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AN ENDEMIC CATFISH FROM THE SIERRA FAMATINA: NEW DATA AND RECORDS OF *Trichomycterus pseudosilvinichthys* (SILURIFORMES, TRICHOMYCTERIDAE)

Un bagre endémico de la Sierra Famatina: nuevos datos y registros de Trichomycterus pseudosilvinichthys (Siluriformes, Trichomycteridae)

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Abstract. The pauperized ichthyofauna of the La Rioja Province consists of 15 species native fishes, six of which are members of the Trichomycteridae Family (*Trichomycterus alterus*, *T. corduensis*, *T. hualco*, *T. pseudosilvinichthys*, *T. riojanus* and *Hatcheria macraei*). We report the first record of *Trichomycterus pseudosilvinichthys* at elevation above 2,500 m at the Sierra Famatina, near La Mexicana mine, Departamento de Famatina. Some specimens of *T. pseudosilvinichthys* from two streams (Puerto Alegre and Guanchin) show losses of the pelvic-fin and girdle; a pattern perhaps reflecting an underlying propensity for the loss of this system in Trichomycteridae. At present, members of this species are threatened by anthropogenic activities, such as mining (copper, gold and lithium) and introduced salmonids (rainbow trout).

Key words. Mountain catfish, endemic, La Rioja, Northwestern of Argentina, pelvic-fin loss

Resumen. La ictiofauna poco diversa de la Provincia de La Rioja la constituyen 15 especies de peces autóctonos, seis de los cuales son miembros de la Familia Trichomycteridae (*Trichomycterus alterus*, *T. corduensis*, *T. hualco*, *T. pseudosilvinichthys*, *T. riojanus* y *Hatcheria macraei*). *Trichomycterus pseudosilvinichthys* es registrado por primera vez a una altura superior a los 2.500 m en la Sierra Famatina, próxima a la mina La Mexicana, Departamento Famatina. Algunos ejemplares de *T. pseudosilvinichthys* de dos arroyos (Puerto Alegre y Guanchin) muestran pérdidas de la aleta y cintura pélvica, reflejando la tendencia de la familia Trichomycteridae a la reducción de estas estructuras. En la actualidad, los miembros de esta especie se encuentran amenazados por actividades antrópicas como la minería (cobre, oro y litio) y la introducción de salmónidos (trucha arco iris).

Palabras clave. Bagre de montaña, endémico, La Rioja, Noroeste de Argentina, aleta pélvica reducida

INTRODUCTION

Trichomycterus (Valenciennes 1846) presents a wide distribution in Central and South America, ranging from the lowlands of the Atlantic Forest to high elevations streams of the Andean Mountains (Fernández and Vari 2012, Reis *et al.* 2020, Reis and de Pinna 2022). The Sierra Famatina corresponds to the Sierras Pampeanas system and begins in the Puna and crosses the provinces of Catamarca and La Rioja in a north-south direction (Aniello 1946). The complex topography and diversity of habitats of Andean Argentina may account for the speciose trichomycterid fauna in the region including 19 species of *Trichomycterus*, eight of which (*T. belensis* Fernandez and Vari 2002, *T. catamarcensis* Fernandez and Vari 2002, *T. hualco* Fernandez and Vari 2002, *T. pseudosilviniichthys* Fernandez and Vari 2002, *T. puna* Fernandez *et al.* 2023, *T. ramosus* Fernandez 2000, *T. varii* Fernandez and Andreoli Bize 2018, and *T. yuska* Fernandez and Schaefer 2003) are endemic to the area, whereas the rest (*T. alterus* (Marini, Nichols and La Monte 1933), *T. areolatus* Cuvier and Valenciennes 1846, *T. barbouri* (Eigenmann 1910), *T. borellii* Boulenger 1897, *T. boylei* (Nichols 1956), *T. corduvenensis* Weyenbergh 1877, *T. heterodontus* (Eigenmann 1918), *T. riojanus* (Berg 1897), *T. rivulatus* Valenciennes 1846, *T. roigi* Arratia and Menu Marque 1984 and *T. spegazzinii* (Berg 1897)) are varyingly more broadly distributed (Liotta 2005, Andreoli Bize *et al.* 2021, Fernández *et al.* 2023). The species of *Trichomycterus* are among the few native fishes occurring in the high Andes (Fernández 2000, Fernández and Schaefer 2003, Firpo *et al.* 2020, Andreoli Bize 2021). *Trichomycterus pseudosilviniichthys* was recorded only from Sierra Famatina at elevation between 1,200 to 1,300 m above level sea (Fernández and Vari 2004). Herein, we report an expansion on the altitudinal dis-

tribution from *Trichomycterus pseudosilviniichthys* at 2,600 m elevation and 1,800 m elevation in La Rioja province, Argentina.

MATERIAL AND METHODS

Each of the four sites was sampled using dip nets 60 cm long and 40 cm wide, and nylon beach seines 3 m length and 1 m high (2 mm mesh opening screen) at a maximum depth of 60 cm. The techniques were slightly different according to the substrates. Specimens were anaesthetized with benzocaine and killed by immersion in cold water (0°C) in situ (Metcalf and Craig, 2011). Measurements were taken from the left side of the specimens with digital calipers under a binocular microscope following the methods outlined by Fernández and Vari (2012). Cleared and counterstained specimens for osteological study were prepared following the procedure of Taylor and Van Dyke (1985) and osteological nomenclature follows de Pinna (1989). The terminology for laterosensory canals follow Northcutt (1989). The papillae terminology follows Miquelarena and Molly (1974). Institutional abbreviations are as listed in Sabaj (2020).

Abbreviations. AMNH, American Museum of Natural History, New York; CAS, California Academy of Sciences, San Francisco; CFA, Fundación de Historia Natural Félix de Azara, Buenos Aires; CIFML, Fundación Miguel Lillo, Tucumán; FACEN, Facultad de Ciencias Exactas y Naturales, Catamarca; KU, University of Kansas, Lawrence; MACN, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires; MCZ, Museum of Comparative Zoology, Cambridge; MLP, Museo de La Plata, Buenos Aires; USNM, Smithsonian National Museum of Natural History, Washington D.C.

Material comparative examined. *Trichomycterus alterus* FACEN 186, 3 specimens. *T. areolatus* MCZ 98726, 2 specimens; MCZ 98724, 1 specimen (radiograph). *T. atochae* CAS 64576, holotype (radiograph). *T. belensis* FACEN 167, 4 specimens. *T. boylei* KU 20188, 1 specimen. *T. catamarcensis* CFA-IC 3759, 2 specimens; CFA-IC 11398, 1 specimen; FACEN 168, 3 specimens. *T. corduensis* FACEN 174, 1 specimen, FACEN 184, 3 specimens. *T. chiltoni* USNM 84350, paratypes, 2 specimens. *T. chungaraensis* KU 19392, 2 specimens. *T. heterodontus* CAS 58139, holotype (radiographs). *T. hualco* FACEN 169, 2 specimens. *T. laucaensis* KU 19403, 2 specimens. *T. pseudosilvinichthys* AMNH 233620, 3 specimens; CIFML 2588, holotype; CIFML 2558, 6 specimens, paratypes; MLP-Ict 7370, 3 specimens, paratypes. *T. riojanus* MACN-Ict 5175, holotype (dehydrated). *T. rivulatus* FACEN 102, 2 specimens. *T. roigi* FACEN 115, 2 specimens. *T. tiraquae* AMNH 39740, 1 specimen. *T. varii* FACEN 106, 5 specimens, paratypes. *T. yuska* CIFML 1130, 2 specimens, paratypes.

RESULTS

Trichomycterus pseudosilvinichthys Fernández and Vari 2004 (Figures 1-3)

FACEN 104, 2 specimens, 25.0-32.5 mm SL, Arroyo Puerto Alegre near Pagancillo, Departamento General Lamadrid, Provincia La Rioja, 29°26'14.18"S 67°56'6.62"W,

1,375 m elevation, 29 Set 2012, J. Andreoli Bize and L. Fernández. FACEN 116, 2 specimens, 25.7-55.6 mm SL, Río Achavil, near Famatina, Departamento Famatina, Provincia La Rioja, 28°48'52.76"S 67°43'43.64"W, 2,635 m elevation, 5 Nov 2014, J. Fernandez. FACEN 173, 1 specimen, 34.3 mm SL, Río Miranda, near Siciliano, Departamento Chilecito, Provincia La Rioja, 29°23'4.46"S 67°47'44.23"W, 1,819 m elevation, 29 Oct 2022, R. Lobo and L. Fernández. FACEN 188, 4 specimens, 29.5-36.6 mm SL, Río Miranda, Bordo Atravesado, Departamento Chilecito, Provincia La Rioja, 29°20'40.38"S 67°47'17.64"W, 2,073 m elevation, 29 Set 2012, J. Andreoli-Bize and L. Fernández. FACEN 183, 1 cleared and stained, Río Guanchin, Departamento Chilecito, Provincia La Rioja, 29°9'46.71"S 67°39'30.63"W, 1,821 m elevation, 29 Oct 2022, J. Andreoli Bize, A. Cerezo, G. Contrera, and L. Fernández.

Study site. The Achavil (Figure 4) and Del Marco rivers are tributaries of the Amarillo River, and downstream, they form the Famatina River, which discharges its waters into the alluvial fans of the endorheic system of Paimán-Velasco (Lecomte *et al.* 2016). The Famatina drainage lies entirely within the Mar Chiquita - Salinas Grandes freshwater ecoregion (Abell *et al.* 2008).

Identification. The specimens of *Trichomycterus pseudosilvinichthys* were re-



Figure 1 - *Trichomycterus pseudosilvinichthys*, FACEN 116, Río Achavil, Departamento Famatina, Provincia La Rioja. Scale bar: 5 mm.



Figure 2 - *Trichomycterus pseudosilviniichthys* FACEN 188, Argentina, Arroyo Puerto Alegre, Departamento General Lamadrid, Provincia La Rioja: **A**, The tip of pelvic fin not reaching the anus; **B**, Some specimens show intraspecific pelvic-fin variation. Scale bar: 2 mm.

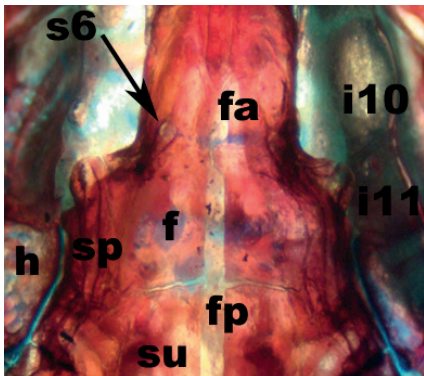


Figure 3 - *Trichomycterus pseudosilviniichthys*. FACEN 183, 47.5 mm SL. Dorsal view of cranium with cephalic sensory canal. Abbreviations: f, frontal; fa, anterior fontanelle; fp, posterior fontanelle; i10-i11, pores 10-11 of infraorbital sensory canal; pore 6 of supraorbital sensory canal; sp, sphenotic, prootic and pterosphenoid; su, supraoccipital; h, hyomandibula,

cognized by the following combination of characters: possession of a rectangular premaxilla, seven branched dorsal-fin rays, 17–19 ribs, lack of a very thick, rugose layer of fatty tissue on the body and head, extension of a portion of the laterosensory canal system through the sphenotic, reduction of the segment of the portion of the laterosensory canal within the frontal with a loss of a segment of the canal between pores 2 and 6 with the resultant absence of intervening pore, lack of an extensive perforation of the skin surface by ampullary organs, termination of the first pectoral-fin ray at the margin of the fin, insertion of the first proximal dorsal-fin pterygiophore located at, or posterior to, the neural spine of vertebrae 20 to 22, presence of a fronto-lachrymal tendon bone with

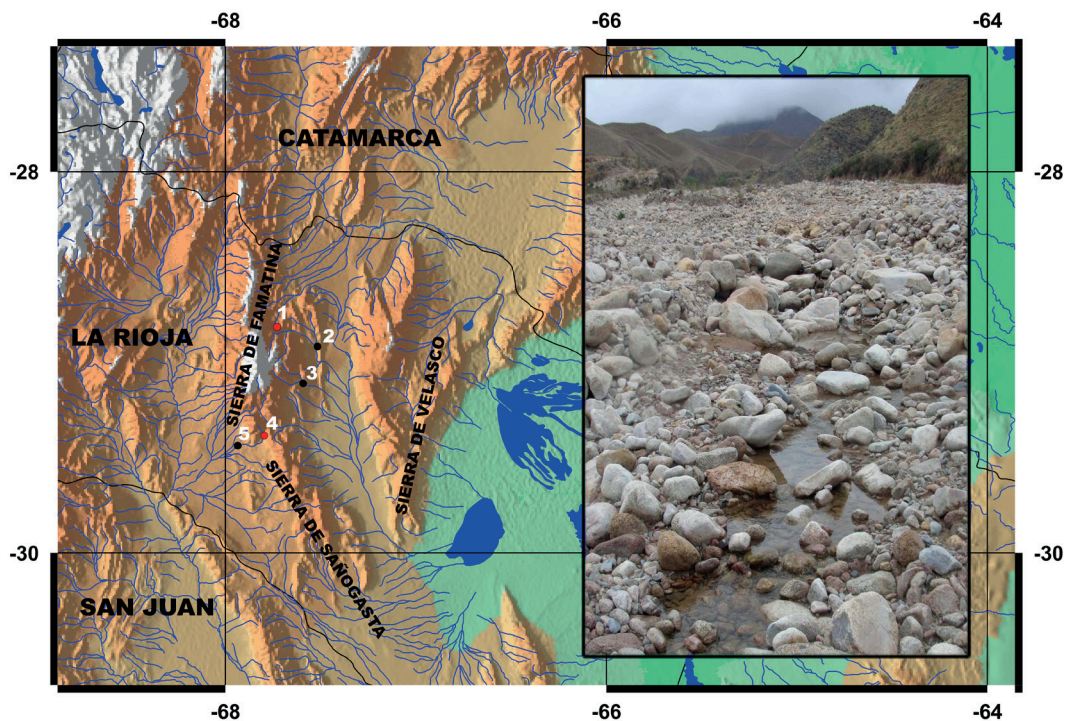


Figure 4 - *Trichomycterus pseudosilvinichthys*: red circle new locality, black circle types localities: 1- Río Aschavil, Departamento Famatina; 2- Río Amarillo, Departamento Famatina, 3- Río Guanchin, Departamento Chilecito; 4- Río Miranda near Bordo Atravesado, Departamento Chilecito; 5- Arroyo Puerto Alegre near Pagancillo, Departamento General Lamadrid.

a lateral expansion and an incomplete supraorbital laterosensory canal segment in that bone with the consequent loss of pore 3, caudal peduncle not expanded in the area of the procurrent caudal-fin rays, pelvic fin falling short of the anal opening and the possession of one or two pores on the anterior most portion of the lateral line.

Additional notes. Some specimens of *Trichomycterus pseudosilvinichthys* from two endorheic streams (Puerto Alegre in General Lamadrid and Guanchin in Chilecito) show losses of the pelvic-fin and girdle; a pattern perhaps reflecting an underlying propensity for the loss of this system in Trichomycteridae. Four specimens (FACEN 188) show intraspecific pelvic-fin variation (Figure 2B): one specimen with pelvic-fin

absent on left side, two specimens with pelvic-fin absent on right side and two specimens lacking pelvic-fins.

Trichomycterus pseudosilvinichthys is known only from Sierra Famatina (Figure 4) at elevation between 1,200 to 1,300 m above level sea. They are rarely collected because they occur in limited habitats and they are usually overlooked. The new specimens of *T. pseudosilvinichthys* revised in this work were collected at 2,635 m elevation, in a small creek, a clearwater stream, approximately 30 cm deep with sand and rocky substrate. The fish burrow into the sand and could be collected by removing it. It is an endorheic system that experiences torrential hydrological conditions associated with scarce but intense summer rains (December to March) (Maza *et al.*, 2014;

Turner, 1971). The only other species of fishes collected at that site were *T. corduensis* (FACEN 174) and *Oncorhynchus mykiss* (FACEN 196).

Trichomycterus pseudosilvinichthys is bottom-dwelling and they tend to swim upstream. Trichomycterids generally are equipped with interopercles and opercles that support odontodes and they can evert these odontodes and to provide friction when climbing waterfalls.

The stomach of one cleared and stained specimen contained autochthonous benthic macroinvertebrates, mainly larvae of Diptera (Chironomidae and Simuliidae) and Trichoptera.

DISCUSSION

Most Andean habitats remain poorly explored or even unmapped. The ichthyofauna of the La Rioja Province consists of 15 species of native fishes, six of which are members the Trichomycterinae (Fuchs *et al.* 2013, Fulvio Pérez *et al.* 2017, Fricke *et al.* 2023). Among these, *Trichomycterus hualco* (Sierra Velasco) and *T. pseudosilvinichthys* (Sierra Famatina) are endemic to La Rioja, whereas *Hatcheria macraei*, *T. alterus*, and *T. corduensis* range beyond the boundaries of that province (Fernández and Andreoli Bize 2017, Andreoli Bize *et al.* 2021). *Trichomycterus riojanus* is known only from the holotype (MACN-Ict 5175). In 1897, Berg described *T. riojanus* based on one specimen from “arroyo of the Cordillera in La Rioja” and the holotype is now dried and the original description is uninformative (Fernandez and Vari 2004: 881).

Regarding the asymmetric loss of the pelvic-fin recorded in *T. pseudosilvinichthys*, it should be noted that it was found in another stygobitic or interstitial species of the Trichomycterinae, as mentioned by Trajano and de Pinna (1996) for *Ituglanis*

itacambiensis. Loss of the pelvic-fin, is reduced more frequently than the pectoral-fin, it occurs independently in several groups of teleosts, in at least 80 events (Yamonou *et al.* 2010, Don *et al.* 2013). de Pinna (1989) mentioned minimally three independent losses of the pelvic-fin and girdle within the Trichomycteridae; a pattern perhaps reflecting an underlying propensity for the loss of this system in this family. The absence of the pelvic-fin and girdle has been observed elsewhere in the Trichomycterinae, such as in *Eremophilus*, some species of *Cambeva*, *Ituglanis*, *Trichomycterus* (in Argentina *T. catamarcensis*), and *Silvinichthys* (in Argentina *S. bortayro*, *S. leoncitisensis*, *S. gualcamayo*, *S. huachi*, *S. pachonensis*, and *S. pedernalensis*) (Ferrer and Malabarba 2011, Fernández *et al.* 2017, Rizzato and Bichuette 2014, Reis and de Pinna 2022). However, these findings cast further doubt on the usefulness of pelvic fin loss in propose phylogenetic relationships within the Trichomycterinae (e.g., *T. catamarcensis* Fernandez and Vari 2000).

Exploiting resources stored in unexplored environments can have unexpected consequences that will likely affect undescribed biodiversity, with potential cascading effects on surface ecosystem functions and services (Ficetola *et al.* 2018). The human activities in the high mountains such as the use of fertilizers, livestock overgrazing, off-road driving, mineral extraction (copper, gold and lithium), and the introduction of species (rainbow trout), affect fresh waters (Fernández *et al.* 2021, Contrera and Fernández 2023). Specially, *Trichomycterus* shows low tolerance to adverse environmental conditions, and has high requirements for dissolved oxygen (Fernández and Bechara 2010: Table 7, Figure 2). Mountain catfishes may be the most vulnerable vertebrate because of the relatively elevate degree of fragmentation and isolation of inland aquatic habitats in these areas (e.g.,

the endemic species *T. pseudosilvinichthys* in Sierra Famatina, *T. catamarcensis* in Laguna Blanca, *T. varii* in Sierra Santa Catalina or *T. yuska* in Cerro Aguas Calientes).

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