

REVUE SUISSE DE ZOOLOGIE 112 (1): 13-20; mars 2005

***Astyanax hermosus*, a new species from the Primero River basin, Córdoba, Argentina (Characiformes, Characidae)**

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***Astyanax hermosus*, a new species from the Primero River basin, Córdoba, Argentina (Characiformes, Characidae).** - A new species of the characid genus *Astyanax* is described from the endorheic Primero River basin, in central Argentina: *Astyanax hermosus* sp. n. This species can be distinguished from all other in the genus by the following combination of characters: body relatively low (33.1-38.7% SL); head short (23.5-27.1% SL); snout short (18.3-26.6% HL); interorbital broad (34.9-41.5% HL); maxilla with 1-3 teeth, usually one; iv-v, 17-22 anal-fin rays; 35-38 perforated scales on the lateral line; transverse scales 7/6; and distinctive color pattern, with Y-shaped humeral spot, a broad grayish longitudinal stripe on the flanks, extending weakly onto the middle caudal-fin rays, and extremely dark opercular, subopercular and preopercular regions. In addition, the males of the new species are distinguished by the presence of bony hooks in all their fins.

Keywords: Ostariophysi - Characidae - *Astyanax* - new species- taxonomy - biodiversity - Central Argentina.

INTRODUCTION

The genus *Astyanax* Baird & Girard includes about one hundred nominal species and subspecies (Garutti & Britski, 2000). It is one of the most speciose and geographically widespread genus within the Characidae, occurring from southern North America to northern Patagonia in Argentina.

Eigenmann (1921, 1927) analyzed the genus and provided identification keys for species and subspecies. Géry (1977) provided keys for the species of subgenus *Astyanax*. In recent years several species belonging to this genus have been described (Azpelicueta & García, 2000; Garutti & Britski, 2000; Bertaco & Malabarba, 2001; Almirón *et al.*, 2002; Azpelicueta *et al.*, 2002 a, b; Casciotta *et al.*, 2003 a, b; Garutti, 2003; Triques *et al.*, 2003 and Mirande *et al.*, 2004). However, there are neither recent critical evaluations of the diversity within *Astyanax*, 86 species appear in Reis *et al.* (2003). Weitzman & Malabarba (1998) believe that there is no existing evidence for

the monophyly of the genus. In this paper, we describe a new species of *Astyanax* collected from San Francisco River. This stream is part of the endorheic Primero River basin and arises at the Sierras Grandes mountain range in Valle Hermoso, a locality in central Argentina.

MATERIAL AND METHODS

Measurements to the nearest 0.01 mm were made using a Digimess digital caliper following Fink & Weitzman (1974). Counts were made with a WILD M8 stereomicroscope. Osteological observations were made on eight specimens cleared and stained (c&s) for bone and cartilage following Taylor & Van Dyke (1985). All measurements are expressed as percentage of standard length (SL), except for head measurements, which are recorded as percentage of head length (HL). In all counts, frequencies are given in parentheses and the holotype is indicated by an asterisk.

Material is deposited in the Instituto de Limnología “Dr. Raúl A. Ringuelet”, Argentina (ILPLA); Museo de La Plata, Argentina (MLP); and Museum d’histoire naturelle de Genève, Switzerland (MHNG).

COMPARATIVE MATERIAL

Astyanax asuncionensis Géry, 1972: ILPLA 382, 2 ex., 44.4-64.8 mm SL, Uruguáí stream, Iguazú Department, Misiones Province, Argentina, coll.: C. R. Guillén, Apr. 1977.

Astyanax cordovae (Günther, 1880): ILPLA 44, 2 ex., 84.5-119.3 mm SL, Primero River, Córdoba Province, Argentina, coll.: H. Haro, Sep. 1988.

Astyanax eigenmanniorum (Cope, 1894): ILPLA 705, 5 ex., 53.8-77.1 mm SL, Laguna Chascomús (35°36' S-58°02' W), Buenos Aires Province, Argentina, coll.: C. Togo and H. López, May. 1979; ILPLA 716, 4 ex., 51.9-82.9 mm SL, Laguna Chascomús, Buenos Aires Province, Argentina, coll.: O. Padin and J. Iwaszkiw, Apr. 1984.

Astyanax cf. *fasciatus*: ILPLA 569, 6 ex., 70.7-80.6 mm SL, Brazo Chico stream, Entre Ríos Province, Argentina, coll.: N. Landoni, Jan. 1985; ILPLA 596, 6 ex., 54.2-63.5 mm SL, Laguna de Lobos (35°17' S-59°07' W), Buenos Aires Province, Argentina, coll.: A. Miquelarena *et al.*, Jun. 1986.

Astyanax lineatus (Perugia, 1891): ILPLA 1487, 2 ex., 32.9-36.5 mm SL, Metán River (tributary of Juramento River), on Route 46, road between Punta del Agua and La Costosa, Salta Province, Argentina, coll.: A. Miquelarena *et al.*, Mar. 1987; ILPLA 1515, 10 ex., 50.0-74.5 mm SL, an unnamed creek before Huaico Mora creek, on the road between Zapla and Jujuy City, Jujuy Province, Argentina, coll.: A. Miquelarena *et al.*, Mar. 1987.

Astyanax ojara Azpelicueta & García, 2000: MLP 9470, holotype ♂, 50.0 mm SL, Benítez stream, headwaters of Yaboty River, Uruguay basin, Misiones Province, Argentina, coll.: O. García, May. 1983; MLP 9472, 6 paratypes, 50.2-67.5 mm SL, collected with the holotype.

Astyanax troya Azpelicueta, Casciotta & Almirón, 2002: ILPLA 1152, 12 ex., 60.7-86.3 mm SL, Cuña-Pirú creek (27°10' S-54°57' W), Cainguás Department, Misiones Province, Argentina, coll.: R. Filiberto & F. De Durana, Sep. 1997; ILPLA 1154, 3 ex., 52.4-67.0 mm SL, Cuña-Pirú creek (27°10' S-54°57' W), Cainguás Department, Misiones Province, Argentina, coll.: R. Filiberto & L. Protogino, Nov. 1999; ILPLA 1156, 14 ex., 32.6-85.3 mm SL, Cuña-Pirú creek (27°10' S-54°57' W), Cainguás Department, Misiones Province, Argentina, coll.: A. Miquelarena *et al.*, Sep. 2000.

RESULTS

Astyanax hermosus sp. n.

Fig. 1; Table 1

Holotype: ILPLA 1690, ♂, 78.5 mm SL; San Francisco River, Primero River basin, Valle Hermoso (31° 07' S - 64° 29' W), Punilla Department, Córdoba Province, Argentina, coll.: O. de Ferreri, Jan. 1965.

Paratypes: ILPLA 1691, 19 ex.: 6 ♂ (2c&s) and 13 ♀, 48.7-77.9 mm SL; ILPLA 1692, 6 ♀ (c&s), 47.0-51.1 mm SL; MHNG 2647.68, 4 ex. ♀, from the same locality as holotype.

DIAGNOSIS

Astyanax hermosus sp. n. differs from other species of the genus by the following combination of characters: body relatively low (33.1-38.7% SL); head short (23.5-27.1% SL); snout short (18.3-26.6% HL); mouth superior; maxilla with 1 to 3 (usually 1) teeth, with 1 to 4 cusps; interorbital broad (34.9-41.5% HL); anal-fin rays iv-v, 17-22; perforated scales on lateral line 35-38; transversal scales 7/6 and distinctive color pattern: Y-shaped humeral spot, a wide longitudinal grayish stripe extending weakly onto the middle caudal-fin rays, and very dark opercular, subopercular and preopercular regions. *Astyanax hermosus* sp. n. is also distinguished by the presence of bony hooks on all fins of the males.

DESCRIPTION

Body relatively low, with maximum body depth at dorsal-fin origin. Head short. Mouth superior. Thick lips. Snout short. Eye larger than snout length (29.7-34.7 % HL vs. 18.3-26.6 % HL). Interorbital broad. Dorsal profile of body slightly convex from snout tip to dorsal-fin origin; descending smoothly from dorsal-fin base origin to adipose-fin base origin. Dorsal profile of caudal peduncle slightly straight, ventral profile slightly concave or straight. Ventral profile of body slightly convex from tip of snout to pelvic-fin origin, almost straight between pelvic and anal-fin origins. Caudal peduncle relatively high. Dorsal-fin origin almost equidistant from tip of snout and base of caudal-fin rays. Anal-fin origin clearly behind level of last dorsal-fin ray. Pelvic-fin origin situated slightly anterior to vertical level of dorsal-fin origin. In males the pectoral-fin tip may reach or not the origin of pelvic fin (extending beyond pelvic-fin origin in two specimens only). In females the pectoral-fin tip does not reach the pelvic-fin origin by a considerable distance, except for a few small specimens. Tip of pelvic fin not reaching anal-fin origin in males and females. Presence of bony hooks on rays of all fins in males.

Dorsal-fin rays iii, 8 (1); iii, 9 (17*); iii, 10 (2). Margin of dorsal fin approximately straight or rounded, last unbranched ray and first three branched rays are longest. Bony hooks of males small scattered on the branches of the first to sixth fin rays.

Pectoral-fin rays i, 9, i (2); i, 10, i (5); i, 11, i (12*); i, 12, i (1). Bony hooks of large specimens are also small and scarce, 2-4 hooks on a few branched rays.

Pelvic-fin rays i, 6 (3); i, 7 (17*). Bony hooks short, broad and abundant, one on each segment of the posterior branch of each branched ray; though in some specimens hooks are present on both anterior and posterior branches. Pelvic axillary scale without hooks.

Anal-fin rays iv, 17 (1); iv, 18 (3); iv, 19 (7); iv, 20 (4); iv, 21 (1); iv, 22 (*); v, 20 (2); v, 21 (1), males having distal margin straight and females concave, with inflexion point almost in the first third of fin length. Bony hooks are conspicuous as in the pelvic fins and appear from the last unbranched ray to approximately the 15th branched ray.



Fig.1
Astyanax hermosus sp. n., ILPLA 1690. Holotype male, 78.5 mm SL.

TABLE 1. Morphometric data of *Astyanax hermosus* sp. n. SD: standard deviation.

| Characters | Holotype | | Paratypes | | | | |
|------------------------------|----------|------------------|-----------|-----|-------------------|------|-----|
| | ♂ | ♂ (n=6) Range | Mean | SD | ♀ (n=13) Range | Mean | SD |
| Standard length (mm) | 78.5 | 53.0-71.1 | 66.7 | | 48.7-77.9 | 55.6 | |
| As a percentage of SL | | | | | | | |
| Head length | 24.6 | 23.5-25.9 | 24.7 | 1.0 | 24.3-27.1 | 25.9 | 0.8 |
| Body depth | 33.1 | 33.9-37.8 | 36.1 | 1.5 | 34.8-38.7 | 36.3 | 1.4 |
| Predorsal distance | 47.0 | 47.5-51.0 | 48.8 | 1.2 | 47.1-52.2 | 49.2 | 1.4 |
| Prepectoral distance | 24.3 | 21.0-24.5 | 22.9 | 1.4 | 20.9-25.6 | 24.2 | 1.2 |
| Prepelvic distance | 41.9 | 41.5-45.4 | 43.2 | 1.5 | 42.8-47.0 | 44.6 | 1.3 |
| Preanal distance | 59.3 | 59.5-63.9 | 61.4 | 1.5 | 62.3-66.9 | 63.7 | 1.4 |
| Caudal peduncle length | 9.9 | 6.8-10.0 | 8.9 | 1.2 | 7.5-10.4 | 9.2 | 0.8 |
| Caudal peduncle depth | 12.7 | 13.5-14.3 | 13.7 | 0.3 | 12.6-14.7 | 13.6 | 0.7 |
| Dorsal fin base | 14.9 | 15.2-16.5 | 15.9 | 0.5 | 14.5-17.0 | 16.2 | 0.8 |
| Anal fin base | 28.2 | 26.0-29.5 | 28.3 | 1.3 | 25.1-28.6 | 27.1 | 1.2 |
| Pectoral-pelvic distance | 20.2 | 19.8-21.7 | 20.8 | 0.6 | 20.1-25.2 | 21.5 | 1.6 |
| Pelvic-anal distance | 17.7 | 18.8-20.3 | 19.3 | 0.6 | 18.2-21.0 | 19.8 | 0.7 |
| Pectoral length | 22.0 | 19.6-22.2 | 20.9 | 1.0 | 16.5-22.5 | 20.1 | 1.7 |
| Pelvic length | 17.3 | 16.0-17.9 | 17.1 | 0.9 | 15.5-19.2 | 17.6 | 1.0 |
| As a percentage of HL | | | | | | | |
| Caudal peduncle length | 40.1 | 26.5-41.1 | 36.1 | 5.9 | 30.9-39.8 | 35.3 | 2.6 |
| Caudal peduncle depth | 51.6 | 52.4-58.7 | 55.6 | 2.4 | 47.8-55.9 | 52.4 | 2.8 |
| Orbital diameter | 33.0 | 31.3-34.7 | 32.7 | 1.1 | 29.7-33.0 | 31.7 | 1.0 |
| Snout | 26.6 | 20.0-25.9 | 22.8 | 2.4 | 18.3-23.2 | 20.1 | 1.7 |
| Interorbital width | 37.3 | 37.0-40.0 | 38.8 | 1.1 | 34.9-41.5 | 38.2 | 2.2 |
| Postorbital length | 40.9 | 38.7-47.6 | 44.5 | 3.0 | 39.0-47.8 | 44.1 | 2.1 |
| Upper jaw length | 38.1 | 36.2-42.9 | 39.4 | 2.3 | 36.8-41.9 | 39.8 | 1.5 |
| Maxillary length | 30.0 | 30.9-33.0 | 32.0 | 0.8 | 30.8-34.0 | 32.2 | 1.1 |

Caudal-fin principal rays, ii 17. Dorsal procurrent rays 8-10; ventral procurrent rays 8-9. Bony hooks are fine but visible, present in the distal tip of almost all branched rays in males larger than 60 mm SL; in smaller specimens there are a few scattered hooks.

All the fins are short with slightly rounded edges.

Cycloid scales regularly distributed on body. Lateral line complete, perforated scales 35 (2); 36 (11*); 37 (6); 38 (1). Predorsal scales 9 (1); 10 (6*); 11 (13). Rows of scales from dorsal-fin origin to lateral line 6 (6); 7 (14*), and from lateral line to anal-fin origin 6 (16*); 7 (4). Single row of scales at base of anal fin, 7 (1); 8 (*); 9 (3); 10 (4); 11 (5); 12 (4); 13 (1); 14 (1).

Maxilla short with 1 to 3 (usually 1) teeth, with 1 to 4 cusps (Fig. 2a). Posterior tip of the maxilla extending beyond the middle of a vertical line traced through the second suborbital. Premaxilla with narrow pointed ascendent process and relatively short lateral process, bearing two rows of teeth. Outer row with 4 evenly arranged teeth, with 3 to 5 cusps, typically pentacuspoid (5 teeth observed in one specimen); inner row with 5 teeth, a symphyseal tooth, narrowest and highest, with 4 or 5 cusps, followed by two very broad teeth with 5 to 7 cusps, typically with 6 cusps. Fourth tooth with 4 or 6 cusps and fifth tooth with 1 to 4 cusps, typically tricuspoid (Fig. 2b). Dentary with 4 or 5 (usually 4) teeth, with 4 to 7 cusps, followed by a series of 3 to 7 smaller monocuspid teeth (Fig. 2c). All teeth on premaxilla, maxilla and dentary have smooth rounded cusps.

Vertebrae 34-36. Supraneurals 5-6, typically 5. Upper gill rakers 7-8, lower gill rakers 10-13. Infraorbitals 6, third suborbital contacting at some point with the preopercular sensory canal.

COLOR IN ALCOHOL

Background light yellowish. Dorsal area of head and body darker. Y-shaped humeral spot, the upper arms of the Y above the lateral line, at the level of upper-posterior edge of opercle, and the lower arm extending ventrally onto 2 or 3 scales, including the perforated lateral-line scale. Gray broad lateral stripe along the sides, above the lateral line, expanded at base of caudal fin and thinner over middle caudal fin rays. Scales of sides with dark chromatophores on the central area and sometimes arranged on scale margins. Ventrolateral region of the body uniformly colored. Opercular, subopercular, and preopercular regions dark brown. This dark area is due to densely arranged chromatophores on the inner surface of these bones. Dark chromatophores scattered on premaxilla, maxilla and lower jaw. Dorsal fin with small dark chromatophores on membrane and rays. Adipose fin with small dark chromatophores. Pectoral and pelvic fins hyaline, with small dark chromatophores on membrane. Caudal and anal fins with chromatophores scattered on membrane, more abundant on distal margin.

ETYMOLOGY

The specific epithet *hermosus* refers to the town of Valle Hermoso where the new species was found.

DISTRIBUTION AND HABITAT

Astyanax hermosus sp. n. is known only from San Francisco River, of the endorheic Primero River basin in Valle Hermoso (31° 07' S - 64° 29' W), Córdoba Province, Argentina. The locality, situated at 900 m a.s.l. is a typical mountain stream with fast-flowing current and gravelly, rocky and sandy bottoms.

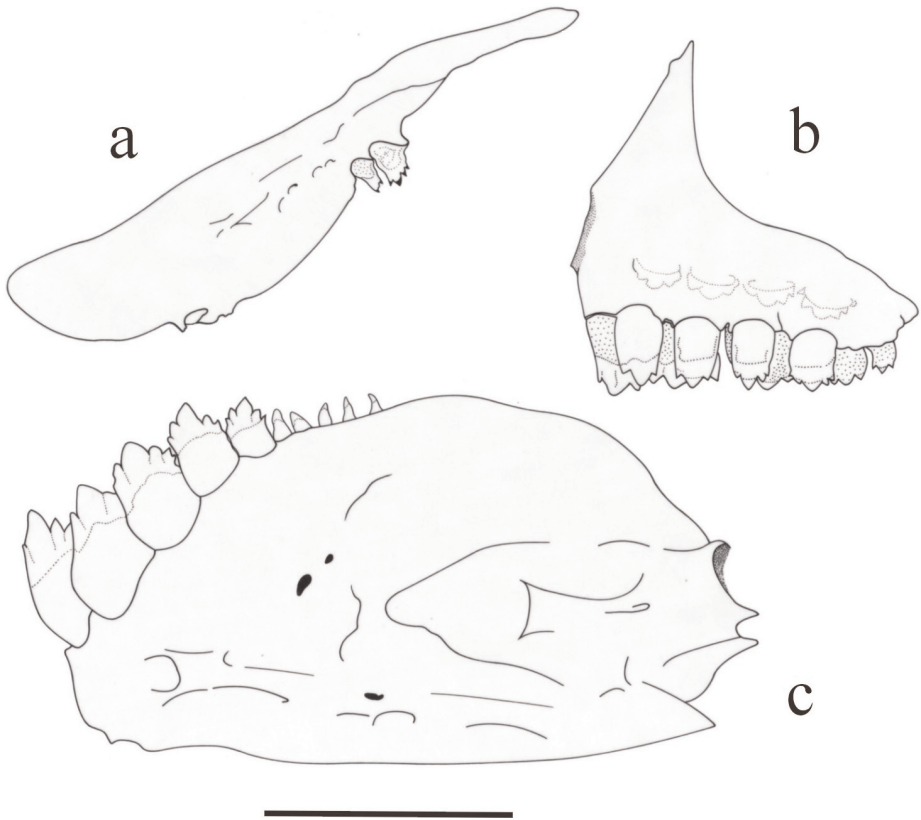


FIG. 2

Astyanax hermosus sp. n., ILPLA 1691. Paratype male, 71.1 mm SL: a. Left maxilla, internal view; b. Left premaxilla, external view; c. Left hemimandible, external view. Scale bar = 1 mm.

DISCUSSION

Of all the species of *Astyanax* described for the Paranoplatensean basin, *Astyanax hermosus* sp. n. is similar to a small group of species in which the males have bony hooks on all fins, namely: *A. leonidas* Azpelicueta, Casciotta & Almirón, 2002; *A. ojiara*; *A. pynandi* Casciotta, Almirón, Bechara, Roux & Ruiz Díaz, 2004; and *A. troya* (*A. leonidas* lacks bony hooks on the dorsal fin). However, the new species differs from these by several morphometric characters, the most remarkable of which is the presence of a wider interorbital (34.9-41.5% HL vs. 26.9-30.4; 31.0-35.6; 27.7-34.0; 27.6-33.4% HL, respectively); different color pattern (single humeral spot vs. two humeral spots) and also by its different geographical distribution. *Astyanax hermosus* sp. n. occurs in an endorheic basin in central Argentina, whereas *A. leonidas*, *A. pynandi* and *A. troya* have been described for the Paraná River basin and *A. ojiara* for the Uruguay River basin, all from Northeastern Argentina.

The new species is also distinguished from *A. leonidas* by lesser prepelvic distance (41.5-47.0% SL vs. 46.0-52.3% SL) and larger caudal peduncle depth (47.8-58.7 % HL vs. 34.9-41.0% HL). From *A. ojiara* by lesser number of branched anal-fin rays (17-22 vs. 20-23) and maxillary teeth (1 to 3 with 1 to 4 cusps vs. 1 with 7 cusps). From *A. pynandi* by the shorter head (23.5-27.1 vs. 27.5 -30.8 % SL); lesser orbital diameter (29.7-34.7 vs. 36.7-43.5 % HL); larger caudal peduncle depth (12.6-14.7 vs. 10.5-12.3 % SL); lesser anal-fin branched rays (17-22 vs. 21-26) and maxillary teeth (1 to 3 with 1 to 4 cusps vs. 1 with 5 or 7 cusps). From *A. troya* by the shorter head (23.5-27.1 % SL vs. 26.9-30.9% SL) and smaller eye (29.7-34.7 % HL vs. 35.0-44.6% HL).

Other species of *Astyanax* reported in the distribution range of *Astyanax hermosus* sp. n. are *A. asuncionensis* (sub *A. bimaculatus*), *A. cordovae*, and *A. eigenmanniorum* (Bistoni & Hued, 2002). The new species differs from *A. asuncionensis*, by the lesser number of anal-fin rays (21-27 vs. 30-32) and by having a vertically elongated vs. horizontally elongated humeral spot. From *A. cordovae* by the lesser number of scales on the lateral series (35-38 vs. 43-45) and by the presence of teeth on maxillary vs. absence. From *A. eigenmanniorum*, among other characters, by the position of the mouth (superior vs. terminal); more maxillary teeth (1 to 3 vs. 1); short rounded fins vs. long falcate fins. Also by the different color pattern and the presence of bony hooks on all fins of males vs. pelvic and anal fins only.

According to Bistoni & Hued (2002), *A. eigenmanniorum*, *A. cordovae* and *A. asuncionensis* have different altitudinal distribution ranges. *A. hermosus* sp. n. occurs at 900 m a.s.l., therefore it would belong in 'level 3' as proposed by these authors.

Astyanax hermosus sp. n. along with *A. cordovae* are endemic species for the endorheic Primero River basin. From an ichthyogeographical standpoint, this area is part of the Paranoplatensean Province (Ringuelet, 1975) and the Central Endorheic Ecoregion (López *et al.*, 2002) of Argentina.

ACKNOWLEDGEMENTS

We are grateful to Roberto Menni (MLP) for his critical review and for checking the English. Thanks are also due to Carlos Tremouilles (MLP), who completed the final drafts of the figures and Justina Ponte Gómez (MLP) for technical assistance.

REFERENCES

- ALMIRÓN, A. E., AZPELICUETA, M. M. & CASCIOTTA, J. R. 2002. *Astyanax ita* sp. n.-a new species from the Río Iguazú basin, in Argentina (Teleostei, Characiformes, Characidae). *Zoologische Abhandlungen* 52: 3-10.
- AZPELICUETA, M. M. & GARCÍA, J. O. 2000. A new species of *Astyanax* (Characiformes, Characidae) from Uruguay river basin in Argentina, with remarks on hook presence in Characidae. *Revue suisse de Zoologie* 107(2): 245-257.
- AZPELICUETA, M. M., ALMIRÓN, A. E. & CASCIOTTA, J. R. 2002 a. *Astyanax paris*: a new species from the Río Uruguay basin of Argentina (Characiformes, Characidae). *Copeia* 4: 1052-1056.
- AZPELICUETA, M. M., CASCIOTTA, J. R. & ALMIRÓN, A. E. 2002 b. Two new species of the genus *Astyanax* (Characiformes, Characidae) from the Paraná River basin in Argentina. *Revue suisse de Zoologie* 109(2): 243-259.

- BERTACO, V. A. & MALABARBA, L. R. 2001. Description of two new species of *Astyanax* (Teleostei: Characidae) from headwater streams of Southern Brazil, with comments on the "A. *scabripinnis* species complex". *Ichthyological Exploration of Freshwaters* 12(3): 221-234.
- BISTONI, M. A. & HUED, A. C. 2002. Patterns of fish species richness in rivers of the central region of Argentina. *Brazilian Journal of Biology* 62 (4 B): 753-764.
- CASCIOTTA, J. R., ALMIRÓN, A. E. & AZPELICUETA, M. M. 2003. A new species of *Astyanax* from río Uruguay basin, Argentina. *Ichthyological Exploration Freshwaters* 14(4): 329-334.
- CASCIOTTA, J. R., ALMIRÓN, A. E., BECHARA, J. A., ROUX, J. P. & RUIZ DIAZ, F. 2003. *Astyanax pynandi* sp.n. (Characiformes, Characidae) from the Esteros del Iberá wetland, Argentina. *Revue suisse de Zoologie* 110 (4): 807-816.
- EIGENMANN, C. H. 1921. The American Characidae. Part 3. *Memoirs of the Museum of Comparative Zoology, Harvard University*, 43: 208-310.
- EIGENMANN, C. H. 1927. The American Characidae. Part 4. *Memoirs of the Museum of Comparative Zoology, Harvard University*, 43: 311-428.
- FINK, W. L. & WEITZMAN, S. H. 1974. The so-called Cheirodontin fishes of Central America with descriptions of two new species (Pisces: Characidae). *Smithsonian Contributions to Zoology* 172: 1-46.
- GARUTTI, V. 2003. Revalidação de *Astyanax rupunini* Fowler, 1914 (Teleostei, Characidae) e descrição de duas espécies novas para o gênero. *Papéis Avulsos de Zoologia, Museo de Zoologia da Universidade de São Paulo* 43 (1):1-9.
- GARUTTI, V. & BRITSKI, H. A. 2000. Descrição de uma espécie nova de *Astyanax* (Teleostei: Characidae) da bacia do Alto Rio Paraná e considerações sobre as demais espécies do gênero na bacia. *Comunicações do Museu Ciências e Tecnologia da PUCRS, Série Zoologia, Porto Alegre*, 13: 65-88.
- GÉRY, J. 1977. Characoids of the world. *T.H.F. Publications, Neptune City, New Jersey*, 672 pp.
- LÓPEZ, H. L., MORGAN, C. C. & MONTENEGRO, M. J. 2002. Ichthyological ecoregions of Argentina. *Documents Series, Probiota, Online version*, (ISSN 1666-7328).
- MIRANDE, J. M., AGUILLERA, G. & AZPELICUETA, M. M. 2004. A new species of *Astyanax* (Characiformes, Characidae) from the upper río Bermejo basin, Salta, Argentina. *Revue suisse de Zoologie* 111(1): 213-223.
- REIS, R. E., KULLANDER, S. O. & FERRARIS, JR., C. J. (org.). 2003. Check list of the freshwater fishes of South and Central America. *EDIPUCRS, Porto Alegre*, 742 pp.
- RINGUELET, R. A. 1975. Zoogeografía y ecología de los peces de aguas continentales de la Argentina y consideraciones sobre las áreas ictiológicas de América del sur. *Ecosur* 2 (3): 1-151.
- TAYLOR, W. R. & VAN DYKE, G. C. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium* 9: 107-119.
- TRIQUES, M. L., VONO, V. & CAIAFA, E. V. 2003. *Astyanax turmalinensis*, a new species from the Rio Jequitinhonha basin, Minas Gerais, Brazil (Characiformes: Characidae: Tetraogopterinae). *Aqua, Journal of Ichthyology and Aquatic Biology* 7(4): 145-150.
- WEITZMANN, S. H. & MALABARBA, L. R. 1998. Perspectives about the phylogeny and classification of the Characidae (Teleostei: Characiformes) (pp. 161-170). In: MALABARBA, L. R., REIS, R. E., VARI, R. P., LUCENA, Z. M. S. & LUCENA, C. A. S. (eds). Phylogeny and classification of neotropical fishes. *EDIPUCRS, Porto Alegre*, 603 pp.