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***Trichomycterus sketi*: a new species of subterranean catfish (Siluriformes: Trichomycteridae) from the Andean Cordillera of Colombia**

César A. Castellanos-Morales¹

Abstract

A new catfish species belonging to genus *Trichomycterus* Valenciennes (Trichomycteridae) is described. *Trichomycterus sketi* n. sp. was collected in Cueva del Indio located in the upper río Opón basin, Magdalena river system, in the Andean Cordillera, Santander department, Colombia. The new species differs from other species of the genus by having posterior fontanel divided into two widely separated portions; head wider than body; body thin, nearly as deep as wide. The new species is compared with cave species of the genus having restricted distributions in South America and with epigeal species from Colombia.

Key words: troglomorphisms, hypogean catfish, Opón river basin, Magdalena system, Santander department.

Resumen

Una nueva especie de bagre perteneciente al género *Trichomycterus* Valenciennes (Trichomycteridae) es descrita. *Trichomycterus sketi* n. sp. fue colectada en la Cueva del Indio localizada en la cuenca superior del río Opón, sistema del río Magdalena, en el departamento de Santander, cordillera de los Andes de Colombia. La nueva especie se diferencia de otras especies del género por tener la fontanela posterior dividida en dos porciones ampliamente separadas; cabeza más ancha que el cuerpo; cuerpo delgado, casi tan alto como ancho. La especie nueva es comparada con especies cavernícolas del género que tienen distribución restringida en Suramérica y con especies epigeas de Colombia.

Palabras clave: troglomorfismos, bagres hipógeos, cuenca del río Opón, sistema del Magdalena, departamento de Santander.

Introduction

The Neotropical freshwater family Trichomycteridae is a large group of small-sized catfishes widely distributed in Central and South America, on both sides of the Andes from sea level to 4500 m above sea level (de Pinna y Wosiacki 2003; Nelson 2006). Trichomycteridae represents one of the richest groups of Siluriformes with approximately 241 valid species

in 41 valid genera (Datovo y Bockmann 2010; Ferraris 2007). The genus *Trichomycterus* Valenciennes, 1832 has approximately 114 nominal species, but many additional species have been recently discovered and described (*e.g.*, Castellanos-Morales 2007, Fernández y Chuquihuamaní 2007, Fernández y Miranda 2007, Ardila-Rodríguez 2008, Barbosa y Costa 2008,

Castellanos-Morales 2008, Lima *et al.* 2008, Wosiacki y de Pinna 2008a, b, Fernandez y Vari 2009, Barbosa y Costa 2010). The monophyly of *Trichomycterus* has been questioned by Baskin (1973), de Pinna (1989), Costa y Bockmann (1993) and Wosiacki (2002). Most recently Datovo y Bockmann (2010) demonstrated the non-monophyly of *Trichomycterus* in a phylogenetic analysis based on dorsolateral head muscles wherein several species were recovered as more closely related to species of *Bullockia* and *Hatcheria* than to other *Trichomycterus*.

Brazil and Venezuela are distinguished in the South American Neotropics by having remarkably diverse subterranean ichthyofaunas. Brazil has 21 species described and at least two unpublished reports of hypogean populations (Bichette y Trajano 2008). In Venezuela three troglobitic catfishes have been described from the Sierra de Perijá, Río Guasare system (DoNascimento *et al.* 2004): *Ancistrus galani* Pérez y Vilorio, *Rhamdia guasarensis* DoNascimento, Provenzano y Lundberg, and *Trichomycterus spelaeus* DoNascimento, Villarreal y Provenzano.

In Colombia the hypogean ichthyofauna is poorly known. To date, only three species have been described from subterranean environments, all from Santander department, northeastern Andean Cordillera. All of them belong to the catfish genus *Trichomycterus*: *T. sandovali* Ardila-Rodríguez, Don Juan Cave; *T. santanderensis* Castellanos-Morales, El Puente Cave; *T. uisae* Castellanos-Morales, El Misterio Cave. These species exhibit troglomorphic characteristics (e.g., some degree of eye and pigmentation reduction beyond that observed in their epigeal congeners), indicating a troglobitic condition. A new species of hypogean *Trichomycterus* from Cueva del Indio in the upper Opón river basin, southwestern Santander department, Colombia, is herein described.

Material and methods

Methodology and terminology for measurements and counts follow de Pinna (1992). Measurements were taken point-to-point with dial calipers on the left side of each specimen with the aid of a stereomicroscope. Measurements are presented as percentage of standard

length (SL) and as percentage of head length (HL). Osteological data were obtained from two specimens cleared and stained (CyS) following the procedure of Taylor y Van Dyke (1985). Counts of odontodes, teeth and branchiostegal and procurrent rays were based only on CyS specimens. Osteological nomenclature follows de Pinna (1989) except urohyal is replaced by parurohyal because the so-called urohyal in catfishes does not entirely correspond to the urohyal of other teleosts (Arratia y Schultze 1990). Color was determined according to the Munsell soil color chart (1994). Morphological data of troglomorphic species, with the exception of *Trichomycterus santanderensis* Castellanos-Morales, 2007 and *T. uisae* Castellanos-Morales, 2008, were based on Durand (1968), Trajano y de Pinna (1996), DoNascimento *et al.* (2001) and Ardila-Rodríguez (2006).

Acronyms and abbreviations

ANSP = Ichthyological Collection of the Academy of Natural Sciences of Philadelphia, CAC-CDMB = Colección Ictiológica de César Castellanos-Corporación Autónoma para la Defensa de la Meseta de Bucaramanga, IAvH-P = Colección de Peces de Agua Dulce del Instituto Alexander von Humboldt, MBUCV-V = Museo de Biología de la Universidad Central de Venezuela, MLS = Museo de Historia Natural La Salle de Bogotá, UIS-T = Colección Ictiológica de la Universidad Industrial de Santander. HL = head length, SL = standard length, M = Munsell soil color chart.

Results

Trichomycterus sketi, new sp.

Holotype. CAC-CDMB 104, 61.5 mm SL, Colombia, departamento de Santander, Municipio La Paz, vereda Casas Blancas, Cueva del Indio (73°05'18"W, 6°50'21"N, elevation 2157 m), upper Opón river basin, Magdalena river system, 10 Jan 2008. César Castellanos-M., Laura Lucía Marino-Zamudio.

Paratype. Six specimens all collected with the Holotype. ANSP 189652, 60.0 mm SL, CAC-CDMB 105, 55.9 mm SL, CAC-CDMB 110, 2, CyS,

45.2-55.3 mm SL. IAvH-P 11806, 2, 45.7 mm SL, MBUCV-V-35641, 45.6 mm SL, MLS 1256, 20.5, mm SL. UIS-Th 1718, 43.8 mm SL.

Non-type material. All collected at type locality. CAC-CDMB 139, 49.1 mm SL, 10 Feb. 2009. MBUCV-V-35642, 45.0 mm SL, 10 Jan 2009. C. Castellanos-M., L. Marino-Zamudio.

Diagnosis. *Trichomycterus sketi* is distinguished from both epigeal and cave restricted species of the genus by having posterior fontanel divided into two widely separated openings, anterior opening with triangular

shape pointed posteriorly, and posterior opening with triangular or sub-conical to circular shape, the former pointed anteriorly (Figure 3). The following combination of characters yet useful for identification, and shared with various other species of *Trichomycterus* include: head relatively deep (45.6-54.1% of HL); mouth narrow (39.3-45.3% of HL); nasal, maxillary and rictal barbels longer (71.4-95.3%, 89.3-112.8% and 50.8-64.1% of HL, respectively), tip of maxillary barbel surpassing pectoral-fin origin; 10 to 14 opercular odontodes; posteriormost



Figure 1. *Trichomycterus sketi*, holotype, CAC-CDMB 104, 61.5 mm SL. Cueva del Indio, upper Opón river basin, Santander, Colombia. Lateral view of the right side.

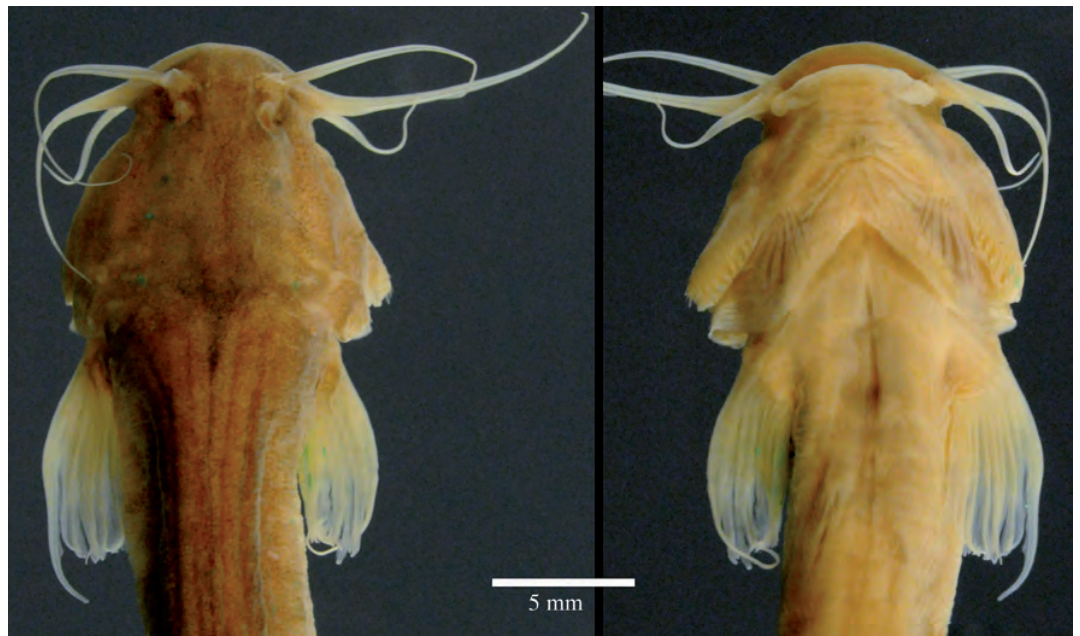


Figure 2. *Trichomycterus sketi*, paratype, ANSP 189653, 61.5 mm SL. Cueva del Indio, upper Opón river basin, Santander, Colombia. Dorsal view of head. Photo courtesy of Mark Sabaj Pérez ANSP.

branchiostegal rays considerably longer than anterior ones (Figure 4); tip of first pectoral ray prolonged as medium length filament (44.9-55.6% of pectoral-fin length); pelvic-fin origin anterior to vertical through dorsal-fin origin, pelvic fin covering urogenital papilla, not reaching origin of anal fin; caudal fin obliquely rounded, upper portion of caudal-fin slightly longer than lower portion; body color pattern plain dark-gray without spots (see also Discussion).

Description. Morphometric data presented in Table 1. Body elongated, thin, nearly as deep as wide; dorsal profile of trunk shallowly convex, becoming slightly deeper toward caudal peduncle. Head depressed, wider than body, trapezoidal shape in dorsal view; dorsal profile of head straight, ventral and lateral profiles convex. Eye small (3.1 - 9.3% HL) positioned dorsally on anterior half of head. Mouth subterminal,

with corners oriented posteriorly. Lower lip with conspicuous fleshy lateral lobes. Teeth conical, recurved, arranged in three irregular rows in both jaw. Jaw muscles not particularly developed and not bulging from surface of head. Neurocranium with three middorsal fontanels, anterior fontanel small with trianglular shape pointed anteriorly, confined by paired frontals, at level of infraorbital canal exit from neurocranium; posterior fontanel widely separated into two openings, anterior opening (Figure 3: pf₁) with trianglular shape pointed posteriorly, confined by paired frontals, posterior opening (Figure 3: pf₂) with trianglular or sub-conical to circular shape, the former pointed anteriorly, located in posterior portion of supraoccipital bone.

Thick branchial membranes united to isthmus at anterior medial point, forming a free fold across isthmus. Gill openings free. Seven branchiostegal rays, posteriormost branchiostegal rays considerably longer than anterior ones (Figure 4). Nasal and

Table 1. Morphometric measurements in *Trichomycterus sketi*. H: holotype; P: paratype. Standard length expressed in millimeters. Measurements 2 to 11 expressed in percentage of standard length (SL), Measurements 12 to 19 expressed in percentage of head length (HL).

	Character	H	P (n=6) Range	Mean
1	Standard length	61.5	38.1-60	60.9
2	Total length	114.8	115.3-121.4	116.3
3	Body depth	9.7	10.4-13.3	11.2
4	Predorsal length	59.9	57.9-64.2	60.5
5	Prepelvic length	57.2	55.7-61.5	57.5
6	Preanal length	69.3	65.2-76.4	69.9
7	Caudal peduncle length	21.7	21.9-24.5	23.1
8	Caudal peduncle depth	12.8	9.9-14.7	12
9	Dorsal-fin base length	10.3	9-10.7	10.2
10	Pelvic-fin base length	2.1	1.9-2.2	2.1
11	Head length	19.4	18.8-22.2	20.2
12	Head width	96.1	101.6-113.1	104.4
13	Head depth	50.4	45.6-54.3	52.8
14	Mouth width	40.9	39.3-45.3	42.3
15	Eye diameter	5.7	3.1-9.3	6.9
16	Interorbital width	35.1	29.3-36.1	32.6
17	Nasal barbel length	94.8	71.5-95.4	85.3
18	Maxillary barbel length	102.7	89.4-112.7	97.8
19	Rictal barbel length	64.1	50.8-62.9	57.9

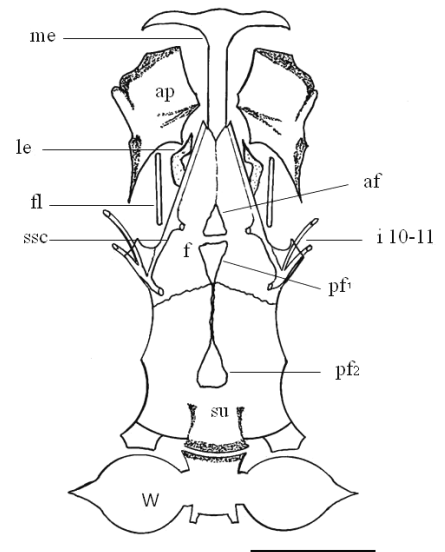


Figure 3. Dorsal view of the neurocranium of *Trichomycterus sketi*. CAC-CDMB 110, 55.3 mm SL. af: anterior fontanel; ap: autopalatine; f: frontal; fl: fronto-lachrymal tendon bone; i10-11: infraorbital sensory pores 10-11; le: lateral ethmoid; me: mesethmoid; pf₁: anterior portion of posterior fontanel; pf₂: posterior portion of posterior fontanel; soc: supraoccipital; ssc: supraorbital sensory canal; w: Weberian capsule. Scale bar=1 mm.

maxillary barbels extend beyond opercular patch of odontodes and surpass base of pectoral fin, maxillary barbel extending further than nasal barbel. Anterior nostril surrounded by slightly raised thick integument continuous with nasal barbel, both forming a tubular-shaped structure around nostril. Posterior nostril oriented transversely, its anterior edge delimited by a thin and long flap of integument. Interopercular patch of odontodes well developed, with 29 to 34 conical and elongated odontodes arranged in four irregular rows, larger odontodes along posterior edge. Opercular patch of odontodes small, with 10-14 conical odontodes arranged in three irregular rows.

Ten dorsal-fin rays (iv,6) with two anteriormost unbranched rays apparent only in CyS specimens; dorsal fin rounded, origin located posterior to SL midpoint; first pterygiophore inserted between neural spines of free vertebra 17-18. Ten pectoral-fin rays (i,9), pectoral fin rounded, first ray thin and fragile, prolonged as medium length filament; scapulocoracoid with a long anteriorly directed process, located close to single unbranched pectoral-fin ray base. Five pelvic-fin rays (i,4) externally visible, posterior edge of fin surpasses urogenital opening; pelvic-fin origin slightly anterior to dorsal-fin origin; pelvic fins not widely separated at base; pelvic basipterygium with two long anterior processes slender from base to

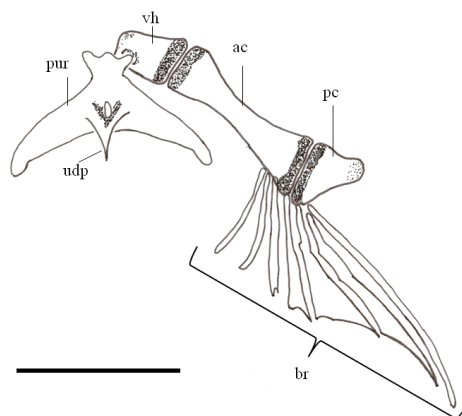


Figure 4. Left hyoid arch of *Trichomycterus sketi*. CAC-CDMB 110, 55.3 mm SL. Ventral view. Abbreviations: ac, anteriorceratohyal; br, branchiostegal rays; pc, posterior ceratohyal; vh, ventral hypohyal; pudp, parurohyal ventral process; pur, parurohyal. Scale bar = 1 mm.

distal tip, one or two medial processes and one short posterior process. Seven anal-fin rays (ii,v); anal fin similar to dorsal fin but smaller, its origin below that of last dorsal-fin ray; first pterygiophore inserted between the hemal spines of free vertebrae 20-21.

Thirteen caudal-fin rays; caudal fin obliquely rounded; 7 rays associated with parhypural + hypural 1+2, 4 rays on hypural 3+4, and 2 rays on hypural 5. Caudal skeleton with neural spine of preural centrum 2 well developed. Hypurals 1+2 sutured to parhypural, sometimes slightly separated near distal edge; hypural 3 largely fused to hypural 4 but slightly separated near distal edge, hypural 5 narrowly separated from hypural 3+4 for entire length (Figure 5). Procurent rays 16-18 dorsal and 12-14 ventral. Anal and urogenital opening closer to pelvic-fin base than to anal-fin origin, totally covered when pelvic fin folded.

Thirty-five free vertebrae. Eleven to twelve paired ribs.

Coloration. In live specimens body color light-gray (M 10YR - 5/6) to dark gray; base of all fins with yellow tones from base to edge (M 5YR - 6/8 to M 2.5Y - 7/6). Nasal and maxillary barbels with a thinner dark gray band from base to tip. Smaller specimen has narrow, grayish blue stains, lateral band from dorsal fin to caudal fin. Specimens preserved in alcohol vary between yellow-brownish (M 10YR - 5/6) and dark gray; base of all fins with light-yellow tones (M 2.5Y).

Etymology. Named in honor of Boris Sket, who reported the existence of this new species of *Trichomycterus* in his speleobiological investigation of the Colombian Andes (1988).

Ecological data. The Cueva del Indio is located seven kilometers south of the municipio La Paz on the east side of Serranía de los Yariquíes; at 2200 meters above sea level in departamento de Santander, Colombia. The entrance to the cave is not connected to an epigeal stream and is covered by cloud forest (Figure 6a) and some swampy bottomland (Figure 6b). The cave is fed by water jets which percolate through the ceiling near the entrance and flow inwards (Sket 1988). Among its 860+ m of explored passages are found many galleries formed by gently sloped tunnels and passageways. During the dry season, isolated sump

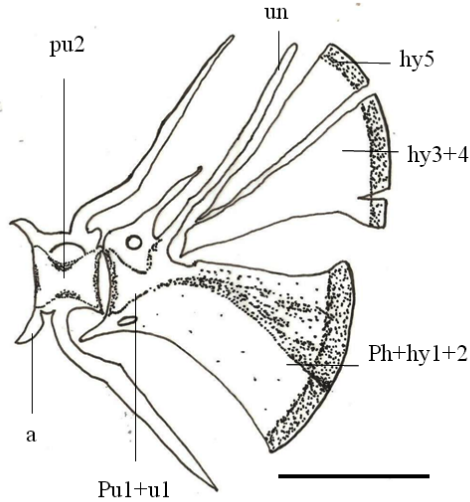


Figure 5. Caudal skeleton of *Trichomycterus sketi*. CAC-CDMB 110, 55.3 mm SL. a: apophysis; hy 1-5: hypurals 1-5; un: uroneural; ph: parhypural; pu1+u1: preural centrum 1+ural centrum 1; pu2: preural centrum 2. scale bar=1 mm.

pools in each gallery were observed. The bottom of the wells is rocky and contains much sediment composed chiefly of bat excrement. The cave is inhabited by bats, crickets, and gastropods. Some cydnid bugs (Hemiptera: Heteroptera) and Diptera were found inside the wells. Water temperature during sampling was 15 °C and cave temperature was 17.5 °C.

Discussion

Trichomycterus sketi is a normally pigmented species. A few specimens exhibit reduced eyes. Despite the fact that the new species was sampled from a subterranean population, characters used to identify troglomorphic species such as reduction in pigment (Trajano y de Pinna 1996, Romero y Paulson 2001, Bichuette y Trajano 2008), or cutaneous folds encircling body (Castellanos-Morales 2008), are not well defined in *T. sketi*. For this reason, the new species is considered hypogean but not troglomorphic.

The division of the posterior fontanel into two separated orifices is the most remarkable feature of the skull of *Trichomycterus sketi*. This condition suggests a derived state of the morphological patterns described for congeners (e.g., Baskin 1973, Arratia 1983, Arratia y Menu-Marque 1984, de Pinna 1989, Rojas *et al.* 1997, Fernández y Chuquihuamani 2007, Castellanos-Morales 2008), which possess a large, elongate posterior fontanel (except *T. cachiraensis* Ardila-Rodríguez, 2008.)

The posterior cranial fontanel reduced on the posterior portion of parieto-supraoccipital is a sympomphy for *Ituglanis* (Costa y Bockmann 1993). This condition is also present in an epigeal species belonging to the genus *Trichomycterus*: *T.*



Figure 6. Type locality of *Trichomycterus sketi*. A: Outside of Cueva del Indio. B: Inside Cueva del Indio, upper Opón river basin, Magdalena river system, Santander, Colombia.

cachiraensis. *Trichomycterus sketi* has the posterior fontanel divided into two opening (pf_1 , pf_2) of which, the posterior orifice (pf_2) is variably reduced. *Ituglanis* and *T. cachiraensis*, however, has only one posterior fontanel. A comprehensive analysis of the reduction of posterior cranial fontanel could provide evidence supporting a hypothesis of monophyly of *T. sketi* + *T. cachiraensis* + *Ituglanis*.

Among the hypogean *Trichomycterus* species from South America, *T. sketi* is further distinguished from *T. chaberti*, *T. itacarambiensis*, *T. sandovali*, *T. santanderensis*, *T. spelaeus* and *T. uisae* by the absence (vs. presence) of troglomorphic characters such as reduction in pigment and cutaneous folds encircling body. Furthermore, *T. sketi* differs from *T. sandovali* and *T. spelaeus* by the presence (vs. absence) of eyes, and origin of pelvic fin anterior to vertical through the dorsal-fin origin (vs. vertically aligned). *Trichomycterus sketi* differs from *T. santanderensis*, *T. spelaeus* and *T. uisae* by the absence (vs. presence) of cutaneous folds forming vertical rings. *Trichomycterus sketi* differs from *T. uisae* by having anterior and posterior openings of posterior fontanel well separated (vs. anterior and posterior openings of fontanel connected by a channel) and 10 pectoral fins rays (vs. 9). The new species is distinguished from *T. chaberti* by the presence of 10 pectoral fins rays (vs. 9). *Trichomycterus sketi* differs from *T. itacarambiensis* in pigmentation: dark gray without spots (vs. small, irregular, roundish dark spots), 10 pectoral fins rays (vs. 6-7), and anal and urogenital openings closer to pelvic-fin base than to anal-fin origin (vs. anal and urogenital openings nearly equidistant from bases of anal and pelvic fins).

Of the 27 species of *Trichomycterus* reported from Colombia (Castellanos-M 2008, Castellanos *et al.* 2011), only three are restricted to subterranean environments and exhibit troglomorphic characters. One epigeal species, *T. gorgonae*, is restricted to Gorgona Island off the Pacific coast, and 23 species inhabit different epigeal environments from sea level to more than 4000 m above sea level.

Of the epigeal species, there are 15 species distributed in the Cordillera Andina; of which, only one species has been reported from Opón river basin: *T. transandianus* (Castellanos-Morales *et al.* 2011).

However, *T. transandianus* has incisive teeth vs. conical teeth in *T. sketi*. The following Inter-Andean species of *Trichomycterus* from Colombia share conical teeth, like those of *T. sketi*: *Trichomycterus banneai*, *T. bogotense*, *T. cachiraensis*, *T. latistriatus*, *T. nigromaculatus*, *T. ruitoquensis*, *T. retropinnis*, *T. straminius* and *T. striatus*. *Trichomycterus sketi* differs from *T. banneai* by the obliquely rounded shape of caudal-fin (vs. emarginate caudal fin) and 10 pectoral fin rays (vs. 8). *Trichomycterus sketi* differs from *T. bogotense*, *T. latistriatus*, *T. nigromaculatus* and *T. retropinnis* by having body dark gray without spots (vs. with irregular spots) and 10 pectoral fin rays (vs. 8-9). *Trichomycterus sketi* differs from *T. straminius* by having pelvic-fin origin anterior to that of dorsal fin (vs. origins of pelvic and dorsal fins vertically aligned) and 10 (vs. 9) pectoral fin rays. *Trichomycterus sketi* differs from *T. cachiraensis*, *T. ruitoquensis* and *T. striatum* by having body plain dark-gray without rows of spots (vs. one to three rows of spots) and 10 (vs. 8-9) pectoral fin rays.

Comparative material. *Trichomycterus bogotense*, MLS 25, 3, Colombia: municipality of Guasca - Cundinamarca. *Trichomycterus latistriatus*, MLS 850, 1, Colombia: municipality of Machetá - Cundinamarca. *Trichomycterus retropine*, IAvH-P 99, 2, Colombia: Santander: Suarez river basin. *Trichomycterus ruitoquensis*, IAvH-P 4342, 2, Colombia: Santander: upper Lebrija river basin: río Frío. *Trichomycterus santanderensis*, CAC-CDMB 35, holotype, Colombia: upper Lebrija river basin: El Puente Cave. *Trichomycterus straminius*, IAvH-P 440, 3, Colombia: Santander: Suarez river basin. *Trichomycterus striatus*, CAC-CDMB 111, 4, Colombia: Santander: Sogamoso river basin: río Chicamocha. *Trichomycterus uisae*, CAC-CDMB 072, holotype, Colombia: upper Sogamoso river basin: El Misterio Cave.

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