

Description of *Silvinichthys pedernalensis* n. sp. (Teleostei, Siluriformes) from the Andean Cordillera of southern South America

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Fernández, L., Sanabria, E. A. & Quiroga, L. B., 2017. Description of *Silvinichthys pedernalensis* n. sp. (Teleostei, Siluriformes) from the Andean Cordillera of southern South America. *Animal Biodiversity and Conservation*, 40.1: 41–47.

Abstract

Description of Silvinichthys pedernalensis n. sp. (Teleostei, Siluriformes) from the Andean Cordillera of southern South America.— *Silvinichthys pedernalensis*, a new species, is described from an Andean stream in Provincia San Juan, Argentina, based on its coloration pattern, and its meristic, morphometric and osteological characters. *S. pedernalensis* differs markedly from all other known members of the genus *Silvinichthys* as a result of the combination of the absence of pelvic girdle and fin, the wide supraorbital bone, the number of interopercle odontodes 14–18, the number of opercular odontodes 6–8, the branched pectoral-fin rays 7, the dorsal-fin rays 11, the number of dorsal pterygiophore 7, the branchiostegal rays 6, the dorsal procurvent caudal-fin rays 14 and ventral 15, the ribs 16, the vertebrae 39, the dark marmorated pigmentation on the body and head, the head depth 9.9–12.2% SL, the interorbital wide 28.3–36.1% HL, the nasal barbel length 27.3–39.0% SL, the maxillary barbel length 39.5–61.7% SL, the submaxillary barbel length 24.7–41.9% SL, the snout length 40.6–44.4% HL, the body depth 10.1–12.6% SL, the anal base fin 10.2–11.7% SL, and the caudal peduncle length 19.3–21.5% SL.

Key words: Neotropical, Catfish, Trichomycteridae, *Silvinichthys pedernalensis*, New species

Resumen

Descripción de Silvinichthys pedernalensis sp. n. (Teleostei, Siluriformes) de la cordillera de los Andes en la parte meridional de Sudamérica.— Se describe una nueva especie, *Silvinichthys pedernalensis*, en un arroyo andino de la provincia de San Juan, en Argentina, a partir del patrón de coloración y caracteres merísticos, morfométricos y osteológicos. *S. pedernalensis* difiere notablemente de todos los demás miembros conocidos del género *Silvinichthys* debido a la combinación de los siguientes rasgos: ausencia de cintura y aleta pélvica, hueso supraorbital ancho, 14–18 odontoides interoperculares, 6–8 odontoides operculares, 7 radios ramificados de la aleta pectoral, 11 radios de la aleta dorsal, 7 pterigióforos de la aleta dorsal, 6 radios branquiostegos, 14 radios dorsales procurventes de la aleta caudal y 15 ventrales, 16 costillas, 39 vértebras, pigmentación marmórea oscura de la cabeza y el cuerpo, altura de la cabeza (9,9–12,2% de la longitud estándar [LE]), ancho interorbital (28,3–36,1% de la longitud de la cabeza [LC]), longitud de la barbilla nasal (27,3–39,0% LE), longitud de la barbilla maxilar (39,5–61,7% LE), longitud de la barbilla submaxilar (24,7–41,9% LE), longitud del hocico (40,6–44,4% LC), altura del cuerpo (10,1–12,6% LE), ancho de la aleta anal (10,2–11,7% LE) y longitud del pedúnculo caudal (19,3–21,5% LE).

Palabras claves: Neotropical, Bagre, Trichomycteridae, *Silvinichthys pedernalensis*, Nueva especie

Received: 5 II 16; Conditional acceptance: 26 V 16; Final acceptance: 6 IX 16

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Introduction

Silvinichthys is the second most speciose genus of the Trichomycterinae (exclusive of *Ituglanis* and *Sclerone-ma*, which are currently unassigned to subfamily (Costa & Bockmann, 1993; de Pinna 1998; Fernández & de Pinna, 2005) with five species recognized to date and two undescribed species. The genus *Silvinichthys* was erected by Arratia (1998) for a species previously placed in *Trichomycterus* (*T. mendozensis* Arratia et al., 1978) mainly based on the reduction of the cephalic laterosensory canal system to the nasal portion of the supraorbital canal and the postotic canal and the entire skin surface perforated by pores of the ampullary organs. In later years, four new species of *Silvinichthys* have been described (Fernández et al., 2011, 2013, 2014) and other known new species await formal description. The genus inhabits headwaters and temporary endorheic streams, characterized by cold waters and rocky bottom, and included one species from phreatic waters. *Silvinichthys* shows a restricted distribution between 24°S to 32°S latitude in the western of Argentina and it is endemic to this arid region (Fernández et al., 2014). We describe here a sixth species of *Silvinichthys*, the fifth to lack the pelvic girdle from a mid-elevation location in western Argentina.

Material and methods

Measurements were taken from the left side of the specimens using digital calipers under a binocular microscope following the methods outlined by Tchemavin (1944). Cleared and counterstained specimens were prepared following the procedure of Taylor & Van Dyke (1985) and osteological nomenclature follows de Pinna (1989). Counts of dorsal and anal fin rays follow the methods proposed by de Pinna (1992) and taken from radiographs and cleared and stained specimens. Meristic values are followed by the number of specimens with that count in brackets; meristic values for the holotype in the text are indicated (*). Following de Pinna (1992), the vertebral counts exclude the vertebrae in the Weberian apparatus, with the compound caudal centrum counted as one element. Counts of caudal vertebrae follow Fernández & Schaefer (2003) with counts of vertebrae and ribs taken from one cleared and stained specimen. The numbering system and terminology for laterosensory pores of the head follow Northcutt (1989).

Institutional abbreviations are as listed at Sabaj Perez (2014), with the addition of FACEN, Facultad Ciencias Exactas y Naturales, Universidad Nacional de Catamarca, Catamarca; FLBS, Flathead Lake Biological Station, Poulson; and MPSZI, Museo de Ciencias Naturales 'P. Antonio Scasso', San Nicolás de los Arroyos, Buenos Aires.

Abbreviations are head length (HL) and standard length (SL).

Comparative material examined

Additional material is that cited in Fernández & Vari (2009) and Schaefer & Fernández (2009). The number

of specimens indicated refers to those examined for this study, not necessarily to the total number in lot. Abbreviations are: number specimens (ex), holotype (h), paratypes (p), cleared and stained specimens (cs), radiographed specimen (r):

Hatcheria macraei: FACEN 0012, 1 ex; FACEN 0014, 1 ex; MCNI 1521, 1 ex, 1 cs; MCNI 1561, 2 ex.

Silvinichthys bortayro: AMNH 233621, 1 p; FACEN 0040, 1 ex.

Silvinichthys gualcamayo: MCNI 1531, 5 p; MCNI 1532, 1 cs p.

Silvinichthys huachi: MCNI 1515, 2 cs p; MCNI 1517, 4 p, 3 r.

Silvinichthys leoncitensis: MCNI 1511, 1 h; MCNI 1512, 1 p, 1 cs; ILPLA 2171, 1 p.

Silvinichthys mendozensis: FACEN 0078, 2 ex, 1 cs.

Silvinichthys sp. A: MPSZI 1381, 1 ex; MPSZI 1382, 1 ex; ILPLA 1807, 1 ex.

Trichomycterus alterus: FACEN 35, 8 ex; FML 2085, 9 ex, 1 cs.

Trichomycterus areolatus: MCNI 1370, 1 ex.

Trichomycterus barbouri: MCNI 0048, 3 ex; MCNI 1163, 6 ex; MCNI 1178, 3 ex; MCNI 1376, 1 ex.

Trichomycterus belensis: FML 2531, 4 p, 1 cs; FACEN 0068, 1 ex; FACEN 0082, 3 ex.

Trichomycterus boylei: MCNI 0795, 2 ex.

Trichomycterus catamarcensis: FACEN 0069, 1 ex; FACEN 0083, 3 ex; FML 2510, 4 ex, 1 cs.

Trichomycterus corduvensis: MCNI 1530, 4 ex; MCNI 1372, 4 ex; MCNI 1375, 1 ex; UNCa 66, 4 ex.

Trichomycterus hualco: FML 2602, 1 p, 1 cs; USNM 383794, 4 p.

Trichomycterus minus: MCNI 1529, 1 p, 1 cs.

Trichomycterus pseudosilvinichthys: FML 2589, 4 p, 1 cs.

Trichomycterus ramosus: FML 2071, 4 p, 1 cs.

Trichomycterus roigi: MCNI 0757 2 ex; MCNI 0994, 5 ex.

Trichomycterus spegaziinii: FACEN 0067, 1 cs; MCNI 0321, 3 ex; MCNI 0356, 5 ex; MCNI 0815, 1 ex

Trichomycterus yuska: FML 1132, 4 p, 2 cs.

Results

Silvinichthys pedernalensis n. sp. (fig. 1, table 1)

Holotype: FACEN 0071, 45.1 mm SL; Argentina, Provincia de San Juan, Departamento Sarmiento, Río Pedernal (31° 59' S, 68° 44' W), 1.092 m elevation, collected by L. Fernández, E. Sanabria, and L. Quiroga, 20 VII 2013.

Paratypes: three specimens, 37.5–43.2 mm SL, collected with holotype: FACEN 0072, 2 specimens, 37.5–43.2 mm SL; FACEN 0073, 1 specimen, 42.7 mm SL CS.

Diagnosis

Silvinichthys pedernalensis is distinguished from *S. mendozensis* by the absence of pelvic girdle and fin (versus presence), the number of interopercle odontodes 14–18 (vs. 30–42), the marmorated pigmentation



Fig. 1. *Silvinichthys pedernalensis* n. sp., holotype, FACEN 0071, 45.1 mm SL.

Fig. 1. *Silvinichthys pedernalensis* sp. n., holotipo, FACEN 0071, 45,1 mm de LE.

on the body and head (vs. uniformly brown); from *S. bortayro* by the number of branched pectoral-fin rays 7 (vs. 5), the number of total dorsal-fin rays 11 (vs. 9), the anal base fin 10.2–11.7% SL (vs. 8.8–10.2), the supraorbital tendon bone wide (vs. slender), the dark marmorated pigmentation on the body and head (vs. the lack of dark pigmentation in larger individuals), the nasal barbel length 27.3–39.0% SL (vs. 47.1–74.4), the maxillary barbel length 39.5–61.7% SL (vs. 60.5–105.9), the submaxillary barbel length 24.7–41.9% SL (vs. 41.2–57.1), the snout length 40.6–44.4% HL (vs. 35.8–40.5), the number of opercular odontodes 6–8 (vs. 2–4), the number of interopercle odontodes 14–18 (vs. 9–12); from *S. huachi* by the body depth 10.1–12.6% SL (vs. 12.6–16.5), the supraorbital tendon bone wide (vs. slender), the number of interopercle odontodes 14–18 (vs. 21–28), the number of branchiostegal rays 6 (vs. 7–8), the number of dorsal procurrent caudal-fin rays 14 (vs. 11), the number of ventral procurrent caudal-fin rays 15 (vs. 10); from *S. gualcamayo* by the caudal peduncle length 19.3–21.5% SL (vs. 21.1–23.6), the head depth 9.9–12.2% SL (vs. 9.1–9.8), the interorbital wide 28.3–36.1% HL (vs. 26.1–27.8), the number of branchiostegal rays 6 (vs. 7), the number of dorsal procurrent caudal-fin rays 14 (vs. 11), the number of ventral procurrent caudal-fin rays 15 (vs. 9), and

the number of total vertebrae 39 (vs. 38); from *S. leoncitis* by the total number of dorsal-fin rays 11 (vs. 13), the number of dorsal pterygiophore 7 (vs. 8), the number of ribs 16 (vs. 20), the number of total vertebrae 39 (vs. 40), and the number of interopercle odontodes 14–18 (vs. 18–28).

Description

Table 1 shows the morphometrics for holotype and paratypes of *Silvinichthys pedernalensis*. Body elongate, approximately cylindrical overall and gradually becoming more compressed transversely across the entire vertical extent of the body towards the caudal fin. Dorsal and ventral profiles of trunk region are nearly straight. Caudal peduncle smoothly continuous with dorsal and ventral profiles of trunk. Papillae-like structures absent on body. Urogenital and anal openings vertical through base of first or second branched dorsal-fin rays.

Head profile nearly triangular from dorsal view, slightly longer than broad. Eye circular located on dorsal surface of head but visible from lateral view. Skin covering eye thin, transparent and separate from surface of eyeball. Anterior nostril slightly smaller than posterior nostril and bordered medially by fleshy flap and laterally by base of nasal barbel. Flap and base

Table 1. Morphometric data for *Silvinichthys pedernalensis*. Measurements are based on the holotype: FACEN 0071 and three paratypes: FACEN 0072 (2) y FACEN 0073 (1).

Tabla 1. Datos morfológicos de *Silvinichthys pedernalensis*. Mediciones basadas en el holotipo: FACEN 0071 y en tres paratipos: FACEN 0072 (2) y FACEN 0073 (1).

	Range	Mean
LS (mm)	37.5–45.1	42.1
Percentage of LS		
Body depth	10.1–12.6	11.4
Caudal peduncle length	19.3–21.5	20.6
Caudal peduncle depth	7.8–9.0	8.5
Predorsal length	64.2–67.4	65.9
Preanal length	67.4–70.0	68.5
Dorsal–fin base length	10.3–13.4	11.9
Anal–fin base length	10.2–11.7	10.7
Head length	16.5–18.1	17.5
Head width	15.0–17.6	16.3
Head depth	9.1–9.8	9.1
Percentage of HL		
Interorbital width	26.1–27.8	27.2
Snout length	40.6–44.4	42.0
Nasal barbel length	27.3–39.0	33.2
Maxillary barbel length	39.5–61.7	47.9
Rictal barbel length	24.7–41.9	34.5
Mouth width	33.9–42.5	39.0

of barbel continuous and forming short tube. Posterior nostril located approximately midway between anterior nostril and anterior orbital rim. Anterior margin of posterior nostril bordered by flap of thin skin. Infraorbital canal absent. Supraorbital canal incomplete, with segment between pores s1 and s2 present. Preoperculomandibular sensory canal absent. Postotic canal with two pores, with pterotic branch present at junction of pterotic and posttemporo–supracleithrum. Laterosensory canal along midlateral portion of trunk reduced, with three pores on anterior most portion of lateral line, with single terminal pore opening situated slightly posterior to posterior tip of opercular patch of odontodes.

Mouth subterminal, with rictus directed posteriorly. Mesethmoid T-shaped, elongate, with anterior margin straight and shaft slightly smaller than lateral cornua, its posterior process extending between anterior portions of frontals, lateral ethmoids, and vomer.

Premaxilla rectangular and approximately equal in size to maxilla from ventral view. Premaxilla bearing 3 or 4 rows of teeth. Outer premaxillary tooth row with 8–9 teeth and total of 20 to 25 teeth. Maxilla enlarged, L-shaped, with pair of condyles, projecting between premaxilla and anterior border of autopalatine. Supraorbital tendon bone (=frontolachrymal or sesamoid supraorbital) wide. Anterior portion of sphenotic laterally directed in dorsal view. Autopalatine rectangular, broad anteriorly with short posterior process dorsally placed to broad metapterygoid. Medially, autopalatine articulates with both vomer and lateral ethmoid. Dentary with 3 rows of teeth, with 9 teeth in outer row. Lower lip fleshy anteriorly with anterior, and to a lesser degree, anteroventral surfaces covered with papillae. Lower lip with prominent lobes along lateral limits. Upper lip fleshy and bearing numerous papillae.

Barbels relatively short and tapering distally, but not thread-like or with distal branching. Tip of maxillary barbel falling short of vertical through anterior limit of patch of opercular odontodes in some specimens but extending somewhat posterior of that point in other individuals. Submaxillary barbel shorter than maxillary barbel and falling short of vertical through anterior limit of opercular patch of odontodes. Nasal barbel extending posteriorly distinctly beyond posterior margin of eye.

Branchiostegal membrane narrowly attached to isthmus anteriorly at midline, with wide and almost free branchial opening. Branchiostegal rays 6 in one cs specimen. Interopercular odontode patch elongate, straight and bearing 14 to 16 odontodes and 18 odontodes present in one cs specimen. Interopercular odontodes patch with maximum of 3 irregular rows. Opercular odontode patch small and rounded; odontodes straight overall. Opercular odontode patch bearing up to 6 odontodes arranged in up to 2 irregular rows and 8 odontodes present in one cs specimen; odontodes not imbedded in fleshy tissue covering of opercle.

Dorsal–fin rays obvious in whole specimens 11 [4], with 4 unbranched rays and 7 branched rays, including one cs specimen. Pterygiophores 7. Dorsal–fin fleshy basally. Distal margin of dorsal fin semicircular in expanded fin. Dorsal–fin origin located distinctly anterior to vertical through anterior limit of vent. First proximal dorsal–fin pterygiophore inserting posterior to neural spine of vertebra 23. Anal–fin rays 10 [2] or 11* [1] with 4 [2] or 5* [1] unbranched rays and 6 [3] branched rays. Total of 11 rays in one cs specimen, with 5 unbranched rays and 6 branched rays. Pterygiophores 6. Anal–fin fleshy basally. Anal–fin relatively elongate; equal in size to, or slightly smaller than, dorsal fin with distal margin slightly rounded. Anal–fin origin located approximately at vertical through posterior portion of dorsal–fin base. First proximal anal–fin pterygiophore inserting posterior to haemal spine of vertebra 24. Dorsal–fin base either terminating at vertical through insertion of anal fin or overlapping anal–fin base for distance of up to 2 vertebrae. Pectoral–fin rays 8 [4], with lateral–most ray unbranched, including one cs specimen. Distal margin of pectoral–fin straight to slightly convex. First pectoral–fin ray terminating at

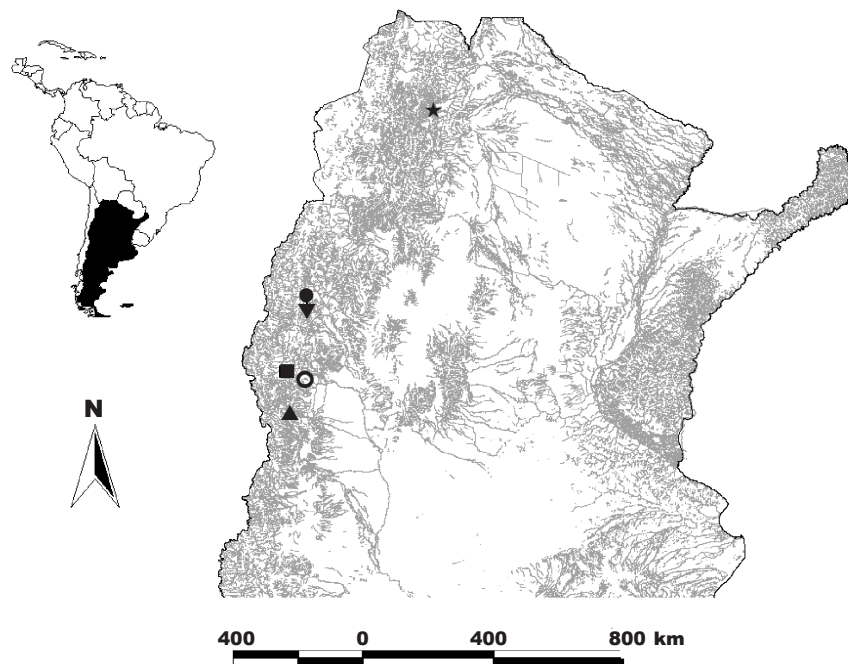


Fig. 2. Map of Argentina showing distribution of known *Silvinichthys* species. 1. *S. gualcamayo* (●); 2. *S. leoncitensis* (■); 3. *S. mendozensis* (▲); 4. *S. bortayro* (★); 5. *S. huachi* (▼); 6. *S. pedernalensis* (○).

Fig. 2. Mapa de Argentina en el que se muestra la distribución conocida de las especies de *Silvinichthys*: 1. *S. gualcamayo* (●); 2. *S. leoncitensis* (■); 3. *S. mendozensis* (▲); 4. *S. bortayro* (★); 5. *S. huachi* (▼); 6. *S. pedernalensis* (○).

fin margin without forming distal filament. Pelvic-fin, girdle and muscles absent. Distal margin of caudal fin nearly straight or slightly convex. Principal caudal-fin rays 6 + 7 [3]. Three principal dorsal caudal-fin rays attaching to fused fourth plus fifth hypurals and 3 rays attaching to third hypural. Seven principal ventral caudal-fin rays attaching to fused hypurals 1–2 and separate parahypurals. Dorsal procurrent caudal-fin rays 14 and ventral procurrent caudal-fin rays 15. Total vertebrae 39, with 7 precaudal and 32 caudal vertebrae. Ribs on each side of body 16. No externally obvious sexual dimorphism present in examined population samples. All specimens with cysts on head, body, and fins (fig. 1).

Color in alcohol

Head and body with distinct marmoration formed by patches of small, dark chromatophores. Ventral surface of head from hyaline to slightly darkly pigmented. All barbels except by submaxillary barbel, with diffuse pattern of scattered dark chromatophores. Dorsal, anal, and pectoral fins with irregular, dark pigmentation on rays and membranes usually more intense along rays. Variation in intensity of dark dorsal-fin pigmentation sometimes in form of indistinct transverse bar. Caudal-fin membranes irregularly darker than those

of dorsal and anal fins. Pectoral-fin hyaline to slightly dusky ventrally, with irregular dark pigmentation on dorsal surface that becomes less intense distally. Opercular and interopercular odontodes and oral dentition unpigmented. Opercular, but not interopercular, patch of odontodes with web-like pattern of dark pigmentation around base of odontodes.

Color in life

Head and body with dark pigmentation as described for preserved specimens in alcohol, but with marmoration pattern more pronounced. Dorsal surface of head and body with slight yellowish coloration. Ventral surface of body silvery from isthmus to anus.

Distribution and habitat

Silvinichthys pedernalensis is known only from Río Pedernal (31° 59' S, 68° 44' W) in San Juan, Argentina (fig. 2). The type locality is a small creek, approximately 0.50 m deep and 1 to 3 m wide with silt in suspension, rock bottom without aquatic vegetation (fig. 3) at an elevation of 1,092 m a.s.l. The drainage lies within an endorheic system that experiences torrential hydrological conditions associated with scarce but intense summer rains. All captured specimens were hiding under



Fig. 3. Type locality of *Silvinichthys pedernalensis*. Río Pedernal, Sarmiento, Provincia San Juan, Argentina.

Fig. 3. Localidad tipo de *Silvinichthys pedernalensis*. Río Pedernal, Sarmiento, Provincia San Juan, Argentina.

rocks; the usual habit for fishes in other streams in the Andes. The one other species of fish collected at that site was *Hatcheria macraei* (Siluriformes, Trichomycteridae). The Río Pedernal is impacted by limestone mining operations. Many Andean drainage systems are altered by mining activities, including mountain mining/valley fill practices primarily for extraction of minerals.

It is difficult to provide reliable conservation recommendations for Andean catfishes, mainly because data are deficient as geographic distributions are still poorly known; in many cases data are restricted to streams and access is difficult.

Etymology

The specific name, *pedernalensis*, is in reference to the type locality of the species, the Río Pedernal. A noun in apposition.

Discussion

The new species is a member of *Silvinichthys*, diagnosed by five synapomorphies: the perforation of the entire skin surface by the pores of the ampullary organs; the reduction of the laterosensory canal system,

with the posterior region of that system on the head reduced to the postotic portion (pores p1–p2) and the nasal portion of the supraorbital canal (pores s1–s2); the narrow and elongate opercle; the unossified gill rakers, and a urohyal with two foramina (Arratia, 1998; Fernández & de Pinna, 2005).

Additional evidence for a sister-group relationship between the new species and four species of *Silvinichthys* is found in various other anatomical traits. *Silvinichthys pedernalensis* shares with *S. bortayro*, *S. gualcamayo*, *S. huachi*, and *S. leoncitensis* (Fernández et al., 2014) the absence of pelvic girdle. Several trichomycterids species show reductive trends in their pelvic fins and girdle, such as *Trichomycterus anhangá*, *T. candidus*, *T. catamarcensis*, *T. tropeiro*, *Eremophilus mutisi*, the Tridentinae *Miuroglanis platycephalus*, the Glanapteryginae (except for some specimens of *Glanapteryx*), *Ituglanis apteryx*, and some specimens of *Ituglanis parahybae* (Fernández & Vari, 2000; Ferrer & Malabarba, 2011; Dutra et al., 2012; Datovo, 2014). *S. pedernalensis* also shares the three derived characters mentioned by Fernández et al. (2013) along with *S. bortayro*, *S. gualcamayo*, *S. huachi*, and *S. leoncitensis*: the reduced numbers of odontodes on the opercular (2–9) and interopercular (9–28), and the absence of the orbitosphenoid bone. Possession of these characters may indicate sister species, but confirmation of such a hypothesis requires a broader comparative analysis incorporating information from multiple character systems.

Acknowledgements

Research associated with this project was supported by PIP (Proyecto Investigación Plurianual, CONICET) project n° 11420090100321. For loans and other assistance we thank S. Schaefer, B. Brown and R. Arrindell (AMNH), M. Sabaj Pérez (ANSP), D. Catania (CAS), J. Maclaine (BMNH), J. Andreati-Bize (FACEN), M. Rogers (FMNH), M. Retzer (INHS), A. Bentley (KU), G. Chiaramonte (MACN), F. Lobo and V. Martínez (IBIGEO), K. Hartel (MCZ), J. Lima de Figueiredo and O. Oyakawa (MZUSP), L. Malabarba and R. Reis (PUCRS), H. López and L. Protogino (MLP), M. Araya, F. Carvajal, and M. Maldonado (UMSS), P. Buckup (MNRJ), H. Ortega and M. Velasquez (MUSM), V. Jerez (MZUC), R. Robins (UF), D. Nelson (UMMZ), S. Raredon and R. Vari (USNM). This paper benefited from comments and suggestions from M. Hilal (UNT), the Editor of ABC, and three anonymous reviewers.

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