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Neoplecostomus (Teleostei: Loricariidae) from the upper Rio Paraná basin, Brazil, with description of three new species

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Abstract

Neoplecostomus paranensis was the only *Neoplecostomus* species known from the upper Rio Paraná basin, and it was diagnosed from its congeners mainly by the absence or reduction of the adipose fin. In this study we describe three new *Neoplecostomus* species. All of them are promptly differentiated from *N. paranensis* by having a well-developed adipose fin. Furthermore, the new species are differentiated from congeners by morphometric and meristic traits, in addition to color pattern. *Neoplecostomus paranensis* is redescribed. We also provide an identification key to all *Neoplecostomus* species.

Key words: catfishes, freshwater, Neotropical, Ostariophysi, Siluriformes, ichthyology

Resumo

Neoplecostomus paranensis era a única espécie de *Neoplecostomus* conhecida na bacia do alto rio Paraná e era diagnosticada de suas congêneres principalmente pela ausência ou redução da nadadeira adiposa. Neste estudo, descrevemos três novas espécies de *Neoplecostomus*. Todas são prontamente diferenciadas de *N. paranensis* por apresentar uma nadadeira adiposa bem desenvolvida. Além disso, as espécies novas são diferenciadas das congêneres por caracteres morfométricos e merísticos, além do padrão de colorido. *Neoplecostomus paranensis* é redescrita. Uma chave para identificação de todas as espécies de *Neoplecostomus* também é fornecida.

Introduction

Neoplecostomus was revised by Langeani (1990) who recognized two valid species, *N. granosus* (Valenciennes) from Cayenne (French Guyana) and Rio de Janeiro, and *N. microps* (Steindachner), type-species of the genus, from the Rio Paraíba do Sul basin, and described four new species from Brazil: *N. espiritosantensis*, from coastal streams of Espírito Santo State, *N. franciscoensis*, from headwater streams of Rio São Francisco basin, *N. paranensis*, from headwater streams of upper Rio Paraná basin (*sensu* Britski and Langeani 1988), and *N. ribeirensis*, from the Rio Ribeira de Iguape basin. Bizerril (1995) described an additional species, *N. variipictus* from the Rio Paraíba do Sul basin.

Neoplecostomus paranensis, diagnosed by the lack or reduction of adipose fin, is the only species known from the upper Rio Paraná basin to date. In recent years increasing inventory efforts in that basin allowed the recognition of three new *Neoplecostomus* species, from small tributaries of the Paranaíba, Paranapanema, and Tibagi rivers, upper Rio Paraná basin, which are readily differentiated from *N. paranensis* by having a well-

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developed adipose fin. These three new species are described herein; their discovery is indicative that more new species should be revealed once additional headwaters and small streams in Southeastern Brazil become further surveyed.

Material and methods

Institutional abbreviations follow standard ASIH abbreviations listed at http://www.asih.org/files/codons.pdf, with addition of the following Brazilian institutions: DZSJRP, Departamento de Zoologia e Botânica, Universidade Estadual Paulista, São José do Rio Preto (SP); LPB, Laboratório de Biologia e Genética de Peixes, Universidade Estadual Paulista, Botucatu (SP); NUP, Coleção Ictiológica do Nupélia, Universidade Estadual de Maringá, Maringá (PR). Measurements and counts of bilaterally symmetrical features were taken from left side, whenever possible. Body plate nomenclature follows Schaefer (1997) and measurements follow Langeani (1990), with addition of: upper and lower caudal-fin spine length, from origin to tip; greatest lower lip width, at widest region at maxillary barbells insertion; lower lip length, at midline, just from posterior portion of enlarged papillae, following dentary teeth, to its distal border. All measurements were taken point to point with digital calipers to the nearest 0.1 mm. Abbreviations used in the text are HL (head length), SL (standard length), sexes in brackets (m, male; f, female), and Nupélia (Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura, of the Universidade Estadual de Maringá). Measurements are presented as percentages of SL, HL and other measurements. Comparative material of other *Neoplecostomus* species is listed in Langeani (1990), Bizerril (1995), and in the "Additional comparative material" section below. The three states of the adipose fin are illustrated in Fig. 1, and they are defined here as: a) absent: without adipose-fin spine or adipose-fin membrane; b) poorly developed: adipose-fin spine reduced in length and usually reaching just the second plate after its origin; and c) well developed: fully-developed adipose-fin spine, which generally reaches the third or fourth plate after its origin and bears adipose-fin membrane.

Neoplecostomus corumba, n. sp.

Figure 2; Table 1

Neoplecostomus sp.: Zawadzki *et al*., 2004:574 (photo; Goiás, Rio Corumbá, tributary to Rio Paranaíba; comparison to *N. paranensis*; allozymes).

Neoplecostomus sp.—"cascudinho": Pavanelli *et al*., 2007:61 (citation; Goiás, Rio Corumbá, tributary to Rio Paranaíba).

Holotype. DZSJRP 6713 [male], 78.3 mm SL, Goiás State, Corumbaíba, Córrego Gameleira, affluent of Rio Corumbá, Rio Paranaíba basin, 17º59'S/48º29'W, 17 Sep 1996, Nupélia.

Paratypes. (same data as the holotype, excepting date: March 1996 to March 2000) DZSJRP 6193, 5 [3 m, 2 f], 44.0–73.8 mm SL; MZUSP 86208, 9 [4 m, 5 f], 45.7–77.6 mm SL; NUP 2528, 5 [3 m, 2 f], 53.0–66.8 mm SL.

Diagnosis. *Neoplecostomus corumba* can be distinguished from *N. selenae* by lacking enlarged odontodes and distinct swollen skin along lateral margins of snout and along ridges before the eyes in mature males (vs present); from *N. yapo* by lacking enlarged odontodes and distinct swollen skin along lateral margins of snout (vs present), by having smaller interdorsal length/SL (18.4–20.5 vs 20.7–23.0), and greater mandibullary width/HL (16.3–18.1 vs 14.1–15.2); from *N. paranensis* by having well-developed adipose fin (vs reduced or absent), greater orbital diameter/HL (12.2–13.0 vs 7.9–12.0), and greater mandibullary width/HL (16.3–18.1 vs 8.4–12.4); from *N. espiritosantensis* by having 10–18 dentary teeth (vs 19–38), greater cleithral width/SL (24.9–27.6 vs 17.0–19.0), and greater orbital diameter/HL (12.2–13.0 vs 6.0–9.0); from *N. franciscoensis* and *N. ribeirensis* by having a well-developed dorsal-fin spinelet, wider than dorsal-fin spine base (vs absent or

narrower than dorsal-fin spine base); from *N. granosus* by having 27–29 lateral-line plates (vs 34–43), and greater orbital diameter/HL (12.2–13.0 vs 9.0–11.0); from *N. microps* by having greater orbital diameter/HL (12.2–13.0 vs 8.0–11.0); and from *N. variipictus* by having smaller caudal peduncle depth/SL (6.0–6.5 vs 7.3–7.8), greater orbital diameter/HL (12.2–13.0 vs 9.1–9.9), 15–24 premaxillary teeth (vs 12–14), and 10–18 dentary teeth (vs 7).

Description. Counts and measurements are presented in Table 1. Body elongated and depressed. Greatest width at cleithrum, narrowing to caudal peduncle. Dorsal body profile gently convex, elevating from snout tip to dorsal-fin origin and descending to first caudal-fin procurrent spine. Greatest body depth at dorsal-fin origin. Trunk and caudal peduncle dorsally rounded in cross-section; body ventrally flattened to anal-fin origin, flattened to slightly rounded to caudal fin. Dorsal body surface completely covered by dermal plates, excepting for a naked area around dorsal-fin base. Snout tip naked. Ventral head surface naked except by a plate bearing odontodes in front of gill openings. Abdomen with conspicuous, small dermal platelets between insertions of pectoral and pelvic fins, forming a thoracic shield surrounded by naked areas; in some specimens also some isolated platelets near pectoral-fin base.

TABLE 1. Morphometric data and counts of *Neoplecostomus corumba*, *N. selenae*, *N. yapo*, and *N. paranensis* from the upper Rio Paraná basin. CP=caudal-peduncle, IO=interorbital length, OD=orbital diameter, PDS=predorsal, SL=standard length, ad=adipose-fin, an=anal-fin, cd=caudal-fin, ds=dorsal-fin.

Character	*N. corumba* n = 20					*N. selenae* n = 15				
	Holotype	Low	High	Mean/ Mode	SD	Holotype	Low	High	Mean/ Mode	SD
Standard length	78.3	45.5	78.3	60.7	11.21	101.7	52.2	101.7	66.7	15.79
Percents of SL										
Predorsal length	41.6	40.0	44.2	42.1	1.13	41.0	41.0	46.0	44.1	1.12
Head length	29.7	28.7	32.7	30.7	1.10	29.8	29.8	33.5	31.8	1.15
Head width	25.3	25.0	27.2	26.0	0.71	28.1	26.6	29.7	27.8	0.79
Cleithral width	25.3	24.9	27.6	26.1	1.10	27.7	27.5	30.2	28.4	0.96
Occipital-dorsal distance	11.6	11.5	12.4	12.0	0.32	13.5	13.0	14.0	13.6	0.28
Thoracic length	14.6	14.5	15.7	15.0	0.41	16.1	15.6	16.7	16.2	0.45
Interdorsal length	20.0	18.4	20.5	19.8	0.64	19.6	19.1	21.4	20.0	0.71
CP length	32.5	29.9	33.3	31.9	0.99	30.6	27.9	31.7	29.7	1.20
CP depth	6.1	6.0	6.5	6.2	0.13	7.7	6.7	7.7	7.4	0.28
Body depth	17.0	15.0	17.1	16.1	0.70	18.0	16.3	18.6	17.5	0.68
Preanal length	59.6	57.4	63.1	60.4	1.37	60.4	60.2	64.7	62.2	1.17
Percents of head length										
Head width	85.1	78.8	89.9	84.7	2.65	94.4	80.5	97.1	87.4	4.46
Head depth	43.6	43.6	53.6	47.5	2.62	52.5	47.2	53.4	50.5	1.96
Snout length	67.8	62.0	68.9	65.6	2.00	63.0	57.4	65.0	61.9	2.75
OD	12.7	12.2	13.0	12.6	0.26	12.2	12.1	12.7	12.4	0.20
Interorbital width	31.7	30.9	34.3	32.0	1.11	33.0	29.9	34.6	32.6	1.46
Mandibullary width	16.5	16.3	18.1	17.2	0.66	20.1	19.9	21.8	21.7	0.74
Other percents										
Snout length/OD	18.7	18.4	20.1	19.2	0.57	19.4	18.7	21.4	20.1	0.92
IO/OD	40.1	36.7	41.5	39.4	1.31	37.0	35.5	41.8	38.2	2.00
IO/mandibullary width	52.0	49.2	58.4	53.9	2.76	61.0	58.1	72.7	63.7	4.69

PDS length/first ds ray length	57.9	44.4	49.3	46.6	1.31	45.8	42.8	47.7	45.4	1.76
CP length/CP depth	18.7	18.1	20.5	19.5	0.75	25.1	23.6	26.3	24.8	0.77
Pelvic-fin length/CP depth	26.6	24.4	27.5	26.3	1.06	36.5	29.7	36.5	32.1	1.89
Lower cd spine/CP depth	24.0	19.9	24.0	22.6	0.99	27.9	26.7	35.9	28.9	3.17
Counts										
Lateral-line plates	28	27	29	28	0.64	30	28	30	29	0.59
Predorsal plates	5	4	6	6	0.75	6	5	6	6	0.49
Plates of dorsal-fin base	5	5	6	6	0.44	6	5	6	6	0.26
Plates between ds and cd	15	14	16	14	0.61	15	14	15	15	0.49
Plates between ad and cd	5	4	6	5	0.55	4	4	6	5	0.59
Plates between an and cd	10	9	12	10	0.87	10	9	10	10	0.49
Premaxillary teeth	17	15	24	17	2.21	21	17	24	21	1.88
Dentary teeth	10	10	18	12	1.73	18	15	24	18	2.36

continued.

Character	*N. yapo* n = 20					*N. paranensis* n = 10			
	Holotype	Low	High	Mean/ Mode	SD	Low	High	Mean/ Mode	SD
Standard length	97.4	63.8	106.3	87.0	15.08	38.4	92.8	61.1	19.34
Percents of SL									
Predorsal length	40.8	40.0	43.2	41.6	0.98	40.0	41.9	41.2	0.60
Head length	29.4	28.7	31.9	30.0	0.87	28.8	30.6	29.9	0.55
Head width	25.1	23.7	26.2	24.9	0.60	22.8	27.5	25.8	1.31
Cleithral width	25.4	24.1	27.2	25.6	0.81	24.8	26.8	25.8	0.64
Occipital-dorsal distance	12.0	12.0	13.0	12.4	0.32	11.7	16.4	13.7	1.35
Thoracic length	16.7	15.8	17.4	16.6	0.50	10.4	16.1	13.0	1.81
Interdorsal length	20.9	20.7	23.0	21.6	0.73	18.0	24.6	21.7	1.81
CP length	33.2	31.0	34.7	32.9	1.10	28.4	32.5	30.8	1.35
CP depth	6.3	6.0	6.3	6.1	0.07	5.5	7.2	6.3	0.53
Body depth	14.3	13.7	15.0	14.2	0.41	12.3	15.7	13.9	1.14
Preanal length	58.5	58.1	63.8	60.4	1.42	57.1	64.0	60.4	1.87
Percents of head length									
Head width	85.1	77.3	86.0	82.9	2.25	75.6	92.0	86.3	5.04
Head depth	46.2	43.2	49.5	46.0	1.86	44.4	55.4	48.6	3.14
Snout length	63.6	59.3	65.0	61.9	1.40	59.7	65.3	62.9	1.90
OD	12.2	11.9	12.9	12.5	0.30	7.9	12.0	9.2	1.30
Interorbital width	29.2	27.6	31.8	29.5	1.08	28.5	32.5	30.1	1.31
Mandibullary width	14.7	14.1	15.2	14.7	0.33	8.4	12.4	10.0	1.27
Other percents									
Snout length/OD	19.2	19.1	21.4	20.1	0.78	12.4	16.7	14.3	1.38
IO/OD	41.8	39.3	45.1	42.2	1.43	27.6	32.4	29.8	1.60
IO/mandibullary width	49.3	46.0	53.6	49.8	2.15	27.8	43.4	33.6	5.19
PDS length/first ds ray length	46.8	39.9	47.3	44.3	1.86	42.9	49.4	45.5	1.80
CP length/CP depth	18.9	17.6	19.6	18.7	0.68	18.2	23.7	20.4	1.95

Pelvic-fin length/CP depth	27.4	26.2	27.7	27.0	0.95	22.3	32.5	28.3	3.06
Lower cd spine/CP depth	30.7	22.9	30.7	25.7	1.23	–	–	–	–
Counts									
Lateral-line plates	29	29	29	28.6	29	28	30	29	0.79
Predorsal plates	6	5	7	5.8	0.59	5	8	7	1.07
Plates of dorsal-fin base	5	6	6	5.6	0.50	7	7	7	0.00
Plates between ds and cd	15	13	15	14	0.57	–	–	–	–
Plates between ad and cd	5	3	5	4.6	0.83	7	9	7	0.88
Plates between an and cd	10	10	12	10.5	0.69	8	14	13	2.25
Premaxillary teeth	12	10	15	12.4	1.31	10	17	17	2.57
Dentary teeth	11	08	12	10.1	1.09	8	15	11	2.12

Head wide and moderately depressed. Head and snout weakly obtuse in dorsal view. Interorbital space slightly straight in frontal view. Median ridge from snout tip to area between nares weak or not evident. A ridge from naris to superior margin of orbit. Snout convex in lateral profile. Eye moderately small (12.2–13.0 of HL), dorsolaterally placed. Lips well developed and rounded. Lower lip almost reaching pectoral girdle and covered by papillae, wider anteriorly; two or three irregular and conspicuous rows of large and transversally flattened papillae, just posterior to dentary teeth. Maxillary barbel short and mostly coalesced with lower lip, generally with free tip. Teeth long, slender and bicuspid; mesial cusp longer than lateral. Dentary rami forming an angle of approximately 120°.

Dorsal-fin origin slightly posterior to vertical passing through pelvic-fin origin; nuchal plate not covered by skin; dorsal-fin spinelet half-moon shaped and wider than dorsal-fin spine base; dorsal-fin locking mechanism absent. Dorsal-fin with spine flexible, followed by seven branched rays; its posterior margin straight or slightly falcate, reaching about vertical through end of pelvic-fin rays when adpressed. Moderate to well developed and always present adipose fin, not preceded by azygous plate. Pectoral fin with six branched rays and a depressed and inward curved spine (more pronounced in larger specimens) shorter than longest branched ray; its posterior margin slightly falcate, reaching (in smaller specimens) or almost reaching half pelvic-fin length when adpressed. Pelvic fin with one spine and five branched rays; its posterior margin nearly straight, reaching or almost reaching anal-fin insertion when adpressed. Pelvic-fin spine ventrally flattened, with dermal flap on its dorsal surface in males. Anal fin with one flexible spine and five branched rays; its posterior margin straight. Caudal fin bifurcate; lower lobe longer than upper; 14 branched rays. Pectoral and pelvic-fin spines with odontodes on lateral and ventral portions. Anal-fin spine with odontodes only ventrally.

Color in alcohol. Ground color of dorsal surface of head and body yellowish. Head, dorsum, flanks and fins covered by many inconspicuous darker dots or blotches of variable shapes and sizes. Dorsal color pattern, even in mature larger individuals, retains the generic juvenile color pattern of five transverse dark bars: the first through supraoccipital, the second anterior to dorsal fin, the third posterior to dorsal fin, the fourth at adipose fin, and the last at caudal-peduncle posterior portion. Head usually with two light, short and parallel lines anterior to nares, bordering the naked area on snout tip. Orbital margin lighter, mainly on its superior portion. Small light spot on interorbital space, inconspicuous in some specimens. Few specimens with two almost parallel small lighter lines on suppraoccipital posterior part. Body lateral portion with an upper darker region and a lower lighter one, just below lateral line, not easily visualized in large specimens.

Dorsal fin with irregular series of dark dots on rays. Caudal fin irregularly dark at base and distal portion of rays, leaving two lighter areas on median portion and rays tips. Pectorals, pelvics, and anal fins with dark dots forming irregular bands usually diffuse. Adipose fin generally dark laterally and light on spine dorsal portion.

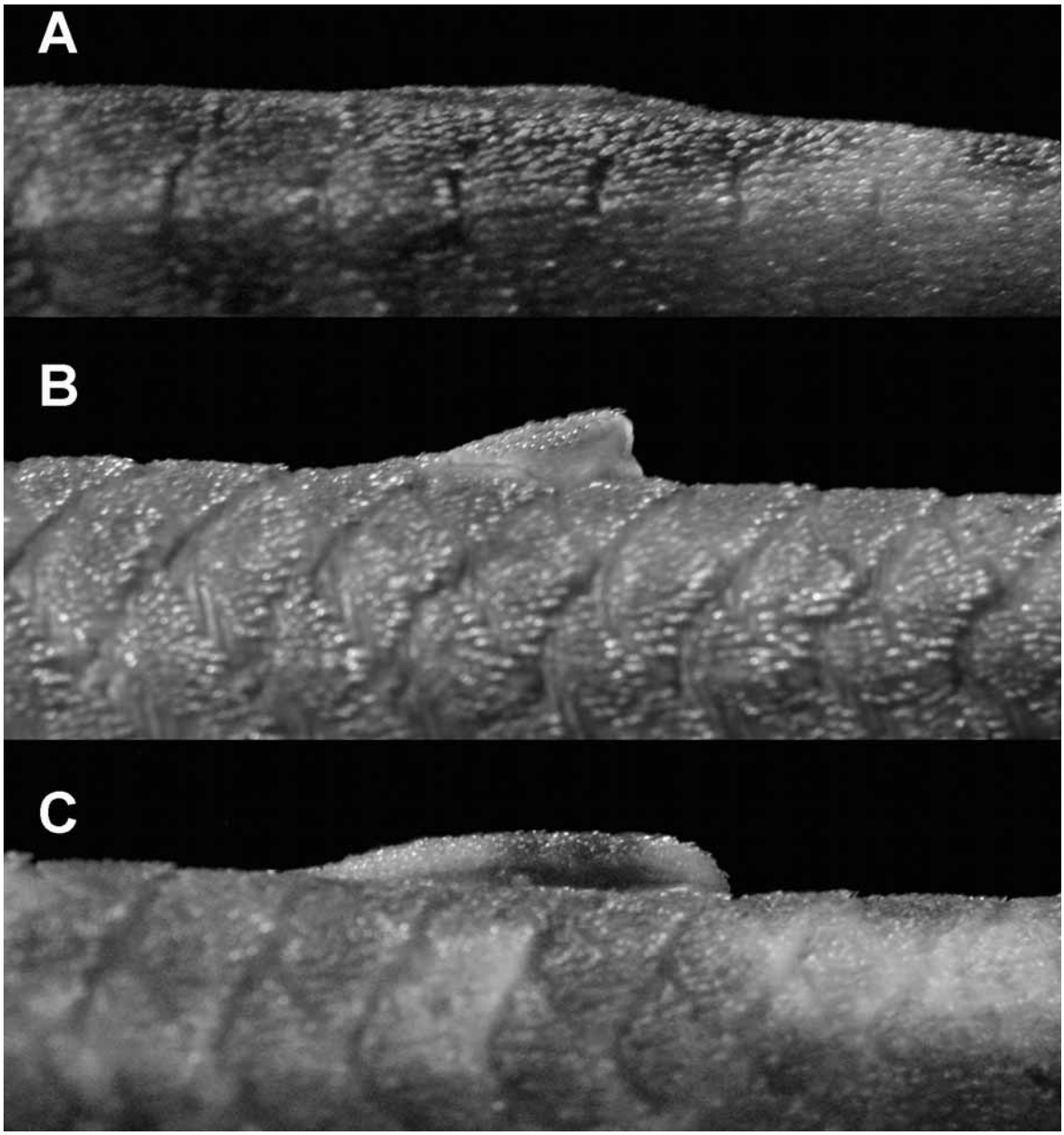

FIGURE 1. Lateral view of three adipose fin stages in *Neoplecostomus*: A) absent – *N. paranensis*, NUP 3774; B) poorly developed – *N. paranensis*, NUP 2608; C) well developed – *N. yapo*, NUP 4300 (anterior to left).

Ventral surface of head and body mostly unpigmented, except for some brown, faded scattered chromatophores near body lateral margins and from pelvic fin to caudal-fin base; upper lip dark brown, except for its light narrow margin.

Etymology. The specific name refers to the Rio Corumbá, type-locality's drainage. It is treated as a noun in apposition.

Distribution. *Neoplecostomus corumba* is known only from the type-locality (Fig. 3).

***Neoplecostomus selenae*, n. sp.**
Figure 4; Table 1

Holotype. MZUSP 51889 [male], 101.7 mm SL, São Paulo State, Ribeirão Grande, Ribeirão das Batéias,

upstream from the bridge at Ribeirão Grande to Intervales road, affluent of the Rio Paranapanema, 24 Aug 1997, O.T. Oyakawa and A. Akama.

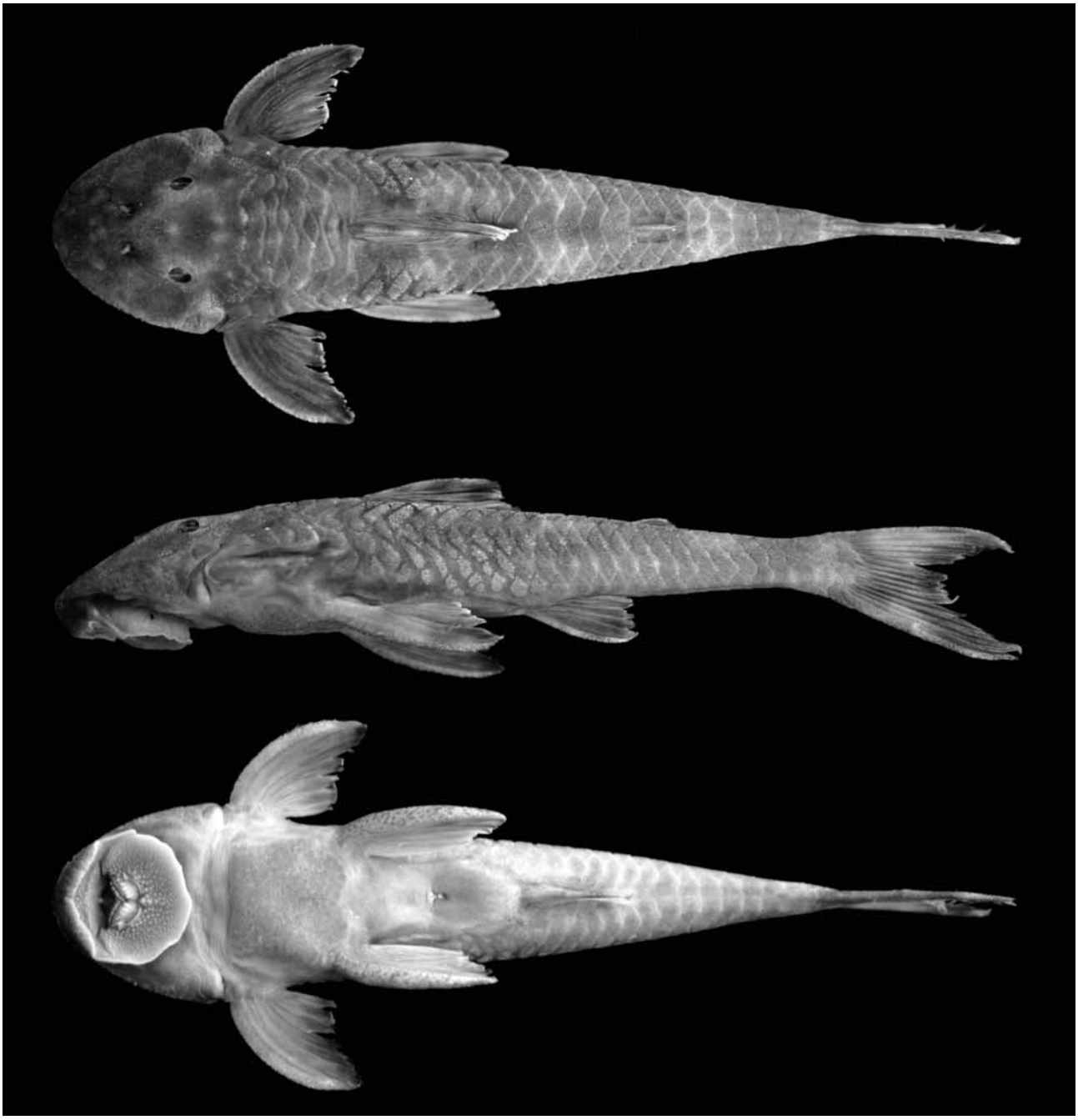

FIGURE 2. *Neoplecostomus corumba*, holotype, DZSJRP 6713, male, 78.3 mm SL.

Paratypes. (same data as the holotype) DZSJRP 7449, 4 [2 m, 2 f], 56.5–95.8 mm SL; MZUSP 51873, 3 [1 m, 2 f], 52.3–66.1 mm SL; MZUSP 52589, 4 [f], 42.8–64.9 mm SL; NUP 3572, 5 [1 m, 4 f (smallest not measured)], 48.0–84.8 mm SL.

Diagnosis. *Neoplecostomus selenae* can be distinguished from its congeners, excepting *N. yapo*, by having enlarged odontodes on distinct swollen skin along snout lateral margins in mature males (vs absent); from *N. yapo* it differs by having enlarged odontodes along ridges before the eyes in mature males (vs absent). Besides these characteristics, *N. selenae* is diagnosed from *N. corumba* and *N. yapo* by having greater mandibullary width/HL (19.9–21.8 vs 16.3–18.1 and 14.1–15.2, respectively), and greater caudal peduncle depth/SL (6.7–7.7 vs 6.0–6.5 and 6.0–6.3, respectively); from *N. paranensis* by having well-developed adipose fin

(vs reduced or absent), and greater orbital diameter/HL (12.1–12.7 vs 7.9–12.0); from *N. franciscoensis* and *N. ribeirensis* by having well-developed dorsal-fin spinelet, wider than dorsal-fin spine base (vs absent or narrower than dorsal-fin spine base); from *N. granosus* by having 28–30 lateral line plates (vs 34–43), and greater orbital diameter/HL (12.1–12.7 vs 9.0–11.0); from *N. microps* by having greater orbital diameter/HL (12.1–12.7 vs 8.0–11.0), and 15–24 dentary teeth (vs 5–12); and from *N. variipictus* by having smaller snout length/HL (57.4–65.0 vs 66.7–72.0), greater orbital diameter/HL (12.1–12.7 vs 9.1–9.9), 17–24 premaxillary teeth (vs 12–14), and 15–24 dentary teeth (vs 7).

Description. Counts and measurements are presented in Table 1. Body relatively short and depressed. Greatest width at cleithrum, narrowing to caudal peduncle. Dorsal body profile gently convex, elevating from snout tip to dorsal-fin origin and descending to first caudal-fin procurrent spine. Greatest body depth at dorsal-fin origin. Trunk and caudal peduncle dorsally rounded in cross-section; body ventrally flattened to anal-fin origin, flattened to slightly rounded to caudal fin. Dorsal body surface completely covered by dermal plates, excepting for a naked area around dorsal-fin base. Snout tip naked. Ventral head surface naked except by a plate bearing odontodes in front of gill openings. Abdomen with conspicuous, small dermal platelets between insertions of pectoral and pelvic fins, forming a thoracic shield surrounded by naked areas.

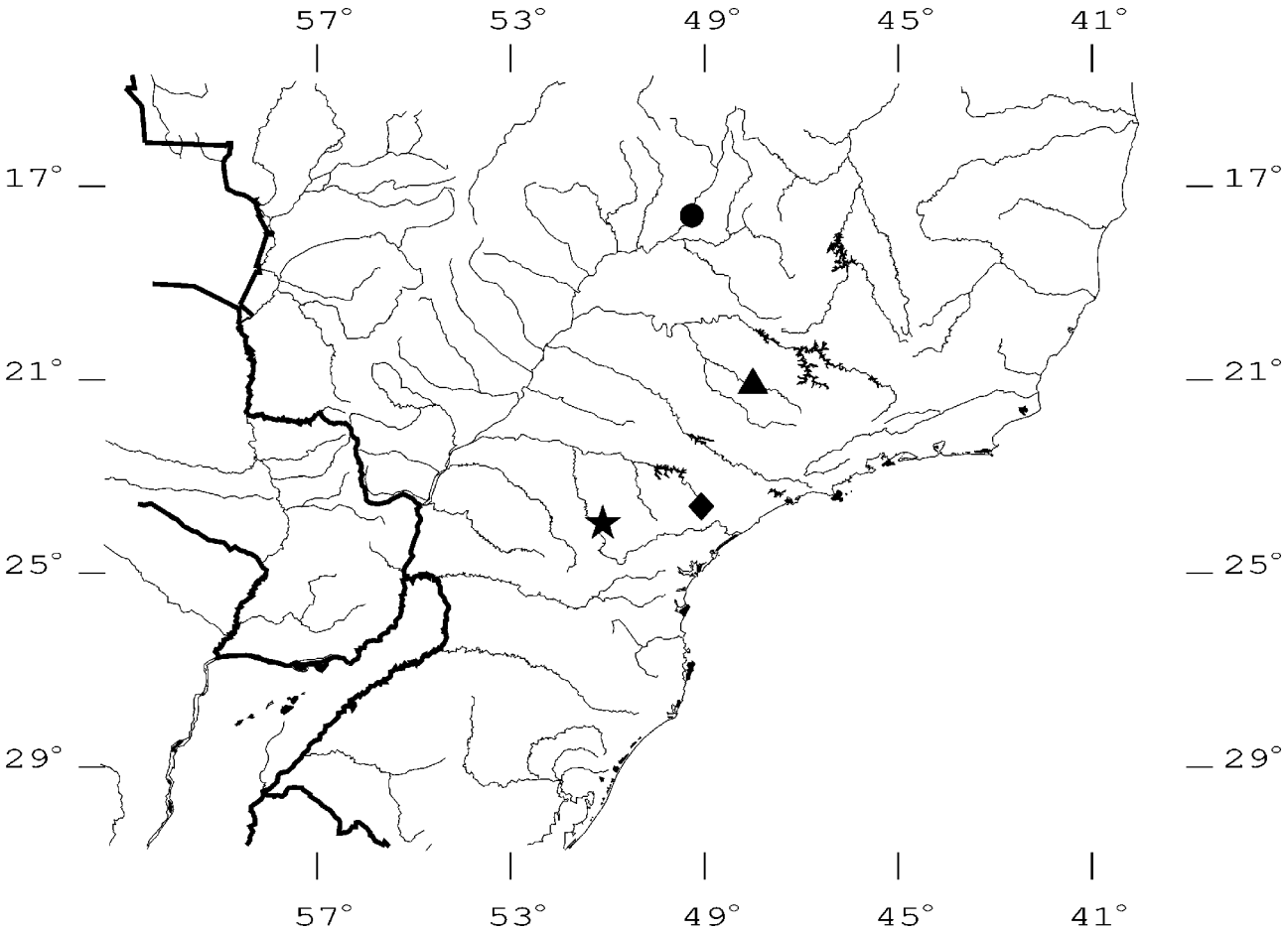

FIGURE 3. The type localities of *N. corumba* (dot), *N. selenae* (lozenge), *N. yapo* (star), and *N. paranensis* (triangle).

Head wide and moderately depressed. Head and snout rounded in dorsal view in larger specimens, and slightly obtuse in smaller ones. Interorbital space slightly concave in frontal view. A weak ridge from snout tip to area between nares, sometimes absent, more evident in larger specimens. A weak ridge from middle of snout to superior margin of orbit. Snout gently convex in lateral profile. Mature males with moderately hypertrophied odontodes and swollen skin along lateral margins of snout sides, head anterior portion, and along ridge in front of eye. Eye moderately small (12.1–12.7 of HL), dorsolaterally placed. Lips well developed and

rounded. Lower lip relatively small, not reaching pectoral girdle and covered by papillae, wider anteriorly; one or two irregular and conspicuous rows of large and transversally flattened papillae, just posterior to dentary teeth. Maxillary barbel short and coalesced with lower lip, generally with free tip. Teeth long, slender and bicuspid; mesial cusp longer than lateral. Dentary rami forming an angle of approximately 95º.

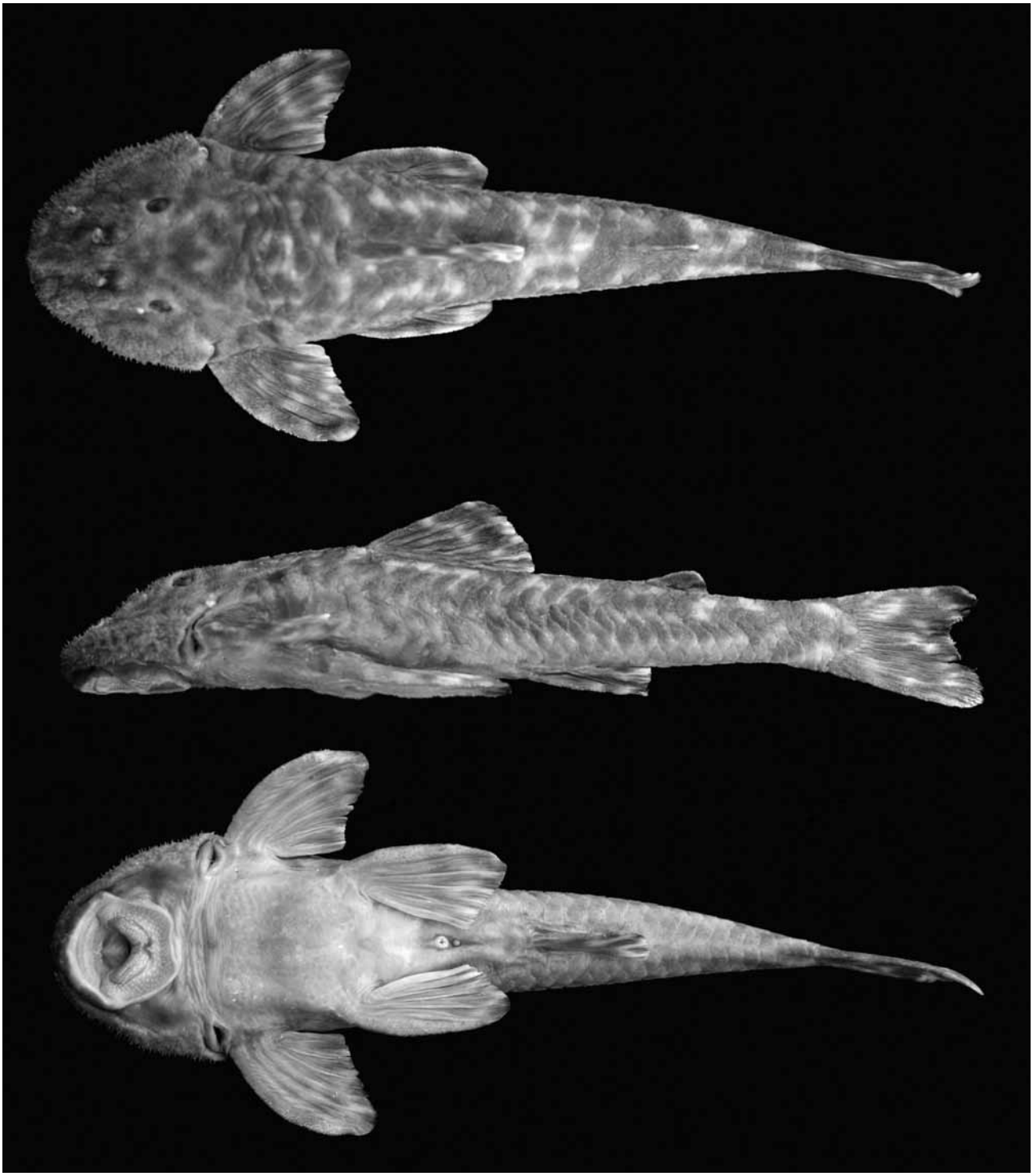

FIGURE 4. *Neoplecostomus selenae*, holotype, MZUSP 51889, male, 101.7 mm SL.

Dorsal-fin origin slightly posterior to vertical passing through pelvic-fin origin; nuchal plate not covered by skin; dorsal-fin spinelet half-moon shaped and wider than dorsal-fin spine base; dorsal-fin locking mechanism absent. Dorsal-fin with spine flexible, followed by seven branched rays; its posterior margin straight,

surpassing vertical through end of pelvic-fin rays when adpressed. Moderate to well developed and always present adipose fin, generally preceded by one or, rarely, two azygous plates. Pectoral fin with six branched rays and a depressed and inward curved spine (more curved in larger specimens), shorter than longest branched ray, its posterior margin nearly straight, reaching or almost reaching first third pelvic-fin length when adpressed. Pelvic fin with one spine and five branched rays; its posterior margin nearly straight, almost reaching anal-fin origin when adpressed. Pelvic-fin spine ventrally flattened, with dermal flap on its dorsal surface in males. Anal fin with one flexible spine and five branched rays; its posterior margin straight. Caudal fin bifurcate; lower lobe longer than upper; 14 branched rays. Pectoral and pelvic-fin spines with odontodes on lateral and ventral portions. Anal-fin spine with odontodes only ventrally.

Color in alcohol. Ground color of dorsal surface of head and body light brown. Head, dorsum, flanks and fins covered by many coalescent darker dots or blotches of variable shapes and sizes. Dorsal color pattern, even in mature larger individuals, retains the generic juvenile color pattern of five transverse dark bars: the first through supraoccipital, the second at dorsal-fin origin, the third at dorsal-fin end, the fourth at adipose fin, and the last at caudal-peduncle posterior portion. Head usually with two light, short and parallel lines anterior to nares, bordering the naked area on snout tip. Orbital margin lighter, mainly on its superior portion. Small light spot on interorbital space, inconspicuous in some specimens. Few specimens with two small convergent light lines on suppraoccipital posterior region, sometimes joined as a lied V with vertex forward. In some specimens, body lateral portions with a longitudinal line dividing upper darker region from lower lighter one, running just below lateral line. All fins with dark dots forming irregular transverse stripes on rays, except adipose fin which is generally dark on laterals and light on dorsal portion of spine.

Ventral surface of head and body mostly unpigmented, except for some brown, faded, scattered chromatophores on body lateral margins and from pelvic fin to caudal-fin base; upper lip entirely dark, except for its light narrow margin.

Etymology. The specific name, *selenae*, is in honor to Selena Canhoto Zawadzki, C.H. Zawadzki's daughter.

Distribution. *Neoplecostomus selenae* is only known from the type-locality (Fig. 3).

***Neoplecostomus yapo*, n. sp.**
Figure 5; Table 1

Holotype. DZSJRP 6714 [male], 97.4 mm SL, Paraná State, Tibagi, Riacho Fortaleza (Fazenda Santo Amaro), affluent of Rio Yapó, Rio Tibagi basin, 18 February 2002, A.M. Gealh and K. de Geus.

Paratypes. (same data as the holotype) DZSJRP 6194, 6 [3 m, 3 f], 69.3–105.2 mm SL; MZUSP 86211, 7 [5 m, 2 f], 63.8–105.2 mm SL; NUP 3569, 6 [3 m, 3 f], 68.6–106.34 mm SL; NUP 2609, 15 (not measured) [6 m, 9 f], 48.4–109.6 mm SL.

Diagnosis. *Neoplecostomus yapo* can be diagnosed from its congeners, excepting *N. selenae*, by having enlarged odontodes and distinct swollen skin along lateral margins of snout in mature males (vs absent); from *N. selenae* by lacking enlarged odontodes and distinct swollen skin along ridges before eyes (vs present). It can be further distinguished from *N. corumba* by having greater mandibullary width/HL (14.1–15.2 vs 16.3–18.1); from *N. selenae* by having smaller cleithral width/SL (24.1–27.2 vs 27.5–30.2), and smaller caudal-peduncle depth/SL (6.0–6.3 vs 6.7–7.7); from *N. paranensis* by having well-developed adipose fin (vs ill-developed or absent), and greater mandibullary width/HL (14.1–15.2 vs 8.4–12.4); from *N. espiritosantensis* by having greater orbital diameter/HL (11.9–12.9 vs 6.0–9.0), 10–15 premaxillary teeth (vs 19–38), and 08–12 dentary teeth (vs 15–35); from *N. franciscoensis* and *N. ribeirensis* by having well-developed dorsal-fin spinelet, wider than dorsal-fin spine base (vs absent or narrower); from *N. granosus* by having 29 lateral-line plates (vs 34–43), smaller caudal-peduncle depth/SL (6.0–6.3 vs 7.0–10.0), greater orbital diameter/HL (11.9–

12.9 vs 9.0–11.0), and 8–12 dentary teeth (vs 11–14); from *N. microps* by having a greater thoracic length/SL (15.8–17.4 vs 10.0–15.0), greater orbital diameter/HL (11.9–12.9 vs 8.0–11.0), and greater mandibullary width/HL (14.1–15.2 vs 7.0–13.0); and from *N. variipictus* by having greater head length/SL (28.7–31.9 vs 26.2–26.8), smaller caudal-peduncle depth/SL (6.0–6.3 vs 7.3–7.8), smaller snout length/HL (59.3–65.0 vs 66.7–68.9), and greater orbital diameter/HL (11.9–12.9 vs 9.1–9.9).

Description. Counts and measurements are presented in Table 1. Body elongated and depressed. Greatest width at cleithrum, narrowing to caudal-fin base. Dorsal body profile gently convex, elevating from snout tip to dorsal-fin origin and descending to first caudal-fin procurrent spine. Greatest body depth between supraoccipital process and dorsal-fin origin. Trunk and caudal peduncle dorsally rounded in cross-section; body ventrally flattened to anal-fin origin, flattened to slightly rounded to caudal fin. Dorsal body surface completely covered by dermal plates, excepting for a naked area around dorsal-fin base. Snout tip naked. Ventral head surface naked except by a plate bearing odontodes in front of gill openings. Abdomen with conspicuous, small dermal platelets between insertions of pectoral and pelvic fins, forming a thoracic shield surrounded by naked areas.

Head wide and depressed. Head and snout rounded in dorsal view. Interorbital space straight in frontal view. Median ridge slightly rising from snout tip to area between nares or not evident. A ridge from naris to superior margin of orbit. Snout gently convex in lateral profile. Mature male (DZSJRP 6194, 105.5 mm SL) with moderately enlarged odontodes and distinct swollen skin along lateral margins of snout. Eye moderately small (11.9–12.9 of HL), dorsolaterally placed. Lips well developed and rounded. Lower lip almost reaching pectoral girdle and covered with papillae, wider anteriorly; two or three irregular and conspicuous rows of large and transversally flattened papillae, just posterior to dentary teeth. Maxillary barbel short and coalesced with lower lip, generally with free tip. Teeth long, slender and bicuspid; mesial cusp longer than lateral. Dentary rami forming an angle of approximately 125–130º.

Dorsal-fin origin slightly posterior to vertical passing through pelvic-fin origin; nuchal plate not covered by skin; dorsal-fin spinelet half-moon shaped and wider than dorsal-fin spine base; dorsal-fin locking mechanism absent. Dorsal-fin with spine flexible, followed by seven branched rays; its posterior margin straight or slightly falcate, not reaching vertical through end of pelvic-fin rays when adpressed. Moderate to well developed and always present adipose fin, preceded by azygous plate. Pectoral fin with six branched rays and a depressed and inward curved spine (more pronounced in larger specimens) shorter than longest branched ray, its posterior margin nearly straight, reaching or almost reaching anal-fin insertion when adpressed. Pelvic fin with one spine and five branched rays; its posterior margin nearly straight or slight concave, reaching anal-fin insertion when adpressed. Pelvic-fin spine ventrally flattened, with dermal flap on its dorsal surface in males. Anal fin with one flexible spine and five branched rays; its posterior margin slight concave. Caudal fin bifurcate; lower lobe longer than upper; 14 branched rays. Pectoral and pelvic-fin spines with odontodes on lateral and ventral portions. Anal-fin spine with odontodes only ventrally.

Color in alcohol. Ground color of dorsal surface of head and body yellowish. Head, dorsum, flanks and fins covered by numerous inconspicuous darker irregular blotches of variable shapes and sizes. Dorsal color pattern, even in mature larger individuals retains the generic juvenile color pattern of five transverse dark bars: the first through supraoccipital, the second anterior to dorsal fin, the third at dorsal-fin end, the fourth at adipose fin, and the last at caudal-peduncle posterior portion. Head usually with two light, short and parallel lines anterior to nares, bordering the naked area on snout tip. Orbital margin lighter, mainly on its superior portion. Small light spot or irregular blotch on interorbital space, inconspicuous in some specimens. Few specimens with two small convergent lighter lines on suppraoccipital posterior portion, sometimes joined as a lied V with vertex forward. Body lateral portion frequently with an upper darker region and a lower lighter one, just below lateral line, sometimes very evident.

All fins, except adipose fin, with irregular series of dark dots on rays, sometimes forming irregular, diffused, transverse stripes; adipose fin generally dark on laterals and light on dorsal portion of spine. Ventral

surface of head and body mostly unpigmented, except for some brown, faded and scattered chromatophores on lateral margins of body from pelvic fin to caudal-fin base; upper lip dark brown, except for its light narrow margin.

Etymology. The specific name refers to the Rio Yapó, drainage of the type-locality. It is treated as a noun in apposition. The word "yapo" in Tupi language means flooded area or marsh.

Distribution. *Neoplecostomus yapo* is known only from the type-locality (Fig. 3).

Remarks. One lot of this new species collected at type-locality (NUP 2609) contains various eviscerated paratype specimens neither measured nor counted.

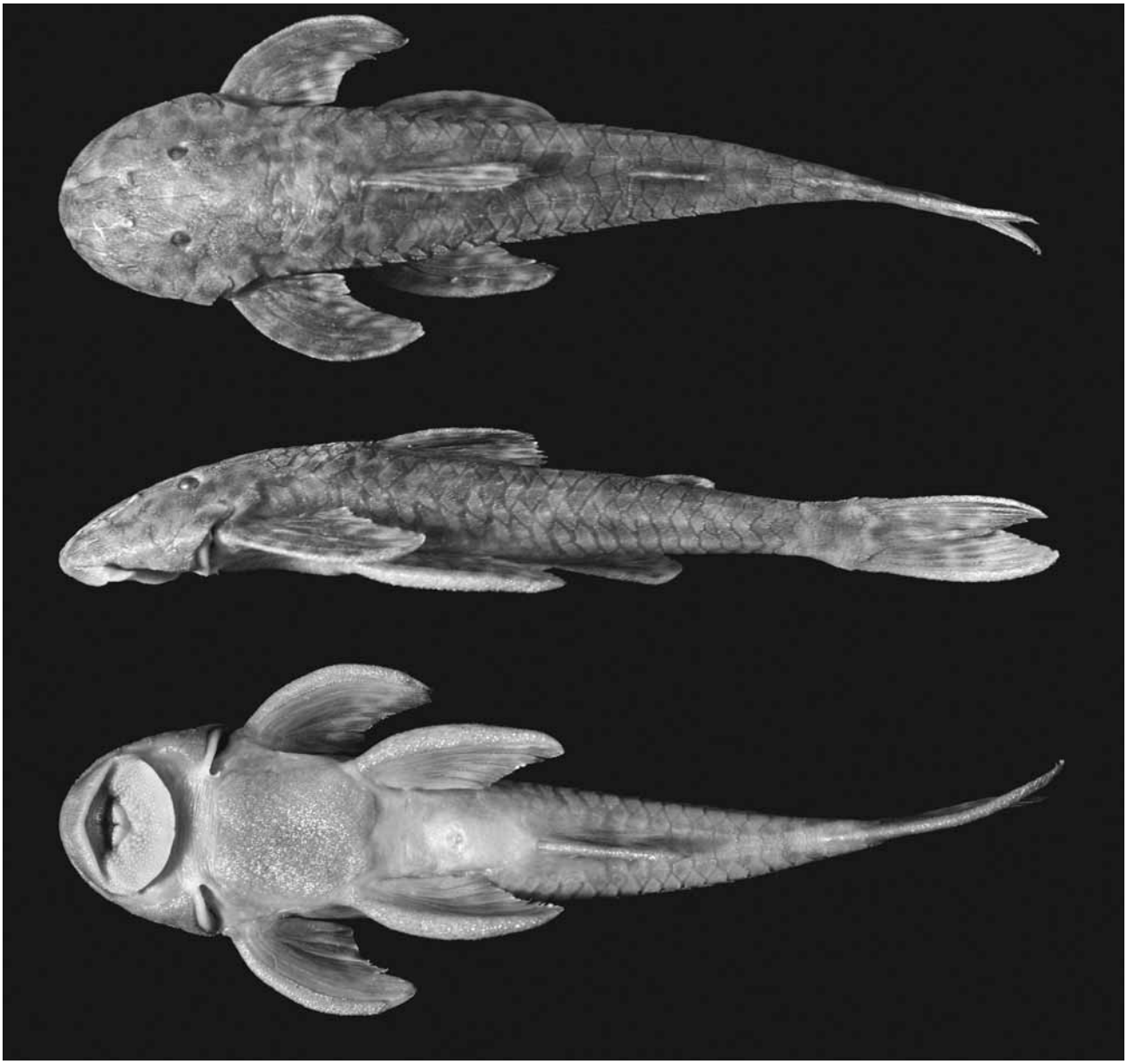

FIGURE 5. *Neoplecostomus yapo*, holotype, DZSJRP 6714, [male], 97.4 mm SL.

***Neoplecostomus paranensis* Langeani, 1990**
Figure 6; Table 1

Holotype. MZUSP 38572, male, 72.2 mm SL, São Paulo State, Cajuru, Rio Cubatão, Santa Carlota farm, 13 Apr 1986, Exc. Dept. Zoologia FFCLRP-USP.

Paratypes. MZUSP 10213, 2 [f], 39.4–41.5 mm SL, Minas Gerais State, Carandaí, Rio Carandaí, 7 Sep 1973, H. A. Britski; MZUSP 35397, female, 38.4 mm SL, Minas Gerais State, Fortaleza de Minas, stream affluent of Rio São João, road between Fortaleza de Minas and Perobas, 16 Jan 1986, Z. C. M. Vasconcelos and F. Langeani; MZUSP 35822–35824, 3 [m], 68.3–92.8 mm SL, same data as the holotype; MZUSP 36583, 4 [undetermined], 36.3–62.4 mm SL, same data as the holotype; MZUSP 36625, female, 56.0 mm SL, Brasília, Distrito Federal, Ribeirão Papuda, affluent of Rio São Bartolomeu, Sep 1985, M. Ribeiro *et al.*

Diagnosis. *Neoplecostomus paranensis* can be distinguished from its congeners by having adipose fin absent or ill-developed (vs moderate to well developed and always present adipose fin). In addition, *N. paranensis* can be separated from *N. corumba*, *N. selenae* and *N. yapo* by having smaller mandibullary width/HL (8.4–12.4 vs 14.1–21.8) and from *selenae* and *N. yapo* by lacking enlarged odontodes and distinct swollen skin along lateral margins of snout in mature males (vs present); from N. espiritosantensis by possessing 8-15 dentary teeth (vs. 19-38); from N. franciscoensis and *N. ribeirensis* by having well-developed dorsal-fin spinelet, wider than dorsal-fin spine base (vs absent or narrower); from *N. granosus* by having 28–30 lateral-line plates (vs 34–43); and from *N. variipictus* by lacking conspicuous roundish dark dots over body and fins (vs present).

Description. Counts and measurements are presented in Table 2. Body elongated and depressed. Greatest width at anterior portion of cleithrum, narrowing to caudal-fin base. Dorsal body profile gently convex, elevating from snout tip to dorsal-fin origin and descending slightly concave from dorsal-fin origin to adipose fin, descending straight from adipose fin to first caudal-fin procurrent spine. Greatest body depth at dorsal-fin origin. Trunk dorsally rounded in cross section; caudal peduncle dorsally rounded to slightly depressed; body ventrally flattened to anal-fin origin, flattened to slightly round to caudal fin. Dorsal body surface completely covered by dermal plates, excepting for a naked area around dorsal-fin base. Snout tip naked. Ventral head surface naked except by a plate bearing odontodes in front of gill openings. Abdomen with conspicuous, small dermal platelets between insertions of pectoral and pelvic fins, forming a thoracic shield surrounded by naked areas.

Head wide and depressed, somewhat triangular in dorsal view. Interorbital space straight in frontal view. Median ridge from snout tip to nares weak or not evident. A weak ridge from middle of snout to superior margin of orbit. Snout convex in lateral profile. Eye moderately small (7.9–12.0 of HL), dorsolaterally placed. Lips roundish and relatively small compared to other species. Lower lip covered by papillae, wider anteriorly, and not reaching horizontal line through opercular-membranes ventral insertion; two irregular and conspicuous rows of large and transversally flattened papillae, just posterior to dentary teeth. Maxillary barbel laterally coalesced with lower lip, with free tip in some specimens. Teeth long, slender and bicuspid; mesial cusp longer than lateral. Dentary rami forming an angle of approximately 130°.

Dorsal-fin origin posterior to vertical passing through pelvic-fin origin; nuchal plate not covered by skin; dorsal-fin spinelet rectangular and wider than dorsal-fin spine base; dorsal-fin locking mechanism absent. Dorsal-fin with spine flexible, followed by seven branched rays; its posterior margin straight or slightly concave, reaching or surpassing vertical through pelvic-fin end when adpressed. Adipose fin absent or ill developed, small, with adipose spine shorter than fin membrane; in some specimens just an azigous plate at adipose fin place. Pectoral fin with six branched rays, and with depressed and inward curved spine (more pronounced in larger specimens), shorter than longest branched ray, its posterior margin nearly straight, reaching or almost reaching half pelvic-fin length when adpressed. Pelvic-fin with one depressed and curved spine and five branched rays; its posterior margin nearly straight, reaching anal-fin insertion when adpressed. Pelvic-fin spine ventrally flattened, with dermal flap on its dorsal surface in males. Anal fin with one flexible spine and five branched rays, its posterior margin straight or slightly concave. Caudal fin moderately bifurcate, lower lobe longer than upper; 14 branched rays. Pectoral and pelvic-fin spines with odontodes on lateral and ventral portions. Anal-fin spine with odontodes laterally and ventrally.

Color in alcohol. Ground color of dorsal surface of head and body yellowish or light brown. Head, dorsum, flanks and fins covered by inconspicuous darker dots or blotches of variable shapes and sizes. Dorsal color pattern, even in mature larger individuals, retains the generic juvenile color pattern of five transverse darker bars: the first, inconspicuous, through supraoccipital, the second at dorsal-fin origin, the third at dorsal-fin base end, the fourth at adipose fin, and the last at caudal-peduncle posterior portion. Head usually with two light lines from snout to nares. Orbital margin lighter, mainly on its anterior and superior portion. Small light, sometimes inconspicuous spot on interorbital space. Lateral body portion usually with an upper darker region and a lighter lower one. Ventral surface of head and body mostly unpigmented, excepting some brown, faded and scattered chromatophores on upper lip.

Dorsal fin with irregular dark dots series on rays. Pectoral, pelvic, anal, and caudal fins with dark dots forming irregular transverse stripes on rays; pectoral and pelvic fins also with some scattered small chromatophores along membrane. Adipose fin generally dark laterally and light on spine dorsal portion.

Distribution. *Neoplecostomus paranensis* occurs in headwater streams of Grande, Paranapanema, Tietê, and Paranaíba rivers in the upper Rio Paraná system (see discussion for details).

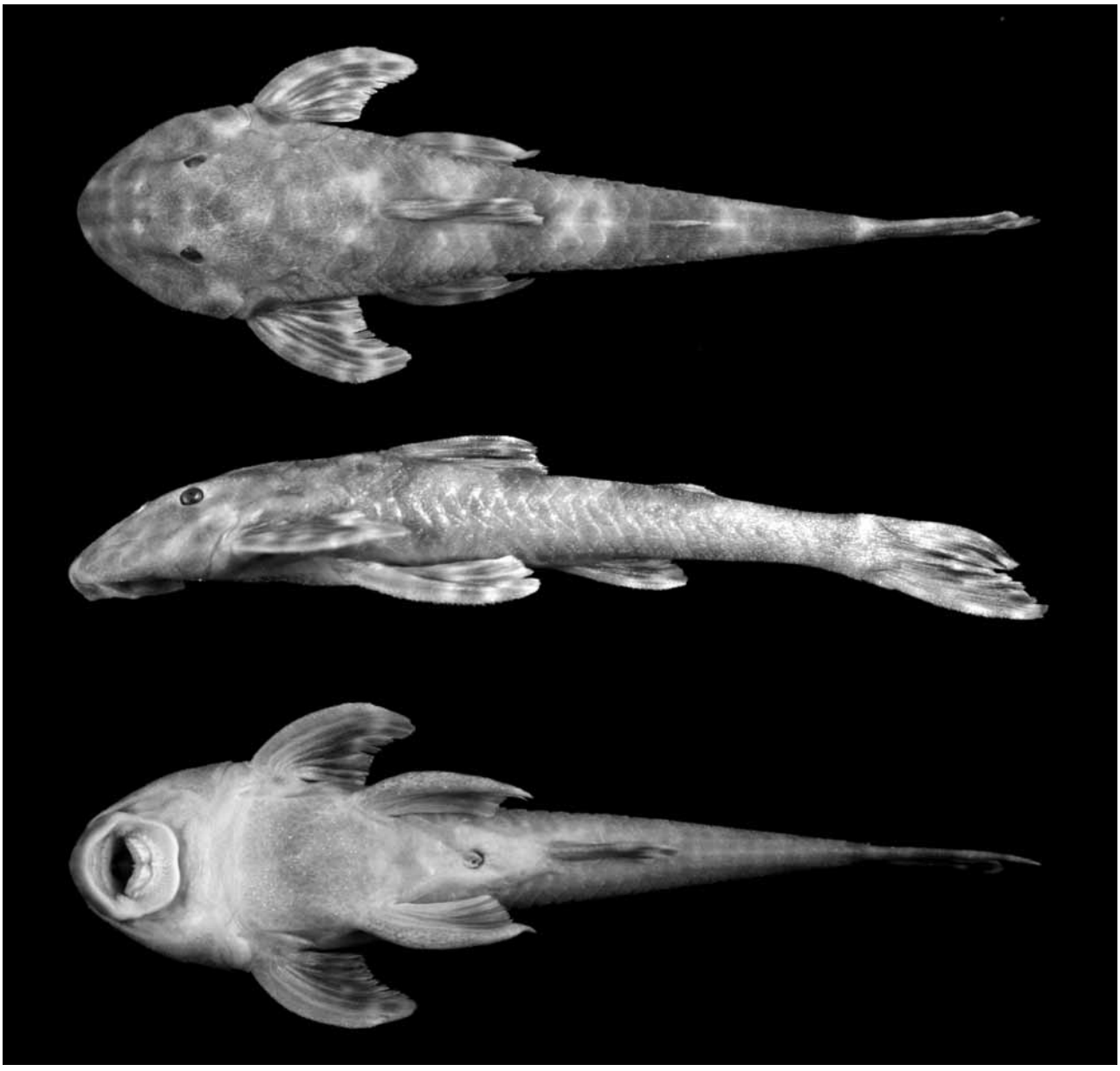

FIGURE 6. *Neoplecostomus paranensis*, holotype, MZUSP 38572, male, 72.2 mm SL.

Discussion

Neoplecostomus selenae and *N. yapo*, among other congeners, are uniquely diagnosed by having sexual dimorphism: large mature males with enlarged odontodes and distinct swollen skin along lateral margins of snout (in both species, although as shown in Fig 7 it is much more developed in *N. selenae*). *Neoplecostomus selenae* is further diagnosed by having a ridge with swollen skin and odontodes in front of eyes in mature males. Hypertrophied skin and enlarged odontodes along lateral margins of snout are also present in mature males of the Loricariinae genera *Harttia* (Langeani *et al.* 2001) and *Rineloricaria* (Langeani and Araújo 1994; Armbruster 2004), and the Neoplecostominae genera *Pareiorhaphis* and *Isbrueckerichthys* (Pereira & Reis 2002). Furthermore, hypertrophied skin and odontodes along a ridge in front of eyes also occur in *Pareiorhaphis*, clearly seen in *P. hystrix* (Pereira & Reis 2002; fig 22).

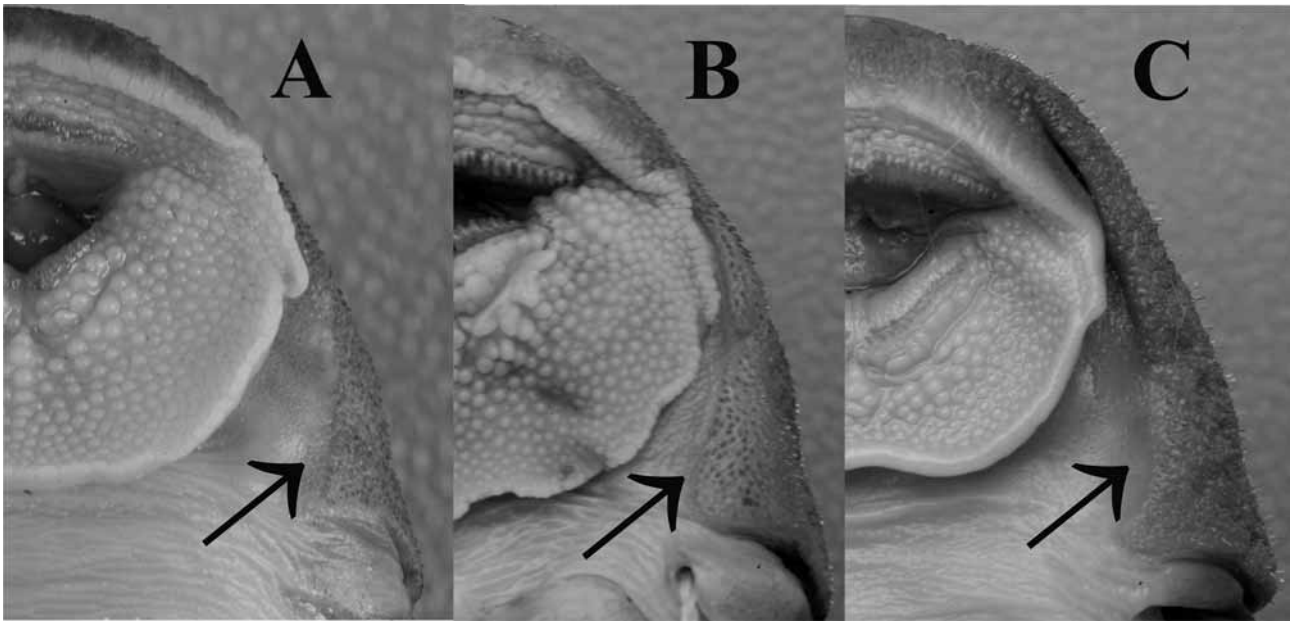

FIGURE 7. Head ventral view of the hypertrophied odontodes in adult males of: A) *N. paranensis*, DZSJRP 7003, 81.3 mm SL; B) *N. yapo*, DZSJRP 6194, 105.2 mm SL and; C) *N. selenae*, DZSJRP 7449, 95.8 mm SL.

The recognition of the new species described here led us to reanalyze the type series of *Neoplecostomus paranensis*. Some paratypes (MZUSP 35201, MZUSP 35207, from the Rio Paranapanema, and MZUSP 36678 from the Rio Tietê) present, among other differences, a greater number of premaxillary and dentary teeth (respectively 19–33, 15–30, and 10–17, vs. 8–15, in *N. paranensis*). These specimens are presently being studied and represent an additional new species (Zawadzki et al., in prep.). Other paratypes (MZUSP 35167, MZUSP 35328, MZUSP 35335, from the Rio Paranapanema, and ZMA 120.341 from the the Rio Tietê), even considered as *N. paranensis* based on the absence or poorly developed adipose fin, among other characters, are very small specimens (smaller than 43 mm SL) not included in the comparisons because of implied allometric implications.

The upper Rio Paraná has already been mentioned as biogeographically distinct from remaining areas of the La Plata basin, which also includes Rio Iguaçu, lower Rio Paraná, Rio Paraguay, and Rio Uruguay basins (Britski & Langeani 1988; Vari 1988). Furthermore, there is evidence concerning area interrelationships between upper Rio Paraná and coastal drainages of Southeastern Brazil, Rio São Francisco, Rio Tocantins, and Rio Paraíba do Sul basins (Malabarba 1998; Pavanelli & Britski 1999; Britto & Castro 2002; Serra *et al.* 2007). These interrelationships attest to the possible complex nature of the upper Rio Paraná (Castro *et al.* 2003) and contribute to its peculiar and highly diverse ichthyofauna (at least for some fish groups, *e.g.*

Hisonotus [Britski & Garavello 2003] and *Planaltina* [Menezes *et al.* 2003]). *Neoplecostomus* corroborates that pattern.

The high degree of the upper Paraná fish endemism and diversity reinforces the importance of further surveys at its headwaters in order to reveal additional new taxa, as already suggested by Castro and Menezes (1998), and Langeani *et al.* (2007). The three new species described herein represent an increase of about 40% in the amount of known *Neoplecostomus* species and quadruplicate the number of known species for the genus for that portion of the basin.

Neoplecostomus species are known to be morphologically very similar to each other (Langeani 1990). but sometimes very different genetically, as showed by Zawadzki *et al.* (2004). These authors used allozyme electrophoresis to compare *Neoplecostomus corumba* (*Neoplecostomus* sp. in that paper) and *N. paranensis.* Despite their general morphological resemblance, they have a genetic distance as high as those generally obtained for species of different genera. Thus, a great genetic divergence may probably be hidden behind the relative morphological conservancy of *Neoplecostomus* populations in the upper Rio Paraná. Zawadzki *et al.* (2004) also found no genetic variability in that population of *N. paranensis* (no heterozygote specimens). These results generally indicate small population size, restricted geographical distribution and reduced gene flow to some neighboring populations. Reduction in gene flow and endogamic genetic events could favor fast speciation processes, which promote high endemism. In the light of these results we suggest that further collecting efforts in headwater streams may increase the number of *Neoplecostomus* species in the upper Rio Paraná and also in some other basins in Southeastern Brazil.

Key to species of *Neoplecostomus*

1 Dorsal-fin spinelet absent or weakly developed, usually narrower than dorsal-fin spine 2
- Dorsal-fin spinelet present and always wider than dorsal-fin spine 3
2 Three plates in ventral head region, just ahead gill openings; dentary teeth followed by two rows of large and transversally flattened papillae .....*N. ribeirensis*
- One large plate in ventral head region, just ahead gill openings; dentary teeth followed by three irregular rows of large and transversally flattened papillae .....*N. franciscoensis*
3 Adipose fin absent or poorly developed ..... *N. paranensis*
- Adipose fin well developed 4
4 Mature males with enlarged odontodes on distinct swollen skin, along lateral margins of snout.....5
- Mature males without enlarged odontodes on distinct swollen skin along lateral margins of snout.....6
5 Mature males with enlarged odontodes on distinct swollen skin along a ridge in front of eye.....
.....*N. selenae* **n. sp.**
- Mature males neither with enlarged odontodes or distinct swollen skin along a ridge in front of eye .....
.....*N. yapo* **n. sp.**
6 Plates in lateral line 34 to 43; plates between adipose and caudal fin 10 to 13..... *N. granosus*
- Plates in lateral line 27 to 33; plates between adipose and caudal fin 4 to 9.....7
7 Cleithral width 24.9 to 27.6% of SL; orbital diameter 12.2 to 13.0% of HL .....*N. corumba* **n. sp.**
- Cleithral width 17.0 to 23.0% of SL; orbital diameter 6.0 to 11.0% of HL 8
8 Premaxilary teeth 19 to 38 and dentary teeth 15 to 35 ..... *N. espiritosantensis*
- Premaxilary teeth 9 to 17 and dentary teeth 5 to 12 9
9 Head length 26.2 to 26.8% of SL; cleithral width 25.3 to 25.4% of SL..... *N. variipictus*
- Head length 29.0 to 32.0% of SL; cleithral width 19.0 to 23.0% of SL..... *N. microps*

Additional comparative material

Neoplecostomus sp. **Brazil**: *Upper Rio Paraná basin*: *São Paulo State*: MNRJ 12805, 2, 66.1–70.0 mm SL, upper Rio Paranapanema; MNRJ 20188, 76.2 mm SL, Rio Verde; MNRJ 22598, 21, 46.2–82.1 mm SL, Rio da Prata; MZUSP 59118, 58.0 mm SL, Rio Tietê; MZUSP 59139, 71.0 mm SL, Rio Paraitinga; NUP 2608, 4, 57.4–90.4 mm SL, Rio Pardo. *Minas Gerais State*: LBP 1086, 13, 55.8–91.2 mm SL; MCP 28316, 2, 74.3–75.0 mm SL, Rio Paranaíba; MNRJ 12804, 81.8 mm SL, Rio São João; MNRJ 22252, 5, 39.8–66.8 mm SL; MNRJ 22253, 80.8 mm SL, Rio das Bicas; MZUSP 73198, 4, 34.9–38.9 mm SL, Rio Piedade; MZUSP 79771, 13, 23.6–40.7 mm SL, and MZUSP 79803, 88.7 mm SL, Rio Mogi Guaçu. *Goiás State*: MNRJ 21522, 4, 19.8–32.1 mm SL, Alto Paraíso; NUP 3774, 68.0 mm SL, Rio Meia Ponte. Paraná State: DZSJRP 6715, 80.8 mm SL, Rio Mourão. *Rio Iguaçu basin*: *Paraná State*: NUP 703, 74.2 mm SL, Caxias Reservoir; NUP 37565, 2, 85.4–85.7 mm SL, Rio Jordão.

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References

Armbruster, J.W. (2004) Phylogenetic relationships of the suckermouth armored catfishes (Loricariidae) with emphasis on the Hypostominae and the Ancistrinae. *Zoological Journal of the Linnean Society*, 141, 1–80.

Bizerril, C.R.S.F. (1995) Description of a new species of *Neoplecostomus* (Loricariidae, Neoplecostominae), with a synopsis of the taxonomical composition of the Loricariidae in eastern Brazil. *Arquivos de Biologia e Tecnologia*, 38, 693–704.

Britski, H.A., & Langeani, F. (1988) *Pimelodus paranaensis*, sp. n., um novo Pimelodidae (Pisces, Siluriformes) do alto Paraná, Brasil. *Revista Brasileira de Zoologia*, 5, 409–417.

Britski, H.A. & Garavello, J.C. (2003) *Hisonotus insperatus*: new species, from the upper Rio Paraná basin (Pisces: Ostariophysi: Loricariidae). *Copeia*, 2003, 588–593.

Britto, M.R. & Castro, R.M.C. (2002) New corydoradine catfish (Siluriformes: Callichthyidae) from the upper Paraná and São Francisco: the sister group of *Brochis* and most of *Corydoras* species. *Copeia*, 2002, 1006–1015.

Castro, R.M.C. & Menezes, N.A. (1998) Estudo diagnóstico da diversidade de peixes do Estado de São Paulo. *In*: Castro, R.M.C. (Ed.), *Biodiversidade do Estado de São Paulo, Brasil*: Síntese do conhecimento ao final do século XX, 6: vertebrados. FAPESP São Paulo, pp. 1–13.

Castro, R.M.C., Ribeiro, A.C., Benine, R.C. & Melo, A.L. (2003) *Lophiobrycon weitzmani*, a new genus and species of glandulocaudine fish (Characiformes: Characidae) from the Rio Grande drainage, upper Rio Paraná system, southeastern Brazil. *Neotropical Ichthyology*, 1, 11–19.

Langeani, F. (1990) Revisão do gênero *Neoplecostomus* Eigenmann & Eigenmann, 1888, com a descrição de quatro novas espécies do sudeste brasileiro (Ostariophysi, Siluriformes, Loricariidae). *Comunicações do Museu de Ciências. PUCRS, série Zoologia*, 3, 3–31.

Langeani, F. & Araújo, R.B. (1994) O gênero *Rineloricaria* Bleeker, 1862 (Ostariophysi, Siluriformes) na bacia do rio Paraná superior: *Rineloricaria pentamaculata* sp. n. e *Rineloricaria latirostris* (Boulenger, 1900). *Comunicações do Museu de Ciências. PUCRS, série Zoologia*, 7, 151–166.

Langeani, F., Castro, R.M.C., Oyakawa, O.T., Shibatta, O.A., Pavanelli, C.S. & Casatti, L. (2007) Diversidade da ictiofauna do Alto rio Paraná: composição atual e perspectivas futuras. Biota Neotropica, 7. Available from http://www.biotaneotropica.org.br/v7n3/pt/abstract?article+bn03407032007 ISSN 1676-0603 (8 Apr 2008).

Langeani, F., Oyakawa, O.T. & Montoya-Burgos, J.I. (2001) New species of *Harttia* (Loricariidae, Loricariinae) from

the Rio São Francisco basin. *Copeia*, 2001, 136–142.
Malabarba, M.C. (1998) Phylogeny of fossil Characiformes and paleobiogeography of the Tremembé Formation. *In*: Malabarba, L.R., Reis, R.E., Vari, R.P., Lucena, Z.M.S. & Lucena, C.A.S. (Eds.), *Phylogeny and classification of Neotropical fishes*. EDIPUCRS Porto Alegre, pp. 69–84.
Menezes, N.A., Weitzman, S.H. & Burns, J.R. (2003) A systematic review of *Planaltina* (Teleostei: Characiformes: Characidae: Glandulocaudinae: Diapomini) with a description of two new species from the upper Rio Paraná, Brazil. *Proceedings of the Biological Society of Washington*, 116, 557–600.
Pavanelli, C.S. & Britski, H.A. (1999) Description of a new species of *Steindachnerina* (Teleostei: Characiformes: Curimatidae) from the upper Rio Paraná basin, Brazil. *Ichthyological Exploration of Freshwaters*, 10, 211–216.
Pavanelli, C.S., Graça, W.J., Zawadzki, C.H., Britski, H.A., Vidotti, A.P., Avelino, G.S. & Veríssimo, S. (2007) Fishes from the Corumbá reservoir, Paranaíba River basin, upper Paraná River basin, State of Goiás, Brazil. *Checklist*, 3, 58–64.
Pereira, E.H.L. & Reis, R.E. (2002) Revision of the loricariid genera *Hemipsilichthys* and *Isbrueckerichthys* (Teleostei: Siluriformes), with description of five new species of *Hemipsilichthys*. *Ichthyological Exploration of Freshwaters*, 13, 97–146.
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.
Serra, J.P., Carvalho, F.R. & Langeani, F. (2007) Ictiofauna do rio Itatinga no Parque das Neblinas, Bertioga, Estado de São Paulo: composição e biogeografia. *Biota Neotropica*, 7. Available from: http://www.biotaneotropica.org.br/v7n1/pt/abstract?article+bn01707012007 (26 Feb 2007).
Vari, R.P. (1988) The Curimatidae, a lowland Neotropical fish family (Pisces: Characiformes): distribution, endemism, and phylogenetic biogeography. *In*: Heyer, W.R. & Vanzolini, P.E. (Eds.), *Proceedings of the Workshop on Neotropical Distribution Patterns*. Acad. Bras. Ciências Rio de Janeiro, pp. 343–377.
Zawadzki, C.H., Alves, A.L., Renesto, E. & Oliveira, C. (2004) Biochemical evidence of a possible new species of *Neoplecostomus* (Teleostei: Loricariidae) from the upper Rio Paraná basin, Brazil. *Biochemical Systematics and Ecology*, 32, 573–582.