A new species of *Hypobrycon* (Characiformes: Characidae) from Uruguay basin in Misiones, Argentina

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Una nueva especie de *Hypobrycon* (Characiformes: Characidae) de la cuenca del río Uruguay, en Misiones, Argentina. El género *Hypobrycon* se registra por primera vez en Argentina. *Hypobrycon poi*, colectado en la cuenca del río Uruguay, se distingue de *H. leptorhynchus* por tener mayor número de escamas perforadas en la línea lateral y de dientes en el dentario, maxila mas corta y cuerpo mas bajo. *Hypobrycon poi* se diferencia de *H. maromba* por la posición de la boca, maxila mas corta, cabeza y diámetro orbitario mas largos y mancha humeral elongada dorso-ventralmente, en lugar de subcircular. Además, los machos de *H. poi* tienen pequeños tubérculos redondeados en los radios de las aletas anal, caudal, dorsal, pectoral y pélvica, ausentes en *H. maromba* y *H. leptorhynchus*.

Palabras claves: Characiformes, Characidae, *Hypobrycon*, Argentina, río Uruguay.

The genus *Hypobrycon* is recorded for the first time in Argentina. *Hypobrycon poi*, collected from the río Uruguay basin, is distinguished from *H. leptorhynchus* in having higher number of perforated lateral line scales, shorter maxilla, lower body, and higher number of dentary teeth. *Hypobrycon poi* differs from *H. maromba* in the position of the mouth, shorter maxilla, longer head, larger eye diameter and humeral spot dorso-ventrally elongated vs. humeral spot rounded. Besides, males of *H. poi* have small rounded tubercles on anal, caudal, dorsal, pectoral, and pelvic fin rays, absent in *H. maromba* and *H. leptorhynchus*.

Key words: Characiformes, Characidae, *Hypobrycon*, Argentina, río Uruguay.

Introduction

In recent years, collecting efforts in different parts of South America have resulted in an important number of papers dealing with descriptions of new fish species (Vari and Malabarba, 1998). In Argentina, the Northeastern territory is inhabited by the most diverse and rich fish fauna (Azpelicueta, 1995; Almirón and Casciotta, 1999; Casciotta *et al.*, 2000; Azpelicueta and García, 2000). Recent field trips to headwaters of rivers and streams of Uruguay and Paraná basins provided specimens of several new species. Some of them were identified as pertaining to the genus *Hypobrycon* Malabarba and Malabarba (1994).

Until now, the genus *Hypobrycon* included two species, *H. maromba* and *H. leptorhynchus*, described from the río Uruguay basin. Both species are small sized characids with ventral mouth and dentary teeth anteriorly directed, with their main axis slightly angled with main dentary axis (Silva and Malabarba, 1996). The purpose of this paper is to describe a new species of *Hypobrycon* from streams the río Uruguay, in Argentina.

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Geography and geology of the area

The arroyos Once Vueltas and Acaraguá are located in southeastern part of the Misiones province of Argentina. This province, which constitutes the northern part of the Argentinean Mesopotamia, is bordered to the west and east by the large ríos Paraná and Uruguay and to the north by the ríos Iguazú and San Antonio. The territory is divided by several aligned sierras (Victoria, Imán or Itacuará, and Misiones) which are lower than 800 m above sea level. The range is actually a high basalt continuation of the Paraná Plateau of Brazil, forming the Misiones Plateau. The Paraná Plateau is included in one of the three morpho-structural units of South America: the upland/highland crystaline massifs. Rivers and streams flow down from the sierras through a subtropical evergreen rain forest quite degradated and over hard rock, sometimes jumping in the way of cascades or little water falls (Castellanos, 1975). The fluvial network of this province is quite dense and highly controlled by structural lineaments and is typically polygenetic (Popolizio, 1973). In fact, it is a network that has been overimposing to the structure while the area was elevated epigenetically, along with the Brazilian shield and in different and alternate climatic conditions. Therefore the river basins present paleotorrent models, carved throughout successive cycles (Popolizio, 1973).

The arroyos Once Vueltas and Acaraguá are tributaries of the río Uruguay in the southern part of the Misiones Plateau. The arroyo Once Vueltas flows down southeast from the Sierra de Imán and the arroyo Acaraguá from the Sierra de Misiones. The río Uruguay basin encompasses 385,000 km^2 of the present territories of Brazil, Argentina, and Uruguay and exists at least from the Pliocene. The eastern part of the basin was greatly influenced by the elevation of the sierras near the sea.

Unfortunately, there are not many geologic studies in Misiones. The oldest rocks cropping out in Misiones correspond to the Early Cretaceous sandstones of the Curuzú Cuatiá Formation (also named Solari Formation; less than 100 m thick; Gentili and Rimoldi, 1979; Chebli *et al.*, 1989). A thick layer of basalts (over 1,100 m in Misiones; Serra Geral Formation; Gentili and Rimoldi, 1979) interdigitates with these sedimentary rocks. The lavas of the Serra Geral Formation constitute the thickest and most extended volcanic plateau in the world (10^6 km^2) encompassing part of the present territories of Uruguay, Brazil, Paraguay and Argentina (Fernández Garrasino, 1989). Eleven lava flows had been reported, each of them ranging in thickness from 3 to 80 m. They formed about 130 Ma ago, during the Early Cretaceous.

Over the Cretaceous rocks, several Pleistocene and Holocene units were recognized: El Palmar Formation, Oberá Formation, unnamed units and the San Guillermo eolian sands (Iriondo, 1996).

Soils in the region correspond to the lateritic type. Considered to be unique of tropical regions, these are residual deposits consisting essentially of hydrated iron oxides, hydrated aluminium oxide and bauxite (Gentili and Rimoldi, 1979; Fernández Garrasino, 1989).

Climatic evolution of the area

The present climate of Misiones is subtropical, with high pressure and without marked dry periods (Chiozza, 1981). Rainfalls are abundant all along the year with an annual mean ranging from 2,121 mm in the northeast to 1,623 mm in the southwest. Mean annual temperature is always over 20 °C. Lower altitudes present a higher mean annual temperature than highlands (above 300 m).

It is quite clear that the great swings of global temperature between glacial/interglacial and stadial/interstadial intervals modified the surface of the Earth (Clapperton, 1993). There, temperature changes provoked strong variations in sea level and humidity what profoundly affected continental basins.

During the Pleistocene glacial maxima, most of South America suffered arid climate, being precipitation greatly reduced (see Clapperton, 1993; Latrubesse and Rancy, 1988; Maslin, 2000; Sayago *et al.*, 2001; Siffedine *et al.*, 2001). The rainy tropical climates, actually so characteristic, had to give place to subtropical climates of dramatical contrasts, with predominancy of a long dry season which definitively put off the water balance, particularly along the subequatorial belt (Ochsenius, 1997). Mean annual temperatures in tropical alluvial plains were 4.5 to 6 °C lower than today (Ochsenius, 1997). At least 25 % of the land area could be classified as a desert compared to ca. 5 % at present (Clapperton, 1993). This dramatic change was caused by a combination of factors, including shifts in the major pressure belts

controlling air mass movements over South America, in the sea surface temperatures which determine the humidity of air masses and in the nature of the vegetation cover and hydrology of the Amazon basin, which also affect moisture inputs to the atmosphere (Clapperton, 1993). Apparently, the closed xerophytic forest and grassland vegetation -Campo Cerrado- changed to dry open scrub -Caatinga- (Clapperton, 1993). The Chacopampean area presented dry and cooler-than today- climate during Glacial times (Iriondo and García, 1993; Iriondo, 1999; Tonni *et al.*, 1999), when extensive loessic sedimentation occurred. According to Iriondo (1996), a "tropical aeolian" unit, the Oberá Formation in Misiones, represents a dry period dated from the Isotopic Stage 4 (60 kyr BP). However, the eolian origin of this unit was debated (Fedoroff, 1999).

According to Iriondo and García (1993), between 18,000 and 8,500 yr BP, the province of Misiones climatic belts showed a displacement and savanna vegetation covered the area presently occupied by subtropical rain forest (see also Clapperton, 1993). Estimates of palaeodischarges in the Chacopampean area, using a regional hydrological model, were considered much reduced during that time, amounting to about 20 % of the present discharges; this climatic phase appear to be ended in the lowermost Holocene (8,500 yr BP; Iriondo and García, 1993). Posteriorly, during the Holocene, other dry periods occurred in the area (Iriondo, 1990; Iriondo and García, 1993; Tonni *et al.*, 1999; Tonni *et al.*, in press). However, some interpretations concerning the aridity or wetness during the high temperature period called Altithermal are contradictory (Clapperton, 1993; Iriondo and García, 1993).

The Misiones Plateau is constituted by an arranged relief that makes a series of steps which increase their height northeastwards. Actually, they are remains of ancient erosion surfaces originated during former dry climate and overelevated by tectonic effect (Popolizio, 1973).

Material and methods

Measurements are straight line distances taken with calliper. Standard length was measured from tip of snout to hypural joint; head length includes the opercular flap; peduncle length is taken from last anal-fin ray to hypural joint. Specimens were cleared and stained (C&S) for cartilage and bone following Taylor and Van Dyke (1985).

The specimens examined belong to Museu de Ciências, Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brasil (MCP); Facultad de Ciencias Naturales y Museo, La Plata, Argentina (MLP), and Muséum d'histoire naturelle, Genève, Switzerland (MHNG).

COMPARATIVE MATERIAL EXAMINED: *Bryconamericus agna* Azpelicueta and Almirón, 2001: FML 3700, holotype, 61.5 mm SL, Argentina, Misiones, arroyo Tabay. *Bryconamericus iheringi* (Boulenger, 1887): MLP 9073, 110 ex., 39.9-44.3 mm SL, Argentina, Buenos Aires, Sierra de la Ventana. *Bryconamericus stramineus* Eigenmann, 1908: MLP 18-IX-80-1, 2 ex., 39.0-43.5 mm SL, Argentina, Buenos Aires, Río de la Plata en Punta Lara. *Hypobrycon poi* n. sp.: MLP (uncat.) 1 ex. (C&S), 45.6 mm SL, Argentina, Misiones, arroyo Once Vueltas.

Results

Hypobrycon poi new species

(Figs. 1-5, table 1)

Holotype. MLP 9573, 50.5 mm SL, Argentina, Misiones, Municipio Leandro N. Alem, arroyo Once Vueltas (27° 38' S - 55° 12' W), Uruguay basin. Coll. Casciotta, Almirón, and Donato, February 10-2001.

Paratypes. MCP 28164, 1 ex., 51.6 mm SL, collected with the holotype. MHNG 2619.44, Argentina, Misiones, Municipio Leandro N. Alem, arroyo Once Vueltas (27° 38' S - 55° 12' W), 3 exs., 34.4-51.5 mm SL, coll. Casciotta *et al.*, April 3-2000. MLP 9574, 1 ex., 49.5 SL mm, Argentina, Misiones, Municipio 25 de Mayo, arroyo Acaraguá (27° 27' S – 54° 55' W), coll. Casciotta *et al.*, April 6-2000.

Diagnosis. *Hypobrycon poi* is distinguished from *H. leptorhynchus* in having higher number of perforated lateral line scales (39-41 vs. 35-38), shorter maxilla (14.7-18.7 vs. 22.1-26.4), lower body (25.0-29.7 vs. 32.7-37.3), and higher number of dentary teeth (6-7 vs. 7-9). *Hypobrycon poi* differs from *H. maromba* in the position of the mouth, which is placed at level of lower orbital margin vs. mouth extremely displaced ventrally; shorter maxilla (14.7-18.7 vs. 23.7-25.7), longer

head (23.6-27.6 vs. 22.7-24.7); larger eye diameter (36.4-40.9 vs. 32.6-36.0), and humeral spot dorso-ventrally elongated vs. humeral spot rounded. Males of *H. poi* have small rounded tubercles on anal, dorsal, caudal, pectoral, and pelvic fin rays, absent in *H. maromba* and *H. leptorhynchus*.

Description. Morphometrics of holotype, and 6 specimens are presented in table 1. *Hypobrycon* with low body (Fig. 1), maximum body depth at dorsal-fin origin. Dorsal profile of body straight from tip of snout to dorsal-fin origin, and straight from this point to caudal-fin base. Ventral profile of body arched from tip of snout to anal-fin origin, straight over anal fin, and slanted dorsally to caudal peduncle, ventral profile of caudal peduncle curved. Body rounded between pectoral and pelvic fins. Body laterally compressed between pelvic and anal fins.

Dorsal-fin origin equally distant from tip of snout and base of caudal fin or scarcely posterior to that point. Dorsal-fin origin behind the vertical through last pelvic-fin ray insertion. Adipose fin present. Tip of pectoral fin surpassing or very close to pelvic-fin origin. Tip of pelvic fin never reaching anal-fin origin.

Dorsal fin with ii,8 rays; posterior margin of dorsal fin straight, first branched dorsal-fin ray longest. Males with first to fifth dorsal-fin rays bearing small rounded tubercles. Anal-fin bearing iii-iv,17-20 rays (1ex.: 17 rays; 2 including holotype: 18; 2: 19; 2: 20). Posterior margin with first five or six rays produced, forming a lobe. Anal fin of males bearing small rounded tubercles, on anterior and posterior branches of anal-fin rays. Sometimes more than one tubercle on each segment.

Caudal fin with one unbranched and nine branched principal rays in upper lobe; eight branched and one unbranched principal rays in lower lobe. Caudal lobes similar in size; in some specimens, lower one scarcely wider than upper one. Few small rounded tubercles.

Pectoral-fin with i,10-11 rays (3 ex.: 10 rays; 4 including holotype: 11); posterior fin margin straight. Tubercles dorsally placed, on both branches of five to six branched rays.

Pelvic fin with i,7 rays; posterior margin slightly rounded. Very small rounded tubercles developed on posterior branches of five or six rays.

Dorsal profile of head gently convex. Snout rounded, mouth inferior, at level of lower orbital margin. Lower jaw completely included. Maxilla short, never reaching anterior orbital margin.

Dentary bearing 6-7 teeth tricuspid, decreasing in size anteroposteriorly (Fig. 2). Premaxilla with ascending and alveolar processes short; alveolar process stout, bearing two series of teeth. Outer series with 3 aligned teeth, all tricuspid (Fig. 3), with larger median cusp. Inner series of pre-maxillary teeth consisting of 4 teeth. Symphysial tooth narrower. Teeth of inner row longer than those of outer row. Maxilla with a very short anterior process, laminar process anteriorly expanded dorso-ventrally, partially covering premaxilla. Two to four tricuspid teeth on maxilla (Fig. 4).

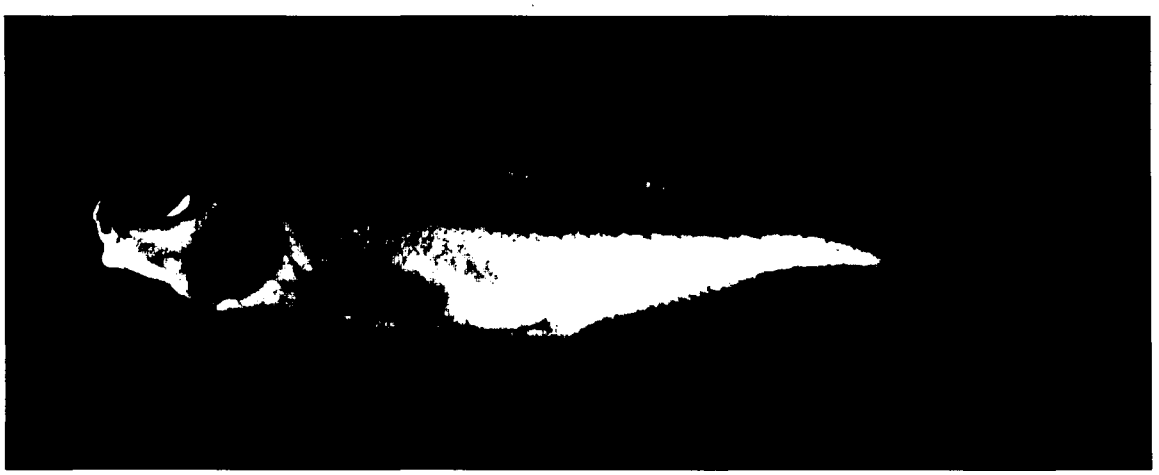
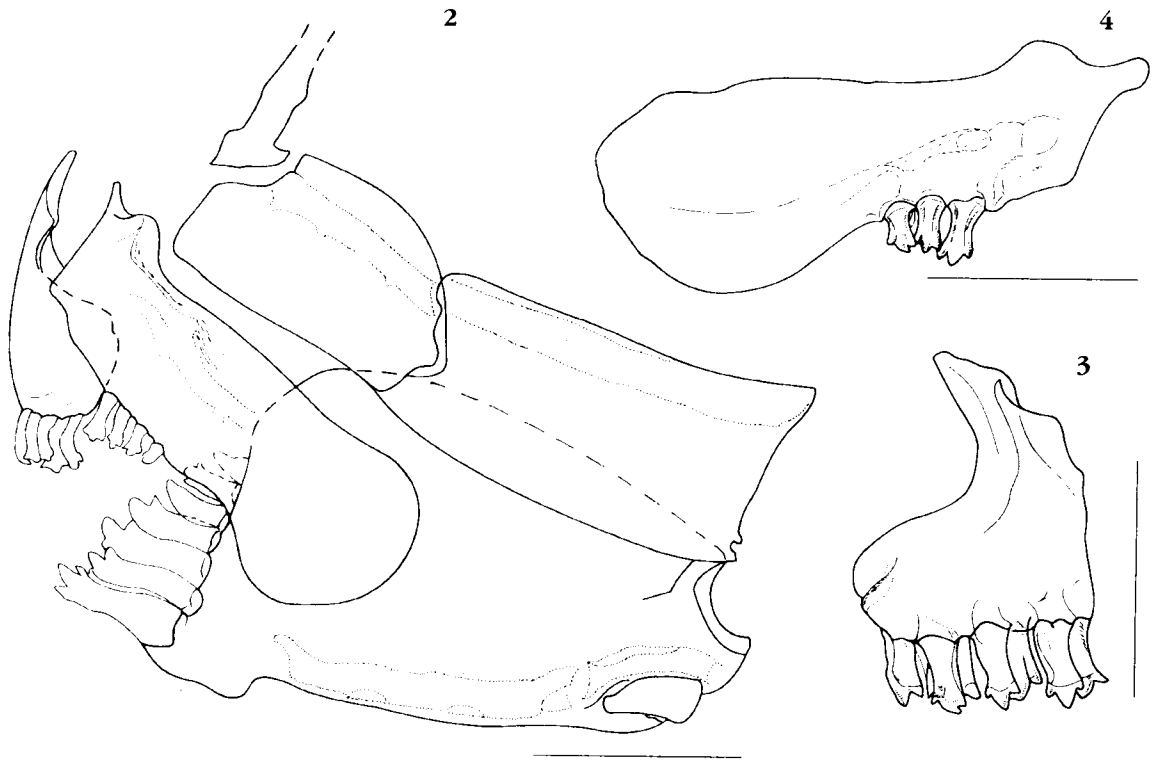


Fig. 1. *Hypobrycon poi* n. sp. , MLP 9573, holotype, 50.5 mm SL. Argentina, Misiones, Municipio Leandro N. Alem, Uruguay basin, arroyo Once Vueltas (27° 38' S - 55° 12' W).



Figs. 2-4. *Hypobrycon poi* n. sp., 45.6 mm SL. 2: Lateral view of left upper and lower jaw; 3: External view of right premaxilla; 4: External view of right maxilla.

Eye large, interorbital wide. Third infraorbital scarcely contacting anterior portion of preopercular sensory tube.

Scales cycloid. Lateral series with 39-41 perforated scales (3 ex.: 39 scales; 2: 40; 2 including holotype: 41). Five scales between dorsal-fin origin and lateral line; 5 scales between lateral line and anal-fin origin. Fourteen scales around caudal peduncle. Eleven or twelve predorsal scales. Seven scales in one row, covering first 7-9 anal-fin rays. On vent, one median series of scales, regularly placed in males only.

Color in alcohol: Ground color pale yellow, with ventral area lighter. A dark humeral spot vertically elongated, on two or three scales above perforated scales. A dark wide midlateral band begining behind opercle; placed on two series of scales, ending on a caudal spot. Over lateral band, numerous chromatophores dark and small. Dark chromatophores arranged as V with apex directed posteriorly on lower area of flank, at anal-fin base level. Series of scales on upper half of body with chromatophores along posterior margin, forming a reticulate pattern.

Dorsum of head with pigmented area between anterior nare and supraoccipital; tip of snout pale yellowish; chromatophores black on posterior half of maxilla; a dark narrow line running on orbital margin of infraorbitals bones. Whitish half-moon shaped dot placed behind pupil. Scattered chomatophores on opercle; internal surface of opercle with dark chromatophores forming a dot at eye level. All specimens with anterior tip of isthmus white.

Black chromatophores on membrane and anterior margin of dorsal-fin rays. Distinctly darker area on upper half of dorsal fin; anterior margin of the first dorsal-fin ray darker. Anal-fin with chromatophores concentrated on membrane and margins of rays. Dark chromatophores concentrated on membrane among middle caudal-fin rays. Scarce chromatophores on pectoral and pelvic fins, especially concentrated along margins of rays.

Etymology. The species name comes from the

Table 1. Morphometrics of the holotype and 6 specimens of *Hypobrycon poi* new species. Standard length is expressed in mm. SD: standard deviation

	holotype	range	mean	SD
Standard length	50.5	34.4-51.6		
Percentage of standard length				
Predorsal distance	50.1	49.6-53.8	51.5	1.82
Preventral distance	46.7	44.6-49.1	46.3	1.42
Preanal distance	63.4	60.0-64.9	61.7	2.01
Dorsal-fin length	11.9	9.9-13.0	11.1	1.05
Anal-fin length	25.5	25.5-28.5	27.3	1.10
Pelvic-fin length	14.1	13.5-14.5	13.8	0.36
Pectoral-fin length	20.6	17.9-21.7	19.8	1.24
Head length	26.3	23.6-27.6	26.2	0.79
Body depth	27.3	25.0-29.7	27.8	1.47
Caudal peduncle depth	11.7	10.7-11.7	11.2	0.40
Caudal peduncle length	16.4	16.3-17.9	16.8	0.58
Percentage of head length				
Eye diameter	37.6	36.4-40.9	38.8	1.65
Interorbital width	29.3	26.4-31.9	29.2	1.98
Snout length	22.5	18.9-26.3	22.6	2.24
Maxillary length	16.5	14.7-18.7	17.13	1.35

Guaraní language word *poí* that means gracile, slender.

Distribution. This species is only known from two different localities, in the headwaters of the arroyo Once Vueltas and the middle course of the arroyo Acaraguá, río Uruguay basin, Province of Misiones, Argentina (Fig. 5). The arroyo Once Vueltas has sandy-rocky bottom, with riffles, small falls and pools, and clear water without vegetation. In the type locality, the depth was 0.80 m (average), the temperature of the water was 25 °C, and the altitude is about 180 m a.s.l. The arroyo Acaraguá, in the collecting place, was wider (about 30 m) with 1 m deep, clear water, sandy bottom; the altitude is about 125 m a.s.l. The arroyo Acaraguá flows in a very deep valley at a relatively low gradient and the arroyo Once Vueltas flows in a small valley at higher gradient. Both banks in the two localities are vegetated.

Discussion

Taxonomic remarks. Within Tetragonopterinae, the genera *Bryconamericus* (Boulenger, 1887); *Creagrutus* Gunther, 1864; *Rhinobrycon* Myers, 1944; *Rhinopetitia* Géry, 1964; *Piabina* Reinhardt, 1866; *Piabarchus* Myers, 1928; *Prodontocharax* Eigenmann and Pearson, 1925; *Hypobrycon* Malabarba and Malabarba, 1994; *Caiapobrycon* Malabarba and Vari, 2000; and *Attonitus* Vari and Ortega, 2000, have a ventral mouth. Among these genera, a combination of characters such as maxilla notably expanded vertically in the anterior portion, dentary teeth anterodorsally oriented, and dentary teeth inserted along the anterior margin of the bone, distinguishes *Hypobrycon*, *Caiapobrycon*, and *Attonitus*. The premaxillary teeth of the outer series longer than the inner ones separate *Caiapobrycon* and *Attonitus* from *Hypobrycon*.

Malabarba and Malabarba (1994) erected the genus *Hypobrycon* based on the following autapomorphies: 1- mouth distinctly ventral with premaxilla displaced posteroventrally; 2- lower jaw shorter than upper jaw, with teeth on dentary clearly along its anterior margin; 3- dentary teeth anteriorly directed and with their main axes continuing the dentary axis; 4- a small laminar anterodorsal process lies posterior to the most posterior tooth of dentary. Later on, Pezzi da Silva and Malabarba (1996), describing the new species

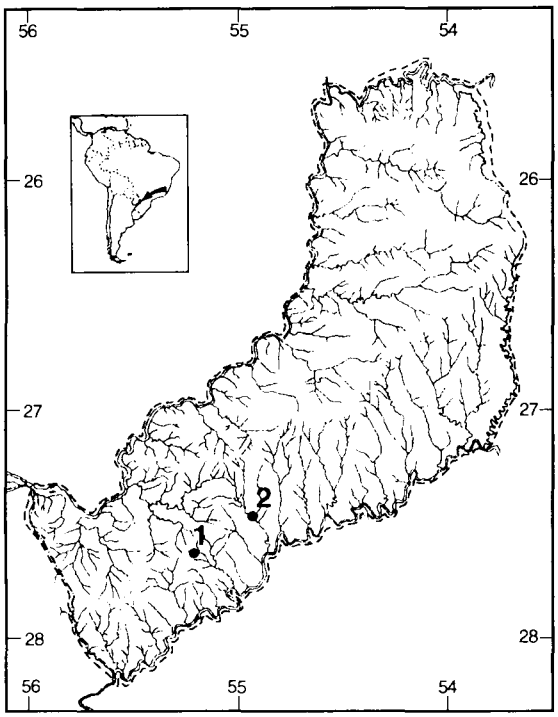


Fig. 5. Geographical distribution of *Hypobrycon poi* n. sp. in Argentina, Misiones, río Uruguay basin. 1: type locality, arroyo Once Vueltas; 2: arroyo Acaraguá.

Hypobrycon leptorhynchus, emmended the diagnosis of the genus. These authors considered that the first character is an autapomorphy of *H. maromba* because *H. leptorhynchus* has a ventral mouth not extremely ventrally displaced. Also, they noted that an anteriorly deep maxilla covering part of the premaxilla is a synapomorphic feature for both species. *Hypobrycon poi* shares the position of the mouth with *H. leptorhynchus*, thus the distinct displacement of the mouth in *H. maromba* remains as an autapomorphy of this species. A deep maxilla is present in *H. poi*, and also in *Caiapobrycon* and *Attonitus*. Additionally, an enlarged maxilla covering part of the premaxilla is also present in *Caiapobrycon*. Consequently, after the description of *Caiapobrycon* and *Attonitus*, the genus *Hypobrycon* lacks autapomorphies.

Hypobrycon has an additional process posterior to the base of the anterodorsal process of the maxilla. This process seems to be larger in *Hypobrycon poi* than in the remaining species of the genus. A similar process is present in *Attonitus irisae* and *A. ephimeros* (Vari and Ortega, 2000). *Hypobrycon maromba*, *H. leptorhynchus*, and *H. poi* bear an anteroventral process in the dentary, a character shared with *Attonitus* although the displacement of the symphysis in the latter results in a very large process (Vari and Ortega, 2000).

Biogeography. The arroyos Once Vueltas and Acaraguá wash out into the río Uruguay at about 35 km one from another (Fig. 5). There is no connection between both basins in the headwaters. It is probable that a relatively small stream such as the arroyo Once Vueltas could have diminished remarkably its discharge and even could be dried up during the glacial maxima (see Climatic evolution of the area). Consequently, fish populations had to be restricted to the main course of the río Uruguay or other streams (lower arroyo Acaraguá?). Until now, no specimens of *Hypobrycon* were found in the río Uruguay. Apparently, the optimum environment for *Hypobrycon* species are relatively small and shallow streams with current, clear water and sandy and rocky bottom (Malabarba and Malabarba, 1994; Silva and Malabarba, 1996; this paper). However, in moments of extreme aridity, when discharges of the río Uruguay were greatly reduced, *Hypobrycon* species could inhabit it. When the hydrological present situation was restored, dispersal into the small drainages connected to the presently large river would have permitted the development of the present fish populations in headwaters.

Hypobrycon maromba and *H. leptorhynchus* are known from the upper Uruguay basin. The enviroments where specimens were caught, seem to be similar to that of *H. poi*. However, headwaters of the río Uruguay are at higher altitude. Di Persia and Neiff (1986) mentioned that the upper section of the río Uruguay presents some different features than the lower ones (eg. different convexity in some stretches, island scarcity and presence of many rapids). Vidal and Lucena (1999) suggested that the occurrence of fish endemism in the area would indicate that it suffered a different historical geologic development.

Acknowledgments

The authors thank C. Tremouilles for his help with the figures. This research was partially supported by Consejo Nacional de Investigaciones Científicas

y Técnicas (CONICET) and Comisión de Investigaciones Científicas de la Provincia de Buenos Aires (CIC).

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