

A new species of *Bryconamericus* (Characiformes, Stevardiinae, Characidae) from the Pacific coast of northwestern Ecuador, South America

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Abstract

A new species of *Bryconamericus* (Characiformes, Stevardiinae, Characidae) from the Pacific coast of northwestern Ecuador, South America.— A new species of *Bryconamericus* (Characiformes, Characidae, Stevardiinae) is described from the Pacific coast of northwestern Ecuador, South America. The new species is distinguished from all congeners by the presence in males of bony hooks on the caudal fin rays (vs. absence). The different layers of pigment that constitute the humeral spots have differing degrees of development and structure that are independent of each other. Brown melanophores are distributed in a thin, vertical, superficial layer of the epithelium (layer 1) and in another deeper (layer 2) that overlaps the first and is centered over the lateral–line. *B. ecuadorensis* has a horizontally oval or elliptical shape layer 2 pigment in the anterior humeral spot (vs. a rectangular or circular layer 2). The new species further differs in having an anterior extension of the caudal peduncle spot (vs. no anterior extension of the caudal peduncle spot) and by having a dark lateral stripe overlaid by the peduncular spot and by the regularly distributed pigmentation on scales on the sides of the body (vs. peduncular spot and other body pigments not superimposed over a dark lateral stripe). Hooks present on all fins of males (vs. hooks present only on anal and pelvic fins of males) distinguishes the new species from *B. dahli*, the only sympatric congener. Seven other diagnostic characters separating the new taxon from *B. dahli* are reported. We also include physical, chemical and biological habitat parameters and analyse the impacts from mining on this new species and other organisms present at the type locality.

Key words: Conservation, Taxonomy, Tropical fish, New taxon, *Bryconamericus ecuadorensis* n. sp.

Resumen

Una nueva especie de *Bryconamericus* (Characiformes, Stevardiinae, Characidae) de la costa pacífica al noroeste de Ecuador, América del Sur.— Se describe una nueva especie de *Bryconamericus* (Characiformes, Stevardiinae, Characidae) de la costa Pacífica al noroccidente de Ecuador, América del Sur. La nueva especie se distingue de todos sus congéneres por la presencia en machos de espinas sobre los radios de la aleta caudal (vs. ausencia). Observamos que las diferentes capas de pigmentos que conforman la mancha humeral registran diferentes grados de desarrollo y estructura que son independientes una de otra. Los melanóforos marrones se distribuyen en una capa delgada, vertical superficial de epitelio (capa 1), y en otra capa más oscura y profunda (capa 2) centrada sobre el canal latero sensorial, ambas sobrepuestas. *B. ecuadorensis* tiene la capa 2 horizontalmente ovalada o de forma elíptica en la mancha humeral anterior (vs. capa 2 de la región humeral rectangular o circular). La nueva especie difiere también por tener una extensión anterior de la mancha en el pedúnculo caudal (vs. sin extensión anterior de la mancha peduncular), por presentar una banda lateral oscura sobrepuesta por la mancha peduncular y por una distribución regular de los pigmentos en las escamas de los lados del cuerpo (vs. mancha peduncular y otros pigmentos del cuerpo no superpuestos sobre la banda lateral oscura). La nueva especie se distingue de *B. dahli*, el único congénere simpátrico, por la presencia de ganchos en todas las aletas de los machos (vs. presencia de ganchos solamente en los radios de las aletas anal y pélvicas de los machos). Además, se reportan siete caracteres diagnósticos adicionales que separan el nuevo taxón de *B. dahli*. Se incluyen también datos sobre los parámetros físicos, químicos y biológicos del hábitat de la nueva especie y un análisis de los impactos causados por la minería sobre esta nueva especie y otros organismos que comparten su hábitat.

Palabras clave: Conservación, Taxonomía, Pez tropical, Nuevo taxón, *Bryconamericus ecuadorensis* sp. n.

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Introduction

Bryconamericus found on the Pacific coasts of Central and South America are *Bryconamericus brevirostris*, *B. bucaiyensis*, *B. dahlí*, *B. emperador*, *B. guaytarae*, *B. miraensis*, *B. peruanus*, *B. simus* and *B. terrabensis* (Román–Valencia, 2000, 2002, 2003; Román–Valencia et al., 2011, 2013; Román–Valencia & Vanegas–Ríos, 2009). From the Pacific versant of Ecuador, four species have been recorded: *B. brevirostris*, *B. bucaiyensis*, *B. dahlí* and *B. simus* (Jiménez–Prado et al., 2015).

The discovery of a new species of *Bryconamericus* from the Pacific versant of western Ecuador is a result of the ongoing revision of *Bryconamericus* (Román–Valencia, 2000, 2002; Román–Valencia et al., 2011, 2013, 2014) by the first author and further demonstrates the undocumented biodiversity of the genus.

Material and methods

Fish were collected using seine nets, preserved in the field in 10% formalin, and later stored in 70% ethanol. Measurements were taken using digital calipers, recorded to hundredths of millimeters and usually expressed as percentages of standard length (SL) or head length (HL) (table 1). Counts were made using a stereoscope with a dissection needle to extend the fins. Counts and measurements were taken from the left side of specimens when possible, according to guidelines in Vari & Siebert (1990). Observations of bones and cartilage were made on cleared and stained adult specimens (C&S) prepared according to techniques outlined in Taylor & van Dyke (1985) and Song & Parenti (1995). Bone nomenclature follows Weitzman (1962) and Vari (1995). In the lists of paratypes, the number of individuals is given immediately after the catalog number, which is followed by the range of standard length in mm (SL) for each lot. For example: MEPN 4004 (2) 63.5–73.9 mm SL indicates two individuals in lot MEPN 4004. The smallest fish was 63.5 mm SL and the largest was 73.9 mm SL. In reporting counts, the values for the holotype are indicated with an asterisk (*). All collections were made in Ecuador. Acronyms used follow Sabaj–Pérez (2010) except CEMZ–p– (Pontificia Universidad Católica del Ecuador sede Esmeraldas, colección de peces). Meters above sea level is abbreviated as m a.s.l. Departamento is translated as Province. Municipio is translated as Canton.

Comparative material

Bryconamericus oroensis (see Román–Valencia et al., 2013)

Bryconamericus dahlí (see Román–Valencia, 2000; Román–Valencia et al., 2013), all from Ecuador: CEMZ–p–107 (3), Esmeraldas Province, San Lorenzo Canton, Wimbí community, 00° 57' 23.4"N–78° 46' 17.9"W, 5 VI 2011. CEMZ–p–220 (28), Esmeraldas Province, Atacames Canton, Las Mareas locality, 00° 50' 25.0"N–79° 50' 01.2"W, V 2012. CEMZ–p–129 (41), Esmeraldas Province, Atacames Canton, Las Brisas local-

ity, 00° 50' 31.1"N–79° 51' 55.5"W, VI 2012. CEMZ–p–309(48), Esmeraldas Province Atacames Canton, Súa locality, Súa River (medio), 00° 46' 43.4"N–79° 53' 26.6"W, VII 2013. CEMZ–p–260 (25), Esmeraldas Province, Atacames Canton, Aguafría community, 00° 43' 08.0"N–79° 51' 26.5"W, VI 2012. CEMZ–p–303 (118), Esmeraldas Province, San Lorenzo Canton, Estero Sabalera, 01° 13' 56.5"N–78° 45' 20.8"W, 21 VI 2013. CEMZ–p–165 (2), Esmeraldas Province, Atacames Canton, Boca de Tazones community, 00° 44' 35.5"N–79° 50' 56.4"W, 7 VII 2012. CEMZ–p–257 (72), Esmeraldas Province, Cumba community, 00° 48' 44.3"N–79° 51' 02.8"W, VI 2012. CEMZ–p–222 (6), Esmeraldas Province, 'Eloy Alfaro' Canton, Maldonado locality, 01° 04' 32.8"N–78° 54' 30.3"W, 21 m a.s.l., 15 III 2012. CEMZ–p–315 (37), Esmeraldas Province, Atacames Canton, Súa River (alto), Súa community, 00° 43' 00.1"N–79° 53' 07.7"W, VII 2013. CEMZ–p–101 (12), Esmeraldas Province, Muisne Canton, Mompiche River, near the community of the same name, 00° 29' 57.4"N–80° 01' 00.5"W, May 2012. CEMZ–p–151 (1), Esmeraldas Province, San Lorenzo Canton, Cayapas River, Zapallo Grande community, 00° 49' 35.9"N–78° 55' 52.9"W, X 2011. CEMZ–p–223 (18), Esmeraldas Province, Atacames Canton, Puente Taseche River, 00° 52' 16.7"N–79° 49' 18.7"W, VI 2012. CEMZ–p–215 (9), Esmeraldas Province, San Lorenzo Canton, Playa de Oro community, Concepción locality, 01° 02' 16.6"N–78° 49' 51.6"W, VI, X, XI 2011. CEMZ–p–217(113), Esmeraldas Province, Atacames Canton, La Unión locality, 00° 48' 48.0"N–79° 52' 01.8"W, VI 2012. CEMZ–p–153(12), Esmeraldas Province, "Eloy Alfaro Canton", Maldonado locality, 01° 04' 32.8"N–78° 54' 30.3" W, 15 III 2012. CEMZ–p–216 (58), Esmeraldas Province, Muisne Canton, Mompiche River, near community of the same name, 00° 29' 53.0"N–80° 00' 52.7"W, V 2012. CEMZ–p–213 (27), Esmeraldas Province, San Lorenzo Canton, San Javier de Cachaví locality, 00° 58' 05.1"N–78° 39' 08.9"W, V, X, XI 2011. CEMZ–p–182(8), Esmeraldas Province, San Lorenzo Canton, Selva Alegre locality, Santiago River, 00° 55' 53.1"N–78° 51' 28.1"W, II 2012. CEMZ–p–297(69), Esmeraldas Province, San Lorenzo Canton, Estero Sabalera, 01° 13' 56.5"N–78° 45' 20.8"W, 23 V 2013. CEMZ–p–115(2), Esmeraldas Province, San Lorenzo Canton, Wimbí community, 00° 57' 23.4"N–78° 46' 17.9"W, 5 V 2011. CEMZ–p–169(16), Esmeraldas Province, Atacames Canton, Repartidero locality, 00° 42' 22.6"N–79° 51' 07.6"W, VI 2012. CEMZ–p–205 (12), Esmeraldas Province, Atacames Canton, Playa Grande locality, 00° 46' 38.2"N–79° 49' 41.5"W, VI 2012. CEMZ–p–239 (36), Esmeraldas Province, Atacames Canton, Puente Atacames locality, 00° 51' 03.9"N–79° 50' 56.2"W, VI 2012. CEMZ–p–223 (22), Esmeraldas Province, Atacames Canton, Puente Taseche River, 00° 52' 16.7"N–79° 49' 18.7"W, VI 2012. CEMZ–p–134(14), Esmeraldas Province, Atacames Canton, Pato locality, 00° 44' 00.7"N–79° 50' 58.6"W, VI 2012. IUQ 3804(1), Esmeraldas Province, Estero María. Canton 'Eloy Alfaro'. San Agustín community, close to the main road. 'Esmeraldas–San Lorenzo, 02° 21' 2.8"N–78° 55' 21.21"W; 21 m a.s.l., 29 IX 2014. IUQ3138 (1, C&S), Mata-

jita River, Mataje tributary one half hour from the Mataje community center, on the road to Rio Mira and Pensamiento Lagoon, 800 m downstream, Pan River locality. IUQ 3140 (1 C&S), 58.32 mm SL, Esmeraldas Province, Pistolosa creek, half hour downstream of "Vargas Torres", IV 1994. IUQ 3806 (33), Esmeraldas Province, Estero Las Antonias, 00° 58' 50,2" N–78° 51' 56" W, 28 m a.s.l., 27 IX 2014. IUQ 3808 (9), Esmeraldas Province, Santiago River, by Estero Las Antonias, 'Eloy Alfaro' Canton, 00° 58' 54,2" N–78° 51' 54,3" W, 24 m a.s.l., 27 IX 2014. IUQ 3809 (51), Esmeraldas, Estero María. 'Eloy Alfaro' Canton, San Agustín community, on main road. Esmeraldas–San Lorenzo, 01° 02' 32,8" N–78° 55' 21,2" W; 21 m a.s.l., 27 IX 2014. IUQ 3811 (75), Esmeraldas, Sabalera River, Reserve La Chiquita, San Lorenzo Canton, 01° 14' 33,2" N–78° 45' 05,5" W, 36 m a.s.l. 27 IX 2014.

Bryconamericus brevirostris (see Román–Valencia et al., 2011, 2013), *B. bucayensis* (see Román–Valencia et al., 2013).

Bryconamericus simus (see Román–Valencia et al., 2013).

Results

Bryconamericus ecuadorensis n. sp. (figs. 1–6; tables 1, 2)

Holotype: IUQ 3813, male, 77.1 mm SL, Ecuador, Esmeraldas Province, Santiago River, 78° 51' 28.1" W, 00° 55' 53.1" N, 24 m a.s.l., VI 2014.

Paratypes: MEPN 11129 (1), 62.8 mm SL, male, Santo Domingo de los Tsáchilas Province, Alluriquín River, km 28, south of Santo Domingo, 79° 08' 25" W, 00° 18' 29" N, 680 m a.s.l., 12 II 1985. MEPN 4004 (5) 63.5–73.9 mm SL, Esmeraldas Province, Estero Tatica, 2 km from Timbre community, 79° 37' 07" W, 00° 50' 26" N, 18 m a.s.l., 20 III 1985. MEPN 3979 (15), 60.5–70.9 mm SL, Esmeraldas Province, Estero Boca del Ónzole, right bank of Guayllabamba River, 450 m from Golondrina Hill, 14 III 1985. IUQ 3141 (1 C&S), 66.1 mm SL, Esmeraldas Province, Estero La Bocana del Cupa 100 m from Puerto Chupa Hill, 11 III 1985. IUQ 3136 (1 C&S), 54.9 mm SL, Esmeraldas Province, Estero Sabalera, 60 m from Chiquita camp, 22 X 1985. IUQ 3147 (1 C&S), 65.2 mm SL,

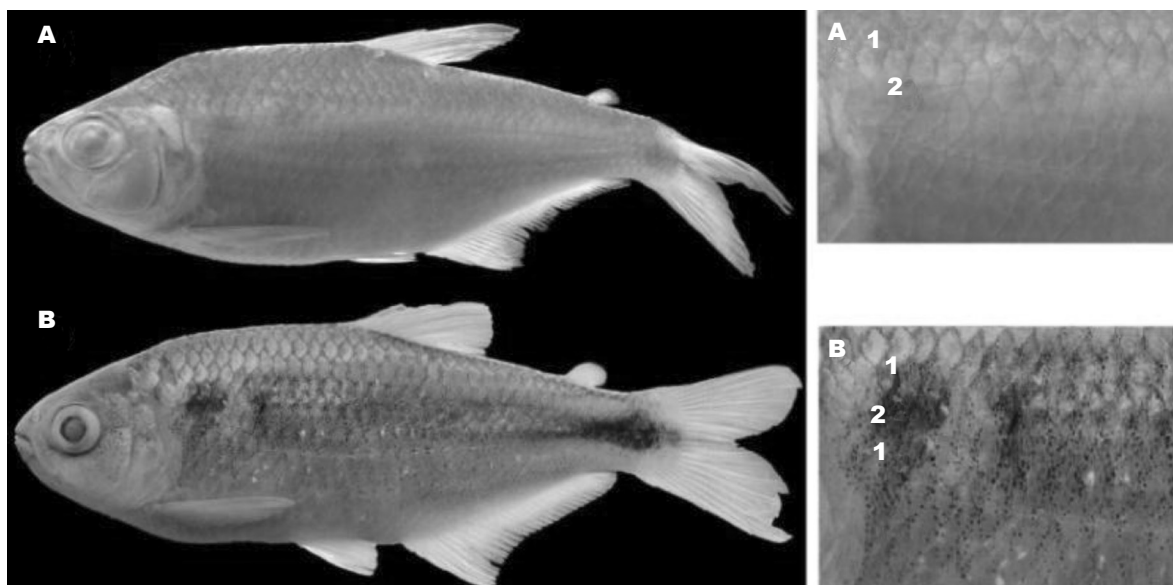


Fig. 1. Distribution of pigment in the humeral region of: A. *Bryconamericus dahli*, paratype IUQ 219 (80.1 mm SL); B. *B. ecuadorensis* n. sp. The anterior humeral spot consists of two overlapping layers of pigment (indicated by numbers 1 and 2) and a third configuration defined as the posterior humeral spot.

Fig. 1. Distribución del pigmento en la región humeral de: A. *Bryconamericus dahli*, paratipo IUQ 219 (80,1 mm LS); B. *B. ecuadorensis* sp. n. La mancha humeral anterior consiste en dos capas superpuestas de pigmento (indicado con los números 1 y 2) y una tercera configuración definida como la mancha humeral posterior.

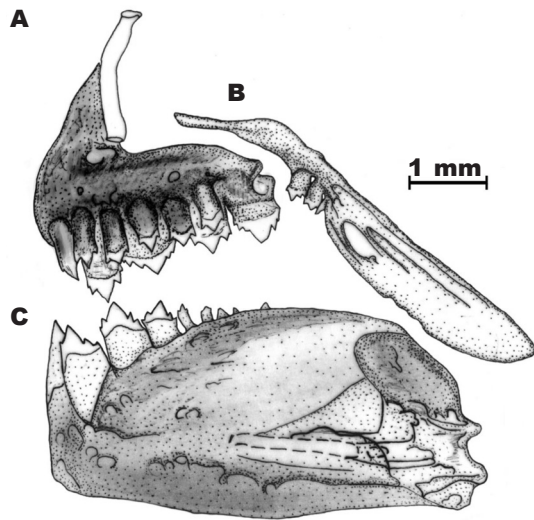


Fig. 2. *Bryconamericus ecuadorensis* n. sp., IUQ 3141 (66.1 mm SL), upper and lower jaws: A. Premaxilla, B. Maxilla, C. Lower jaw.

Fig. 2. *Bryconamericus ecuadorensis* sp. n., IUQ 3141 (66,1 mm LS), mandíbula superior e inferior: A. Premaxilar; B. Maxilar; C. Mandíbula inferior.

Esmeraldas Province, estero Tatica, 2 km from Timbre, 20 III 1985. MEPN 4023 (15), 31.7–65.3 mm SL, Esmeraldas Province, Estero Sabalera 600 m from La Chiquita forestry camp, 78° 45' 19" W, 01° 13' 47" N, 36 to 61 m a.s.l., 22 X 1985. MEPN 11155 (9), 51.2–83.2 mm SL, Santo Domingo de los Tsachilas Province, Río Alluriquín, km 28 on road to Santo Domingo, 79° 08' 25" W, 00° 18' 29" N, 680 m a.s.l., 12 II 1984. MEPN 87158 (20), 38.0–69.4 mm SL, Esmeraldas Province, San Marcos Creek half hour from town, Mira–Mataje River drainage, 78° 32' 12" W, 01° 20' 24" N, 580 m a.s.l., 8 II 1987. MEPN 4042 (1), 51.2–83.2 mm SL, Esmeraldas Province, Estero la Comunidad upstream of confluence with Ónzole River, tributary of the Cayapas River, 79° 00' 48" W, 0° 57' 54" N, 95 m a.s.l., 20 VIII 1985. MEPN 11131 (1), 75.4 mm SL, El Oro Province, Huertas locality, tributary of the Jubones River, 79° 40' 20" W, 03° 35' 40" S, 1,450 m a.s.l., 30 VIII 1978. IUQ 3142 (1 C&S), 54.7 mm SL, Esmeraldas Province, Estero Boca del Ónzole, right bank of Guayllabamba River, 14 III 1985. CEMZ–P–291 (4), 60.5–72.4 mm SL Esmeraldas Province, San Lorenzo, Estero Sabalera, 78° 44' 59,26" W, 01° 15' 39,87" N, 23 V 2013. CEMZ–P–405 (14), 38.5–54.9 mm SL, Esmeraldas Province, Santiago River, 78° 51' 28.1" W, 00° 55' 53.1" N, 24 m a.s.l., VI 2014.



Fig. 3. Sexual dimorphism of *Bryconamericus ecuadorensis* n. sp.: A. Holotype, male, IUQ 3813 (77.1 mm SL); B. Paratype, female.

Fig. 3. Dimorfismo sexual de *Bryconamericus ecuadorensis* sp. n.: A. Holotipo, macho, IUQ 3813 (77,1 mm LS); B. Paratipo, hembra.

Table 1. Morphometric and meristic data of *Bryconamericus ecuadorensis* n. sp. (standard length and total length in mm; SD. Standard deviation).

Tabla 1. Datos morfológicos y merísticos de *Bryconamericus ecuadorensis* sp. n. (longitud estándar y longitud total en mm; SD. Desviación estándar).

	Holotype	Paratypes (n = 90)	SD
Morphometry			
Standard length	77.1	22.56–79.74	0.74
Total length	93.82	28.56–101.1	3.18
Percentages of SL			
Body depth	30.97	25.45–44.19	5.09
Snout–dorsal fin distance	30.97	49.8–56.37	0.65
Snout–pectoral fin distance	25.48	24.36–28.1	0.94
Snout–pelvic fin distance	43.41	42.0–49.6	0.68
Dorsal–pectoral fin distance	39.77	31.91–44.99	3.78
Snout–anal fin distance	59.07	45.72–66.92	0.8
Dorsal fin–hypural distance	51.82	33.58–56.58	0.13
Dorsal–anal fin distance	30.41	24.57–38.89	6.81
Dorsal–fin length	23.88	15.28–33.64	5
Pectoral–fin length	18.81	12.93–30.10	4.05
Pelvic–fin length	13.44	6.18–17.03	0.74
Anal–fin length	14.81	11.03–39.42	5.27
Caudal peduncle depth	12.63	8.0–14.76	0.84
Caudal peduncle length	11.27	6.53–14.86	1.83
Head length	24.23	19.17–28.50	2.55
Percentages of HL			
Snout length	26.5	17.0–31.72	8.22
Orbital diameter	32.87	23.10–45.76	4.3
Postorbital distance	37.53	31.17–51.98	9.27
Maxilla length	31.37	21.86–46.16	1.91
Interorbital distance	40.9	25.27–45.27	0.33
Meristics			
Lateral–line scales	40	36–40	
Scale rows between dorsal–fin origin and lateral line	6	5–7	
Scale rows between anal–fin origin and lateral line	6	5–8	
Scale rows between pelvic–fin and lateral line	6	5–6	
Predorsal median scales	12	10–12	
Dorsal–fin rays	iii, 9	iii, 9	
Anal–fin rays	vi, 27	vi, 25–29	
Pelvic–fin rays	i, 7	i, 7	
Pectoral–fin rays	i, 11, i	i, 10–12, i	
Teeth on maxilla	3	1–3	

Diagnosis

Bryconamericus ecuadorensis n. sp. is distinguished from congeners by the presence in males of bony

hooks on the caudal fin rays (vs. absent). The different layers of pigment that conform the humeral spot(s) have differing degrees of development and structure that are independent of each other. Brown

Table 2. Physicochemical and biological variables in habitat of *Bryconamericus ecuadorensis* n. sp.: 1. Estero Sabalera; 2. Quebrada San Marcos; 3. Estero La Comunidad en boca del Onzole; 4. Rio Santiago; ^a Mosquera (2014); ^b Almeida (2014); ^c CID–PUCESE & PRAS–MAE (2012); ^d CID–PUCESE & PRAS–MAE (2014); ^e Texto Unificado de Legislación Ambiental Secundaria del Ministerio de Ambiente (TULAS): anexo 1, tabla 3; ^f Secretaria Nacional del Agua y PUCESE (2011).

Tabla 2. Variables físicoquímicas y biológicas del hábitat de *Bryconamericus ecuadorensis* sp. n. (Para las abreviaturas, véase arriba.)

	Locality				Limit allowed*
	1 ^a	2 ^b	3 ^{c,d}	4 ^{c,d}	
m a.s.l.	78	580	91	35	
Water temperature °C	27.1	19.8	26.9	23.5	Natural condition + 3°C
Air temperature °C	28.4	21.6	27.3	25.4	Natural condition + 3°C
Dissolved oxygen (mg/l)	–	–	7.66	8.59	> 5
pH	7.1	8.52	7.26	7.14	5 a 9
Turbidity (NTU)	11.63	639	4.67	2,12	100
Conductivity (µs/cm)	35	430	78	29.5	No records
Total solid (mg/l)	–	288	95	5.33	No records
Visible light (cm)	–	–	27.5	70	No records
Hardness	–	–	1.05	0.38	No records
Hg	< 0.0001	–	< 0.0001	< 0.0001	0.0002
Al	–	–	0.13	0.08	0.1
Cr	–	<1	0.19	0.09	0.05
Cu	–	0.04	1.18	0.21	0.02
Cl	–	–	0.62	0.05	0.01
Fe	–	16.3	0.99	0.13	0.3
Zinc	–	–	0.52	0.18	0.18
Mn	–	0.64	0.28	0.2	0.1
Fecal coliforms (nmp/100 ml)		3,500	79 ^f	350 ^f	200

melanophores are distributed in a thin vertical superficial layer of the epithelium (layer 1), and another deeper layer (layer 2, see fig. 1) centered over the lateral–line canal overlaps the first. In *B. ecuadorensis* the anterior humeral spot has a horizontally oval or elliptical shape for pigment layer 2 (vs. layer 2 of anterior humeral spot rectangular or circular) (fig. 1). The new species further differs by having an anterior extension of the caudal–peduncle spot (vs. no anterior extension of caudal peduncle spot) and a dark lateral stripe overlaid by the peduncular spot and by the regularly distributed pigmentation on scales on the sides of the body (vs. peduncular spot and other body pigments not superimposed over a dark lateral stripe), except for *B. oroensis*, from which it differs by the number of unbranched anal–fin rays (vi vs. iii–iv) and by the distribution and number of hooks on the anal and pelvic fin of sexually mature males. *B. oroensis* is found in the Amazon basin in the states of Loja, El Oro and Azyay (Román–Valencia et al., 2013).

Description

Table 1 shows morphometric and meristic data. Body somewhat elongate. Area above orbits flat. Dorsal profile of head and body oblique from supraoccipital tip to dorsal–fin origin and from last dorsal–fin ray to base of caudal fin. Ventral profile of body rounded from snout to base of anal fin. Caudal peduncle laterally compressed. Snout pointed. Head and snout short, jaws equal; mouth terminal, lips soft and flexible, covering the outer row of premaxilla teeth; ventral border of upper jaw not straight; posterior edge of maxilla reaching anterior edge of orbit; opening of posterior nostrils vertically ovoid; opening of anterior nostrils with membranous flap. First dorsal–fin ray vestigial not emerged from skin tissue. Distal tip of pectoral fin surpassing pelvic–fin insertion. Distal tip of pelvic fin not reaching anal–fin origin.

Premaxilla with two rows of teeth and a short lateral process where the maxilla inserts. Five to six teeth of outer row tricuspid, arranged in zigzag. Internal

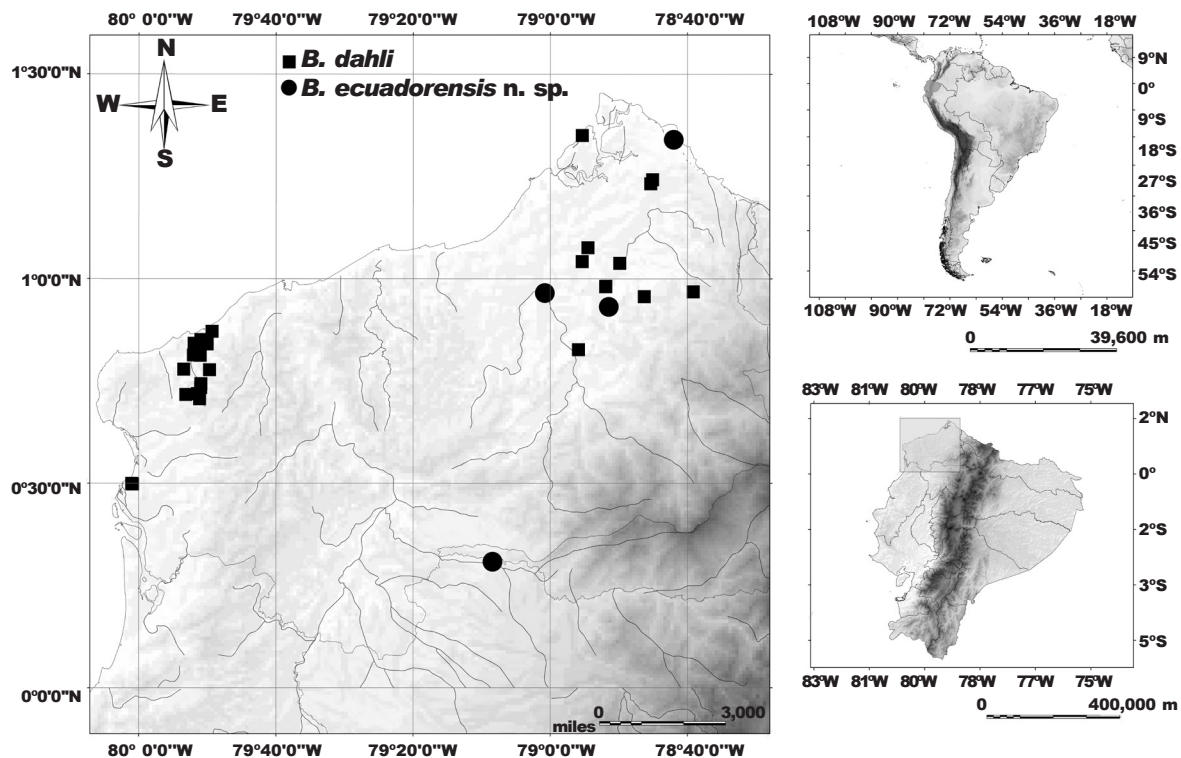


Fig. 4. Distribution and location of *B. ecuadorensis* n. sp. and *B. dahli* in western Ecuador.

Fig. 4. Distribución y localización de *B. ecuadorensis* sp. n y *B. dahli* en Ecuador occidental.

row with four pentacuspoid teeth that do not diminish gradually in size. Posterior tip of maxilla surpasses anterior half of second infraorbital; its anterior margin continuous, with one or two pentacuspoid teeth (fig. 2). Lateral ethmoid lateral surface covered by cartilage. Dentary with four large pentacuspoid teeth with the central cusp largest, followed by six or eight small conical and tricuspoid teeth, the anterior tooth the largest.

Six infraorbitals present, the first long and with sensorial canal running its entire length, reaching posterior margin of antorbital. Second infraorbital short and wide, covering the dorsal part of the angulo-articular. Third infraorbital the widest and longest, its ventral border in contact with the sensorial canal of preopercle. Fourth and fifth infraorbitals short and narrow, covering the dorso-posterior margin of the hyomandibular. Sixth infraorbital covers anterior half of sphenotic foramen over the postero-lateral tip of frontal. Supraorbital absent. Rhinosphenoid present and cartilaginous along border, attached to orbitosphenoid and extending to vomer. Orbitosphenoid wide, short and united to pterosphenoid with or without a band of cartilage. The frontal sensory canal not extended to reach parietal.

Lateral line complete, perforated scales 36–40 (40*, $n = 90$). Scales rows between dorsal-fin origin and lateral line 5–7 (6*, $n = 90$); scale rows between

lateral line and anal-fin origin 5–8 (6*, $n = 90$); scale rows between lateral line and pelvic-fin insertion 5–6 (6*, $n = 90$). Anal-fin rays vi, 25–29 (vi, 27*, $n = 90$); anal-fin origin posterior to vertical through base of first dorsal-fin ray. Dorsal-fin ray iii, 9 (iii, 9*, $n = 90$). Pectoral-fin rays i, 10–12, i (i, 11, i*, $n = 90$). Pelvic-fin rays i, 7 ($n = 90$); pelvic origin anterior to vertical through dorsal-fin origin. Caudal fin not scaled, forked with short pointed lobes, principal rays 1–9/8–1 with 6/9–10 procurrents. Total number of vertebrae 36–37.

Secondary sexual dimorphism

Sexually mature males have rows of hooks on branched anal-fin rays 1 to 26; each simple ray has 15–22 hooks located along the entire length of rays. There are also from 14–16 small hooks on all branched pelvic-fin rays, located on both branches of the rays, also extending along the entire length of rays. Small hooks are also present on pectoral-fin rays located on all branched rays with 10–15 hooks extending on the middle and most posterior portions. Dorsal fin with hooks located on branched rays, with 10–18 hooks found on both branches of rays; short hooks present on caudal-fin rays with 1–12 hooks located on posterior part of 8–10 middle rays. Males have more prominent, darker lateral stripes, deeper and wider caudal peduncles, and thicker caudal-fin

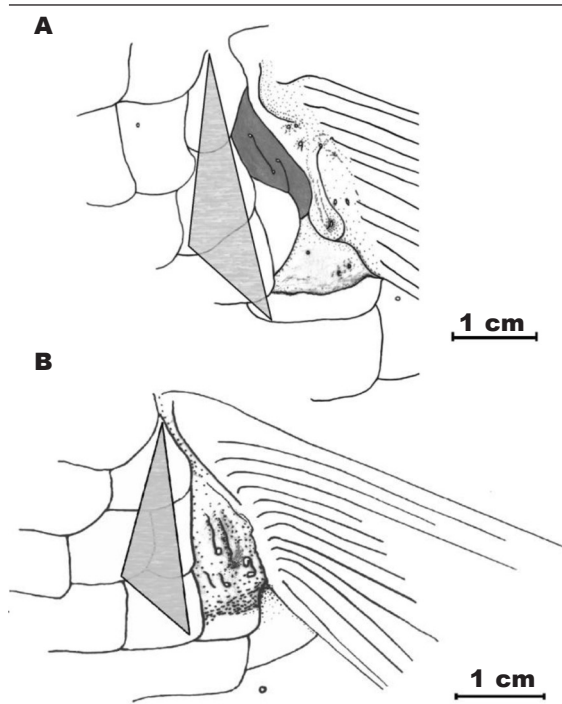


Fig. 5. Pectoral girdle of *B. dahli* (A) and *B. ecuadorensis* n. sp. (B).

Fig. 5. Cintura escapular de *B. dahli* (A) y *B. ecuadorensis* sp. n. (B).

rays than females. Male *B. ecuadorensis* show darker colors, related to higher concentration of melanophores along posterior margins of scales that are strongly concentrated along the lateral stripe and also along the infraorbitals, opercle and lateral surface of the cranium, whereas females have a lighter pigmentation pattern, with only the humeral and peduncular regions pigmented (fig. 3). Thus, males and females have sexually dimorphic pigmentation patterns, a condition rarely observed in other species of *Bryconamericus*, with the exception of *B. oroensis*.

Color in alcohol

Dorsum dark brown. Body with silvery lateral stripe from posterior edge of opercle to base of caudal fin. Anterior humeral spot consists of two overlapping layers of pigment: one layer runs transverse from ventral margin of second layer to posterior margin of opercle and crosses lateral line. The second pigment layer is a horizontal ellipse that extends over the series of scales above lateral line. Posterior humeral spot is present over lateral stripe. The caudal peduncle spot extends over the lateral stripe and continues on the middle caudal-fin rays. Sides and ventral region are yellow from tip of snout to caudal peduncle. Fins hyaline (figs. 1, 3).

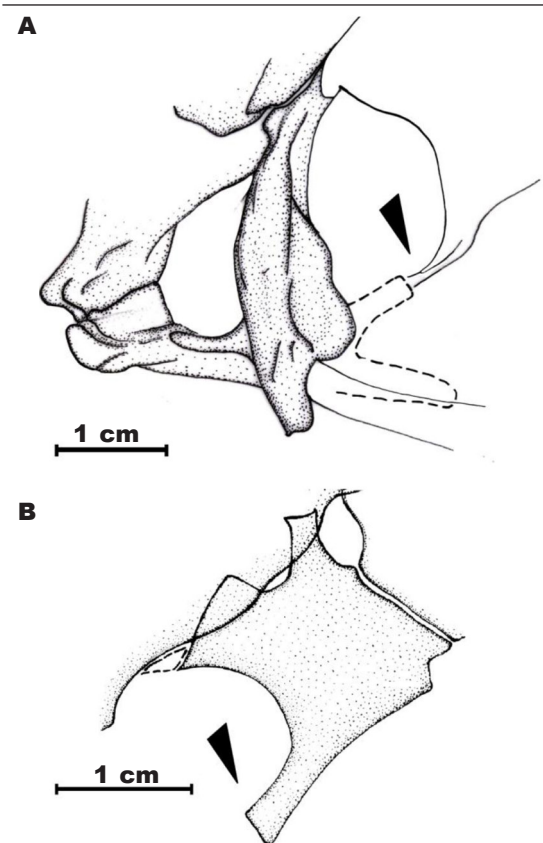


Fig. 6. Orbito-rhinospheoid of *B. dahli* (A) and *B. ecuadorensis* n. sp. (B).

Fig. 6. Órbito y rinosfenoide de *B. dahli* (A) and *B. ecuadorensis* sp. n. (B).

Distribution and ecological notes

This species is known from the La Bocana de Cupa, Boca del Ónzole, Blanco, Sabalera and Atacames Rivers; and the Mataje, Santiago and Súa Rivers, in Esmeralda Province, Pacific versant, northwestern Ecuador and is sympatric with *B. dahli* (fig. 4). *Bryconamericus ecuadorensis* n. sp. was captured in rivers and creeks in lentic habitats over detritus and decomposing vegetal material with low transparency. The pH was near neutral, dissolved oxygen values, conductivity and total solids were high; turbidity and hardness were low (table 2), as is typical of eutrophic environments. These parameters indicate a highly disturbed environment that affects the survival of this new species and those that share its habitat.

Etymology

Bryconamericus ecuadorensis is named for the country of Ecuador, where the type series was collected.

Discussion

The new species presented here differs from the sympatric *B. dahli* by the presence of hooks on all fins in males (vs. hooks present only on anal and pelvic fins). In *B. dahli*, there is a foramen over the lateral tips of the premaxillary that is absent in *B. ecuadorensis*; in *B. dahli*, the teeth of the outer premaxillary row stick out, but in *B. ecuadorensis* they are covered or not visible.

An ongoing analysis has shown seven informative character–states that distinguish *Bryconamericus ecuadorensis* n. sp. from *B. dahli*: (1) margin of pigment layer two of the anterior humeral spot is well defined (vs. irregular in *B. dahli*) (fig. 1); (2) layer two of the anterior humeral spot is horizontally oval or elliptical (vs. rectangular or circular in *B. dahli*); (3) anterior extension of caudal peduncle spot extended over the lateral stripe of the body to reach an imaginary vertical through the last anal–fin pterygiophore I (vs. spot restricted to caudal peduncle); (4) area of dermal tissue beneath pectoral fin narrow, the area narrower than one scale in diameter (vs. area of dermal tissue beneath pectoral fin wider than one scale in diameter) (fig. 5); (5) sheath of scales over pectoral–fin origin consisting of more than four scales (vs. two or three scales) (fig. 5); (6) maxillary teeth orientation vertical, not inclined (vs. maxillary teeth inclined internally); and (7) anterior process of orbitosphenoid not narrowed to filament at union with rhinosphenoid (vs. anterior process of orbitosphenoid narrowed to filament at union with rhinosphenoid) (fig. 6).

Males of some species of Characidae usually have hooks on the anal and pelvic fins but less frequently on the dorsal and caudal fins, a character that has been used as a synapomorphy for several genera of Characidae (Malabarba & Weitzman, 2003). The presence of bony hooks on all fins including the caudal fin is not common for species of *Knodus*, *Hemibrycon*, *Hyphessobrycon* or *Tytocharax*; hooks on all fins of males have only been reported diagnostic in *B. ecuadorensis* described herein, *Hemibrycon brevispini* (Román–Valencia & Arcila–Mesa, 2009), *Hyphessobrycon natagaima* (García–Alzate et al., 2015), *H. togoi* (Miquelarena & Lopez, 2006), *H. taguae* (García–Alzate et al., 2008) and *Tytocharax metae* (Román–Valencia et al., 2012). Moreover, the presence of bony hooks on the rays of the caudal fin of males (vs. absent) is diagnostic for *Acrobrycon* (Arcila et al., 2013) and has been used as a phylogenetically informative character by Mirande (2010) (coded as state 1 but only in some species of Characidae).

Conservation status of the ichthyofauna and in particular *Bryconamericus* from the Pacific slope of northwestern Ecuador

Calvo (2008) listed, for low and highlands in the Andes, common causal elements that typically result in loss of biodiversity and habitat quality: (1) increased human population leading to intensification of resource exploitation; (2) climate change; and (3) pollution from mining activities. While these impacts increase in spatial

extension and local intensity we continue to confront vast information gaps for Neotropical fish distribution, biology and taxonomy (Sarmiento & Barrera, 2008). Gold mining activities have completely destroyed natural waterways in some areas and dangerously increased mercury levels in many species of fish and tadpoles (Carnegie Institution for Science, 2013; Hernández et al., 2013). For the particular case of the fishes in the Pacific versant of Ecuador, and especially those in Esmeraldas Province (the type locality of the new species) in the rivers of the Santiago–Cayapas drainage: Tululbí, Cachaví, Bogotá, Wimbí, Santiago, Estero María, Zabaleta and Zapallito (Rebolledo–Monsalve & Jiménez–Prado, 2013), current conditions are regrettably negative for the survival of fishes and health of human communities, having been affected by both legal and illegal mining activities, uncontrolled tourism, destruction of mangroves and the shrimp cultivation industry (Jiménez Prado, 2012a, 2012b; Rebolledo–Monsalve & Jiménez–Prado, 2013). Levels of Cr, N, V, Co, Hg and S in soils and sediments exceed established maximum limits and heavy metals have been found in the tissues of fishes and other organisms. One example that stands out is the presence of elevated levels of Zn and Cu in tissues of the Cagua (*Gobiomorus maculatus*), in more than ten localities examined from the middle and lower sections of the Santiago–Cayapas River, and also the presence of Hg, Al, As, Cd or Cr, in some of them. The elements analyzed also included Fe, Zinc, Mn, and fecal coliforms were found to exceed the legal limits permitted (table 2).

The type of exploitation observed along the length of the Santiago–Cayapas is not so different from that recorded in other drainages of the Pacific coast, where fluvial gold mining occurs (Idárraga et al., 2010; González, 2013; Hernández et al., 2013). The process is very similar: a cut is made to expose the hillside, and then the area is flooded by blasts of water from high pressure hoses to flush the soil into the sluice where a machine is used to separate gold particles from the remaining matrix of soil and stone. This gravity washing system accelerates erosion and liberates toxic materials from the matrix that then are flushed into the river. This explains why high levels of arsenic have been found in some rivers (CID–PUCESE & PRAS–MAE, 2012, 2014), even though arsenic is not used in the mining process. The huge amounts of sediments dangerously increase the turbidity of the water and downstream transport of materials that directly affect water quality downstream (table 2). This activity has greatly increased since 2008, when there were just a few mines, to over 200 in 2012, along almost the entire length of the Santiago River (Lapierre–Robles, 2012), and the practice shows no signs of diminishing, since gold prices remain high, a fact that underlies the great increase observed since 2008.

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