lower lip, central area of the pectoral girdle (medial area naked and exposed only laterally supporting odontodes), and areas around bases of paired fins and anus. Abdomen mostly covered by rounded dermal plates arranged in T-shape between pectoral girdle and anus (Fig. 5). Total vertebrae 26 (2 c&s).

**Coloration.** Background color in ethanol dark brown to yellowish brown. Specimens larger than 30 mm SL with yellowish gold rounded spots on dorsal and lateral portions of head and trunk, with lighter spot on pineal region. The spots are smaller in the anterior region of the body forming several series (5-7 series) longitudinal, and increase in size towards the caudal peduncle, converging to two or three series on lateral of trunk. Four inconspicuous dark bars on dorsum; upon pineal region features grayish yellow spot approximately on parieto-supraoccipital; ventral area of head and abdomen whitish yellow, with small sparse chromatophores on anterior portion of mouth, abdomen, pectoral fins and pre-anal region. Dorsal and caudal-fin rays with concentrated patch of dark chromatophores, forming irregular set of bands that alternates between dark brown and brownish yellow: four on dorsal fin and three to four on caudal fin, with chromatophores concentrated in conspicuous a spot on each caudal-fin lobe, especially in smaller individuals (Fig. 2). Pectoral, pelvic and anal fins with same color pattern, but slightly lighter. Live coloration with same pattern described above, with spotted pattern more evident (Fig. 4).

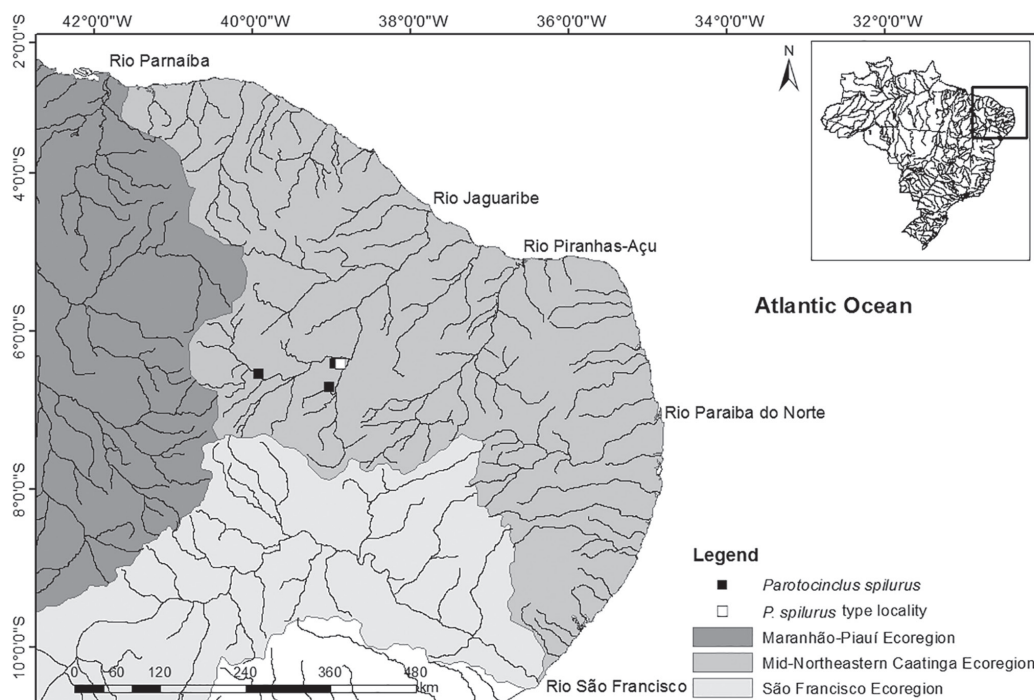
**Sexual dimorphism.** Males possess urogenital papilla positioned just behind anal opening and with developed dermal flap along posterodorsal margin of thickened first pelvic-fin ray. Adult males (>30 mm SL) have the odontodes of caudal peduncle dorsally or posterodorsally directed, and modified into cluster (Fig. 7), females lack this odontodes arrangement.



**Fig. 7.** Dermal plates at posterior end of caudal peduncle of *Parotocinclus spilurus*, topotype, UFRN 1300, male, 40.2 mm SL. Arrow indicates odontodes dorsally or posterodorsally directed and modified into a cluster. Scale bar = 1 mm.

**Distribution.** *Parotocinclus spilurus* is known from four localities in the rio Jaguaribe basin, in the Ceará State (Fig. 8). Individuals of *P. spilurus* were collected in the putative type locality of the species, in the rio Salgado, at Icó Municipality (Fig. 9), and were also found in three other sites: the rio Lima Campos in the Lima Campos Municipality, the riacho Machado in the Lavras da Mangabeira Municipality, all from rio Salgado sub-drainage; and the rio Jaguaribe itself in the Saboeiro Municipality, suggesting a restricted geographic distribution in the upper rio Jaguaribe basin. At Icó, the sampling site was under the BR 404 bridge at rio Salgado immediately upstream the urban area. Due to the ease of access, low environmental degradation and reduced metropolitan area this site may represent the type locality of *P. spilurus*.

**Ecological notes.** In the semi-arid Caatinga region, through which the rio Jaguaribe basin flows, the rivers may completely dry in some stretches and become restricted to small ponds, especially in periods of drought, due to the irregular rainfall regime (Rosa *et al.*, 2003). *Parotocinclus spilurus* was usually found in moderate current flow in clear-water streams with small rocky bottoms and gravel substrates (Fig. 9). However, in recent collections *P. spilurus* was only found on rocky stretches below artificial dams that were releasing water, suggesting that the species may now be restricted to places where water availability is regulated by human action. The following species were also collected sympatrically in the rio Salgado: *Astyanax* aff. *fasciatus* (Cuvier), *Cichla* sp., *Cichlasoma orientale* Kullander, *Crenicichla menezesi* Ploeg, *Hemigrammus marginatus* Ellis, *Cheirodon jaguaribensis* Fowler, *Hoplias malabaricus* (Bloch), *Hypostomus jaguaribensis* (Fowler), *Hypostomus* sp., *Leporinus taeniatus* Lütken, *Loricariichthys derbyi* Fowler, *Moenkhausia costae* (Steindachner), *Moenkhausia* sp., *Oreochromis niloticus* (Linnaeus), *Pimelodella dorseyi* Fowler, *Pseudancistrus genisetiger* Fowler, *Serrapinnus heterodon* (Eigenmann), *S. piaba* (Lütken), *Serrasalmus brandtii* Lütken and *Tetragonopterus chalcus* Spix & Agassiz. In addition to these species, in the rio Lima Campos were also collected: *Characidium bimaculatum* Fowler, *Geophagus brasiliensis* (Quoy & Gaimard), *Leporinus piau* Fowler, and *Poecilia vivipara* Bloch & Schneider. In the rio Jaguaribe we also found: *Pimelodella witmeri* Fowler and *Triporthes signatus* (Garman). At least two species, *Cichla* sp. and *O. niloticus*, are exotic in northeastern Brazil (Leão *et al.*, 2011).



**Fig. 8.** Geographic distribution of *Parotocinclus spilurus* in upper Jaguaribe, Ceará State, northeastern Brazil. Open symbol represents type locality Icó Municipality, rio Salgado, rio Jaguaribe basin.





**Fig. 9.** The putative type locality of *Parotocinclus spilurus*, Brazil, Ceará, Icó, rio Salgado, rio Jaguaribe basin.

**Remarks.** *Parotocinclus spilurus* is endemic to the upper portion of the rio Jaguaribe basin in the State of Ceará. This basin is situated almost entirely within the boundaries of Ceará State, with a small portion extending to the south, into Pernambuco State, occupying part of Exú, Moreilândia and Serrita municipalities. In the last five years, several expeditions were carried out in the rio Jaguaribe basin, including one directed at capturing *P. spilurus*. As the result of over 40 sampling sites throughout the rio Jaguaribe basin, *P. spilurus* was only collected in four localities in a specific biotope of a restricted area in the upper portion of the drainage (about 16 km<sup>2</sup> in area of occupancy), suggesting that this species has a narrow distribution, further lending support to the belief that this area contains several restricted-range species (Nogueira *et al.*, 2010).

**Conservation status.** According to IUCN criteria (International Union for Conservation of Nature (IUCN), 2001, 2010) *P. spilurus* was categorized as endangered (EN) in the recently published Brazil's official list of endangered species of fish and aquatic invertebrates (Brasil, 2014), representing one of the first freshwater fish species of the Mid-Northeastern Caatinga ecoregions to be recognized as imperiled. The region deserves more attention when considering that the rio Jaguaribe is one of the basins that will receive waters from the rio São Francisco transposition.

**Material Examined.** All from Brazil. Ceará State. rio Jaguaribe basin. ANSP 69403, 28.6 mm SL, holotype; ANSP 69404, 5, 24.4-28.4 mm SL (1 c&s), paratypes, rio Salgado, Icó Municipality, 1937, R. von Ihering; UFRN 0321, 10, 12.2-41.9 mm SL (1 c&s); UFRN 0376, 2, 33.9-35.9 mm SL; MCP 48176, 4, 30.8-38.4 mm SL; UFRN 0389, 4, 39.2-46.1 mm SL; UFRN 1248, 1, 34.8 mm SL, 11 Jul 2012, S. Lima, L. Neto, W. Berbel, R. Paiva, C. Alencar & F. Freire; UFRN 1248, 1, 34.8 mm SL; UFRN 1253, 1, 33.3 mm SL, 22 Mar 2013, Lima Campos Municipality, rio Lima Campos, 6°24'13.7"S 38°57'19.4"W, S. Lima, T. Ramos, W. Berbel, L. Neto, S. Moraes & A. Moraes; UFRN 0345, 1, 33.1 mm SL,

Saboeiro Municipality, 6°32'31.1"S 39°54'32.5"W, 10 Jun 2012, S. Lima, L. Neto, W. Berbel, R. Paiva, C. Alencar & F. Freire; UFRN 1252, 4, 31.5-35.9 mm SL; UFRN 1255, 4, 32-37.2 mm SL; UFRN 1300, 1, 40.2 mm SL, Icó Municipality, rio Salgado, 6°24'53.8"S 38°52'23"W, 21 Mar 2013, S. Lima, T. Ramos, W. Berbel, L. Neto, S. Moraes & A. Moraes; UFPB 9012, 9, 17.7-31.3 mm SL, Icó Municipality, rio Salgado, rio Jaguaribe basin, 6°24'28.9"S 38°52'06.6"W, 12 Jun 2011, T. Ramos, S. Ramos, R. Ramos & C. Zawadzki; UFPB 9013, 3, 28.5-39.4 mm SL, Lavras da Mangabeira Municipality, Machado small stream tributary to rio Salgado, rio Jaguaribe basin, 6°42'25.7"S 39°01'40.4"W, 19 Jul 2009, T. Ramos, P. Honório & G. Moro; UFPB 9989, 17, 21.6-26.9 mm SL (2 c&s), Senador Pompeu Municipality, riacho Caconde, Senador Pompeu, 5°33'44.2"S 39°21'11.4"W, 22 Jul 2009, T. Ramos, P. Honório & G. Moro.

## Discussion

Examination of a large number of specimens of *Parotocinclus spilurus* revealed a range of teeth number higher than presented in the original description (Fowler, 1941) and redescription (Garavello, 1977). According to Fowler (1941), *P. spilurus* has 8 to 9 teeth in the premaxilla and 10 to 12 in the dentary, while in the diagnosis presented by Garavello (1977) it has 13-18 premaxillary teeth, and 11-15 dentary teeth. In the present study, however, we observed 15 to 24 teeth in the premaxilla, and 17 to 28 in the dentary in the type series (including tooth scars count), meanwhile counts of the topotypes have 14 to 24 teeth in the premaxilla and 12 to 28 in the dentary. The recently collected material has shown the total number of teeth of *P. spilurus*, which is similar to the type series (including tooth scars), but distinct from counts made by Fowler (1941) and Garavello (1977). Thus, it is possible that these authors have counted only the remaining teeth, without considering the loss of teeth that can occur due to the age, preservation and handling of ichthyologic specimens.

Another noteworthy aspect is in the size of the adipose fin of *P. spilurus* illustrated in Fowler (1941: 149). In Fowler's drawing, the adipose fin appears as a small flap devoid of the spinelet, but no specimen of the type series or recently collected topotypes has the adipose fin in this stage of development, but instead have vestigial adipose fins (Figs. 1-2).

Observation of the coloration of live specimens highlights phenotypic differences among *Parotocinclus* species from Mid-Northeastern Caatinga ecoregion, and provides support to specific epithets proposed by Fowler (1941). Live and recently preserved *P. spilurus* specimens have, besides the black spot in caudal peduncle and transverse dark bands, there are conspicuous dark spots in each caudal-fin lobe (Fig. 4), a character that also explains the etymology of the epithet referred by Fowler "with reference to the dark marks on the caudal" (Fowler, 1941). Another conspicuous difference between the color pattern described by Fowler (1941) and Garavello (1977) is the

presence of rounded spots on the head and side of the body in individuals larger than 30 mm SL, evident both in live and recently collected specimens (Figs. 2-4). In smaller specimens (< 30 mm SL), as the holotype (28.6 mm SL) the color pattern is as described by those authors, but above this size the rounded yellowish spots become more evident and the transverse bands inconspicuous (Fig. 3). Ontogenetic color variation is already known in some Siluriformes (Ferrer & Malabarba, 2013) and Loricariidae species (Zawadzki & Carvalho, 2014). Besides the color pattern, a few morphological variation could also be observed across the size range in *P. spilurus* specimens. These differences are mainly related to head shape, eye diameter and position and snout length (Fig. 3). Ontogenetic shape changes were already observed in loricariids, including hypoptopomatine catfishes (Aquino & Miquelarena, 2001; Rosa *et al.*, 2014) and must be related to allometric development of bones, muscles and plates structures (Geerinckx *et al.*, 2008, 2009).

Most drainages in Ceará, Rio Grande do Norte and Paraíba States, and part of Piauí, Pernambuco and Alagoas States belong to the Mid-Northeastern Caatinga ecoregion, which comprises the small and medium-sized basins eastern to the rio Parnaíba (Maranhão-Piauí ecoregion) and northern to the rio São Francisco (São Francisco ecoregion) basins (Rosa *et al.*, 2003; Abell *et al.*, 2008; Albert *et al.*, 2011), which have been subjected to several anthropic impacts due to water use conflicts (Rosa *et al.*, 2003). These basins are mainly in the semi-arid region, subject to long periods of drought, and there is a predominance of temporary rivers. The major basins of the Mid-Northeastern Caatinga ecoregion will receive water from the ongoing inter-basin water transfer of the rio São Francisco, the largest perennial river in northeastern Brazil, which constitutes a distinct ecoregion (Rosa *et al.*, 2003).

In some drainages of the Mid-Northeastern Caatinga ecoregion, as the Jaguaribe and Paraíba do Norte basins, at least three species of *Parotocinclus* occur in sympatry and sometimes in syntopy: *P. spilurus*, *P. jumbo* Britski & Garavello and *P. cf. cearensis* Garavello in the former, and *P. spilosoma* (Fowler) and the other previous mentioned species in the latter. Britski & Garavello (2002) suggested the presence of two additional *Parotocinclus* species in rio Salgado, besides *P. spilurus*, one of which is possibly young specimens of *P. jumbo*, but they could not determine the identity of the other species due to the poor condition of the material. These authors emphasized the need of well-preserved specimens from the rio Salgado to allow an accurate identification of this third species. According to the recently collected material from rio Salgado, comparative material and bibliographic information, the third species is *P. cf. cearensis* and the presence of *P. jumbo* is also corroborated (see Material examined below). Actually, *P. jumbo* and *P. cf. cearensis* seem to be the only species of *Parotocinclus* to have a broad geographic distribution in northeastern Brazil, and could in fact represent species complexes that may have dispersed through adjacent coastal

basins in periods of lower sea levels during the Quaternary (Garavello, 1977). These two lineages (*P. jumbo* and *P. cf. cearensis*) are not closely related (Lehmann, 2006), and it is probably that the co-occurrence of *Parotocinclus* species in northeastern Brazil is due to secondary contact events.

Rosa (2004) indicated that the rio Salgado is a high biological priority area for fish conservation in the semi-arid Caatinga based on the occurrence of special biological phenomena, such as the presence of annual fish and/or cave species, the high phyletic diversity and occurrence of endemism. The restricted distribution of *P. spilurus* in the rio Jaguaribe basin, besides other species that may be endemic to that basin, such as *Ancistrus salgadae* Fowler, *Hypostomus carvalhoi* (Miranda Ribeiro), *H. jaguribensis*, *Pseudancistrus genisetiger*, *Pimelodella witmeri*, *P. dorseyi*, *Squaliforma gomesi* (Fowler) and *Trachycorystes cratensis* Miranda Ribeiro, although some of these species may not be valid (*e.g.* *A. salgadae* and *H. carvalhoi*), supports that drainage as an important area of endemism for fishes.

The geographically closest species to *Parotocinclus spilurus* are *P. seridoensis* Ramos, Barros-Neto, Britski & Lima, endemic to the upper rio Piranhas-Açu basin, *P. haroldoi* Garavello inhabiting the rio Parnaíba basin (Ramos *et al.*, 2013). Despite being isolated in separate river basins, these species are similar in morphology and color pattern and apparently are closely related. They share the yellowish spots on the dorsal and lateral portions of the head; however, *P. haroldoi* has smaller spots, while *P. seridoensis* has large, faint rounded spots, usually uniform in size, and *P. spilurus* with conspicuous intermediate size spots.

Another character shared between *P. spilurus* and *P. seridoensis* is the sexual dimorphism related to the orientation of modified odontodes on the caudal peduncle in adult males. A similar modification is known in males of some *Otocinclus* species, and in both sexes of the monotypic genus *Gymnotocinclus* Carvalho, Lehmann & Reis (Carvalho *et al.*, 2008). Ramos *et al.* (2013) mentioned characters, such as the adipose fin rudimentary or absent, which can represent synapomorphies for *Parotocinclus spilurus* and *P. seridoensis*, indicating a sister-species relationship. The authors also mentioned a possible vicariant process due to a tectonic activation in northeastern Brazil (Lima, 2000; Bezerra *et al.*, 2006), in which the Chapada de Apodi acted as a watershed divisor between the rio Jaguaribe and rio Piranhas-Açu basins, which could be involved in the origin of these species.

**Comparative material examined.** A list of the comparative material is available in Ramos *et al.* (2013). In addition, the following material was examined: **Brazil:** *Parotocinclus* sp. UFRN 0459, 1, 30.8 mm SL, Brazil, Pernambuco State, Toritama Municipality, rio Capibaribe, rio Capibaribe basin, 8°1'7.9"S 36°4'45.6"W, 15 Aug 2012, S. Lima, W. Berbel, C. Alencar, R. Paiva, S. Moraes & T. Ramos.

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### References

- Abell, R., M. L. Thieme, C. Revenga, M. Bryer, M. Kottelat, N. Bogutskaya, B. Coad, N. Mandrak, S. C. Balderas, W. Bussing, M. L. J. Stiassny, P. Skelton, G. R. Allen, P. Unmack, A. Naseka, R. Ng, N. Sindorf, J. Robertson, E. Armijo, J. V. Higgins, T. J. Heibel, E. Wikramanayake, D. Olson, H. L. López, R. E. Reis, J. G. Lundberg, M. H. S. Pérez & P. Petry. 2008. Freshwater ecoregions of the world: a new map of biogeographic units for freshwater biodiversity conservation. *BioScience*, 58: 403-414.
- Albert, J. S., P. Petry & R. E. Reis. 2011. Major biogeographic and phylogenetic patterns. Pp. 21-58. In: Albert, J. S. & R. E. Reis (Eds.). *Historical biogeography of neotropical freshwater fishes*. Berkeley, University of California Press.
- Aquino, A. E. & A. M. Miquelarena. 2001. Redescription of *Hypoptopoma inexpectata* (Holmberg, 1883), with notes on its anatomy (Siluriformes: Loricariidae). *Physis* (Buenos Aires), Secc. B, 58: 1-18.
- Barros, M. C., E. C. Fraga & J. L. O. Birindelli. 2011. Fishes from the Itapecuru River basin, state of Maranhão, northeast Brazil. *Brazilian Journal of Biology*, 71: 375-380.
- Bezerra, F. H. R., J. M. Ferreira & M. O. M. Sousa. 2006. Review of seismicity and Neogene tectonics in northeastern Brazil. *Revista de la Asociación Geológica Argentina*, 61: 525-535.
- Böhlke, E. B. 1984. Catalog of type specimens in the ichthyological collection of the Academy of Natural Sciences of Philadelphia. Philadelphia, PA, The Academy of Natural Sciences of Philadelphia, 246 p. (The Academy of Natural Sciences of Philadelphia, special publication, 14).
- Brasil. Ministério do Meio Ambiente. 2014. Portaria N° 445, de 17 de Dezembro de 2014. Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção - Peixes e Invertebrados Aquáticos. *Diário Oficial da União*, seção 1, no. 245, p. 126-130.
- Britski, H. A. & J. C. Garavello. 2002. *Parotocinclus jumbo*, a new species of the subfamily Hypoptopomatinae from northeastern Brazil (Ostariophysi: Loricariidae). *Ichthyological Exploration of Freshwaters*, 13: 279-288.
- Burgess, W. E. 1989. An atlas of freshwater and marine catfishes: a preliminary survey of the Siluriformes. Neptune City, NJ, T. F. H. Publications, 784p.
- Carvalho, T. P., P. Lehmann A. & R. E. Reis. 2008. *Gymnotocinclus anosteos*, a new uniquely-plated genus and species of loricariid catfish (Teleostei: Siluriformes) from the upper rio Tocantins basin, central Brazil. *Neotropical Ichthyology*, 6: 329-338.
- Carvalho, T. P. & R. E. Reis. 2009. Four new species of *Hisonotus* (Siluriformes: Loricariidae) from the upper rio Uruguay, southeastern South America, with a review of the genus in the rio Uruguay basin. *Zootaxa*, 2113: 1-40.
- Eigenmann, C. H. & R. S. Eigenmann. 1889. Preliminary notes on South American Nematognathi, II. *Proceedings of the California Academy of Sciences*, 2, series 2: 28-56.
- Eigenmann, C. H. & R. S. Eigenmann. 1890. A revision of the south America Nematognathi or cat-fishes. *Occasional Papers of the California Academy of Sciences*, 1, 1-508.
- Ferraris, C. J., Jr. 2007. Checklist of catfishes, recent and fossil (Osteichthyes: Siluriformes), and catalogue of siluriform primary types. *Zootaxa*, 1418: 1-628.
- Ferrer, J. & L. R. Malabarba. 2013. Taxonomic review of the genus *Trichomycterus* Valenciennes (Siluriformes: Trichomycteridae) from the laguna dos Patos system, Southern Brazil. *Neotropical Ichthyology*, 11: 217-246.
- Fowler, H. W. 1941. A collection of fresh-water fishes obtained in eastern Brazil by Dr. Rodolpho von Ihering. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 93: 123-199.
- Garavello, J. C. 1977. Systematics and geographical distribution of the genus *Parotocinclus* Eigenmann & Eigenmann, 1889 (Ostariophysi, Loricariidae). *Arquivos de Zoologia* (São Paulo), 28: 1-37.
- Gauger, M. F. W. & P. A. Backup. 2005. Two new species of Hypoptopomatinae from the rio Paraíba do Sul basin, with comments on the monophyly of *Parotocinclus* and the Otothyriini (Siluriformes: Loricariidae). *Neotropical Ichthyology*, 3: 509-518.
- Geerinckx, T., F. Huysentruyt & D. Adriaens. 2009. Ontogeny of the jaw and maxillary barbell musculature in the armoured catfish families Loricariidae and Callichthyidae (Loricarioidea, Siluriformes), with a discussion on muscle homologies. *Zoological Journal of the Linnean Society*, 155: 76-96.
- Geerinckx, T., Y. Verhaegen & D. Adriaens. 2008. Ontogenetic allometries and shape changes in the suckermouth armoured catfish *Ancistrus* cf. *triradiatus* Eigenmann (Loricariidae, Siluriformes), related to suckermouth attachment and yolk-sac size. *Journal of Fish Biology*, 72: 803-814.
- Isbrücker, I. J. H. 1980. Classification and catalogue of the mailed Loricariidae (Pisces, Siluriformes). *Verslagen en Technische Gegevens, Instituut voor Taxonomische Zoölogie* (Zoologisch Museum), Universiteit van Amsterdam, 22: 1-181.
- Isbrücker, I. J. H. 2001. Nomenklator der Gattungen und Arten der Harnischwelse, Familie Loricariidae Rafinesque, 1815 (Teleostei, Ostariophysi). *DATZ Harnischwelse*, 2: 25-32.
- Isbrücker, I. J. H. 2002. Nomenklator of the 108 genera with 692 species of the mailed catfishes, family Loricariidae Rafinesque, 1815 (Teleostei, Ostariophysi). *Cat Chat, Journal of the catfish study group* (UK), 3: 11-30.

- International Union for Conservation of Nature (IUCN). 2001. IUCN Red List Categories and Criteria. Version 3.1. IUCN Species Survival Commission. Gland, Switzerland and Cambridge, UK, IUCN.
- International Union for Conservation of Nature (IUCN). Standards and Petitions Subcommittee. 2010. Guidelines for using the IUCN Red List Categories and Criteria. Version 8.1. Prepared by the Standards and Petitions Subcommittee. Gland, Switzerland and Cambridge, UK, IUCN, 85p. Available from: <http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf>. (4 December 2013).
- Lacerda, M. T. C. & H.-G. Evers. 1996 *Parotocinclus*-Arten aus Brasilien. DATZ Aquarien Terrarien, 492: 88-95.
- Leão, T. C. C., W. R. Almeida, M. S. Dechoum & S. R. Ziller. 2011. Espécies exóticas invasoras no nordeste do Brasil: contextualização, manejo e políticas públicas. Recife, Centro de Pesquisas Ambientais do Nordeste (CEPAN), Instituto Hórus, 99p.
- Lehmann A., P. 2006. Anatomia e relações filogenéticas da família Loricariidae (Ostariophysi: Siluriformes) com ênfase na subfamília Hypoptopomatinae. Unpublished Ph.D. Dissertation, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, 419p.
- Lehmann A., P., B. Koech Braun, E. H. L. Pereira & R. E. Reis. 2013. A new species of the Hypoptopomatinae catfish *Parotocinclus* (Siluriformes: Loricariidae), from the headwaters of the Rio Jequitinhonha, Brazil. *Copeia*, 2013(3): 435-440.
- Lehmann A., P., H. Lazzarotto & R. E. Reis. 2014. *Parotocinclus halbothi*, a new species of small armored catfish (Loricariidae: Hypoptopomatinae), from the Trombetas and Marowijne River basins, in Brazil and Suriname. *Neotropical Ichthyology*, 12: 27-33.
- Lehmann A., P. & R. E. Reis. 2012. A new species of *Parotocinclus* (Siluriformes: Loricariidae) from the upper Rio São Francisco, Brazil. *Zootaxa*, 3390: 56-64.
- Lehmann A., P., L. J. Schwambach & R. E. Reis. 2015. A new species of the armored catfish *Parotocinclus* (Loricariidae: Hypoptopomatinae), from the Amazon basin in Colombia. *Neotropical Ichthyology*, 13: 47-52.
- Lima, C. C. U. 2000. O Neotectonismo na costa do sudeste e do nordeste brasileiro = Neotectonism of southeastern and northeastern Brazilian Coast. *Revista de Ciência & Tecnologia*, 15: 91-102.
- Lima, L. C. 2005. Além das águas, a discussão no Nordeste do rio São Francisco. *Revista do Departamento de Geografia*, 17: 94-100.
- Martins, F. O., H. A. Britski & F. Langeani. 2014. Systematics of *Pseudotothyris* (Loricariidae: Hypoptopomatinae). *Zoological Journal of the Linnean Society*, 170: 822-874.
- Nogueira, C., P. A. Buckup, N. A. Menezes, O. T. Oyakawa, T. P. Kasecker, M. B. Ramos Neto & J. M. C. da Silva. 2010. Restricted-range fishes and the conservation of Brazilian freshwaters. *PLoS ONE*, 5(6): e11390.
- Ramos, T. P. A., L. F. Barros-Neto, H. A. Britski & S. M. Q. Lima. 2013. *Parotocinclus seridoensis*, a new hypoptopomatine catfish (Siluriformes: Loricariidae) from the upper rio Piranhas-Açu basin, northeastern Brazil. *Neotropical Ichthyology*, 11: 787-796.
- Reis, R. E. & T. P. Carvalho. 2007. Família Loricariidae: Hypoptopomatinae. Pp. 82-87. In: Buckup, P. A., N. A. Menezes & M. S. Ghazzi (Eds.). *Catálogo das espécies de peixes de água doce do Brasil*. Rio de Janeiro, Museu Nacional (Série Livros, 23).
- Reis, R. E., S. O. Kullander & C. J. Ferraris Jr. (Orgs.). 2003. Check list of the freshwater fishes of South and Central America. Porto Alegre, Edipucrs, 729p.
- Rosa, A. C., F. O. Martins & F. Langeani. 2014. Miniaturization in *Otothyris* Myers, 1927 (Loricariidae: Hypoptopomatinae). *Neotropical Ichthyology*, 12: 53-60.
- Rosa, R. 2004. Diversidade e conservação dos peixes da Caatinga. Pp. 149-161. In: Silva, J. M. C., M. Tabarelli, M. T. Fonseca & L. V. Lins (Orgs.). *Biodiversidade da Caatinga: áreas e ações prioritárias para a conservação*. Brasília, DF, Ministério do Meio Ambiente; Recife, UFPE, Fundação de Apoio ao Desenvolvimento.
- Rosa, R. S., N. A. Menezes, H. A. Britski, W. J. E. M. Costa & F. Groth. 2003. Diversidade, padrões de distribuição e conservação dos peixes da Caatinga. Pp. 135-180. In: Leal, I. R., M. Tabarelli & J. M. C. da Silva (Eds.). *Ecologia e conservação da Caatinga*. Recife, Ed. Universitária da UFPE.
- Schaefer, S. A. 1997. The Neotropical cascudinhos: systematics and biogeography of the *Otocinclus* catfishes (Siluriformes: Loricariidae). *Proceedings of the Academy of Natural Sciences of Philadelphia*, 148: 1-120.
- Taylor, W. R. & G. C. Van Dyke. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybio*, 9: 107-119.
- Zawadzki, C. H. & P. H. Carvalho. 2014. A new species of the *Hypostomus cochliodon* group (Siluriformes: Loricariidae) from the rio Aripuanã basin in Brazil. *Neotropical Ichthyology*, 12: 43-51.

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