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FISHES (Actinopteri, Characiformes) FROM THE TAPYTA RESERVE WITH THREE NEW ADDITIONS TO THE PARAGUAYAN ICHTHYOFAUNA

Peces (Actinopteri, Characiformes) de la Reserva Tapytá con tres nuevas adiciones a la ictiofauna paraguaya

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ABSTRACT

The Characiform fish species from the Tapyta Reserve and surrounding area, Caazapa, Paraguay, were inventoried during a year with electrofishing, netting, and trapping. A total of 20 species were registered, being Characidae the richest family. We also report three species as new records to the Paraguayan ichthyofauna and discuss the update of the inventory of fishes from Paraguay.
Keywords: *Bryconamericus*, *Characidium*, Fish inventory, La Plata River basin.

RESUMEN

Los peces Characiformes de la Reserva Tapytá y sus alrededores, Caazapá, Paraguay, fueron inventariados durante un año de muestreo mediante pesca eléctrica, redes, y trampeo. Un total de 20 especies fueron registradas, siendo Characidae la familia con mayor riqueza. Reportamos además tres especies como nuevos registros para la ictiofauna paraguaya y discutimos la actualización del inventario de peces del Paraguay.
Palabras Clave: *Bryconamericus*, *Characidium*, Inventario de peces, Cuenca del Río de La Plata.

INTRODUCTION

Paraguay is in the center of South America, the freshwater aquatic ecosystems of this country drain to La Plata basin, the second largest river of this continent. Considering the biogeographic units of the Neotropics, Paraguay is composed by three major habitat types: Tropical and subtropical floodplain rivers and wetland complexes, Temperate floodplain rivers and wetlands, and Tropical and subtropical upland rivers (WWF/TNC, 2020). Within these major habitats, Paraguay encloses four aquatic ecoregions: Chaco, Paraguay, Upper Parana, and Lower Parana (Abell et al., 2008).

The diversity of fishes from Paraguay was initially revised by some authors as Boulenger (1895a, 1895b), Eigenmann (Eigenmann and Kennedy, 1903; Eigenmann et al., 1906), and Bertoni (1939). In the end of the 20th century, we can mention the papers of Géry et al. (1987), Ramlow (1989), and Mandelburger et al. (1996). In a recent revision, a total of 307 fish species were confirmed in Paraguay by Koerber et al. (2017).

The Characiformes fishes from La Plata basin are commonly known by aquarist, sport fishers, and consumers in general. They include representatives popularly known as the aquarium tetras, the carnivorous piranhas, large sport fishes as the dorados, and market fishes as the sabalos. This order comprises around 2270 valid species arranged into 46 families (Fricke et al., 2020a).

The monophyly of Characiformes were corroborated by some authors, however, others questioned this condition. Fink and Fink (1981) studied the ostariophysan lineages and reported Characiformes as monophyletic and sister to Siluriformes [clade composed there by (Siluroidei + Gymnotoidei)]. They supported this monophyly by osteological

characters of the neurocranium (presence of openings and projections as the auditory foramen, the post temporal foramen, and a large lagenar capsule); by dentition in the jaws (presence of multicuspid teeth, and formation of replacement teeth into the bone); by processes of the anterior vertebrae (presence of a transverse process in the third neural arch); and by its caudal-fin base structure (presence of a hiatus or discontinuity between the compound centrum and the hypural 1). Betancur-R et al. (2013) tested the phylogeny of bony fishes analyzing molecular data and including all major lineages, they found a monophyletic Characiformes nested in a group named Otophysa [composed there by (Cypriniformes (Gymnotiformes (Characiformes + Siluriformes))]. However, these authors mentioned that the Characiformes presented dubious internal relationships. Chakrabarty et al. (2017) tested the phylogeny of Characiformes by several methods and using different molecular data partitions, they mentioned the non-monophyly of this group indicated by an arrangement of (Characoidei + Siluriformes) sister to (Citharinoidei + Gymnotiformes). However, when combining the molecular data with the morphological data, these authors found a monophyletic Characiformes sister to a clade composed by (Gymnotiformes + Siluriformes).

The literature of fish inventory, composition, or distribution from Paraguay is still scarce. The revision of Géry et al. (1987) is the latest revision of the Characiformes from Paraguay; however, this paper did not include the highly diversified Characidae family, and only reported 39 current valid species. According to Koerber et al. (2017), a total of 123 species of Characiformes were listed to Paraguay, arranged into 11 families with their species number composition as follows: Hemiodontidae (two), Parodontidae (three), Curimatidae (13), Prochilodontidae (one), Anostomidae (11), Erythrinidae (five), Lebiasinidae (one), Gasteropelecidae (one), Serrasalmidae (nine), Characidae (75), and Crenuchidae (two).

Tapyta Reserve is a private protected natural park of about 47 km^2, it conforms to an important site because it is located between two larger national parks in Paraguay, as the Caazapa National Park and the San Rafael National Park. This condition contributes to the conservation of relicts of moist broadleaf forest landscapes in Paraguay, specifically the Atlantic Forest, which is dramatically fragmented and is currently categorized as Critically Endangered (Ferrer-Paris et al., 2019). In a freshwater ecoregion framework, Tapyta Reserve contains habitats as headwaters and swamps of the Paraguay Ecoregion. During the year 2017 and 2018 we conducted an aquatic monitoring of this Reserve, including samplings of algae, fishes, and amphibians that was financed by the Consejo Nacional de Ciencia y Tecnología del Paraguay (CONACYT, Proyecto INV15-320). Report of fish inventory or fish distribution is scarce in Paraguay and particularly rare from specific localities within this country, lacking this kind of information from the Tapyta Reserve or the surrounding area. The aim of this paper is to report the first list of fish species from the Tapyta Reserve, focusing on the Characiformes order, emphasizing that this site is a key protected forest in Paraguay, which drains to the Tebicuary River, one of the most important rivers of the left margin of the Paraguay River basin.

MATERIALS AND METHODS

Eight localities were sampled, including five sites inside the Reserve and three sites in the surrounding area. Sampling sites were done at the Yuqueri Stream and Tebicuary River in the Tapyta Reserve, and the Sara Stream outside the protected area (Table 1, Figs. 1–2). The scientific collections were done with the corresponding permissions, under a license from the Paraguayan authority, MADES N° 004/2017 (Ministerio del Ambiente y Desarrollo Sostenible). Specimens were sampled during five field expeditions, from December 2017 to November 2018, by trapping, netting, and electrofishing at day and night.

Table 1. Sampling sites for fishes in the Tapyta Reserve and surroundings, San Juan Nepomuceno, Caazapá, Paraguay.

Site	Locality	Coordinates
1	PARAGUAY, Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá	26°14'22.6"S 55°48'39.9"W
2	PARAGUAY, Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá	26°16'40.5"S 55°46'12.0"W
3	PARAGUAY, Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá	26°16'40.4"S 55°44'39.2"W
4	PARAGUAY, Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.	26°12'17.5"S 55°46'31.1"W
5	PARAGUAY, Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.	26°12'34.2"S 55°45'43.7"W
6	PARAGUAY, Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.	26°13'09.7"S 55°44'16.5"W
7	PARAGUAY, Caazapá, San Juan Nepomuceno, Río Tebicuary en la Reserva Tapytá	26°18'13.64"S 55°45'27.60"W
8	PARAGUAY, Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá	26°16'50.43"S 55°45'45.67"W

Specimens were euthanized by using pure certified Eugenol, through stock solutions in alcohol 96 % and work solutions in water (Lucena et al., 2013). We have taken tissue samples in some specimens, which were fixed in alcohol 96 % and then stored in criotubes and boxes. Voucher specimens were fixed by immersion in a solution of 10 % commercial formalin (40 %) and then stored in plastic jars. All specimens were stored in the Collection of Fishes from the Museo

Nacional de Historia Natural del Paraguay (MNHNP), data are provided in the Examined material subsection under Results as follows: COUNTRY: Department, City, Locality; Coordinates in degrees minutes seconds; Date in days month year; Collectors; Acronym and catalogue number, specimens count and preparation type (alcohol abbreviated as alc. and tissue abbreviated as tej.), size range millimeters (mm) in Standard Length (SL). Measures relative to the head (Head Length) were abbreviated as HL.

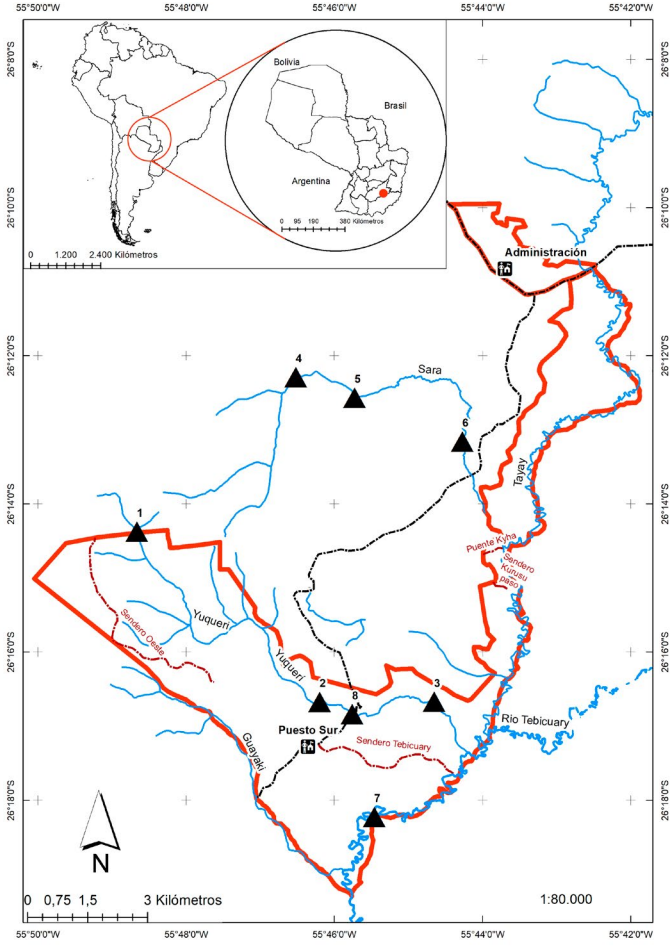

Figure 1. Hydrographic map of the Tapyta Reserve, South America, showing the survey localities for fish study in tributaries to the Tebicuary River (Paraguay River basin), San Juan Nepomuceno, Caazapa, Paraguay. References: Triangles = Sampling sites. Red lines = Tapyta Reserve limits. Blue lines = Streams and rivers. Black and brown dotted lines = Land accesses.

Specimens were identified in the Laboratory by the examination of external characters under a stereoscopic microscope and by analysis of books of fish species from La Plata basin (Britski et al., 2007; Graça and Pavanelli, 2007) and specific taxonomic papers as revisionary studies or species descriptions that are cited in the Identification subsection under Results. We report our proper observations, morphometric, and counts based on the specimens revised in this paper. Finally, we mention in brackets the source of the diagnostic characters consulted in the literature to assign species names to our specimens analyzed. The taxonomic classification used and the assign of scientific names is under the Check List of the Freshwater Fishes of South and Central America (Reis et al., 2003), the Checklist of the Fishes of Paraguay (Koerber et al., 2017), and the online Eschmeyer's Catalog of Fishes (Fricke et al., 2020b).

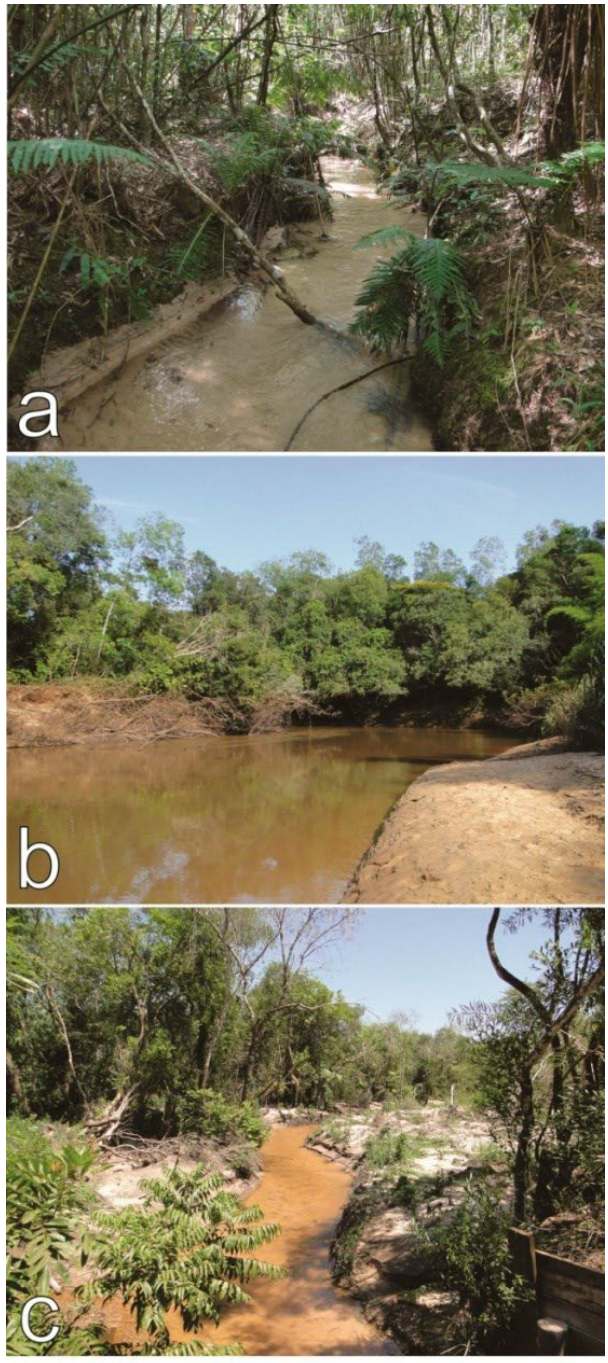

Figure 2. Aquatic environments surveyed in the Tapyta Reserve: a) Yuqueri Stream (Tapyta Reserve). b) Tebicuary River (Tapyta Reserve). c) Sara Stream (surroundings of the Reserve).

Table 2. List of species from the Tapyta Reserve and surroundings, alphabetically organized and indicating other taxonomic ranks.

N	Species	Subfamily	Family	Tapyta Reserve	Surroundings
1	*Apareiodon affinis*		Parodontidae	x	
2	*Aphyocharax dentatus*	Aphyocharacinae	Characidae	x	
3	*Astyanax abramis*	*Astyanax* clade	Characidae		
4	*Astyanax lacustris*	*Astyanax* clade	Characidae	x	x
5	*Astyanax lineatus*	*Astyanax* clade	Characidae		x
6	*Bryconamericus* cf. *coeruleus*	Stevardiinae	Characidae	x	x
7	*Characidium* cf. *pterostictum*		Crenuchidae	x	x
8	*Characidium* cf. *zebra*		Crenuchidae	x	x
9	*Deuterodon luetkenii*	*Hemigrammus* clade	Characidae	x	x
10	*Hoplias mbigua*		Erythrinidae		x
11	*Hoplias misionera*		Erythrinidae		x
12	*Leporinus striatus*		Anostomidae	x	
13	*Moenkhausia australis*	*Hemigrammus* clade	Characidae	x	x
14	*Odontostilbe pequira*	Cheirodontinae	Characidae	x	
15	*Oligosarcus oligolepis*	*Astyanax* clade	Characidae	x	x
16	*Piabarchus stramineus*	Stevardiinae	Characidae	x	x
17	*Psalidodon eigenmanniorum*	Stethaprioninae	Characidae	x	x
18	*Psalidodon rutilus*	Stethaprioninae	Characidae	x	x
19	*Pyrhulina australis*	Pyrrhulininae	Lebiasinidae		x
20	*Steindachnerina brevipinna*		Curimatidae	x	x

RESULTS

We provide the first list of fish species to the Tapyta Reserve, a key protected area in the Paraguayan Atlantic Forest Terrestrial Ecoregion and an important site that holds headwaters and swamps from the Paraguay Freshwater Ecoregion, at the Tebicuary River, which is one of the most important tributaries to the Paraguay River Basin in Paraguay.

A total of 20 fish species belonging to the Characiformes were registered in the Tapyta Reserve, composed by 15 genera and arranged into seven families with each species richness in brackets as follows: Parodontidae (one), Curimatidae (one), Anostomidae (one), Erythrinidae (two), Lebiasinidae (one), Characidae (12), and Crenuchidae (two) (Table 2). Characidae is the most diverse family group, with 12 species that summarize 60 % of the Characiform species richness of the evaluated sites.

Within Characidae, the species are grouped homogeneously into these following clades: Aphyocharacinae (one), *Astyanax* clade (four), Cheirodontinae (one), *Hemigrammus* clade (two), Stethaprioninae (two), and Stevardiinae (two).

Here, we provide the taxonomic list of the species found and give the diagnostic characters based in the literature and based in the observations and counts of the specimens analyzed. Within these 20 characiform species, three species are new records to Paraguay (country) and to the Paraguay Ecoregion in La Plata Basin: *Bryconamericus coeruleus*, *Characidium pterostictum*, and *Characidium zebra* (Fig. 3).

Figure 3. New records to the Paraguayan ichthyofauna: a) *Bryconamericus* cf. *coeruleus*, MNHNP 4460, 54.96 mm SL. b) *Characidium* cf. *pterostictum*, MNHNP 4467, 56.3 mm SL. c) *Characidium* cf. *zebra*, MNHNP 4600, 42.0 mm SL. Scale bar = 1 cm.

CHARACIFORMES

Parodontidae

***Apareiodon affinis* (Steindachner, 1879)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Río Tebicuary en la Reserva Tapytá; 26°18'13.91"S, 55°45'27.97"W; 12–14 December 2017; H. Vera, B.L. Rojas, J. Emhart, J.J. Resquín; MNHNP 4637, 3 alc., 52.2–67.2 mm SL.

Identification: Body with a dark lateral stripe at lateral line, dark shades across the back, maxillary teeth two, predorsal scales 12, lateral line scales 40 (Diagnostic characters based on Eigenmann, 1916).

Curimatidae

***Steindachnerina brevipinna* (Eigenmann & Eigenmann, 1889)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Río Tebicuary en la Reserva Tapytá; 26°18'13.91"S, 55°45'27.97"W; 12–14 December 2017; H. Vera, B.L. Rojas, J. Emhart, J.J. Resquín; MNHNP 4635, 1 alc., 94.4 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4534, 1 alc., 81.5 mm SL.

Identification: Oral cavity roof with numerous digitiform tubercles, upper transversal scales five and a half, lower transversal scales four, lateral line scales 36–39, a single dark stripe along lateral line from supracleithrum to caudal peduncle, dorsal fin with a dark pigmentation on basal portions of middle rays (Diagnostic characters based on Vari, 1991).

Anostomidae

***Leporinus striatus* Kner, 1858**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'50.13"S, 55°45'45.67"W; 13–14 December 2017; H. Vera, B.L. Rojas, J. Emhart, J.J. Resquín; MNHNP 4624, 1 alc., 102.6 mm SL.

Identification: Body with four longitudinal stripes, ventral portion of the upper lip with a red spot in live specimens, upper transversal scales five, lower transversal scales four, lateral line scales 36, scales around caudal peduncle 16, premaxillary teeth three, dentary teeth three (Diagnostic characters based on Birindelli and Britski, 2013).

Erythrinidae

***Hoplias mbigua* Azpelicueta, Benítez, Aichino & Mendez, 2015**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4358, 1 alc., 38.8 mm SL.

Identification: Head with a concave profile on dorsum, transversal bands on lower jaw (Diagnostic characters based on Azpelicueta et al., 2015).

***Hoplias misionera* Rosso Mabragaña, González-Castro, Delpiani, Avigliano, Schenone & Díaz de Astarloa, 2016**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S,

55°45'43.7"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4401, 1 alc., 181.3 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4586, 1 alc., 154.9 mm SL.

Identification: Head with a straight profile on dorsum, last scale series forming a rounded vertical line on base of caudal fin (Diagnostic characters based on Rosso et al., 2016).

Lebiasinidae

***Pyrrhulina australis* Eigenmann & Kennedy, 1903**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4375, 1 alc., 29.7 mm SL.

Identification: Head with a conspicuous black spot on the snout, lateral line scales 22, anal fin with ten rays (Diagnostic characters based on Eigenmann and Kennedy, 1903).

Characidae

***Aphyocharax dentatus* Eigenmann & Kennedy, 1903**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Río Tebicuary en la Reserva Tapytá; 26°18'13.91"S, 55°45'27.97"W; 12–14 December 2017; H. Vera, B.L. Rojas, J. Emhart, J.J. Resquín; MNHNP 4636, 75 alc., 30.9–39.9 mm SL.

Identification: Large maxillary bone with ten teeth, premaxillary teeth seven, anal fin with 15 rays, upper transversal scales five, lower transversal scales three, lateral line scales 36 (Diagnostic characters based on Eigenmann and Kennedy, 1903).

***Astyanax abramis* (Jenyns, 1842)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Río Tebicuary en la Reserva Tapytá; 26°18'13.91"S, 55°45'27.97"W; 12–14 December 2017; H. Vera, B.L. Rojas, J. Emhart, J.J. Resquín; MNHNP 4634, 1 alc., 82.6 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4532, 1 alc., 114.8 mm SL.

Identification: Humeral spot horizontally elongated, transversal scales on body small, upper transversal scales nine, lower transversal scales eight, lateral line scales 44, anal fin iii+29–30 (Diagnostic characters based on Lucena and Soares, 2016).

***Astyanax lacustris* (Lütken, 1875)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'50.13"S, 55°45'45.67"W; 13–14 December 2017; H. Vera, B.L. Rojas, J. Emhart, J.J. Resquín; MNHNP 4623, 2 alc, 71.6–76.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 19–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4317, 4 alc., 74.4–86.0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.4"S, 55°44'39.2"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4306, 4 alc., 51.5–91.1 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4353, 1 alc., 80.7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4394, 2 alc., 61.5–64.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4418, 9 alc., 49.7–89.6 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.4"S, 55°44'39.2"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4559, 1 alc., 5.8 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4575, 1 alc., 94.3 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4592, 1 alc., 88.6 mm SL.

Identification: Body with a humeral spot horizontally elongated, transversal scales on body large, upper transversal scales seven, lower transversal scales six, lateral line scales 36–38, anal fin iii+25–28 (Diagnostic characters based in Lucena and Soares, 2016).

***Astyanax lineatus* (Perugia, 1891)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4382, 1 alc., 66.9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4409, 4 alc., 54,5–84,9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 4–7 June 2018; H.

Vera, B.L. Rojas, J. Emhart; MNHNP 4429, 1 alc., 67.6 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°12'17.5"S, 55°46'31.1"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4456, 3 alc., 72.2–87.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4484, 5 alc., 72.1–100.0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4609, 1 alc., 97.0 mm SL.

Identification: Distinguished by its robust head, low body, and color pattern. Coloration characterized by lateral stripes forming around five or more zigzag lines on body, a diffuse vertical humeral spot, a second spot forming a diffuse lateral band ending in a large and elongated caudal peduncle spot, upper transversal scales seven to eight, lower transversal scales four to five, lateral line scales 38–39, anal-fin rays iii+21–23 (Diagnostic characters based on Perugia, 1891).

***Bryconamericus* cf. *coeruleus* Jerep & Shibatta, 2017**

New Record, Figure 3a

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°14'22.6"S, 55°48'39.9"W; 19–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4304, 1 alc., 44.7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 19–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4326, 1 alc., 48.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4340, 1 alc., 48.8 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4348, 2 alc., 41.0–45.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4366, 7 alc., 48,8–58,0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'34.2"S, 55°45'43.7"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4393, 12 alc., 43,8–63,2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.5"S, 55°46'12.0"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4432, 2 alc., 33.8–62.9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°12'17.5"S, 55°46'31.1"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4460, 3 alc., 46.2–54.9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'34.2"S, 55°45'43.7"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4489, 1 alc., 54.3 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.4"S, 55°44'39.2"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4522, 1 alc., 50.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.5"S, 55°46'12.0"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4576, 1 alc., 38.9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'34.2"S, 55°45'43.7"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4591, 5 alc., 44.7–55.7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'17.5"S, 55°46'31.1"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4597, 2 alc., 58.8–60.4 mm SL.

Identification: Premaxillary teeth showing an unaligned outer row (Diagnostic characters based on Jerep and Shibatta, 2017). Other useful characters of the species here reported are body depth high (33.6–36.7 % SL), mouth subterminal, large anal-fin base (23.8–27.1 % SL), long upper jaw length (34.1–37.4 % HL), few lateral line scales (34–37), and few anal-fin rays (19–23). See Discussion for more details.

***Deuterodon luetkenii* (Boulenger, 1887)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'17.5"S, 55°46'31.1"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4370, 1 alc., 46,7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'34.2"S, 55°45'43.7"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4395, 5 alc., 26,0–41,0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.4"S, 55°44'39.2"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4556, 1 alc., 30.6 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'34.2"S, 55°45'43.7"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4594, 6 alc., 31.6–46.5 mm SL.

Identification: Conspicuous humeral spot, maxillary teeth two, lateral line incomplete, longitudinal scales on body 32–34, upper transversal scales five, lower transversal scales four, perforated lateral line scales 11–14, caudal fin not covered with scales, A iii+21–22 (Diagnostic characters based on Boulenger, 1887 and Britski et al., 2007).

***Moenkhausia australis* Eigenmann, 1908**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.5"S, 55°46'12.0"W; 19–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4318, 3 alc., 51.0–63.1 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.4"S, 55°44'39.2"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4327, 1 alc., 47.5 mm SL. Caazapá, San Juan Nepomuceno,

Arroyo Sará en Pomera S.A. 26°12'17.5"S, 55°46'31.1"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4334, 12 alc., 50.1–56.3mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'34.2"S, 55°45'43.7"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4354, 3 alc., 52.3–57.4 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'34.2"S, 55°45'43.7"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4388, 4 alc., 55.5–31.1 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°13'09.7"S, 55°44'16.5"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4427, 4 alc., 53.1–63.6 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.4"S, 55°44'39.2"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4448, 1 alc., 58.1 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4545, 1 alc., 147.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.4"S, 55°44'39.2"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4561, 4 alc., 59.7–71.3 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4573, 2 alc., 59.6–61.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4593, 1 alc., 58.8 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4598, 1 alc., 58.7 mm SL.

Identification: Lateral line scales complete, upper transversal scales five, lower transversal scales four, lateral line scales 25–28, circumpeduncular scales 12, and caudal peduncle depth with a large dark blotch (Diagnosis based on Reia et al., 2019).

***Odontostilbe pequira* (Steindachner, 1882)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Río Tebicuary en la Reserva Tapytá; 26°18'13.91"S, 55°45'27.97"W; 12–14 December 2017; H. Vera, B.L. Rojas, J. Emhart, J.J. Resquín; MNHNP 4640, 28 alc., 27.8–8.0 mm SL.

Identification: Body depth shallow, dorsal fin with a distinct distal black stain, upper transversal scales five, lower transversal scales four, lateral line scales 32–33, anal-fin rays iii+18–20, premaxillary teeth six to seven, maxillary teeth three (Diagnosis based on Steindachner, 1882).

***Oligosarcus oligolepis* (Steindachner, 1867)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4485, 1 alc., 146.7–182.0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 24–8 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4506, 1 alc., 98.7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4585, 1 alc., 153.9 mm SL.

Identification: Premaxillary and dentary teeth conical and tricuspidate, dentary with 14–15, lateral line 72–78, anal-fin rays iv+25–27 (Diagnosis based on Steindachner, 1867 and Menezes, 1987).

***Piabarchus stramineus* (Eigenmann, 1908)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.4"S, 55°44'39.2"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4303, 1 alc., 36.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4428, 1 alc., 43,8 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4433, 2 alc., 83.7–88.3 mm SL.

Identification: Dorsal-fin rays ii+7 (total nine rays), anal-fin rays i-iii+17–18 (total 19–21 rays), body depth 24.5–25.9 % SL, head length 21.4–23.1 % SL, eye diameter 35.0–35.3 % SL, upper transversal scales five, lower transversal scales three to four, lateral line scales 35–36, and maxillary teeth two to three (Diagnosis based on Eigenmann, 1908 and Britski et al., 2007).

***Psalidodon eigenmanniorum* (Cope, 1894)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 19–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4321, 2 alc., 53.0–71.0 mm. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4335, 6 alc., 53.11–76.30 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP4346, 4 alc., 39.85–64.59 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4365, 5 alc., 45,8–58,0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4390, 14 alc.,

40,0–85,2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4416, 4 alc., 65,7–80,5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°12'17.5"S, 55°46'31.1"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4457, 6 alc., 30.6–69.9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP4483, 18 alc., 28.2–81.7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4512, 4 alc., 44.2–69.4 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4580, 4 alc., 27.4–83.0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4595, 3 alc., 22.2–40.3 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4606, 2 alc., 48.6–64.2 mm SL.

Identification: Body short and deep, with a rhombic form; humeral spot vertically elongated, anal fin iii+20–25, upper transversal scales seven to eight, lower transversal scales five to six, lateral line scales 32–39 (Diagnostic characters based on Cope, 1894).

***Psalidodon rutilus* (Jenyns, 1842)**

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 19–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4320, 3 alc., 76.9–87.8 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.4"S, 55°44'39.2"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4312, 5 alc., 89.1–116.6 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4351, 2 alc., 64.7–82.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4383, 1 alc., 88,4 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4445, 1 alc., 39.0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°12'17.5"S, 55°46'31.1"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4474, 1 alc., 62.7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4488, 2 alc., 75.2–92.9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4500, 1 alc., 88.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S 55°46'12.0"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4515, 1 alc., 33.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4543, 3 alc., 81.75–114.8 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4578, 1 alc., 84.4 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4608, 4 alc., 76.7–113.2 mm SL.

Identification: Body elongated and shallow, anal-fin rays iii+24–28, upper transversal scales eight to nine, lower transversal scales five to six, lateral line scales 35–40 (Diagnostic characters based on Cope, 1894).

Crenuchidae

***Characidium* cf. *pterostictum* Gomes, 1947**

New Record, Figure 3b

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'50.13"S, 55°45'45.67"W; 13–14 December 2017; H. Vera, B.L. Rojas, J. Emhart, J.J. Resquín; MNHNP 4626, 1 alc., 32.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4367, 1 alc., 60.9mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A. 26°12'34.2"S, 55°45'43.7"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4405, 6 alc., 38.4–58.8 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.5"S, 55°46'12.0"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4443, 6 alc., 1 tej., 28.4–42.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4467, 4 alc., 1 tej., 35.6–56.3 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S 55°45'43.7"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4482, 6 alc., 29.7–56.1 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá;

26°16'40.5"S, 55°46'12.0"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4508, 2 alc., 21.0–41.4 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá 26°16'40.4"S, 55°44'39.2"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4529, 3 alc., 24.2–41.7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.4"S, 55°44'39.2"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4552, 3 alc., 30.2–36.6 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4562, 7 alc., 29.4–41.5 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4588, 4 alc., 32.5–45.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4600, 1 alc., 42.0 mm SL.

Identification: Lateral line complete, circumpeduncular scales 14, caudal fin with dark marks, upper transversal scales five, lower transversal scales four (Diagnosis based on Gomes, 1947 and Buckup and Reis, 1997). See discussion for more details.

***Characidium* cf. *zebra* Eigenmann, 1909**

New record, Figure 3c

Examined material: PARAGUAY: Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 20–22 March 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4347, 2 alc., 29.3–48.4 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°13'09.7"S, 55°44'16.5"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4423, 1 alc., 37.7 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 4–7 June 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4447, 3 alc., 26.7–35.0 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S, 55°46'31.1"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4466, 1 alc., 37.9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'34.2"S, 55°45'43.7"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4493, 1 alc., 34.9 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 24–28 September 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4509, 1 alc., 33.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.4"S, 55°44'39.2"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4555, 1 alc., 37.2 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Yuquerí en la Reserva Tapytá; 26°16'40.5"S, 55°46'12.0"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4577, 1 alc., 33.8 mm SL. Caazapá, San Juan Nepomuceno, Arroyo Sará en Pomera S.A.; 26°12'17.5"S 55°46'31.1"W; 26–30 November 2018; H. Vera, B.L. Rojas, J. Emhart; MNHNP 4603, 2 alc., 36.1–42.6 mm SL.

Identification: Lateral line complete, circumpeduncular scales 14, caudal fin hyaline without dark bars, upper transversal scales four, lower transversal scales five (Diagnosis based on Eigenmann, 1909 and Buckup and Reis, 1997). See discussion for more details.

DISCUSSION

A total of 20 Characiform species was found in the Tapyta Reserve. No previous work has reported an inventory or distribution of the fishes in this site, being the first list of fish species from this protected area.

In addition, the literature reviewing the surrounding area is also scarce in that region. The paper of Géry et al. (1987) is the single one dealing with a locality in the nearby region and tributaries of the Tebicuary-mi River, in a locality named Tavai, Caazapa, Paraguay. In this locality, they mentioned the presence of *Hoplias malabaricus* (Bloch, 1794), which is considered a valid species from Paraguay based in Koerber et al. (2017). The characters provided by Géry et al. (1987) are too generic to distinguish between the species split of the *malabaricus* group in La Plata Basin done recently by Azpelicueta et al. (2015) and Rosso et al. (2016). However, based in the photographs provided by these authors and the species we have found in our fish inventory we conclude that this mention should be referred to either *Hoplias mbigua* or *Hoplias misionera*, considering that both species are found in the Tapyta Reserve.

In this work we add three species to the Paraguayan ichthyofauna, they are new records to the inventory of fishes of the country and are based on the analysis of voucher specimens deposited in the Museo Nacional de Historia Natural del Paraguay (MNHNP). These specimens were properly compared with data obtained in the analysis of the literature of known species of the Neotropics that is commented below. The new species records are: *Bryconamericus coeruleus*, *Characidium pterostictum*, and *Characidium zebra* (Fig. 3).

Regarding Paraguayan congeners of these new records, the species *Bryconamericus exodon* Eigenmann, 1907; *Characidium etzeli* Zarske & Géry, 2001; and *Characidium laterale* (Boulenger 1895) were originally described with type localities in Paraguay and all of them are valid species (Fricke et al., 2020b). In addition, these taxa are the only known and confirmed congeneric species to Paraguay according to Koerber et al. (2017).

Bryconamericus coeruleus were originally described with a geographical distribution covering the Tibagi, Piquiri, and Ivai rivers (Upper Parana basin) in Parana, Brazil by Jerep and Shibatta (2017). Comparing this species with known congeners in Paraguay, it was mentioned in the original description of Eigenmann et al. (1907) that *Bryconamericus exodon* is characterized by its slender body (25–27 % SL), mouth terminal, lateral line scales 39–40, and anal-fin rays 23–25. In contrast to this species, our specimens determined as *Bryconamericus* cf. *coeruleus* presents a higher body depth (33.6–36.7 % SL), mouth subterminal, fewer lateral line scales (34–37), and lower anal-fin rays (19–23). Nevertheless, we can mention another species of this genus, *Bryconamericus iheringi* (Boulenger, 1887), that was previously mentioned from Paraguay by Eigenmann et al. (1907) but there cited as *Astyanax iheringi*. This species was not confirmed to Paraguay in Koerber et al. (2017). However, we make comparisons with the redescription of *Bryconamericus iheringi* done by Malabarba and Kindel (1995) and found the anal-fin base (20.1–24.4 % SL) and the upper jaw length (21.4–34.7 % HL) as contrasting characters. In addition, Langeani et al. (2005) discussed that *Bryconamericus iheringi* has an aligned outer premaxillary tooth series. In contrast to this species, our specimens here determined as *Bryconamericus* cf. *coeruleus* presents a larger anal-fin base (23.8–27.1 % SL), longer upper jaw length (34.1–37.4 % HL), and an unaligned outer row of premaxillary teeth.

Characidium pterostictum were originally described with type specimens from the Maquine River in Southern Brazil by Gomes (1947). This species was confirmed to the Tramandai, dos Patos, and Uruguay River basins in Brazil, but presumed to range from coastal rivers in the South of Uruguay to the Ribeira do Iguape River in the Southeast of Brazil (Buckup and Reis, 1997; Frota et al., 2019). *Characidium zebra* was originally described from the Ireng River (Amazonas basin) in Guyana by Eigenmann (1909). This species was confirmed tentatively to the Tramandai, dos Patos, and Uruguay River basins in Southern Brazil by Buckup and Reis (1997). The specimens from the Tapyta Reserve in Paraguay shares diagnostic characters of the above cited species (body scale counts and color pattern) as conceived by Buckup and Reis (1997) and were positively identified as *Characidium* cf. *pterostictum* and *Characidium* cf. *zebra*. In contrast to the known Paraguayan *Characidium* species, they presented a body with greater circumpeduncular scales (14 *vs*. 12 in *Characidium etzeli*) and a complete lateral line scales (*vs*. lateral line incomplete in *Characidium laterale*).

Updating these new records and adding other recent findings, we can update the fish species inventory of Paraguay. Despite of being known Paraguayan taxa, we comment that the following species were usually named differently or recently suffered new generic treatments: *Hoplias mbigua* according to Azpelicueta et al. (2015); *Hoplias misionera* according to Rosso et al. (2016); *Moenkhausia australis* according to Reia et al. (2019); and *Deuterodon luetkenii*, *Psalidodon eigenmanniorum*, and *Psalidodon rutilus* according to Terán et al. (2020). Even not being recorded in the Tapyta Reserve, we consider important to mention in this paragraph that Vanegas-Rios et al. (2019) attributed all previous known records of *Moenkhausia intermedia* Eigenmann, 1908 from La Plata basin to *Moenkhausia bonita* Benine, Castro & Sabino, 2004. This species was recently reported from Laguna Blanca (Paraguay basin in San Pedro, Paraguay) by Dickens (2019). Considering all these mentions, we can contribute with an actualization of the inventory of the ichthyofauna from Paraguay. The total species of fishes from Paraguay now summarize 311 species, from which the Characiformes contribute now with 127 species.

CONCLUSIONS

A total of 20 fish species of the Characiformes were recorded in the Tapyta Reserve and surroundings, Caazapá, Paraguay in South America, being Characidae the richest group with 12 species. Three species were reported as new records to the Paraguayan ichthyofauna: *Bryconamericus coeruleus*, *Characidium pterostictum*, and *Characidium zebra*. The fish species inventory from Paraguay was updated according to these findings, now summarize 311 species, from which the Characiformes contribute with 127 species. This is the first list of fish species from the Tapyta Reserve, and the first comprehensive revision of the fishes from the Tebicuary-mi River Basin in Paraguay, a poorly sampled tributary to the Tebicuary River in the Paraguay Ecoregion. This paper also contributes to the distribution pattern of the *Bryconamericus* and *Characidium* species in La Plata Basin.

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DISCLOSURE OF INTEREST

The authors declare that there is no conflict of interest.

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