

## *Crenicichla ypo* (Teleostei: Cichlidae), a new species from the middle Paraná basin in Misiones, Argentina

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A new species of *Crenicichla*, *C. ypo*, is described from the Arroyo Urugua-í, a left-hand tributary of the middle Paraná River, Misiones province, Argentina. The new species is recognized by 6 to 8 irregular blotches along the upper lateral line, absence of scattered dark spots on flanks, low number (47-55) of E1 scales, and a slightly prognathous lower jaw. Females have a distinctive coloration of the dorsal fin, with a wide black longitudinal stripe on the distal portion with an equally wide red stripe below it.

Una nueva especie de *Crenicichla*, *C. ypo*, es descrita de la cuenca del arroyo Urugua-í, tributaria de la margen izquierda del río Paraná medio, provincia de Misiones, Argentina. La nueva especie es reconocida por tener 6 a 8 manchas irregulares sobre la línea lateral superior, ausencia de pequeñas manchas oscuras dispersas sobre el flanco, bajo número (47-55) de escamas en la serie E1 y la quijada inferior levemente prognata. Las hembras tienen una coloración distintiva en la aleta dorsal con una banda ancha negra en la porción distal y otra roja del mismo ancho por debajo de esta.

**Key words:** Water dweller, Urugua-í basin, Taxonomy.

### Introduction

The genus *Crenicichla* Heckel includes at present about 80 valid species and is the most speciose genus within the family Cichlidae (Kullander, 2003, 2009; Casciotta *et al.*, 2006). Most *Crenicichla* species are found in tropical and subtropical cis-Andean drainages (Kullander & Lucena, 2006), although few of them, such as *Crenicichla lepidota* Heckel, *C. vittata* Heckel, and *C. scottii* (Eigenmann) also inhabit temperate waters in the La Plata River basin in Buenos Aires province and northern Patagonia in Argentina (Casciotta, 1987).

The Paraná River basin with 3,100,000 km<sup>2</sup> is the second largest basin of South America, and fourteen species of *Crenicichla* are known from that basin (Kullander, 2003, 2009; Casciotta *et al.*, 2006; Casciotta & Almirón, 2008). Some of them, such as *C. haroldoi* Luengo & Britski, *C. jaguarensis* Haseman, and *C. britskii* Kullander are restricted to the upper Paraná basin. *Crenicichla jupiaensis* Britski & Luengo and *C. niederleini* (Holmberg) also occur in the middle Paraná basin (Kullander, 2003; Casciotta *et al.*, 2007), and *C. mandelburgeri* Kullander is endemic to the middle Paraná basin (Kullander, 1981, 2009; pers. obs.). *Crenicichla iguassuensis* Haseman and *C. tesay* Casciotta & Almirón are restricted to the Iguazú River

above the Cataratas del Iguazú (Casciotta & Almirón, 2008). *Crenicichla yaha* Casciotta, Almirón & Gómez has an interesting distribution occurring both in the Iguazú above the Cataratas del Iguazú and in the adjacent arroyo Urugua-í (middle Paraná basin). *Crenicichla semifasciata* (Heckel), *C. lepidota*, *C. scottii*, and *C. vittata* are found both in the lower and middle Paraná basin (*C. scottii* in lower only), and the last three species also are present in the Uruguay River (Casciotta, 1987; Lucena & Kullander, 1992).

The aim of this paper is to describe a new species of *Crenicichla* restricted to the arroyo Urugua-í, middle Paraná basin, Argentina.

### Material and Methods

We use the following nomenclature in naming of drainages. River is used to designate large international drainages (*e.g.* Uruguay River), while arroyo (“stream” in Spanish) is used for smaller, exclusively Argentinean drainages (*e.g.* arroyo Urugua-í). This nomenclature bypasses the confusion between similar names of distinct drainages (*e.g.* Portuguese spelling of Uruguai for the Uruguay River *vs.* arroyo Urugua-í).

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Division of the Paraná River into sections differs substantially between various authors (*e.g.* Carolsfield *et al.*, 2004; Iriondo *et al.*, 2007). In this text we refer to the middle Paraná River as to the section from its confluence with the Paraguay River upstream to the Saltos del Guairá. Today this natural upper barrier of the middle Paraná is replaced by the Itaipu hydroelectrical dam.

Specimens were cleared and counterstained (c&s) following the method of Taylor & van Dyke (1985). Measurements and counts were taken as described by Kullander (1986). Pharyngeal teeth description and counts of frashed zone concavities follow Casciotta & Arratia (1993). Holotype values are indicated by an asterisk. Body length is expressed as standard length (SL). E1 scale counts refer to the scales in the row immediately above that containing the lower lateral line (Lucena & Kullander, 1992).

Institutional abbreviations are as listed in Ferraris (2007), except for AI (Asociación Ictiológica, La Plata, Argentina).

### *Crenicichla ypo*, new species

#### Figs. 1-4

**Holotype.** MACN-ict 9431, 105.5 mm SL, Argentina, Misiones, Paraná basin, arroyo Urugua-í, at Establecimiento "Alto Paraná", approx. 25°57.9'S 54°06.5'W, Feb 1986, Gómez *et al.*

**Paratypes.** All from Argentina, Misiones, Paraná River basin. AI 212, 4, 102.0-130.0 mm SL, arroyo Falso Urugua-í, 25°58'26.2"S 54°15'28.5"W, Nov 2007, Casciotta *et al.* AI 263, 1 c&s, 95.3 mm SL, arroyo Urugua-í basin, arroyo Grapia, 6 km north from Colonia Gobernador J. J. Lanusse, approx. 25°52.2'S 54°10.4'W, Nov 1986, Gómez *et al.* MACN-ict 9432, 3, 101.0-116.0 mm SL, arroyo Urugua-í basin, arroyo Grapia, 6 km north from Colonia Gobernador J. J. Lanusse, approx. 25°52.2'S 54°10.4'W, Nov 1986, Gómez *et al.* MACN-ict 9433, 1, 133.0 mm SL, arroyo Uruzú at route 19, Parque Provincial Islas Malvinas, approx. 25°56.3'S 54°13.0'W, Sep 1986, Gómez *et al.* MACN-ict 9434, 1, 111.0 mm SL, arroyo Urugua-í and route 19, Parque Provincial Islas Malvinas, approx. 25°56.3'S 54°13.0'W, Feb 1986, Gómez *et al.* MACN-ict 9435, 1, 137.0 mm SL, arroyo Urugua-í and route 19, Parque Provincial Islas Malvinas, approx. 25°56.3'S 54°13.0'W, Sep 1986, Gómez *et al.* MACN-ict 9436, 1, 123.0 mm SL, arroyo Urugua-í in Isla Palacio, approx. 25°52.8'S 54°24.0'W, Feb 1986, Gómez *et al.* MACN-ict 9437, 1, 123.0 mm SL, same data as holotype. MACN-ict 9438, 3, 89.8-109.0 mm SL, arroyo Falso Urugua-í, 25°58'26.2"S 54°15'28.5"W, Nov 2007, Casciotta *et al.*

**Diagnosis.** The new species is recognized in the Paraná River basin by the following combination of characters: 6 to 8 irregular blotches along the upper lateral line, absence of scattered dark spots on flanks, low number (47-55) of E1 scales, and a slightly prognathous lower jaw. Females have a distinctive coloration of the dorsal fin, with a wide black longitudinal stripe on the distal portion with an equally wide red stripe below it.

*Crenicichla ypo* lacks the humeral spot present in *C. britskii* and *C. lepidota*. Lateral line scales in *C. ypo* are without brown dots such as are present on each scale in *C. haroldoi*. Numerous scattered dark spots on flanks are absent in *C. ypo* that distinguishes this species from *C. iguassuensis* and *C. tesay*.

*Crenicichla ypo* has a distinct caudal spot, inconspicuous or absent in *C. jaguarensis*. *Crenicichla ypo* lacks the lateral stripe displayed in *C. jaguarensis*, *C. mandelburgeri*, and *C. vittata*.

*Crenicichla ypo* differs from *C. jupiaensis* in having lower jaw slightly prognathous, having a well-developed suborbital stripe composed of spots, and the cheek bearing up to 8 scale rows *vs.* isognathous jaws, a suborbital stripe reduced to a few spots posterior to the orbit, and a naked cheek.

*Crenicichla ypo* does not bear well developed vertical bars which are reduced to irregular blotches. This distinguishes this species from those with complete vertical bars: *C. jupiaensis*, juveniles of *C. mandelburgeri*, and *C. niederleinii*.

*Crenicichla ypo* differs from *C. niederleinii* and *C. vittata* in having a low number of E1 scales (47-55 *vs.* 56-65 and 78-85, respectively).

Parallel and thin longitudinal stripes are absent in *C. ypo* *vs.* present in *C. scottii*.

*Crenicichla ypo* is easily distinguished from *C. semifasciata* in having the ascending arm of the premaxilla longer than the dentigerous one, the blotches on flanks including the upper lateral line and extending 3 to 4 scale rows above and below it, and having about half of the caudal fin scaled *vs.* ascending arm of the premaxilla shorter than the dentigerous one, the flanks bearing quadrangular blotches placed below the upper lateral line or lateral band, and caudal fin scaled in most of its surface.

The new species differs from *C. yaha* in having the lower jaw slightly prognathous and head depth 14.5-17.6% of SL *vs.* isognathous or upper jaw slightly prognathous and head depth 17.9-20.8% of SL. Females of *C. ypo* are distinguished from females of *C. yaha* by having dorsal fin with a wide black stripe above a red stripe *vs.* dorsal fin with a wide black irregular stripe.

**Description.** Body elongate, depth 4.2 to 4.8 times in SL. Head as deep as wide or slightly deeper. Snout short, bluntly pointed in lateral view, 2.5 to 3.0 times in head length. Lower jaw slightly prognathous. Tip of maxilla reaching anterior margin of orbit in most specimens. Lower lip widely interrupted medially. Nostrils dorsolateral, close to anterior margin of orbit (12; MACN- ict 9431, 9432, 9434, 9435, 9437, 9438, AI 212, AI 263) or close to snout tip (5; MACN-ict 9432, 9433, 9436, AI 212). Posterior margin of preopercle serrated (12; MACN-ict 9431, 9432, 9433, 9434, 9435, 9437, 9438, AI 212, 263), or smooth on one or both sides (6; MACN-ict 9432 right side, MACN-ict 9436 both sides, MACN-ict 9438 left side, AI 212 right side); variation of the last two characters does not display any biogeographical pattern. Scales on flank strongly ctenoid. Head scales cycloid. Predorsal scales small, superficially embedded in skin. Prepelvic scales smaller than predorsal ones. Interopercle naked. Cheek scaled, 5 to 8 scales below eye embedded in skin. Scales in E1 row 47(2\*), 48(1), 51(3), 53(5), 54(3), 55(3). Scales in transverse row 9/15(1), 10/14(1), 10/15(3), 10/16(3), 11/14(1), 11/15(6\*), 11/16(2). Three scale rows between lateral lines. Upper lateral line scales 20(1), 21(2), 22(1), 23(4\*), 24(1), 25(7), 27(1). Lower lateral line scales 1(1), 5(1), 9(1), 10(2), 11(6), 12(4\*), 13(1), 14(1). Dorsal, anal, pectoral and pelvic fins naked. Dorsal fin XX, 10(1), XXI, 10(2), XXI, 11(3),

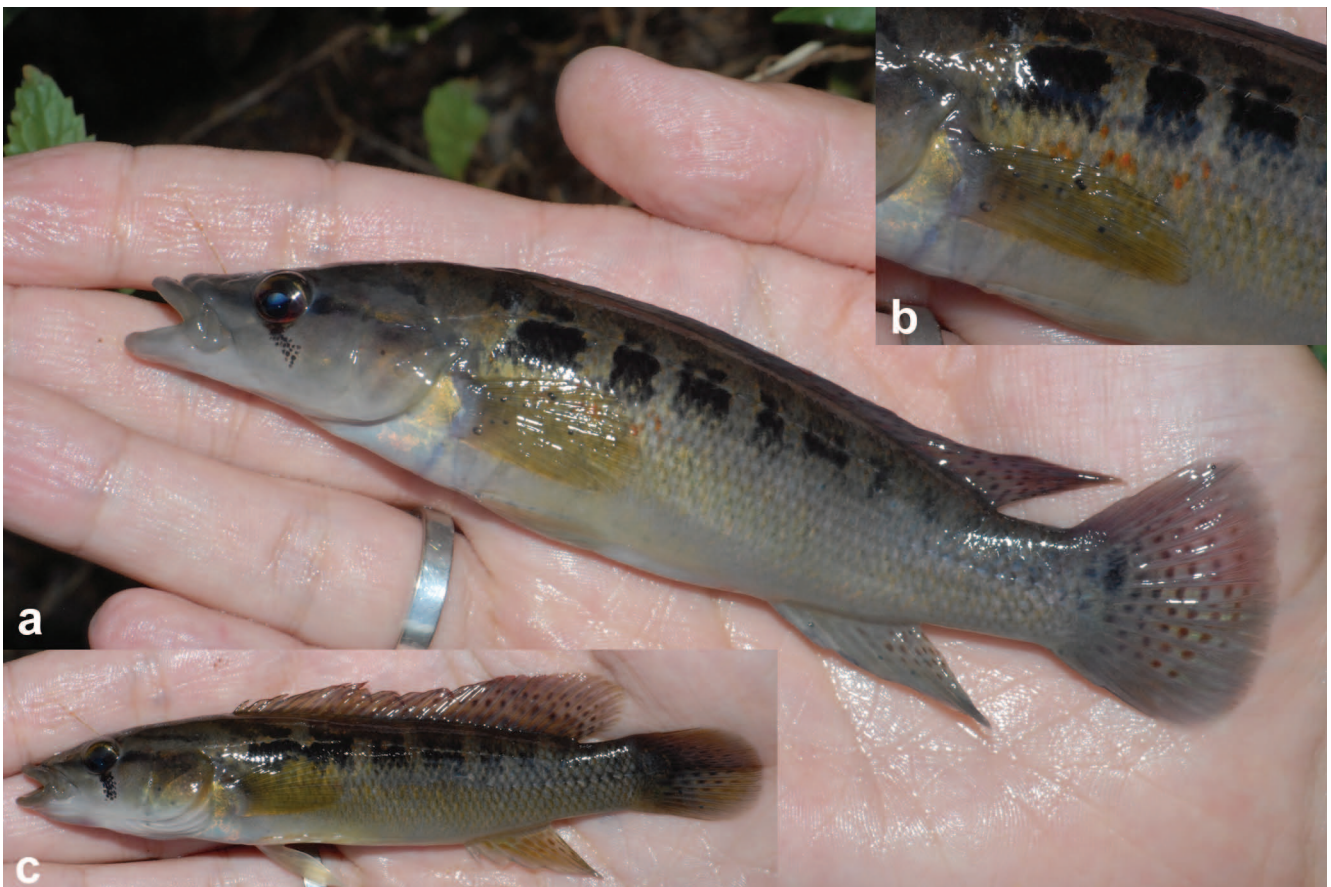


**Fig. 1.** *Crenicichla ypo*, holotype, MACN-ict 9431, 105.5 mm SL. Argentina, Misiones, arroyo Uruguay-í.

XXI,12(1), XXII,10(3), XXII,11(5\*), XXII,12(1). Anal fin III,7(1), III,8(13\*), III,9(3). Pectoral fin 15(1), 16(16\*). Caudal-fin squamation not reaching the middle of fin. Soft-dorsal fin rounded or pointed, extending beyond caudal-fin base. Tip of anal fin usually not reaching caudal-fin base (reaching in 4; MACN-ict 9431, 9432, 9433, AI 212). Caudal fin rounded. Pectoral fin rounded, reaching the tip of pelvic fin. Microbranchiospines present on second through fourth gill arches. Gill rakers externally on first gill arch: 3 on epibranchial, 1 on angle, and 8 on ceratobranchial. Two to five patches of unicuspid teeth on fourth ceratobranchial. Lower pharyngeal tooth plate with unicuspid recurved and curved crenulated bicuspid teeth, those of posterior and medial row larger than remaining ones (Fig. 4). Upper pharyngeal tooth plate

with unicuspid and bicuspid teeth. Frashed zone bearing one concavity with small unicuspid teeth. Premaxillary ascending process longer than dentigerous process. Premaxilla with 20(1) unicuspid teeth on outer row, larger than inner ones. Five tooth rows near symphysis. Dentary with 25(1) unicuspid teeth on outer row, four rows near symphysis. Total vertebrae: 37 (1 c&s). Premaxillary and dentary outer row teeth slightly movable, inner ones fully depressible.

**Colour upon capture.** Background colour of body grey. Deep grey preorbital stripe between anterior margin of orbit and snout tip, visible only in small specimens. Postorbital stripe between posterior margin of orbit and preopercle or opercle



**Fig. 2.** *Crenicichla ypo*, AI 212, live male paratypes: **a)** 113.1 mm SL; **b)** detail of the orange dots on flank; and **c)** 102.7 mm SL, showing a spotted dorsal fin.



**Fig. 3.** *Crenicichla ypo*, MACN-ict 9438, 104.0 mm SL, female, paratype: **a)** a freshly collected specimen damaged from gillnets; **b)** detail of the dorsal fin showing the diagnostic black-red stripe pattern of females.

distal margin deep grey. Suborbital stripe black almost reaching ventral margin of cheek; wide and fragmented (up to eight dots wide). Flanks with 6 to 8 irregular black blotches below (up to four scales) and above (up to three scales) upper lateral line, marginally reaching dorsal-fin base. Posteriormost blotch not extending onto caudal peduncle. Dorsal, anal, and caudal fins pale grey, males with numerous dark scattered dots on dorsal, anal, and caudal fins, (Fig. 2) which are absent or rarely seen in females. Caudal fin with a black subcircular spot, in some specimens bearing an irregular white ring, just above of midline of caudal fin. Pectoral and pelvic fins pale grey. Some male specimens with several irregular orange dots on flank at level and behind pectoral fin (Fig. 2b).

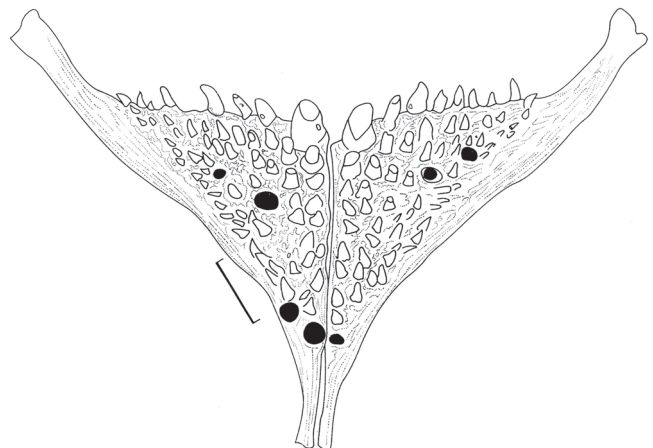
Females with head, upper half of flank, and caudal fin deep grey. Yellow and orange pigment on flank at level and behind pectoral fin. Dorsal and anal fins of females lacking small dark dots, few of them present on caudal fin. Females with a distinctive coloration of the dorsal fin, with a wide black longitudinal stripe on the distal region of dorsal fin and an equally wide red stripe below it (Fig. 3).

**Colour in alcohol.** Similar to that of live specimens with a tendency to become pale. Conserved specimens lack the carotenoid pigments, such as orange dots on flank of males, yellow or orange area on flank of females, and wide red stripe in dorsal fin of females.

**Distribution.** *Crenicichla ypo* is found in the arroyo Urugua-í basin, middle Paraná River basin, Misiones province, Argentina (Figs. 5-6).

**Etymology.** The specific epithet *ypo*, is a Mbya Guaraní word *y po* that means water dweller.

**Habitat.** *Crenicichla ypo* was collected both before and after the Urugua-í hydroelectrical dam was built in 1989 (see material);



**Fig. 4.** *Crenicichla ypo*, AI 263, 95.3 mm SL, lower pharyngeal tooth plate in occlusal view. Scale bar = 1 mm.

**Table 1.** Proportional measurements in percents of standard length of holotype and 16 paratypes of *Crenicichla ypo*. SD = Standard deviation.

	Holotype	Range	Mean	SD
Standard length (mm)	105.5	89.8-137.0	-	-
Head length	34.6	32.0-34.6	33.2	0.76
Snout length	11.5	10.8-12.8	11.8	0.64
Head depth	15.6	14.5-17.6	16.0	0.97
Body depth	21.1	20.5-23.9	22.3	1.05
Orbital diameter	6.6	5.7-7.1	6.4	0.37
Interorbital width	6.8	6.2-7.9	7.1	0.50
Pectoral-fin length	19.7	18.7-22.0	20.1	0.84
Caudal-peduncle depth	12.3	10.9-12.9	12.1	0.60
Caudal-peduncle length	15.4	14.3-16.7	15.5	0.55

the species presently occurs also directly in the reservoir (pers. obs.). The arroyo Urugua-í is a moderately fast flowing river with tributaries of an average depth of 1 m outside of the dam influence. Macrophytes such as *Echinodorus uruguayensis* Arechavaleta and *Potamogeton pseudopolygonus* Hagström are present. The bottom consists of mud, sand with gravel and/or bedrock. After dam construction some parts of impoundment lake are up to 6 m deep and some previous localities like Isla Palacio are below the water surface. *Crenicichla ypo* is sympatric with *C. yaha* and one additional undetermined *Crenicichla* species (pers. obs.).

### Discussion

The new species, *Crenicichla ypo*, is in its morphology more similar to other species of *Crenicichla* from the Paraná River basin, than to species from the Uruguay River (*C. celidochilus*, *C. empheres*, *C. gaucho*, *C. hadrostigma*, *C. igara*, *C. jurubi*, *C. minuano*, *C. missioneira*, *C. prenda*, *C. scottii*, *C. tendybaguassu*). These Uruguayan species are traditionally included in the *C. missioneira* and *C. scottii* species groups (Lucena & Kullander, 1992; extended by Kullander *et al.*, 2010), and differ from the herein discussed taxa in a combination of color-pattern and meristic characters (Lucena & Kullander, 1992). The relationships of the new species with the Paraná River *Crenicichla* is also confirmed



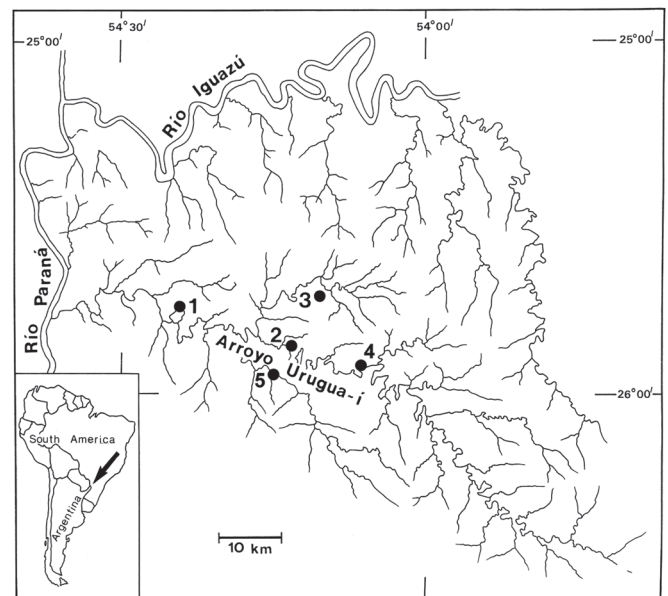
**Fig. 5.** Arroyo Falso Urugua-í, one of the paratype localities of *Crenicichla ypo*.

with analysis of molecular data (mitochondrial genes ND2 and cytochrome b) which included all at-present-known species from the Misiones province (Piálek *et al.*, in prep.). Therefore a detailed morphological comparative analysis was directed towards the *Crenicichla* species from the Paraná River basin.

*Crenicichla ypo* inhabits the arroyo Urugua-í basin, a left-hand tributary of the middle Paraná River that drains roughly 3,000 km<sup>2</sup> of the northern part of Misiones. This river as well as most of the other tributaries of Paraná, Uruguay, and Iguazú basin in the central and northern portions of the province are divided from their main streams by a significant number of waterfalls, highest of which are invariably found closest to their mouths (pers. obs.). The isolation by high-level riverbed drops lasted apparently long enough so that many endemic taxa have evolved within these streams.

High level of endemism of the Misioneran ichthyological ecoregion (López *et al.*, 2002; López *et al.*, 2005) has been recently accentuated by a description of a number of endemic fish species, especially from the central and northern parts of the province, where endemism seems to be the highest (e.g. *Australoheros kaaygua* Casciotta *et al.*, Iguazú; *Cnesterodon pirai* Aguilera *et al.*, Cuñá-Pirú; *Crenicichla tesay*, Iguazú basin; *Crenicichla yaha*, arroyo Urugua-í and Iguazú; *Hisonotus hungy* Azpelicueta *et al.*, Tirica, Paraná; *Rhamdella cainguae* Bockmann & Miquelarena, Cuñá-Pirú).

*Crenicichla ypo* is yet another faunal element of the unique hydrography of Misiones, an hyperdiverse area lying at the intersection of three major drainages (Paraná, Uruguay, and Iguazú).



**Fig. 6.** Distribution of *Crenicichla ypo* in the Province of Misiones, Argentina. 1- Isla Palacio, 2- Parque provincial Isla Malvinas, 3- Arroyo Grapia and Arroyo Uruzú, 4- Establecimiento "Alto Paraná" (type-locality), and 5- Arroyo Falso Urugua-í.

**Comparative material.** A list of comparative material of *C. scottii* and *C. vittata* is available in Casciotta (1987). In addition, the following material was studied: *Crenicichla hadrostigma*, AI 220, 1, 72.8 mm SL, Argentina, Misiones, Uruguay River basin, Itacaruaré. *Crenicichla iguassuensis*, FMNH 54159, holotype, 137 mm SL, Brazil, rio Iguaçú, Porto União da Victoria. *Crenicichla jupiaensis*: Argentina, Corrientes, Paraná River at Yahapé: AI 226, 2, 87.7-93.0 mm SL; AI 227, 1, 60.7 mm SL. *Crenicichla lepidota*: Argentina: Buenos Aires, Isla Martín García: MACN-ict 2314, 6, 59.9-104.2 mm SL. Chaco, Esteros del Palmar: MACN-ict 7275, 1, 151.6 mm SL. Corrientes, Isla Apipé Grande, Ituzaingó: FML 312, 1, 138.0 mm SL. Entre Ríos, Uruguay River, Concepción del Uruguay: MACN-ict 4091, 1, 98.4 mm SL. Formosa, Riacho de Oro: MACN-ict 3656, 2, 116.0-165.7 mm SL. Misiones, Represa Estación Experimental Cerro Azul: MACN-ict 5067, 4, 67.7-113.4 mm SL. Salta, Luna Muerta, Hickman: FML 528, 1, 111.5 mm SL. Uruguay: Departamento Colonia, arroyo Limetas: MNHN 2087, 1, 72.9 mm SL. *Crenicichla cf. mandelburgeri*: Argentina: Misiones, Paraná River basin, arroyo Chapa at route 6: MACN-ict 9442, 2, 102.2-208 mm SL. Misiones, Paraná River basin, arroyo Cuñapirú, at route 223 near Ruiz de Montoya: MACN-ict 9440, 2, 72.6-82.3 mm SL. Misiones, Paraná River basin, arroyo Cuñapirú (arroyo Tucangua): MACN-ict 9441, 7, 56.0-93.0 mm SL. Misiones, Paraná River basin, arroyo Guaruhape at route 220: MACN-ict 9439, 2, 83.7-93.0 mm SL. *Crenicichla ocellata*, MSNG 33700, holotype, 257.5 mm SL, Paraguay, Puerto 14 de Mayo, Bahía Negra, Chaco Boreal. *Crenicichla semifasciata*: Argentina: Entre Ríos, arroyo Curupí: MACN-ict 6239, 1, 176.6 mm SL. Formosa, Riacho de Oro: MACN-ict 3683, 1, 68.8 mm SL. *Crenicichla tesay*, MACN-ict 9016, holotype, 115.1 mm SL, Argentina, Misiones, Iguazú River basin, arroyo Verde. *Crenicichla yaha*: Argentina: Misiones, Iguazú River basin, arroyo Benavente: AI 199, 1, 116.6 mm SL. Misiones, Paraná River basin, arroyo Urugua-í at Isla Palacio: MACN-ict 8924, holotype, 103.7 mm SL. Misiones, Paraná River basin, arroyo Urugua-í at provincial route 19, Parque Provincial Islas Malvinas: MTD-F 30606, paratype, 105.9 mm SL. Misiones, Paraná River basin, arroyo Urugua-í at provincial route 19, arroyo Uruzú, Parque Provincial Islas Malvinas: AI 200, paratype, 135.8 mm SL. Misiones, Paraná River basin, arroyo Urugua-í at Isla Palacio: AI 202, paratypes, 4 (1 c&s), 37.4-48.5 mm SL.

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### Literature Cited

Carolsfield, J., B. Harvey, C. Ross & A. Baer (Eds.). 2004. Migratory fishes of South America: Biology, Fisheries, and Conservation Status. World Fisheries Trust, IDRC/The World Bank, 380p.

- Casciotta, J. R. 1987. *Crenicichla celidochilus* n. sp. from Uruguay and a multivariate analysis of the *lacustris* group (Perciformes, Cichlidae). *Copeia*, 1987: 883-891.
- Casciotta, J. & A. Almirón. 2008. *Crenicichla tesay*, a new species of cichlid (Perciformes: Labroidei) from the río Iguazú basin in Argentina. *Revue suisse de Zoologie*, 115: 651-659.
- Casciotta, J., A. Almirón, J. Bechara, F. Ruiz Diaz, S. Sanchez & A. González. 2007. First record of *Crenicichla jupiaensis* Britski & Luengo, 1968 (Perciformes: Cichlidae) in freshwaters of Argentina. *Ichthyological Contributions of Peces Criollos*, 4: 1-4.
- Casciotta, J. R., A. E. Almirón & S. E. Gómez. 2006. *Crenicichla yaha* sp. n. (Perciformes: Labroidei: Cichlidae), a new species from the río Iguazú and arroyo Urugua-í basins, northeastern Argentina. *Zoologische Abhandlungen, Staatliche Naturhistorische Sammlungen Dresden, Museum für Tierkunde*, 56: 107-112.
- Casciotta, J. R. & G. Arratia. 1993. Jaws and teeth of American Cichlids (Pisces: Labroidei). *Journal of Morphology*, 217: 1-36.
- Ferraris, C. J., Jr. 2007. Checklist of catfishes, recent and fossil (Osteichthyes: Siluriformes), and catalogue of siluriform primary types. *Zootaxa*, 1418: 1-300.
- Iriondo, M. H., J. C. Paggi & M. J. Parma (Eds.). 2007. The Middle Paraná River: Limnology of a Subtropical Wetland. Springer, Heidelberg, 327p.
- Kullander, S. O. 1981. Cichlid fishes from the La Plata basin. part I. Collections from Paraguay in the Muséum d'Histoire naturelle de Genève. *Revue suisse de Zoologie*, 88: 675-692.
- Kullander, S. O. 1986. Cichlid fishes of the Amazon River drainage of Peru. Stockholm, Swedish Museum of Natural History, 431p.
- Kullander, S. O. 2003. Family Cichlidae. Pp. 605-654. In: Reis, R. E., S. O. Kullander & C. J. Ferraris Jr. (Eds.). Check list of the freshwater fishes of South and Central America. Porto Alegre, Edipucrs, 729p.
- Kullander, S. O. 2009. *Crenicichla mandelburgeri*, a new species of cichlid fish (Teleostei: Cichlidae) from the Paraná river drainage in Paraguay. *Zootaxa*, 2006: 41-50.
- Kullander, S. O. & C. A. S. Lucena. 2006. A review of the species of *Crenicichla* (Teleostei: Cichlidae) from the Atlantic coastal rivers of southeastern Brasil from Bahia to Rio Grande do Sul State, with description of three new species. *Neotropical Ichthyology*, 4: 127-146.
- Kullander, S. O., M. Norén, G. B. Friðriksson & C. A. S. Lucena. 2010. Phylogenetic relationships of species of *Crenicichla* (Teleostei: Cichlidae) from southern South America based on the mitochondrial cytochrome b gene. *Journal of Zoological Systematics & Evolutionary Research*, 48: 248-258.
- López, H. L., A. M. Miquelarena & J. Ponte Gómez. 2005. Biodiversidad y distribución de la ictiofauna mesopotámica. Pp. 311-354. In: Aceñolaza, F. G. (Ed.). Temas de la biodiversidad del litoral fluvial argentino II. INSUGEO, Miscelánea, Tucumán.
- López, H. L., C. C. Morgan & M. J. Montenegro. 2002. Ichthyological ecoregions of Argentina. *Probiota: Serie Documentos N° 1*, La Plata, Buenos Aires, Argentina.
- Lucena, C. A. S. & S. O. Kullander. 1992. The *Crenicichla* (Teleostei: Cichlidae) species of the Uruguai River drainage in Brazil. *Ichthyological Exploration of Freshwaters*, 3: 97-160.
- Taylor, W. R. & G. C. van Dyke. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium*, 9(2): 107-119.

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