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Tucumán
Argentina

doi

A new species of the *Phalloceros harpagos* species complex (Cyprinodontiformes: Poeciliidae) from the middle and lower Uruguay River floodplains

Una nueva especie del complejo de especies *Phalloceros harpagos* (Cyprinodontiformes: Poeciliidae) de las llanuras de inundación del Río Uruguay medio y bajo

Wilson S. Serra^{1,2,3,4*} , Fabrizio Scarabino^{2,1} , Noelia Gobel^{5,6} , Gabriel Laufer^{5,6} 

¹ Sección Ictiología, Museo Nacional de Historia Natural, Miguelete 1825, 11800, Montevideo, Uruguay.

² Centro Universitario Regional del Este – Sede Rocha (CURE), Ruta 9 y Ruta 15, Rocha, Uruguay.

³ Killifish Foundation, La Plata, Buenos Aires Province, Argentina.

⁴ Autóctonos de Uruguay (ADU). <https://www.instagram.com/autoctonosdeuruguay>

⁵ Área Biodiversidad y Conservación, Museo Nacional de Historia Natural, 25 de Mayo 582, 11800, Montevideo, Uruguay.

⁶ Vida Silvestre Uruguay, Canelones 1198, 11100, Montevideo, Uruguay.

* Autor correspondiente: <serraelbicho@gmail.com>

Abstract

Phalloceros mimbi sp. nov. is described from specimens collected in the floodplains of the middle and lower Uruguay River in Uruguay (Río Negro and Salto Departments) and Argentina (Entre Ríos Province). This species belongs to the *P. harpagos* species complex and is diagnosed by the following unique combination of characters: 1) presence of a symmetric hood-like structure located immediately anterior to the urogenital papilla in females, 2) absence of large papillae at the mandibular symphysis of large adult females, 3) possession of well-developed hooks positioned in distal portion of gonopodial appendices of males and 4) lateral spot usually present in both sexes. To date, *P. mimbi* has not been found coexisting in sympatry with other *Phalloceros* species. The

► Ref. bibliográfica: Serra, W. S.; Scarabino, F.; Gobel, N.; Laufer, G. 2025. "A new species of the *Phalloceros harpagos* species complex (Cyprinodontiformes: Poeciliidae) from the middle and lower Uruguay River floodplains". *Acta Zoológica Lilloana* 69 (1): 309-326. DOI: <https://doi.org/10.30550/j.azl/2096>

► Recibido: 15 de diciembre 2024 – Aceptado: 11 de marzo 2025.



OPEN ACCESS

► URL de la revista: <http://actazoologica.lillo.org.ar>

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geographically closest species is *P. caudimaculatus*, who differs from *P. mimbi* by the absence of hooks in gonopodial appendix in males. Two of the three known populations of *P. mimbi* are relatively protected from the main threats to the species. However, conservation initiatives should consider its presence and ensure that it receives the necessary attention; considering that its global distribution occupies less than 200.000 km² and its occurrence area represents less than 10% of the national territory it must be considered a priority for conservation and an Threatened Species for the species list of Sistema Nacional de Áreas Protegidas (SNAP) of Uruguay.

Keywords: Poeciliinae, freshwater fishes, conservation, Argentina, Uruguay.

Resumen

Se describe *Phalloceros mimbi* sp. nov. a partir de especímenes colectados en las llanuras de inundación del curso medio e inferior del río Uruguay en Uruguay (departamentos de Río Negro y Salto) y Argentina (provincia de Entre Ríos). Esta especie pertenece al complejo de especies *P. harpagos* y se diagnostica por la siguiente combinación única de caracteres: 1) presencia de una estructura simétrica en forma de capucha ubicada inmediatamente anterior a la papila urogenital en las hembras, 2) ausencia de papilas grandes en la sínfisis mandibular de las hembras adultas grandes, 3) presencia de ganchos bien desarrollados ubicados en la porción distal de los apéndices gonopodiales de los machos y 4) mancha lateral usualmente presente en ambos sexos. Hasta la fecha, no se ha encontrado a *P. mimbi* coexistiendo en simpatria con otras especies de *Phalloceros*. La especie geográficamente más cercana es *P. caudimaculatus*, la que difiere de *P. mimbi* por la ausencia de ganchos en el apéndice gonopodial en los machos. Dos de las tres poblaciones conocidas de *P. mimbi* están relativamente protegidas de las principales amenazas a la especie. Sin embargo, las iniciativas de conservación deben considerar su presencia y asegurar que reciba la atención necesaria; considerando que su distribución global ocupa menos de 200.000 km² y su área de ocurrencia representa menos del 10% del territorio nacional debe ser considerada una prioridad para la conservación y una Especie Amenazada para la lista de especies del Sistema Nacional de Áreas Protegidas (SNAP) de Uruguay.

Palabras clave: Poeciliinae, peces dulceacuícolas, conservación, Argentina, Uruguay.

INTRODUCTION

The Neotropical fish genus *Phalloceros* Eigenmann, 1907 comprises 21 valid species, distributed across Argentina, Brazil, Paraguay and Uruguay, in the Araguaia, La Plata and Patos-Merín basins and coastal drainages in southern and southeastern Brazil (Lucinda, 2008; Souto-Santos, Ferraro, Jennings, da Silva Vergara, Buckup, 2019; Souto-Santos, Lucinda & Buckup, 2023; Fricke, Eschmeyer, Van der Laan, 2024). Species of the genus are diagnosed by the following unique characters: 1) preopercular canal present and partially closed and 2) paired appendix at tip of third ray of the gonopodium (R3) (Lucinda, 2008).

Phalloceros harpagos Lucinda, 2008 is one of the most widespread species of the genus, having been reported from the southeast of Brazil, northern Argentina and southern Paraguay (Lucinda, 2008; Casciotta et al., 2016; Thomaz, Carvalho, Malabarba, Knowles, 2019). It is considered a morphologically and chromatically highly variable species diagnosed by the following characters: 1) female urogenital papilla straight along midline, 2) absence of a lateral ramus of female urogenital papilla, 3) small and simple hook in gonopodial appendix of males, 4) absence of symphyseal papillae on large females, and 5) possession of seven or eight dorsal-fin rays (Lucinda, 2008). However, subsequent studies based on molecular characters recovered this species as polyphyletic, likely representing a species complex (Thomaz et al., 2019; Souto-Santos et al., 2019, Oliveira et al., 2024). Gene flow between this taxon and another co-distributed species cannot be ruled out (Thomaz et al., 2019). The recent description of *Phalloceros maldonadoi* Souto-Santos, Lucinda & Buckup, 2023, based on populations previously identified as *P. harpagos*, supports the hypothesis of a species complex (Souto-Santos et al., 2023).

At the southern extent of the genus' distribution in the lower La Plata basin and the Dos Patos-Merín lagoon system, three species has been recorded: *Phalloceros caudimaculatus* (Hensel, 1868), *Phalloceros heptaktinos* Lucinda, 2008 and *Phalloceros spiloura* Lucinda, 2008 (Litz and Koerber, 2014; Lucinda, 2008; Arias, Demonte, Miquelarena, Protogino, López, 2013; Bonato and Ferrer, 2013; Serra et al., 2014; Loureiro, González-Bergonzoni, Teixeira de Mello, 2023). None of these species resemble *P. harpagos*.

In this paper, we describe a new species belonging to the *Phalloceros harpagos* species complex. This species was collected from the floodplains of the middle and lower Uruguay River in Uruguay and Argentina, contributing to our understanding of biodiversity within the genus and highlighting the need for conservation in this region.

MATERIALS AND METHODS

The analyzed specimens were obtained from the ichthyologic collections of the Museo Nacional de Historia Natural de Montevideo (MHNM), and the Facultad de Ciencias de la Universidad de la República (ZVC-P), Montevideo, Uruguay, as well as from the Fundación Miguel Lillo (CI-FML), Tucumán, and Instituto de Bio y Geociencias del NOA (IBIGEO-I), Salta, Argentina. Counts were taken according to Lucinda (2005, 2008). Numbers in parentheses indicate the number of specimens for each count, while an asterisk denotes the holotype counts. Measurements followed Lucinda (2005, 2008) and Souto-Santos et al. (2023), but distances were taken point-to-point to the nearest 0.1 mm with a digital caliper under a stereomicroscope. Standard length (SL) was measured from snout tip to the end of the hypural plate. Cleared and double stained specimens (c&s) were prepared following Dingerkus and Uhler (1977). Nomenclature of the gonopodium follows Rosen and Gordon (1953) modified by Lucinda and Reis (2005): R3 = third anal-fin ray, R4p = posterior ramus of the fourth anal-fin ray.

The electronic edition of this work follows the requirements of the International Code of Zoological Nomenclature. Accordingly, the new names contained herein are available under that Code from the electronic edition of this article. This published work and the nomenclatural acts it contains have been registered in ZooBank, the online registration system for the ICZN. The ZooBank life science identifiers (LSIDs) can be resolved, and the associated information viewed through any standard web browser by appending the LSID to the prefix “<http://zoobank.org/>”. The LSID for this publication is urn:lsid:zoobank.org:pub: E031028C-AFC7-423E-8859-AAF6ECFB9E7D.

RESULTS

Phalloceros mimbi sp. nov.

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(Figs. 1-4)

Holotype.— **URUGUAY: Salto: MHNM 7011**, 1 ex., male 21.5 mm SL, Salto Grande (31°17'12"S 57°56'08"W), col. W.S. Serra, F. Bordet & G. Machado, 11/IV/2024.

Paratypes.— **ARGENTINA: Entre Ríos: MHNM 5689**, 5 ex., 1 male 18.2 mm SL and 4 females 15.9-20.5 mm SL, Salto Grande (31°16'25"S 57°57'26"W), col. G. Laufer & N. Gobel, 30/V/2013; **MHNM 5690**, 13 ex., 4 males 16.1-22.8 mm SL (1 c&s 21.2 mm SL) and 9 females 15.7-27.2 mm SL (1 c&s 22.9 mm SL), Salto Grande (31°16'22"S 57°57'25"W), col. G. Laufer & N. Gobel, 30/V/2013. **URUGUAY: Río Negro: MHNM 7245**, 1 ex., female 16.4 mm SL, Arroyo Amarillo (32°52'31"S 58°03'31"W), Esteros



Figure 1. *Phalloceros mimbi* sp. nov., MHN 7011, holotype, male, 21.5 mm SL, before (top) and after (below) fixation. Salto Grande (31°17'12"S 57°56'08"W), Salto Department, Uruguay.

Figura 1. *Phalloceros mimbi* sp. nov., MHN 7011, holotipo, macho, 21.5 mm SL, antes (arriba) y después (abajo) de ser fijado. Salto Grande (31°17'12"S 57°56'08"W), Departamento de Salto, Uruguay.

y Algarrobales del Río Uruguay, col. I. González-Bergonzoni, 20/I/2023; **MHN 7246**, 9 ex., 3 males 13.9-15.8 mm SL, 1 female 14.6 mm SL and 5 juveniles 9.78-13.7 mm SL, Arroyo Amarillo (32°52'31"S 58°03'31"W), Esteros y Algarrobales del Río Uruguay, col. I. González-Bergonzoni, 22/XI/2022; **MHN 7247**, 1 ex., juvenile 11.2 mm SL, Arroyo Amarillo (32°52'31"S 58°03'31"W), Esteros y Algarrobales del Río Uruguay, col. I. González-Bergonzoni, 4/XI/2022. **Salto: CI-FML 8103**, 3 ex., 1 male 19.3 mm SL and 2 females 28.2-29.2 mm SL, Salto Grande (31°17'12"S 57°56'08"W), col. W.S. Serra, F. Bordet & G. Machado, 11/IV/2024; **IBI-GEO-I 499**, 3 ex., 1 male 19.5 mm SL and 2 females 17.6-20.2 mm SL, Salto Grande (31°17'33"S 57°56'01"W), col. G. Laufer & N. Gobel, 31/V/2013; **MHN 2818**, 2 ex., 2 females 24.8-26.5 mm SL, coastal wetlands of Uruguay River (ca. 30°56'47"S 57°49'06"W), Establecimiento "El Espinillar", ANCAP, col. L.H. Amato, G. Acosta y Lara & F. Achaval, 19-22/VI/1987. **MHN 2844**, 6 ex., 4 males 20.8-22.8 mm SL and 2 females 23.9-26.2 mm SL, Arroyo Espinillar, Establecimiento "El Espinillar" (ca. 30°57'11"S 57°50'23"W), ANCAP, col. L.H. Amato, G. Acosta y Lara & F. Achaval, 19-22/VI/1987. **MHN 5466**, 11 ex., 2 males 17.4-21.8 mm SL and 9 females 20.0-29.2 mm SL, Salto Grande (31°17'12"S 57°56'09"W), col. G. Laufer & N. Gobel, 31/V/2013. **MHN 5688**, 12 ex., 4 males 17.6-20.2 mm SL (1 c&s 18.0 mm SL) and 8 females 16.0-25.9 mm SL (2 c&s 19.7-21.2 mm



Figure 2. *Phalloceros mimbi* sp. nov., MHNM 6856, paratype, female, 27.9 mm SL, before (top) and after (center) fixation. Salto Grande (31°17'12"S 57°56'08"W), Salto Department, Uruguay. Bottom: detail of urogenital area, illustrating dermal hood.

Figura 2. *Phalloceros mimbi* sp. nov., MHNM 6856, paratipo, hembra, 27.9 mm SL, antes (arriba) y después (abajo) de ser fijada. Salto Grande (31°17'12"S 57°56'08"W), Departamento de Salto, Uruguay. Abajo: detalle del área urogenital, ilustrando la capucha dermal.

SL), Salto Grande (31°17'33"S 57°56'01"W), col. G. Laufer & N. Gobel, 31/V/2013; **MHNM 6856**, 29 ex., 14 males 16.4-25.3 mm SL (2 c&s 18.2-18.2 mm SL), 10 females 24.0-33.8 mm SL (2 c&s 26.3-30.7 mm SL) and 5 juveniles 10.8-12.4 mm SL, Salto Grande (31°17'12"S 57°56'08"W), col. W.S. Serra, F. Bordet & G. Machado, 11/IV/2024; **MHNM 6857**, 18 ex., 10 males 15.6-18.7 mm SL and 8 females 13.4-27.0 mm SL, Salto Grande (31°17'12"S 57°56'08"W), col. W.S. Serra, F. Bordet & G. Machado, 11/IV/2024; **ZVC-P 16080**, 3 ex., 1 male 18.9 mm SL and 2 females 25.4-27.1 mm SL, Salto Grande (31°17'12"S 57°56'08"W), col. W.S. Serra, F. Bordet & G. Machado, 11/IV/2024.

Diagnosis.— *Phalloceros mimbi* differs from all the other species except from *P. caudimaculatus*, *P. elachistos* Lucinda, 2008, *P. heptaktinos*, *P. mikrommatos* Lucinda, 2008 and *P. titthos* Lucinda, 2008 by the presence of a symmetric hood-like structure located immediately anterior to the urogenital papilla in

Table 1. Morphometrics of specimens of *Phalloceros mimbi* sp. nov. Ranges of males includes the Holotype. SL = Standard length.**Tabla 1.** Morfometría de los especímenes de *Phalloceros mimbi* sp. nov. Los rangos de los machos incluyen al Holotipo. SL = Longitud estándar.

Character	Males (n=21)				Females (n=21)		
	Holotype	Range	Mean	SD	Range	Mean	SD
Standard length (mm)	21.5	16.4-25.3	19.4	-	20.0-33.8	27.0	-
Percents of SL							
Predorsal distance	58.0	54.2-60.0	57.6	1.3	60.3-77.3	63.6	3.3
Dorsal-fin base length	11.1	9.0-11.8	10.4	0.9	8.6-10.5	9.8	0.5
Anal-fin base length	6.8	6.1-8.7	7.1	0.6	8.1-12.0	10.2	1.0
Body depth	24.2	21.4-27.6	24.5	1.6	22.3-31.0	26.0	2.6
Pre-pelvic length	30.0	29.6-36.8	32.3	1.9	42.0-48.3	44.4	1.6
Preanal length	40.0	40.0-46.5	42.6	1.6	54.9-62.5	58.1	2.1
Postanal length	66.1	58.1-67.0	63.6	2.0	42.5-47.8	45.1	1.4
Caudal peduncle depth	15.7	14.1-17.0	16.0	0.7	13.6-14.9	14.4	0.4
Head length (HL)	22.6	22.4-24.6	23.5	0.6	22.3-26.0	24.3	0.9
Percents of HL							
Snout length	13.0	12.4-21.4	15.4	2.4	19.3-25.9	22.7	1.4
Orbital diameter	42.0	34.4-42.0	39.0	2.1	33.1-41.2	35.4	1.9
Postorbital length	45.9	40.2-49.1	43.6	2.2	40.5-46.2	43.7	1.4

females (*vs.* absent in *P. alessandrae* Lucinda, 2008, *P. anisophallos* Lucinda, 2008, *P. buckupi* Lucinda, 2008, *P. enneaktinos* Lucinda, 2008, *P. harpagos*, *P. leptokeras* Lucinda, 2008, *P. leticiae* Lucinda, 2008, *P. lucenorum* Lucinda, 2008, *P. malabarbai* Lucinda, 2008, *P. megapolos* Lucinda, 2008, *P. ocellatus* Lucinda, 2008, *P. pellos* Lucinda, 2008, *P. reisi* Lucinda, 2008, *P. spiloura* and *P. uai* Lucinda, 2008, or present but asymmetrical in *P. maldonadoi*); from *P. titthos* and *P. heptaktinos* by the lateral spot usually present (*vs.* absent); from *P. titthos* by the absence of large papillae at the mandibular symphysis of large adult females (*vs.* present); differs from the remaining species by possession of hooks well developed and positioned in distal portion of gonopodial appendices of males (*vs.* hooks absent in *P. caudimaculatus*, *P. heptaktinos* and *P. mikrommatos*, or present but forming a lateral minute protuberances in *P. elachistos*).

Description.— Largest examined male 25.3 mm SL; largest examined female 33.8 mm SL (morphometric data in Table 1). Body elongate, fusiform. Greatest body depth usually between pelvic fin origin and dorsal-fin origin. In lateral view, dorsal profile of the head straight, straight to slightly convex from nuchal area to dorsal-fin origin, and concave from dorsal fin origin to caudal fin dorsal origin. Ventral profile convex from dentary to approximately the transversal plane through the middle of the dorsal fin base, and straight to slightly convex from this point to the end of the caudal peduncle. Distal margin of dorsal fin rounded. Distal margin of caudal fin rounded. In adult males, base of anal and pelvic fins positioned in the anterior portion of belly. Gonopodium base wider than tip. Anal fin in females nearly triangular. Pectoral fin rounded, slightly elongated.

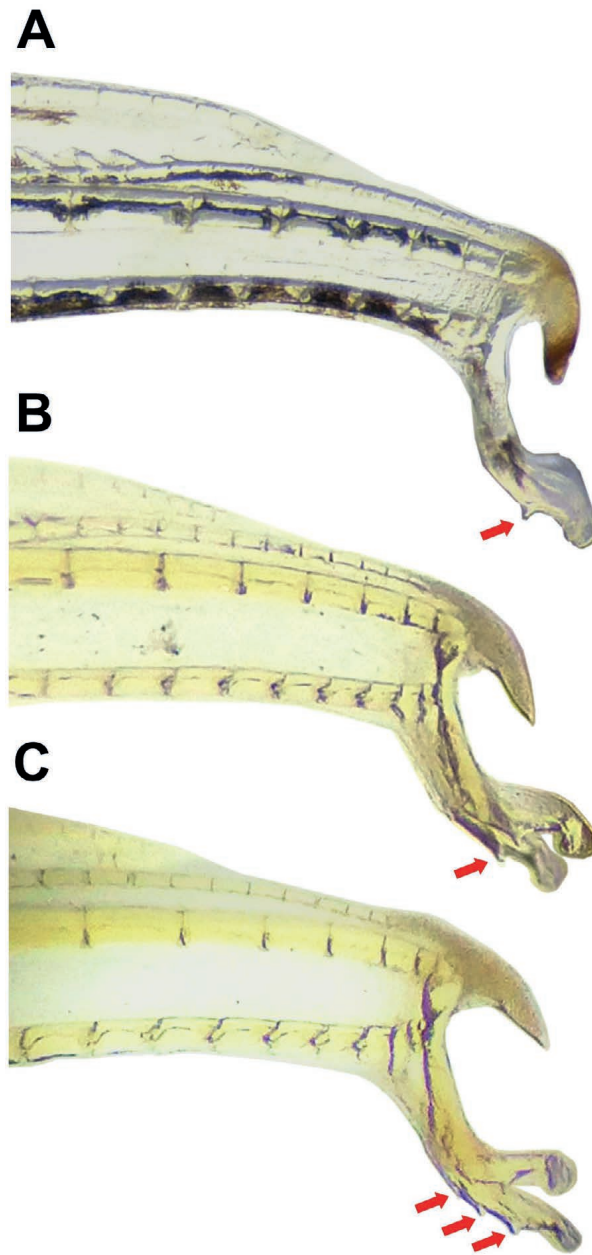


Figure 3. Detail of gonopodial appendix variability of males of *Phalloceros mimbi* sp. nov. A = holotype (MHNM 7011), Salto Grande (31°17'12"S 57°56'08"W), Salto, Uruguay. B and C = paratypes (MHNM 2844), "El Espinillar" (ca. 30°57'11"S 57°50'23"W), Salto, Uruguay. Red arrows indicate the gonopodial hooks.

Figura 3. Detalle de la variabilidad del apéndice gonopodial en machos de *Phalloceros mimbi* sp. nov. A = holotipo (MHNM 7011), Salto Grande (31°17'12"S 57°56'08"W), Salto, Uruguay. B y C = paratipos (MHNM 2844), "El Espinillar" (ca. 30°57'11"S 57°50'23"W), Salto, Uruguay. Flechas rojas señalan los ganchos gonopodiales.

Mouth superior. Maxilla vertically oriented; posterior tip of maxilla not reaching level of anterior margin of orbit. Nares dorsally positioned; anterior and posterior nasal pores distinct and separated. Orbital margin circular. Margin of eye free.



Figure 4. *Phalloceros mimbi* sp. nov., MHNM 6856, paratypes before fixation, showing the color pattern variability. Males on the left and females on the right. Salto Grande (31°17'12"S 57°56'08"W), Salto Department, Uruguay.

Figura 4. *Phalloceros mimbi* sp. nov., MHNM 6856, paratipos antes de ser fijados, mostrando la variabilidad de patrones de coloración. Machos a la izquierda y hembras a la derecha. Salto Grande (31°17'12"S 57°56'08"W), Departamento de Salto, Uruguay.

Teeth unicuspid. Outer premaxillary teeth 14 (2), 16 (3), 18 (1), 19 (1), 20 (1), 21 (1). Outer dentary teeth 15 (3), 16 (1), 17 (2), 18 (1), 19 (1), 21 (1). Maxilla and vomer without teeth. Fourth ceratobranchial toothless; inner surface of fifth ceratobranchial covered with numerous unicuspid teeth. Branchiostegal rays 5 (9).

Scales cycloid, 27 (1), 28* (16), 29 (18), 30 (7) in longitudinal series. Transverse series with 8 (2) or 9* (18) scales in males, and 7 (1), 8 (18) or 9 (2) scales in females. Series of scales around caudal peduncle 14 (4), 15 (4), 16* (34). Predorsal scales 12 (1), 14 (2), 15* (27), 16 (11) or 17 (1).

Total dorsal-fin rays 8* (42) or 9 (1). Branched pectoral-fin rays 5 (2), 6* (35), 7 (2); total pectoral-fin rays 10 (12), 11* (27). Total pelvic-fin rays 5* (40). Total anal-fin rays in females 10 (20), 11 (1). Anal-fin rays in males 9 (2) or 10 (2). Branched caudal-fin rays 10 (1), 11 (26), 12* (15).

Adult females with urogenital papilla base aligned with anus and anal fin, tip of the urogenital papilla posteriorly directed. Papilla covered anteriorly by a symmetric hood (Figure 2). Adult males with large gonopodium, with conspicuous ornamentation at tip. Serrae on ray branch R4p 8 (1), 10 (4), 11* (6), 12 (5), 14 (1), 15 (1). Pair of appendices coalesced at base, inserted into tip of R3. Each appendix with inflection, bearing hook at point of inflection (one specimen with two additional pair of hooks) (Figure 3).

Juveniles without developed appendices or with skin covering tip of appendices. Gonopodial suspensory with three (3) or four (1) large gonapophyses sharply projected anteriorly and emerging from ventral surface of 14th-16th (3), 15th-17th (1) vertebrae.

Epipleural ribs 12 (1), 13 (5), 14 (2), 15 (1). Pleural ribs 14 (6), 15 (3). Vertebrae 31 (2), 32 (5) 33 (2).

Color in ethanol-preserved specimens (fixed in formalin) (Figures 1 and 2).— Eye black with brownish pupil. Ground color of body pale brown. Sub distal area of each scale with a dark brown band of chromatophores parallel to the scale margin, forming a reticulate pattern on body sides. Dark brown bands of scales wider in dorsal portion of the body, covering a third or a half of the scale. Dorsal area of the head dark brown, with a stripe of the same color from this area to dorsal-fin origin along the mid-dorsal scale series. Thin dark brown to black line along ventral margin of caudal peduncle. When present (93% of the examined specimens), lateral dark brown spot with its anterior margin located on the 14th (6), 15th (20), 16th (12*), 17th (1) scale of longitudinal series, below the dorsal-fin. Lateral spot covering approximately one and half or two scales on horizontal direction, and two (4), three (30*) or four (5) scales on vertical. Presence of faint vertical bands along body sides in both sexes, more notorious near lateral spot. Dorsal-fin membrane bearing a dark band of chromatophores on distal border and basal portion of dorsal fin, more intense around the last two rays in both cases. Pectoral, pelvic, and caudal fins hyaline. Anal fin in males with dark chromatophores between rays. Anal fin of females' hyaline, except for patch of dark chromatophores on first three rays.

Color in life (Figures 1, 2 and 4).— Eyes dark gray, inner margin of the iris pale yellow and pupil black. Ground color of body pale grayish brown, with purple iridescences in the upper abdominal area, and sky blue iridescences in the rest of the flanks. Sky blue iridescences of the sides of the body more intense in males, and around lateral spot in both sexes. Pectoral and ventral region whitish to yellowish. Dark reticulate pattern on body as described for preserved specimens. Head dorsal area dark brown, with same color stripe from this area to dorsal-fin origin along the middorsal scale series. Head ventral area whitish. Mouth yellowish. Preopercular area shiny yellow, and opercle iridescent sky blue. Caudal peduncle ventral margin with thin black line along it. Lateral spot usually present and conspicuous, dark gray. Faint vertical bands along body sides, more notorious near lateral spot. Dorsal-fin yellow, bearing a dark gray to black band on distal border and basal portions, more intense in the area of the last two rays. Pectoral fins hyaline. Pelvic fins hyaline with yellowish basal portion, more intense in females. Caudal fin yellow, hyaline to pale gray in the posterior third. Anal fin in males yellow, with black longitudinal band covering R3, more intense in its basal area, and membrane posterior to R5 hyaline. Females'

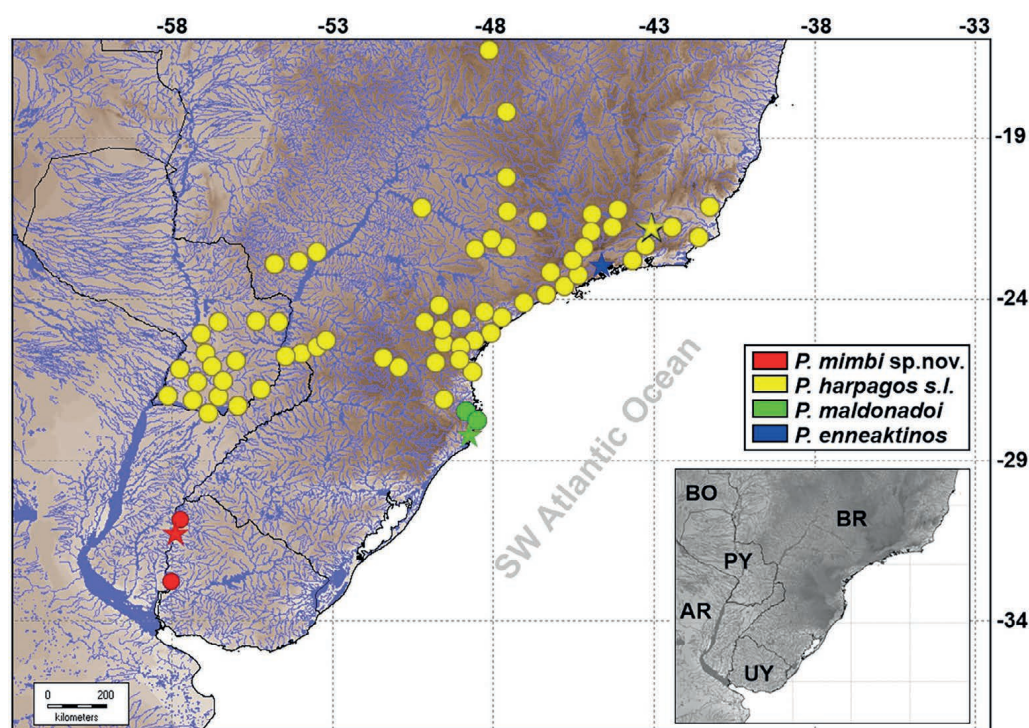


Figure 5. Distribution map of the species of the *Phalloceros harpagos* species complex. Stars represents the type localities. AR = Argentina; BO = Bolivia; BR = Brazil; PY = Paraguay; UY = Uruguay.

Figura 5. Mapa de distribución de las especies del complejo *Phalloceros harpagos*. Estrellas representan las localidades tipo. AR = Argentina; BO = Bolivia; BR = Brasil; PY = Paraguay; UY = Uruguay.

anal fin hyaline, yellow in the median anterior portion, with black chromatophores on first three rays. Females' urogenital papilla yellow. Juveniles color pattern like the adults.

Distribution.— *Phalloceros mimbi* is distributed along the floodplains of the middle and lower Uruguay River in Uruguay (Río Negro and Salto Departments) and Argentina (Entre Ríos Province) (Figure 5).

Habitat.— *Phalloceros mimbi* has been recorded so far only in canals, wetlands and artificial ponds near the Uruguay River. These habitats are typically low-flow lotic environments or lentic habitats associated with the floodplain, containing abundant macrophytes and often bordered by riparian forests, invasive non-native woody vegetation or crops. In Uruguay, these habitats lie in the Western Sedimentary Basin ecoregion (Brazeiro, 2015: Uruguayan ecoregions based on the integration of environmental variables, soil and geomorphology, and biological variables, flora and fauna), while in Argentina they falls within the Pampas Province, Espinal region (Brown, Martínez-Ortiz, Acerbi, Corcuera, 2006: Argentinian regions based on the integration of environmental and biological variables, such as climate, geomorphology, vegetation, and fauna).



Figure 6. Type locality of *Phalloceros mimbi* sp. nov., artificial pond near Salto Grande Hydroelectric Dam (31°17'12"S 57°56'08"W), Salto Department, Uruguay.

Figura 6. Localidad tipo de *Phalloceros mimbi* sp. nov., estanque artificial junto al embalse de la Central Hidroeléctrica de Salto Grande (31°17'12"S 57°56'08"W), Departamento de Salto, Uruguay.

The type locality is a shallow artificial pond with extremely dense emergent aquatic vegetation (Figure 6). It is situated within the land managed by the Comisión Técnica Mixta (CTM) of the Salto Grande hydroelectric complex, an area significantly altered during dam construction. In this area, substantial changes were made to the soil and slopes, and non-native trees, especially *Pinus* spp. and *Eucalyptus* spp., were planted. Nonetheless, the area harbors noteworthy local biodiversity and remains protected from some local threats, such as agricultural intensification.

Conservation assessment.— The few recorded populations of this species (spanning over 200 km along the Uruguay River) suggest that *P. mimbi* it may require conservation measures. Its habitats face significant conservation threats, particularly the expansion of the agricultural frontier, especially with rainfed crops and forestry, which lead to the loss and alteration of aquatic habitats, decreased water quality, and increased chemical pollutants (Ernst et al., 2018; Soutullo, Ríos, Zaldúa, Teixeira-de-Mello, 2020). These populations may also be threatened by hydrological changes caused by dam management. However, two of the three known localities with records of *P. mimbi* may be relatively protected. The CTM Property is managed with a focus on biodiversity conservation (Vaz-Canosa et al., 2020), and the Esteros y Algarrobales del Río Uruguay is a Habitat and/or

Species Management Area within the National System of Protected Areas (SNAP). The management of these areas needs to be particularly alert of the presence of this species to ensure that special attention is given in conservation initiatives. According to the criteria defined by Soutullo et al. (2013), we indicate that *P. mimbi* must be considered a priority for conservation and an Threatened Species for the species list of Sistema Nacional de Áreas Protegidas (SNAP) of Uruguay: its global distribution occupies less than 200.000 km² (Criteria 1) and its occurrence area represents less than 10% of the national territory (Criteria 4).

Etymology.— The name “*mimbi*” is a guarani word that means shiny, in allusion to the light blue and violet glow present on the body sides of specimens of the species.

DISCUSSION

Phalloceros mimbi sp. nov. presents the diagnostic morphological characters of *Phalloceros harpagos sensu* Lucinda (2008), and consequently as a member of the *P. harpagos* species complex *sensu* Souto-Santos et al. (2019). These features include females with urogenital papilla straight along midline with lateral ramus absent and lack of symphyseal papillae, males with small and simple hook in gonopodial appendix, and eight dorsal-fin rays in both sexes. Phylogenetic analyzes based on genetic sequences performed by Thomaz et al. (2019) and Oliveira et al. (2024) recovered *P. harpagos* as polyphyletic, composed by 3 to 8 independent lineages. Souto-Santos et al. (2023) described *Phalloceros maldonadoi* based on specimens from populations of the Santa Catarina area (southern Brazil) previously identified as one of the three lineages of *P. harpagos* species complex by Thomaz et al. (2019). These authors incorporated an anatomical character previously not considered by Lucinda (2008) that consists of a “hood-like projection of skin located between the anus and the urogenital papilla of females”, a structure that would be present in populations of *P. caudimaculatus*, *P. elachistos*, *P. heptaktinos*, *P. maldonadoi*, *P. mikrommatos* and *P. titthos*, and absent in the remaining species of the genus, including *P. harpagos sensu stricto*. This feature is present in female specimens of *P. mimbi*, making its determination against *P. harpagos s.s.* unequivocal.

The closest populations attributed to the *P. harpagos* complex are found in the middle Paraná River basin (Lucinda, 2008). Some authors have proposed that there is an affinity between the aquatic fauna of the Middle Uruguay River and those of the Paraguay and Middle Paraná rivers (e.g. Olazarri 1979, 1984; Clavijo and Olazarri, 2009; Zarucki et al., 2010). Future analysis of populations from the lower Paraná river basin may result in the expansion of the distribution range of *P. mimbi*.

To date, *P. mimbí* has not been found coexisting in sympatry with other *Phalloceros* species. The geographically closest species is *P. caudimaculatus*, reported for Laguna dos Patos/Merín system, lower portions of Río Uruguay, Río Tramandaí drainage, Río Ibicuí drainage, Río Mampituba drainage and coastal drainages of Uruguay (Lucinda, 2008). *Phalloceros mimbí* is only differentiated from *P. caudimaculatus* by the presence of hooks in gonopodial appendix in males.

COMPARATIVE MATERIAL

***Phalloceros buckupi*: BRASIL: Paraná: MHNM 7220**, 11 ex., 2 males 17.9–19.1 mm SL and 9 females 16.1–27.6 mm SL, road Matinhos-Paranguá, km 11 to 12, in ponds near the road, col. L. H. Amato, 9/VII/1985.

***Phalloceros caudimaculatus*: ARGENTINA: Buenos Aires: MHNM 3494**, 48 ex., 7 males 16.6–19.6 mm SL (1 c&s 17.5 mm SL) and 41 females 12.1–34.7 mm SL (2 c&s 26.5–26.9 mm SL), Villa Elisa, La Plata, col. R. Taberner, 30/IX/1973; **MHNM 5462**, 55 ex., 4 males 16.1–18.6 mm SL (1 c&s 16.7 mm SL) and 51 females 20.1–33.5 mm SL (2 c&s 27.6–32.0 mm SL), Ingeniero Rómulo Otamendi, col. R. Taberner, 11/X/1981; **MHNM 5469**, 16 ex., 3 males 16.7–18.5 mm SL and 9 females 20.0–27.8 mm SL, Arroyo lateral, Río Luján, col. R. Taberner, 19/XI/1977; **MHNM 5682**, 5 ex., 2 males 16.0–18.8 mm SL and 3 females 27.4–27.9 mm SL, Arroyo Las Catonas, col. R. Taberner, 23/IX/1973. **URUGUAY: Maldonado: MHNM 4770**, 2 ex., 1 male 22.6 mm SL and 1 female 24.6 mm SL, Arroyo Sarandí Grande, Salamanca (34°06'12"S 54°36'10"W), col. W.S. Serra, G. Sanguinetti & M. García, 2/X/2021. **Montevideo: MHNM 5435**, 2 ex., females 16.6–17.3 mm SL, Arroyo San Gregorio, Camino Luis Eduardo Pérez (34°47,97'S 56°18,40'W), col. E. Lartigau T. Litz & F.I. Prieto, col 14/III/2001. **Rocha: MHNM 4847**, 18 ex., 6 males 11.9–17.9 mm SL, 7 females 23.0–33.8 mm SL and 5 juveniles 8.5–12.5 mm SL, Potrerillo (33°58'23.09"S 53°38'16.82"W), Laguna Negra, col. Pasantías PROBIDES, 26/X/2021; **MHNM 6652**, 2 ex., 1 male 16.9 mm SL 1 female 30.9 mm SL, Ruta 10 N to Arroyo Valizas (34°20'40"S 53°50'22"W), col. W.S. Serra, G. Sanguinetti & G. Núñez, 24/VI/2023. **San José: MHNM 6448**, 8 ex., 3 males 14.2–19.7 mm SL and 5 females 20.7–34.2 mm SL, laogon marginal to San José (34°34'44.7"S 56°31'42.1"W), Establecimiento Sta. Esmeralda, Rincón de Buschental, col. M. Caligari, G. Sanguinetti, M. García & W.S. Serra, 11–12/XI/2023. **Soriano: MHNM 2701**, 16 ex., 6 males 12.9–18.7 mm SL, 8 females 12.8–24.1 mm SL and 2 juveniles 8.9–13.5 mm SL, canal on the southern bank of the mouth of the Río San Salvador, col. L.H. Amato, 20/XII/1986; **MHNM 5669**, 1 ex., male 17.2 mm SL, Río San Salvador, col. L. H. Amato, 20/VII/1986.

***Phalloceros maldonadoi*: BRASIL: Santa Catarina: MHNM 6073**, 32 ex., 8 males 16.4-22.6 mm SL (1 c&s 17.1 mm SL) and 24 females 13.7-33.1 mm SL (2 c&s 28.7-31.2 mm SL), Rio Palha, Estrada to Canasvieiras, Ilha de Santa Catarina (27°27'19.1"S 48°27'27.4"W), col. L. H. Amato, 11/VIII/1985.

***Phalloceros spiloura*: BRASIL: Santa Catarina: MHNM 7170**, 17 ex., 2 males 21.4-25.5 mm SL and 15 females 20.5-32.8 mm SL, canal on the road to Canasvieiras, 50m from Hípico (27°32'28.5"S 48°30'17.7"W), Ilha de Santa Catarina, col. L. H. Amato, 3/VIII/1985; **MHNM 7175**, 4 ex., 1 male 17.5 mm SL and 3 females 24.3-27.7 mm SL, Arroyo San Miguel, Br. Florianópolis-Curitiba, col. L. H. Amato, 5/VIII/1985.

ACKNOWLEDGEMENTS

The individuals of the lots MHNM 5689, 5690, 5466 and 5688 and IBIGEO-I 499 were collected in the context of biodiversity surveys of Comisión Técnica Mixta de Salto Grande (CTMSG) conducted by Vida Silvestre Uruguay. Thanks to Valentín Leites, Gonzalo Machado, Martin Irigoyen, Maximiliano Bertoni, Facundo Bordet, and Nicolas Failache (Área de Gestión Ambiental, CTMSG) for their support in fieldwork and specimens collection. We thank Felipe Alonso for his help with the registration of the species on the ZooBank.org website. The individuals of the lots MHNM 7245, 7246 and 7247 were collected in the context of juvenile fishes monitoring in the Arroyo Amarillo at the protected area of the “Esteros y Algarrobales del Río Uruguay”, SNAP, we thank Iván Grela and Iván Gonzalez for their donation to the MNHN. We also acknowledge the ADU, PROBIDES, CURE and MNHN for the general support of our work.

PARTICIPATION

All authors contributed equally to the idealization, analysis, and writing. GL and NG are members of Sistema Nacional de Investigadores (SNI-ANII), and GL of PEDECIBA, Uruguay.

CONFLICTS OF INTEREST

Authors declare no conflict of interest.

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