

Hemibrycon rafaelse n. sp.
(Characiformes, Characidae),
a new species from the upper Cauca River,
with keys to Colombian species

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Abstract

Hemibrycon rafaelse n. sp. (Characiformes, Characidae), a new species from the upper Cauca River, with keys to Colombian species.— A new fish species of *Hemibrycon* is described from the San Rafael River, upper Cauca River, Colombia. *H. rafaelse* can be distinguished from other species of the genus by the number of cusps on the teeth in the internal premaxilla row (3–5 vs. 5–7 except *H. surinamensis*), by the number of predorsal scales (10–12 vs. 12–17, except *H. jelskii* and *H. orcesi*), and by postcleithrum 1 (much closer to postcleithrum 2 vs. postcleithrum 1 and 2 clearly separated). Ecological data of the aquatic habitat of the new taxon are presented and keys to help identify known Colombian species are included.

Key words: *Hemibrycon*, Tropical fish, South America.

Resumen

Hemibrycon rafaelse sp. n. (Characiformes, Characidae), una nueva especie del alto Cauca, con claves de identificación para las especies colombianas.— Se describe una nueva especie de *Hemibrycon* para el río San Rafael, alto Cauca, Colombia. *H. rafaelse* se diferencia de sus congéneres por el número de cúspides de la fila interna de dientes del premaxilar (3–5 vs. 5–7 excepto *H. surinamensis*), por el número de escamas predorsales (10–12 vs. 12–17, excepto *H. jelskii* y *H. orcesi*), y por el postcleitrum 1 (mucho más próximo al postcleitrum 2 vs. postcleitrum 1 y 2 bien separados). Se incluyen datos ecológicos del hábitat propio del nuevo taxón y las claves para la identificación de las especies conocidas de Colombia.

Palabras clave: *Hemibrycon*, Pez tropical, Sudamérica.

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Introduction

Previous studies of *Hemibrycon* Günther in Colombia and adjacent localities focused on the taxonomy and description of new species (Eigenmann, 1913; Eigenmann et al., 1914; Eigenmann, 1922, 1927; Géry, 1977; Meek & Hildebrand, 1916; Schultz, 1944; Dahl, 1960, 1971; Dahl & Medem, 1964; Miles, 1971; Taphorn, 1992; Román-Valencia, 2001, 2004; Román-Valencia et al., 2006; Román-Valencia & Ruiz-C., 2007; Román-Valencia et al., 2007; Bertaco et al., 2007). Román-Valencia (2004) considered *Hemibrycon tolimae* a synonym of *Bryconamericus tolimae*, while Román-Valencia (2001) distinguished *Hemibrycon boquiae* from *Bryconamericus caucanus* and discussed the validity of traditional diagnostic characters for *Hemibrycon*. There is no modern phylogenetic hypothesis of relationships for this genus, and the characters used to define it have not proven significant in determining its monophyly. Most of these characters are little or non-informative and some coincide with those for other Characidae genera. When no hypothesis is available, it is not possible to reconstruct a spatial model to explain the current geographic distribution (Román-Valencia et al., 2007). The genus lives in secondary creeks between 41 to 1,910 m a.s.l., with crystalline waters flowing over substrates of stones, rocks, sand, or leaf litter in decomposition, with high dissolved oxygen (mean 8 ppm). Their diet is mainly aquatic and terrestrial insects of autochthonous and allochthonous origin (Román-Valencia & Botero, 2006). The purpose of this paper is to describe a new species of *Hemibrycon* from Colombia, as a further contribution to the ongoing revision of the genus.

Material and methods

Fishes were captured using a seine, preserved with 10% formalin and later stored in 70% ethanol. Measurements were made with digital calipers to 0.01-mm precision, and expressed as percentages of standard (SL) and head lengths (HL) (table 1). Measurements and counts were taken on the left side, except if this was damaged. Counts and measurements were recorded following the methodology described in Vari & Siebert (1990). We performed principal component analysis (PCA) on the correlation matrix of morphometric and meristic characters; for meristic characters we used the Mann-Whitney non-parametric rank-sum test for species in biogeographically proximity; bar graphs of 99% confidence were used to provide more information in the differentiation of species.

Observations of cartilage and bone were made on two cleared and stained specimens (C. and S.) following the modifications by Song & Parenti (1995) of the method outlined in Taylor & Van Dyke (1985). Bone nomenclature follows Weitzman (1962), Vari (1995) and Ruiz-C. & Román-Valencia (2006).

Specimens were compared with material housed in the Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá (ICNMNH); Field Museum of Natural History, Chicago (FMNH); Laboratorio de Ictiología, Departamento de Biología, Universidad del Quindío, Armenia, Colombia (IUQ); Museo de Biología, Instituto de Zoología Tropical, Universidad Central de Venezuela, Caracas (MBUCV); Museo de Ciencias Naturales de la UNELLEZ-Guanare, Venezuela (MCNG); Museo de Historia Natural La Salle, Caracas, Venezuela (MHNLS); California Academy of Sciences, Department of Ichthyology, San Francisco, USA (CAS); Instituto de Investigación de Recursos Biológicos "Alexander Von Humboldt", Villa de Leyva, Boyacá, Colombia (IAvH); Staatliches Museum für Tierkunde, Dresden, Fischsammlung, Germany (MTD F); Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Perú (MNH-UNMSM) and National Museum of Natural History, Washington D.C., USA (USNM). In the material examined and comparative sections, the number of specimens is given in parentheses after the catalog number, for example: FMNH 56258 (4), means there were (4) in that lot.

Comparative material

Bryconamericus tolimae: FMNH 56258 (4 paratype), Colombia, Ibagué; IUQ 484 (48), Colombia, Tolima, Ibagué, Pastales, 100 m before Pastales Ibagué-Juntas Road, Combeima, Magdalena River system (4° 30' 19" N, 75° 17' 46" W) 1,586 m a.s.l.

Bryconamericus guaytarae: CAS 40844 (1 paratype); Colombia, Nariño, Patia Basin, Guaitara River on the mouth of the Patia River.

Bryconamericus lassorum: MHNLS 8889 (12), Venezuela, Monagas, Aragua River (bridge on the Becerros Creek), Maturin-Quiriquire Road, ca. 10 km Aragua-Maturin.

Hemibrycon boquiae: IUQ 301a (3), (C. and S.), Colombia, Quindío, Boquia Creek (4° 38' 35" N, 75° 75' 11" O) 1,819 m a.s.l.; IUQ 754 (104), Colombia, Quindío, Boquia Creek (4° 38' 35" N, 75° 75' 11" O) 1,819 m a.s.l.; IUQ 871 (15), Colombia, Quindío, Boquia Creek (4° 38' 35" N, 75° 75' 11" O) 1,819 m a.s.l.

Hemibrycon colombianus: IAvH 3130 (28), Colombia, Santander, Moniquira and Suárez Rivers.

Hemibrycon jelskii: IUQ 1141 (2), (C. and S.), Divino River, 1,600 m before Chontayacu; USNM 361171 (3), Perú Cusco La Convención, Echarate, Peruanita, Igoripato Creek.

Hemibrycon dariensis: USNM 260697 (1), Colombia, Creek Bernal, tributary of Río Negua, 17 III 1967; USNM 293218 (2), Panamá, locality of Kuna Yala, Río Madinga between Río Pingandi, and Madinga (Atlántico) (09° 28' N, 70° 06' W), 3 III 1985; USNM 293234 (1), Panamá, Darién, Río Pirre ca 1/2 km above el Real (Río Tuira), Pacífico, 19 II 1985; USNM 293245 (28), Panamá, Darién, Río Tuira, Darién Province, Pucuro River about 3–4 km above the confluence of the Río Tuira Pacífico,

Table 1. Morphometric and meristic data of *H. rafaelse* n. sp. (Standard and total lengths in mm, mean values in parenthesis.)

Tabla 1. Datos morfométricos y merísticos de *H. rafaelse* sp. n. (Longitud estándar y total en mm, medias entre paréntesis.)

Morphometrics	<i>H. rafaelse</i>	
	Paratype	Holotype
Standard length (mm)	22.73–89.95 (40.91)	49.35
Total length	28.29–105.6 (50.26)	61.02
Percentages of SL		
Body depth	23.27–29.87 (26.22)	26.55
Snout–dorsal fin origin distance	48.33–54.24 (51.31)	51.04
Snout–pectoral fin insertion distance	21.26–25.84 (23.81)	23.32
Snout–pelvic fin insertion distance	42.00–46.74 (44.52)	42.7
Dorsal–fin origin–pectoral–fin distance	35.21–41.26 (38.23)	37.28
Snout–anal fin origin distance	54.74–59.92 (56.99)	55.91
Dorsal fin origin–hypurals plate length	46.33–55.49 (52.20)	53.41
Dorsal fin origin–anal fin origin length	23.78–30.75 (28.00)	27.62
Dorsal fin length	17.39–23.76 (21.68)	19.78
Pectoral fin length	17.75–22.18 (19.66)	19.47
Pelvic fin length	11.06–16.06 (12.41)	13.47
Anal fin length	11.00–19.23 (15.10)	14.77
Caudal peduncle depth	8.28–11.88 (10.48)	10.46
Caudal peduncle length	7.25–13.31 (9.94)	11.21
Head length	18.17–23.14 (22.06)	21.56
Percentages of HL		
Snout length	20.29–29.07 (24.48)	23.87
Orbital diameter	36.65–43.58 (40.18)	36.37
Postorbital distance	31.21–39.9 (35.44)	35.81
Maxilla length	28.00–37.76 (32.35)	33.74
Interorbital distance	34.74–41.55 (37.83)	33.83
Upper jaw length	24.49–35.53 (29.85)	26.79
Meristic		
Lateral–line scales	40–43	42
Scale rows between dorsal–fin origin and lateral line	5–8	6
Scale rows between anal–fin origin and lateral line	4–6	5
Scale rows between pelvic–fin insertion and lateral line	4–7	5
Predorsal median scales	10–13	12
Dorsal–fin rays	ii–iii,7–8	ii,8
Anal–fin rays	iii–iv,24–28	iv,27
Pelvic–fin rays	ii,6	ii,6
Pectoral–fin rays	ii,9–11	ii,10

17 II 1985; IUQ 523 (26), Colombia, Departamento de Antioquia, Río Zungo highway, Río León system, 17 XII 1990; IUQ 524 (2), Colombia, Antioquia, Creek

km 25 road Mutatá–Chigorodo, XII 1990. IUQ 525 (26), Colombia, Antioquia, Río León drainage, Río Villarteaga, XII 1990.

Hemibrycon metae: IAvH 3122 (10), Colombia, Casanare, Aguazul, Cachiza River, Chichaca Creek; III 1995.

Hemibrycon taeniurus: MHNLS 8046 (2), Venezuela, Monagas, Punceres River, to 15 km of Quiriquire (63° 53' 30" N, 63° 9' W); MHNLS 8070 (119), Venezuela, Monagas River, Aragua (bridge on the Becerros Creek), Maturin–Quiriquire Road, ca. 10 km Aragua–Maturin (63° 25' W, 63° 55' N) 100 m a.s.l.; MHNLS 8091 (72), Venezuela, Monagas, Aragua River (bridge on the Becerros Creek, Maturin–Quiriquire road, ca. 10 km Aragua–Maturin (63° 25' W, 63° 55' N) 100 m a.s.l.; MHNLS 8157 (52), Venezuela, Sucre, Parare River, at road 5 km from Grande River, Quiriquire–Cariaco Road (63° 17' W, 10° 19' N), 15 II 1991; MHNLS 8888 (191), Venezuela, Monagas, Aragua River (bridge on the Becerros Creek), Maturin–Quiriquire road, ca. 10 km Aragua–Maturin (63° 25' W, 63° 55' N) 100 m a.s.l.; MHNLS 8891 (6), Venezuela, Monagas, Aragua River (bridge on the Becerros Creek), Maturin–Quiriquire Road, ca. 10 km Aragua–Maturin (63° 25' W, 63° 55' N) 100 m a.s.l.

Hemibrycon microformaa: IUQ 512 (1 paratype), (C. and S.), Colombia, Atrato River Basin, Chintado River, 100 m bridge on the Yuto–Certegui; IUQ 1204 (1 paratype), (C. and S.), Atrato River Basin, Chintado River, 100 m bridge on the Yuto–Certegui.

Hemibrycon pautensis: IUQ 533 (2 paratypes), (C. and S.), Ecuador, Paute River, on the mouth of the Namangoza River.

Hemibrycon polyodon: IUQ 1142 (2), (C. and S.), Ecuador, Antonio–Guadalupe Creek.

Results

Hemibrycon rafaelse n. sp. (table 1, figs. 1–7)

Holotype: ICNMHN 6703, 43.24 mm SL; Colombia, Risaralda, Apia, San Rafael Creek, Apia River system, on the Santuario–Apia road, 12 April 1991.

Paratype: ICNMHN 3505 (50) collected with holotype; IUQ 499 (2) (C. and S.) collected with holotype. IUQ 509 (27); Colombia, Risaralda, Apia, San Rafael Creek in mouth of Apia River, at 100 m of Santuario–Apia Road (5° 04' 54" N, 75° 56' 36" W) 1,253 m a.s.l., 8 VII 2003; MCNG 54101 (5); Colombia, Risaralda, Apia, San Rafael Creek at mouth of Apia River, 100 m from Santuario–Apia Road (5° 04' 54" N, 75° 56' 36" W) 1,253 m a.s.l., 8 VII 2003; MTD F 27623–27624 (2); Colombia, Risaralda, Apia, San Rafael Creek at mouth of Apia River, 100 m from Santuario–Apia Road (5° 04' 54" N, 75° 56' 36" W) 1,253 m a.s.l., 8 VII 2003.

Diagnosis

The new taxon can be distinguished from all congeners by the number of cusps on the row of internal premaxilla teeth (fig. 2) (3–5 vs. 5–7 except *H. surinamensis*, by the number of predorsal scales (10–12 vs. 12–17, except *H. jelskii* and *H. orcesi*) by poscleitrum 1 (fig. 3) (much closer to postcleitrum 2 vs. postcleitrum 1 and 2 clearly separated).

Description

Morphometric in table 1. Body elongate, anteriorly robust, dorsal profile of head convex; area above orbits convex. Dorsal profile of body curved from supraoccipital to dorsal-fin origin, oblique from last dorsal-fin ray to caudal-fin base. Ventral profile of body convex from snout to anal-fin base, convexity more pronounced beyond posterior portion of pectoral fins. Caudal peduncle laterally compressed in all specimens. Head and snout short; jaws equal, mouth terminal; lips soft and flexible, not covering external tooth row of premaxilla; ventral border of upper jaw slightly concave; opening of posterior nostrils vertically ovoid; opening of anterior nostrils with posterior membranous flap.

Six infraorbitals present, all with laterosensory canal; third infraorbital long, wide, with ventral and posterior borders in contact with preopercle. Supraorbital absent. Premaxilla with short lateral process, and two rows of teeth; outer row with 3–5 tricuspid teeth arranged in straight line. Inner row with 3–5 teeth, with central cusp larger. Maxilla short with posterior tip not reaching anterior border of third infraorbital. Maxilla with 8 to 12 teeth, with 1 to 3 cusps, along anterior and ventral border in some specimens (< 40 mm SL). Dentary with 2 to 3 large pentacuspid teeth followed by 8 small teeth with one to three cusps.

Rhinosphenoid cartilaginous and ossified, separated posteriorly from orbitosphenoid by mesethmoid cartilage. Orbitosphenoid with short, narrow apophysis present. Parasphenoid elongate and undivided posteriorly. Mesethmoid cartilage contacting dorsal and lateral margins of rhinosphenoid and extending to anterior extreme of parasphenoid. Anterior portion of parasphenoid covering posterodorsal surface of vomer cartilaginous; posterior portion of parasphenoid in contact with prootic and basioccipital. Nasal bones elongate, the anterior end of the nasal bone lies lateral and dorsal to the external surface of the premaxillar. Seven supra-neurals between head and anterior dorsal fin. Four branchiostegal rays. One to two epurals. 32–34 epineural, 23–24 epipleural, 11–13/12–13 procurrent rays. Dorsal-fin margin oblique, second ray unbranched and first two branched rays longest.

Pectoral girdle with sharp dorsal process on cleithrum reaching one-third length of supra-cleithrum. Cleithrum short. Pelvic-fin short, with tip of fin falling short of anal-fin origin. Pelvic bone elongate, short, straight and pointed; ischiatic process short, curved, with foramen in part upper and without apophysis. Caudal-fin unscaled, bifurcate with short lobe and pointed tips. Caudal-fin rays 10/9. Pored lateral line scales 40–43, extending from supracleithrum to hypural joint. Lateral line pores forming slight curve in ventral direction between first and eighth scales with rest in straight line. Total vertebrae 40–41.

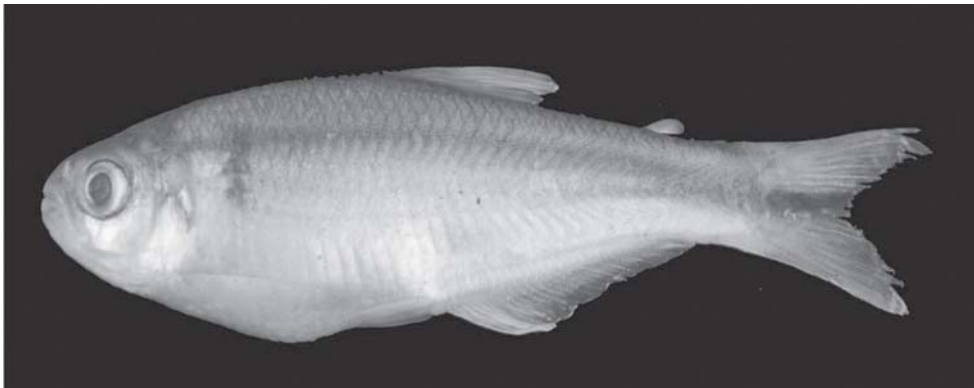


Fig. 1. *Hemibrycon rafaelse*, paratype: MTD F 27623–27624; Colombia, Risaralda, Apia, San Rafael Creek at Apia River mouth, at 100 m of Santuario–Apia Road (5° 04' 54" N; 75° 56' 36" W).

Fig. 1. *Hemibrycon rafaelse*, paratipo: MTD F 27623–27624; Colombia, Risaralda, Apia, arroyo de San Rafael en la desembocadura del río Apia, a 100 m de Santuario–carretera de Apia (5° 04' 54" N; 75° 56' 36" W).

Color in alcohol

Body maroon. Lateral body stripe gray and broad. Dark humeral spot vertically elongate centered on second to fourth scale of scale row just dorsal to lateral line. Distal border of anal and dorsal fins dark. Pectoral and pelvic fins without pigmentation. Chromatophores on middle of caudal fin more intense.

Color in life

Dorsal region greenish–dark, lateral surface sil-

very, more so ventrally. Pectoral and caudal–fins light brown, other fins hyaline. Humeral spot obscure, dark rounded. Middle caudal–fin rays with narrow dark pigmentation, a red spot on ventral portion of caudal fin base.

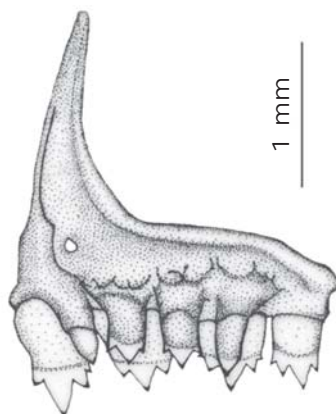


Fig. 2. Premaxillar of *Hemibrycon rafaelse*, lateral view.

Fig. 2. Premaxilar de *Hemibrycon rafaelse*, vista lateral.

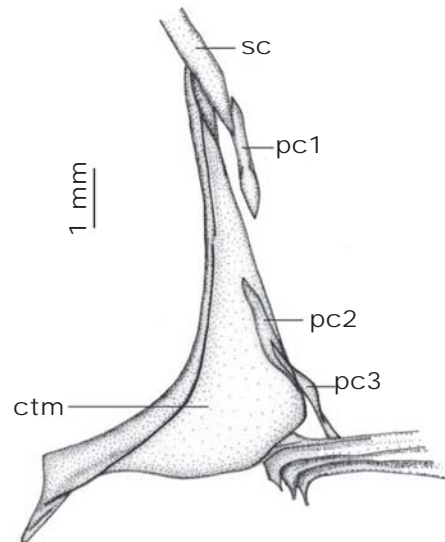


Fig. 3. Left pectoral girdle and fin of *Hemibrycon rafaelse*, lateral view: ctm. Cleithrum; pc. Postcleithrum; sc. Supracleithrum.

Fig. 3. Cintura pectoral y aleta izquierdos de *Hemibrycon rafaelse*, vista lateral: ctm. Cleitro; pc. Postcleitro; sc. Supracleitro.

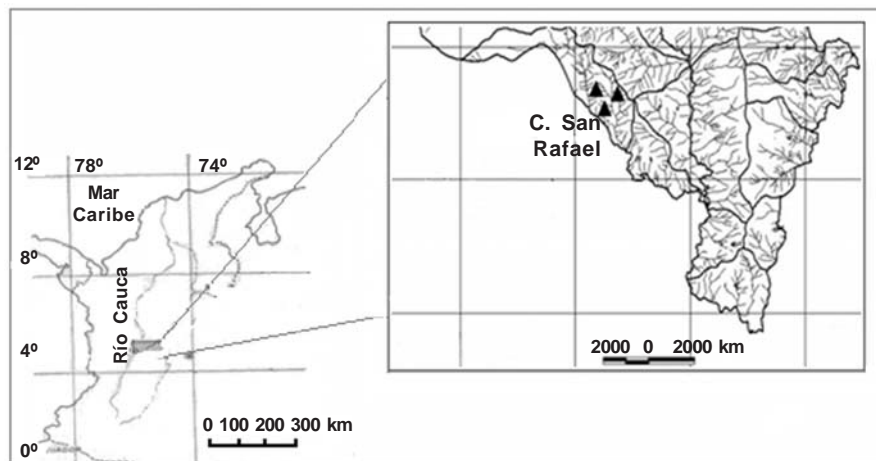


Fig. 4. Distribution of *Hemibrycon rafaelse* (▲ means type locality), Colombia, Risaralda, Apia, San Rafael Creek at Apia River mouth, 100 m from Santuario–Apia Road (5° 04' 54" N; 75° 56' 36" W).

Fig. 4. Distribución de *Hemibrycon rafaelse* (▲ significa localidad tipo), Colombia, Risaralda, Apia, arroyo de San Rafael en la desembocadura del río Apia, a 100 m de la carretera Santuario–Apia (5° 04' 54" N; 75° 56' 36" W).

Sexual dimorphism

The males of *H. rafaelse* presented very small hooks on all except the caudal fin. Hooks were observed on anal–fin rays on the distal end of all branched rays.

Distribution (fig. 4)

San Rafael Creek and Apia River in the Risaralda River system, upper Cauca.

Habitat

Surface temperature 17.7°C, air temperature 17.8°C, dissolved oxygen 8.4 mg/l and 102% saturation, width 1–4 m, substrate stone and sand, water color clear.

Etymology

The specific epithet refers to San Rafael Creek, the drainage system where the new species was collected.

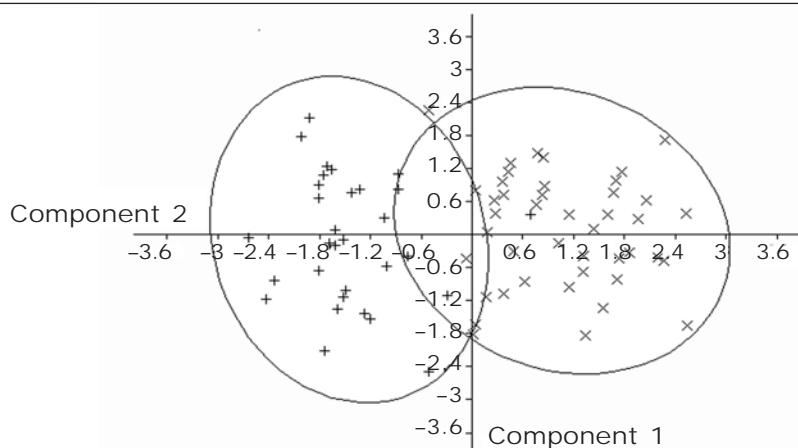


Fig. 5. Principal Component Analysis (PCA) of variation in five meristic data. Circles are the confidence limits exceeding 95% of species *H. boquiae* (+) and *H. rafaelse* (X).

Fig. 5. Análisis de componentes principales (ACP) de la variación de cinco datos merísticos. Los círculos son los límites de confianza que exceden del 95%, de las especies *H. boquiae* (+) y *H. rafaelse* (X).

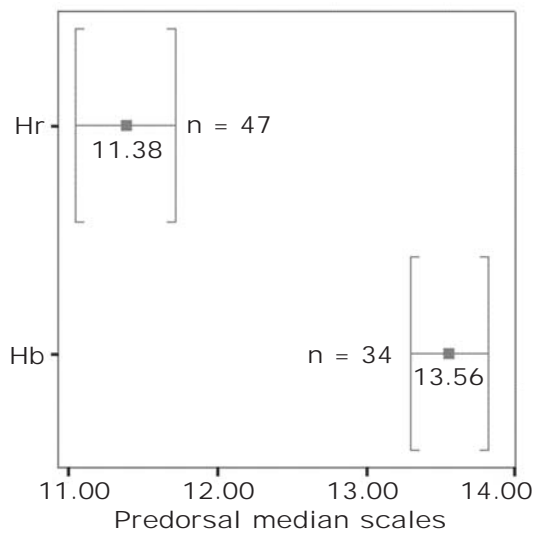


Fig. 6. Bar graphs represent of 99% confidence levels for numbers of predorsal scales between *H. boquiae* (Hb) and *H. rafaelse* (Hr).

Fig. 6. Los gráficos de barras representan el 99% de nivel de confianza para el número de escamas predorsales comparando a *H. boquiae* (Hb) y *H. rafaelse* (Hr).

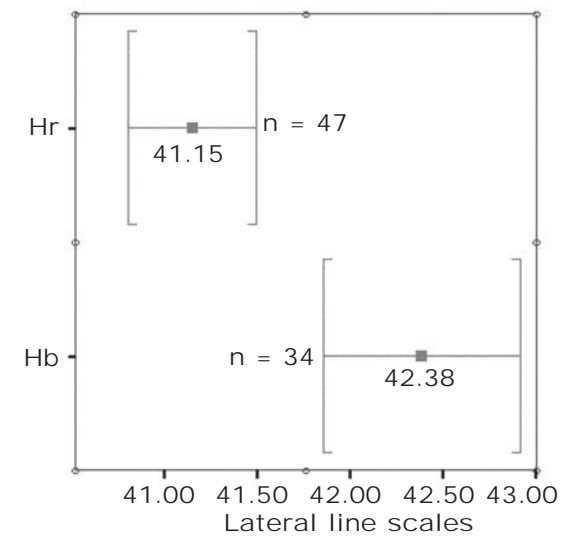


Fig. 7. Bar graphs represent of 99% confidence levels for numbers of lateral line scales with pores between *H. boquiae* (Hb) and *H. rafaelse* (Hr).

Fig. 7. Los gráficos de barras representan el 99% de nivel de confianza para número de escamas de la línea lateral con poros comparando a *H. boquiae* (Hb) y *H. rafaelse* (Hr).

Comments

The morphometric characters provided little information to differentiate *H. rafaelse* from other Rio Magdalena Basin species and populations. Morphological differences between these similar forms are subtle. The first component of the PCA accounted for 40.24% (eigenvalue 2.81) of variability and the second 16.79% (1.17). Only a few specimens of *H. rafaelse* n. sp. overlapped

with individuals of *H. boquiae* (fig. 5). Meristic characters such as predorsal scales number ($P \leq 0001$) (fig. 6) and the number of pored lateral line scales ($P \leq 0001$) (fig. 7) allow the differentiation of *H. rafaelse* from *H. boquiae*. Males of both *H. rafaelse* and *H. boquiae* have very small hooks on all fins, except the caudal fin. This sexually dimorphic character was also reported in *H. divisorensis* (Bertaco et al., 2007).

Key to the species of *Hemibrycon* from the Magdalena River Basin.

Clave para las especies de *Hemibrycon* de la cuenca del río Magdalena.

1	19–25 branched anal–fin rays; males with hooks only on anal and pelvic fins	<i>H. colombianus</i>
	24–28 branched anal–fin rays; males with a few hooks on all fins except caudal	2
2	13–14 predorsal scales; 42–44 line lateral scales; three unbranched anal–fin rays; scales from lateral line to dorsal fin base 5–6	<i>H. boquiae</i>
	10–12 predorsal scales; 40–42 line lateral scales; four unbranched anal–fin rays; scales from lateral line to dorsal fin base 6–8	<i>H. rafaelse</i> n. sp.

Key to the species of *Hemibrycon* from Atrato River Basin, Pacific drainage, Orinoco River and Amazon Basin.

Clave para las especies de Hemibrycon de la cuenca del río Atrato, la vertiente del Pacífico, el río Orinoco y la cuenca del Amazonas.

1	Mature adults less than 40 mm standard length; mandibles unequal in length: superior longer than inferior; mouth subterminal; 14–16 anal fin rays; dentary with two large and two average sized teeth; caudal peduncle lacks dot; five supraneurals; humeral spot on first and second lateral line scales	<i>H. microformaa</i>
	Mature adults larger than 45 mm standard length; mandibles equal, mouth terminal; 19–28 anal fin rays; dentary with one average-sized and three–four large teeth; caudal peduncle with dot; 6–8 supraneurals; humeral spot on third to fifth lateral line scales	2
2	Lateral line rarely incomplete; caudal lobe base with small scales that extend 1/4 of length of caudal fin; caudal peduncle with small round black dot	<i>H. fredcochui</i>
	Lateral line complete; caudal lobe base with large scales that extend 1/4–1/2 of length of caudal fin; caudal peduncle with elongate black dot	3
3	Tips of caudal fin lobes not dotted; medial band on caudal fins extends to the edge of the ventral caudal lobes; dorsal surface of metapterigoid without undulations; 23–26 branched anal–fin rays; 11–13 predorsal scales	<i>H. dariensis</i>
	Tips of caudal fin lobes dotted; medial band on caudal fins does not extend to the edge ventral caudal lobes; dorsal surface of metapterigoide with two undulations; 26–31 branched anal–fin rays; 12–16 predorsal scales	<i>H. metae</i>

Phylogenetic analysis of *Hemibrycon* species is currently underway and is expected to support autapomorphy or diagnostic characters by description of new species from Colombia (Magdalena River) and Ecuador (Amazonian). In the present study we found that the number of teeth on the maxilla is not useful as either a taxonomic or a systematic character.

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