

Two new species of the genus *Astyanax* (Characiformes, Characidae) from the Paraná river basin in Argentina

María de las Mercedes AZPELICUETA, Jorge R. CASCIOTTA
& Adriana E. ALMIRÓN

División Zoología Vertebrados, Facultad de Ciencias Naturales y Museo de La Plata,
Paseo del Bosque, 1900 La Plata, Argentina.

E-mail: azpeli@museo.fcnym.unlp.edu.ar

Two new species of the genus *Astyanax* (Characiformes, Characidae) from the Paraná river basin, in Argentina. - *Astyanax leonidas* and *A. troya* are described from the río Paraná basin in northeastern Argentina. Both species share similar number of anal-fin rays and perforated scales in the lateral line, one maxillary tooth, a deep dentary and the presence of small hooks on pectoral, pelvic, anal, and caudal fin of males. These characters are also present in *A. ojiara* and separate the three species from the remaining species of the genus. *Astyanax leonidas* is differentiated by the robust body, dorsal profile almost straight, a long and slender maxillary tooth, teeth of premaxillary inner row with notable long central cusp, dentary teeth of similar shape than those of premaxilla, and 4 large dentary teeth followed by one intermediate tooth, and 3 or 4 small teeth. Also this species does not have hooks on dorsal-fin rays and pelvic axillary scale. *Astyanax troya* has a dorsal profile with marked concavity on supraoccipital area, one broad and low pentacuspoid maxillary teeth, teeth of inner premaxillary row gently expanded distally with cusps arising in the same line, central cusp of premaxillary teeth scarcely longer, 8-10 dentary teeth decreasing in size anteroposteriorly, and males with hooks in all fins and pelvic axillary scale.

Key-words: Characiformes - Characidae - *Astyanax* - Paraná basin - Iguazú basin.

INTRODUCTION

The genus *Astyanax* is one of the most common genus in freshwaters of South America including about one hundred of nominal species (Garutti & Britski, 2000). According with these authors the most complete systematic revision of the genus was made many years ago by Eigenmann (1921, 1927), therefore a modern revision of *Astyanax* is long overdue.

In northeastern Argentina, the Sierra de Misiones crosses the province of the same name from the NE to the SW, separating the headwaters of many streams flowing into the Paraná and Uruguay river basins. In the last two decades, collecting

efforts have shown the presence of poorly known species and several new ones (Casciotta *et al.*, 2000; Azpelicueta & Almirón, 2001; Almirón *et al.*, 2001). Among those findings, new species of *Astyanax* have been collected in different streams of both slopes.

One of them, *A. ojiara* (Azpelicueta & García, 2000) was described with material collected from the arroyo Yabotí, an affluent of the Uruguay river basin, and other species of the genus are under study. The objective of the present paper is to describe two new species of the genus *Astyanax* from affluents of the Paraná river basin.

MATERIAL AND METHODS

The specimens examined in this study were cleared and counterstained (C&S) following Taylor & Van Dyke (1985). Measurements are straight distances taken with calliper to nearest 0.1 mm. Peduncle length is the distance between last branched anal-fin ray and hypural joint.

Material is deposited in the Academy of Natural Science of Philadelphia (ANSP); Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Argentina (MLP); Fundación Miguel Lillo, Tucumán, Argentina (FML); Museo Argentino de Ciencias Naturales Bernardino Rivadavia (MACN); Muséum d'histoire naturelle de Genève, Genève, Switzerland (MHNG); Museu de Ciências, Pontificia Universidade Católica de Rio Grande do Sul, Porto Alegre, Brasil (MCP).

Comparative material (SL in mm). *Astyanax abramis* (Jenyns, 1842): MLP 9427, 2 ex., 102.0-113.0 mm, Argentina, Misiones, río Paraná. *Astyanax alburnus* (Hensel, 1870): MLP uncat., 5 ex., 40.5-47.2 mm, Uruguay, río Yaguarón. *Astyanax alleni* (Eigenmann & McAtee, 1907): MLP 6774, 5 ex., 50.0-64.2 mm, Argentina, Santa Fe, Laguna Setúbal. MLP 7255, 1 ex., 87.5 mm, Argentina, Santa Fe, río Paraná basin, Lago Parque Sur. *Astyanax asuncionensis* Géry, 1972: MLP 8660, 5 ex., 43.6-61.4 mm, Argentina, Santiago del Estero, Bañado de Añatuya. MLP 8844, 7 ex., 25.0-44.9 mm, Argentina, Formosa, río Bermejo basin, arroyo Mbiguá. *Astyanax eigenmanniorum* (Cope, 1894): ANSP 21627, paratypes, 2 ex., 42.5-49.4 mm, Brasil, Rio Grande do Sul (Photographs and measurements by L. Malabarba); MLP 9160, 6 ex., 37.3-70.6 mm, Argentina, Buenos Aires, Río de la Plata basin, laguna de Los Talas. MLP 2494, 13 ex., 30.0-53.1 mm, Argentina, Córdoba, río Quinto, Barreto. MLP 5202, 5 ex., 56.5-68.5 mm, Argentina, Córdoba, río Primero frente a Capilla de los Remedios. *Astyanax* cf. *fasciatus* (Cuvier, 1819): MLP 7115, 1 ex., 47.8 mm, Argentina, Santa Fe, río Paraná basin, San José del Rincón. MLP 8647, 5 ex. 34.0-45.8 mm, Argentina, Santiago del Estero, río Salado. *Astyanax leonidas* sp. n. (non type material), MLP uncat., 3 ex., 37.5-40.4 mm, Argentina, Misiones, río Iguazú basin, arroyo Lobo. *Astyanax ojiara* Azpelicueta & García: MLP 9470, holotype, 50.5 mm, Argentina, Misiones, arroyo Benítez, headwaters of río Yabotí, an affluent of río Uruguay. *Astyanax troya* sp. n. (non-type material), MLP uncat., 1 ex., 87.0 mm, Argentina, Misiones, río Paraná near Eldorado.

Cleared and stained material (Personal collection): *Astyanax abramis*: 2 ex., 74.5-92.0 mm, Argentina, Buenos Aires, río de la Plata in Punta Lara; 2 ex., 80.6-98.8

mm, Argentina, Misiones, río Piray-Miní, 2 ex., 62.4-72.9 mm, Argentina, Corrientes, río Riachuelo. *Astyanax asuncionensis*: 2 ex., 28.0-37.6 mm, Argentina, Santa Fe, Isla Los Sapos; 2 ex., 80.4-92.7 mm, Argentina, Misiones, río Uruguay in San Isidro. *Astyanax eigenmanniorum*: 2 ex., 17.7-33.0 mm, Argentina, Buenos Aires, desembocadura del río Colorado; 2 ex., 28.0-30.5 mm, Argentina, Buenos Aires, Laguna de Gómez; 1 ex., 60.3 mm, Argentina, Buenos Aires, río de la Plata; 1 ex., 45.0 mm, Brasil, Rio Grande do Sul, Viamão, açude Charolês. *Astyanax* cf. *fasciatus*: 2 ex., 91.0-106.5 mm, Argentina, Misiones, río Uruguay in San Isidro. *Astyanax leonidas* sp. n., 3 males, 3 females, 33.0-45.6 mm, collected with the holotype. *Astyanax ojiara*: 3 females, 46.2-71.0 mm; 7 males, 37.8-58.0 mm, Argentina, Misiones, arroyo Benítez. *Astyanax troya* sp. n.: 3 ex., 76.0-81.5 mm, collected with the holotype. *Astyanax* sp. A, 3 ex., 66.2-68.5 mm, Argentina, Misiones, arroyo Yabotí.

RESULTS

Astyanax leonidas sp. n.

Figs 1-4, 6, 8, 12; Table 1

Holotype. MLP 9580, male, 45.6 mm SL, Argentina, Misiones, río Paraná basin, headwaters of arroyo Urugua-í (26° 10' S-53° 41' W), coll. J. R. Casciotta, October 1998.

Paratypes (collected with the holotype). MLP 9581, 4 ex. (1 male and 3 females), 38.8-39.3 mm SL. MHNG 2624.29, 11 ex. (7 males and 4 females) 37.3-45.4 mm SL.

Diagnosis. *Astyanax leonidas* is distinguished by the following combination of characters: one maxillary tooth long and slender with three or four cusps; teeth of premaxillary inner row with long central cusp; dentary with four large teeth, followed by a median one and three or four very small teeth; males with hooks in anal, caudal, pectoral, and pelvic fins; 35-37 perforated scales in the lateral series; and iii-iv, 17-21 anal-fin rays. The dorsal profile of body is straight or slightly curved. The species has a first humeral spot vertically elongated and a second one faint and irregular in shape.

Description. Morphometrics of holotype and 15 paratypes are presented in table 1. *Astyanax* with low body, maximum body depth before dorsal-fin origin (Fig. 1). Dorsal profile of body straight from snout to posterior tip of supraoccipital process, slightly convex from this point to dorsal-fin origin, rather straight from dorsal-fin origin to adipose fin. Dorsal profile of caudal peduncle slightly convex. Ventral profile of body curved, caudal peduncle slightly concave ventrally.

Dorsal-fin origin almost equidistant from tip of snout and base of caudal-fin rays. Pelvic-fin origin a little before vertical through dorsal-fin origin. Adipose fin anterior to base of last branched anal-fin rays. Tip of pectoral fin reaching pelvic-fin origin in males; in females, pectoral fin short, not reaching pelvic-fin origin. Tip of pelvic fin close to anal-fin origin in males; in females, pelvic-fin tip far from that point.

Dorsal fin iii,9; first one only visible in cleared and stained specimens. Posterior margin of dorsal fin straight, second branched dorsal-fin ray longest. Males without hooks on rays.

Anal-fin iii-iv, 17-21 (holotype = iv,19). Posterior margin almost straight in males; in females, first six branched rays produced forming a small lobe. Anal fin of

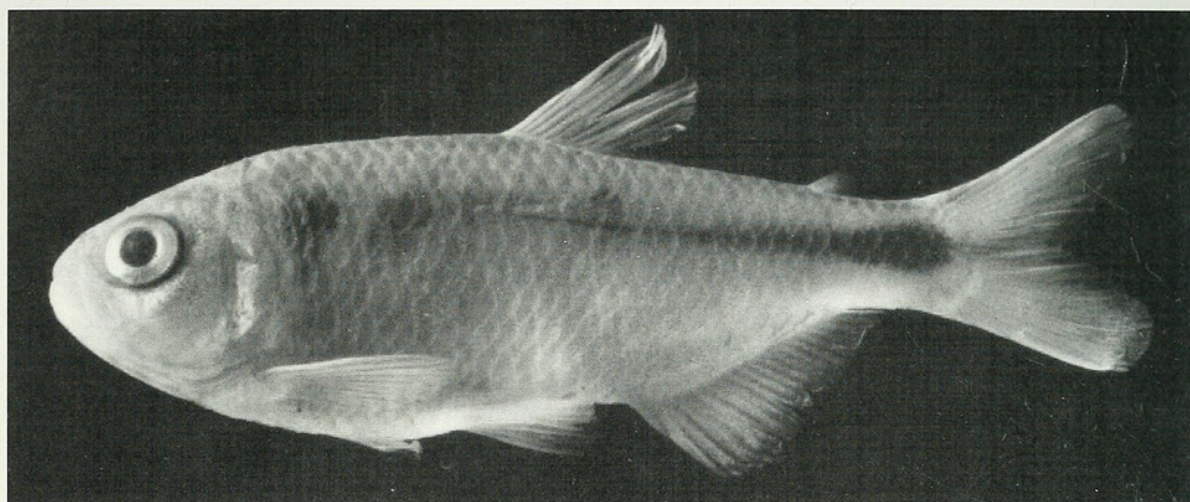


FIG. 1

Astyanax leonidas sp. n., holotype, MLP 9580, male, 45.6 mm SL, Argentina, Misiones, río Paraná basin, headwaters of arroyo Urugua-í.

males with hooks directed posteriorly and outward, slightly curved dorsally. Hooks on last unbranched ray and 1st to 14th (no less than 9th) branched anal-fin rays. Hooks placed on all branches of ray, frequently on posterior branches; sometimes two or three pairs on each segment.

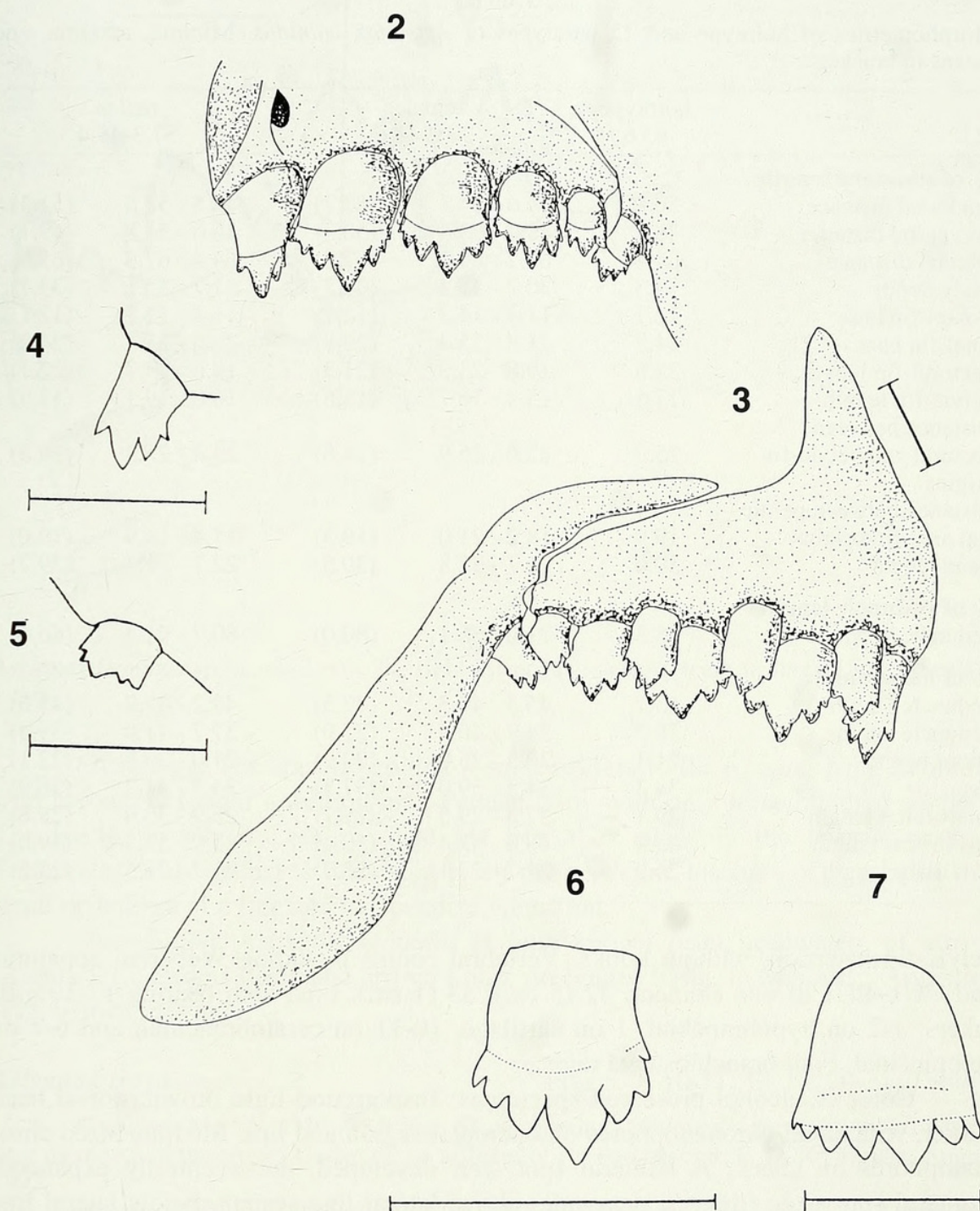
Caudal fin bearing 10/9 (dorsal/ventral) principal rays and 10-11/8-12 procurent rays. Caudal lobes similar in size. One or two pairs of hooks placed on distal tips of middle caudal-fin rays in males.

Pectoral-fin rays i,11-12 (holotype = i,11). Hooks placed on dorsal portion of rays and directed dorsally; one or two hooks on each segment, usually only one hook. Hooks on first unbranched ray and first 5 or 7 branched rays.

Pelvic fin i,7; hooks developed on inner branches of 2nd to 6th branched rays; one hook on each segment.

Head length less than 1/3 of SL, mouth terminal and horizontal; snout short. Lower and upper jaws equal in length. Premaxilla with short ascending process, alveolar process bearing two series of teeth (Figs 2-3). Outer series with 4 tricuspid or pentacuspoid teeth (3 teeth in 1 ex.), central cusp larger. Inner series with 4 or 5 (usually 5) teeth; teeth bearing 3 to 7 cusps (Figs 2, 6). Second tooth of inner series larger, fifth smaller; symphyseal tooth with 4 cusps, second to fourth with 5 to 7 cusps, fifth tooth with 3 or 4 cusps (Figs 2, 6). Maxilla long, scarcely lobed posteriorly, reaching vertical through middle orbital diameter. One or two maxillary teeth (usually only one), with 3 or 4 cusps (Figs 3, 4). Dentary bearing 4 large and 1 medium sized teeth with 5 or 6 cusps, 3 or 4 smaller teeth with 1 or 3 cusps; all teeth with central cusp larger (Fig. 8).

Scales cycloid. Lateral series with 35-37 perforated scales (5 ex.= 35, 7 ex. including holotype= 36, 4 ex.= 37). Lateral line running on lower half of caudal peduncle, ending in a long tube without lamina between caudal rays. Six to seven scales between dorsal-fin origin and lateral line; 5 between lateral line and anal-fin origin (holotype 6/5). Eleven or twelve scales forming a regular row between



FIGS 2-7

Figs 2-4,6: *Astyanax leonidas* sp. n., 42.2 mm SL, right upper jaw; 2, inner series of premaxillary teeth and maxillary tooth in lingual view; 3, premaxilla and maxilla in labial view; 4, detail of maxillary tooth; 6, detail of 3rd tooth of inner premaxillary row. Figs 5, 7: *Astyanax troya* sp. n., 81.5 mm SL, details of teeth; 5, maxillary tooth; 7, third tooth of inner premaxillary row. Scales = 1 mm.

supraoccipital process and dorsal-fin origin. Eight to fifteen (mode= 10) scales placed on anal-fin base, covering all unbranched and first 8 to 12 branched anal-fin rays. Scales placed on basal caudal-fin lobes. A narrow axillary scale present dorsal to

TABLE 1

Morphometrics of holotype and 15 paratypes of *Astyanax leonidas*. Minima, maxima, and means in brackets.

SL	holotype 45.6	females 39.0-47.6	males 37.3-45.4
% of standard length			
Predorsal distance	50.8	49.6 - 54.1 (52.7)	49.5 - 53.6 (51.3)
Preventral distance	46.0	48.7 - 52.3 (50.3)	46.0 - 51.8 (49.1)
Preanal distance	64.4	65.2 - 69.2 (67.2)	64.4 - 67.6 (65.9)
Body depth	33.3	30.2 - 35.3 (32.7)	31.7 - 35.1 (33.7)
Dorsal-fin base	12.7	11.3 - 13.3 (12.1)	11.4 - 12.7 (12.1)
Anal-fin base	24.3	21.8 - 25.4 (23.8)	23.6 - 27.1 (24.9)
Pectoral-fin length	22.8	19.8 - 23.3 (21.3)	19.6 - 23.7 (22.1)
Pelvic-fin length	17.5	15.4 - 16.7 (15.8)	16.0 - 19.1 (17.9)
Distance between pectoral and pelvic-fin origins	25.0	22.6 - 26.9 (24.8)	23.4 - 25.3 (24.5)
Distance between pelvic and anal-fin origins	19.9	18.2 - 21.0 (19.3)	17.4 - 19.9 (19.0)
Head length	30.0	28.7 - 32.8 (30.5)	22.7 - 31.4 (29.7)
% of peduncle length			
Peduncle depth	88.3	71.6 - 86.1 (80.0)	80.7 - 91.4 (86.6)
% of head length			
Peduncle length	43.7	45.5 - 49.5 (47.3)	43.2 - 47.7 (45.3)
Peduncle depth	38.7	34.9 - 40.0 (37.0)	37.7 - 41.0 (39.4)
Snout length	21.1	20.3 - 25.0 (22.9)	21.0 - 23.8 (22.1)
Eye	34.3	34.3 - 39.0 (37.3)	34.3 - 41.2 (36.9)
Interorbital length	29.1	27.3 - 29.5 (28.7)	26.9 - 30.4 (28.8)
Postorbital length	45.9	48.8 - 52.4 (50.4)	45.9 - 52.3 (49.0)
Maxillary length	26.2	22.7 - 27.1 (25.7)	21.7 - 28.5 (25.5)

pelvic-fin insertion, without hooks. Vertebral counts including Weberian apparatus and CU1+PU1 as one element: 32 (5 ex.), 33 (1 ex.). First arch bearing 17-19 gill-rakers: 1-2 on hypobranchial, 1 on cartilage, 10-11 on ceratobranchial, and 6-7 on epibranchial. Four branchiostegal rays.

Color of alcohol preserved specimens: Background light brown, dorsal head darker, with small chromatophores on opercular region and lips. Medium sized chromatophores on cheek. A humeral spot well developed, dorsoventrally expanded. Humeral spot wide (three scales wide) above lateral line system, below lateral line narrow, one scale wide. A second lateral spot placed above lateral line, starting 3 scales backward from humeral spot. Lateral spot very faint and smaller, usually irregular in shape. A clear area between humeral and lateral spots. A dark lateral band with different intensity in coloration and width crossing flanks. Lateral band origin close to lateral spot, anterior portion of it faint, wider posteriorly (1½ scale wide), ending in a caudal spot. Middle caudal-fin rays with chromatophores. Dark chromatophores on distal margin of anal fin, forming a faint band. Dorsal-fin rays and membranes with black chromatophores, more evident on distal portion. Black chromatophores on distal margin of fin and ray margins. Pectoral and pelvic fins hyaline.

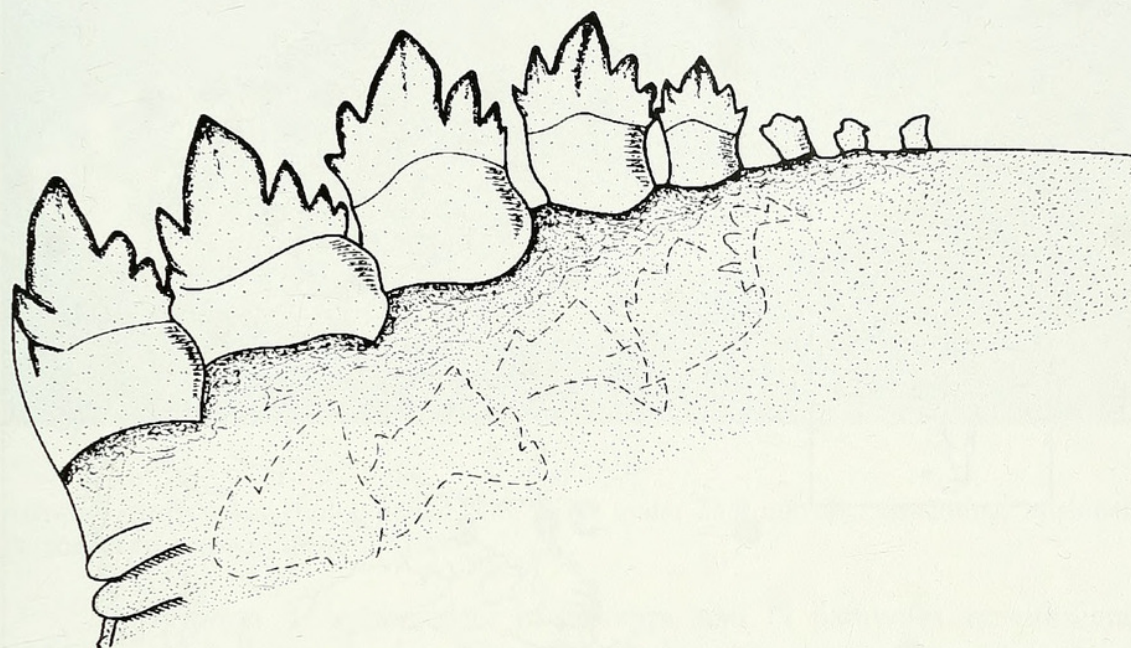


FIG. 8

Astyanax leonidas sp. n., 42.2 mm SL, right lower jaw, dentary teeth in lingual view. Scale = 1 mm.

Etymology. The specific epithet *leonidas* refers to the Spartan King Leonidas who heroically fought a million-man Persian army with only three hundred soldiers. The battle, in which Leonidas lost his life, took place in the narrow pass of Termopilas. This epithet is dedicated to all the academic teachers of Argentina that stand in defense of a free and independent education.

Distribution. *Astyanax leonidas* is only known from headwaters of arroyo Urugua-í, río Paraná basin and arroyo Lobo, río Iguazú basin, in Misiones, Argentina (Fig. 9, localities 1-2).

***Astyanax troya* sp. n.**

Figs 5, 7, 10-11, 13-18, 20-21; Table 2

Holotype. MACN 8310, 73.8 mm SL, Argentina, Misiones, arroyo Cuñapirú Chico, near its mouth in the arroyo Cuñapirú, an affluent of río Paraná, coll. E. D. Rodríguez, August 1993.

Paratypes. FML 3250, 4 ex., 50.5-75.4 mm SL, Argentina, Misiones, coll. Azpelicueta & Braga, arroyo Tabay, October 1987. MHNG 2624.30, 8 ex., 72.4-81.7 mm SL, Argentina, Misiones, arroyo Cuñapirú in Balneario de Aristóbulo del Valle, coll. U. Pardiñas, September 1995. MCP 28438, 5 ex., 76.2-82.4 mm SL, collected with the holotype.

Diagnosis. The species is distinguished by a combination of characters: one maxillary tooth with five cusps, maxillary tooth low and broad; teeth of inner premaxillary row very gently expanded distally, with central cusp not too long, and all cusps arising at same line; 8-10 dentary teeth decreasing in size anteroposteriorly; males with hooks in all fins, and large specimens with 1 or 2 hooks on pelvic axillary scale; 34-37 perforated scales in lateral series; and iv-v, 18-21 anal-fin rays. Dorsal

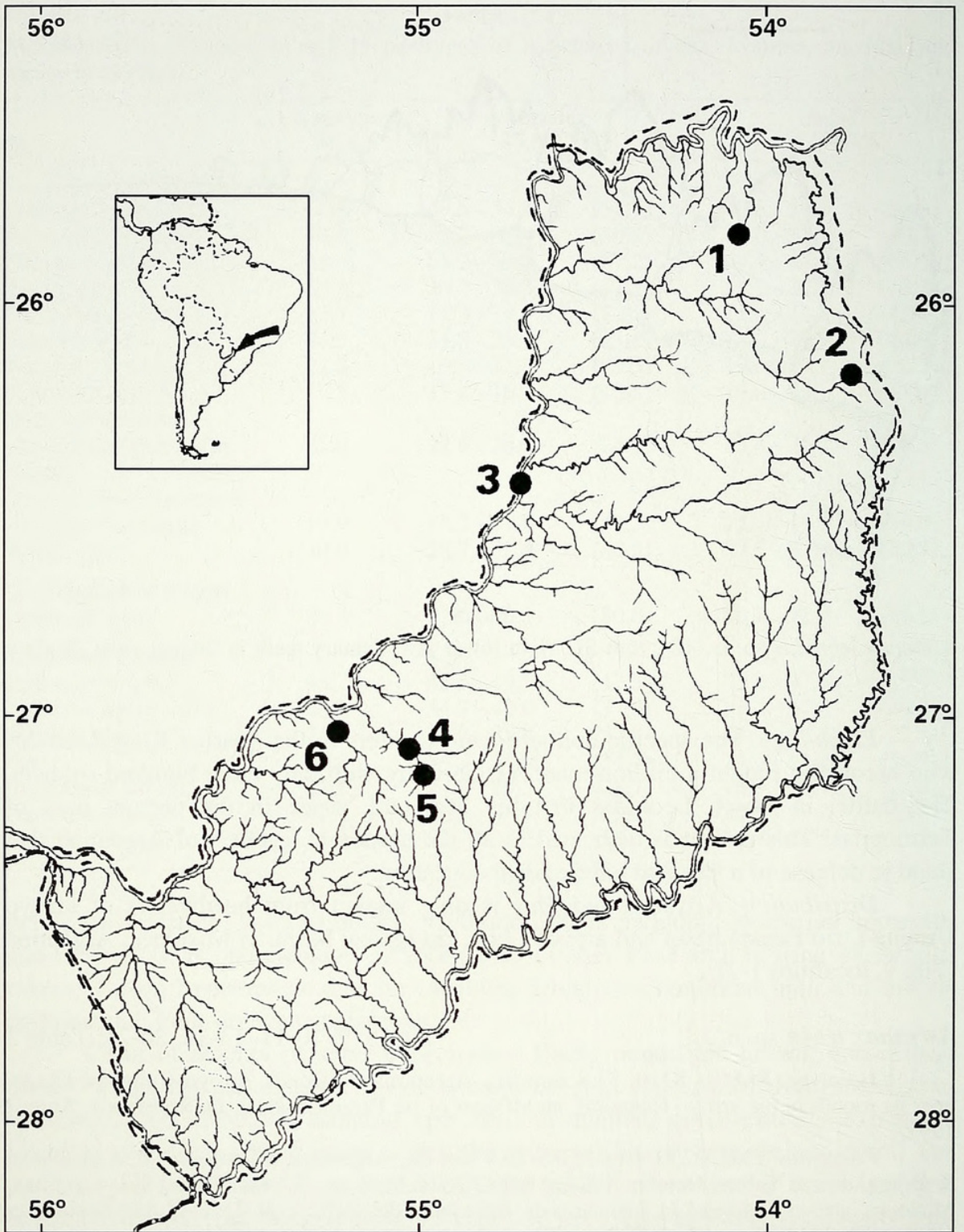


FIG. 9

Geographical distribution of *Astyanax leonidas* sp. n. (1, 2) and *A. troya* sp. n. (3-6) in Argentina, Misiones, río Paraná basin. 1, arroyo Lobo; 2, headwaters of arroyo Urugua-í; 3, río Paraná near Eldorado; 4, arroyo Cuñapirú Chico; 5, arroyo Cuñapirú; and 6, arroyo Tabay.

profile of body concave over supraoccipital area. One humeral spot rounded or horizontally enlarged bounded by a light area, with chromatophores forming a well developed vertical band placed ventral to the spot; a second faint humeral spot present.

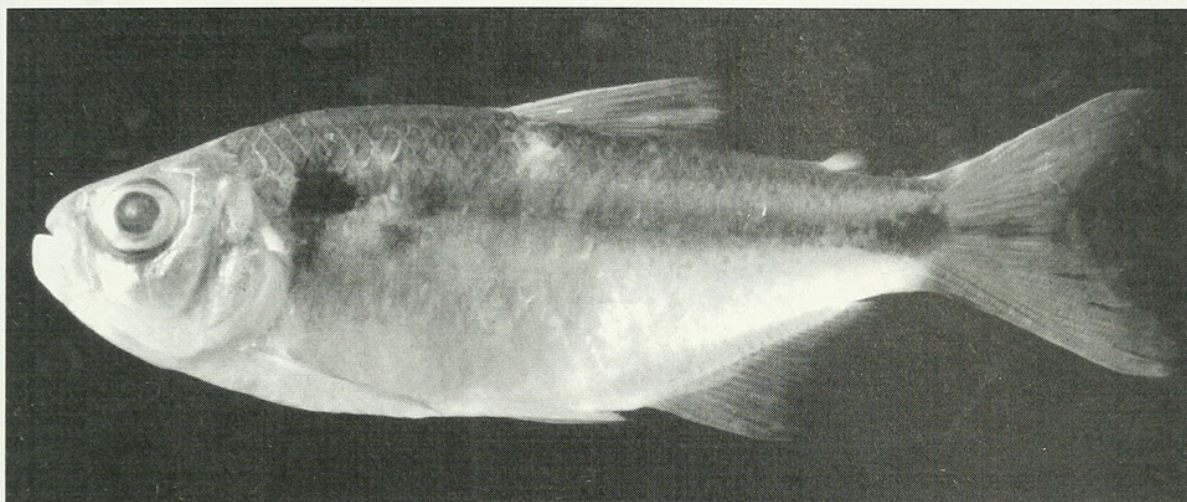


FIG. 10

Astyanax troya sp. n., holotype, MACN 8310, male, 73.8 mm SL, Argentina, Misiones, río Paraná basin, arroyo Cuñapirú Chico.

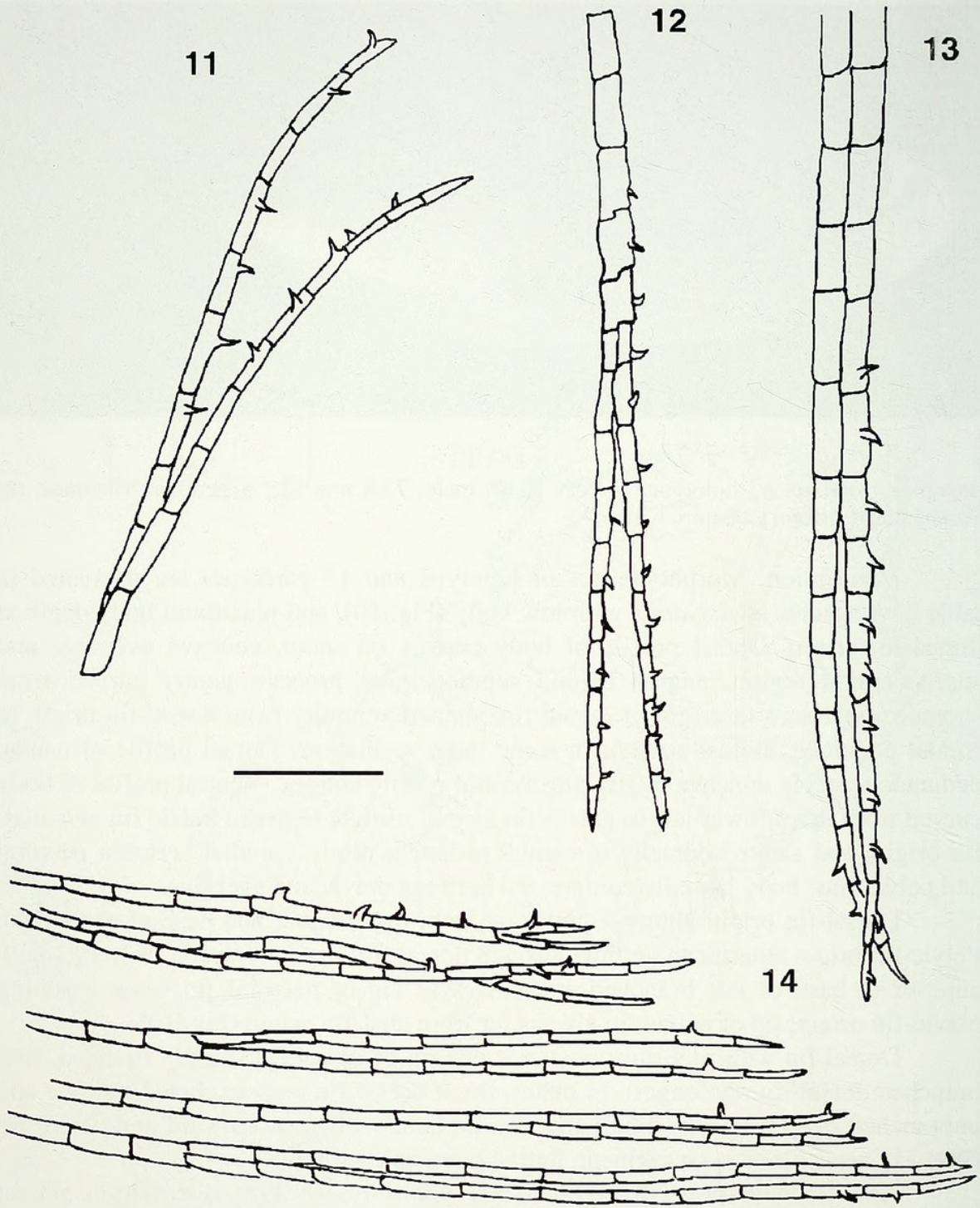
Description. Morphometrics of holotype and 17 paratypes are presented in table 2. A species of *Astyanax* with low body (Fig. 10), and maximum body depth at dorsal-fin origin. Dorsal profile of body convex on snout, concave over eye and supraoccipital region, angled behind supraoccipital process, gently curved from supraoccipital area to origin of dorsal fin, slanted ventrally from dorsal-fin origin to caudal peduncle, almost straight in some large specimens. Dorsal profile of caudal peduncle scarcely concave or straight; ventral profile convex. Ventral profile of body curved from tip of lower jaw to pelvic-fin origin, straight between pelvic fin and anal-fin origin, and slanted dorsally to caudal peduncle. Body rounded between pectoral and pelvic fins; body laterally compressed between pelvic and anal fins.

Dorsal-fin origin almost equidistant from tip of snout and base of caudal-fin. Pelvic-fin origin anterior to vertical through dorsal fin-origin. Adipose fin very small, anterior to base of last branched anal-fin rays. Tip of pectoral fin never reaching pelvic-fin origin; tip of pelvic fin always far from anal-fin origin (Fig. 10).

Dorsal fin with iii,9 rays; posterior margin of dorsal fin slightly rounded, first branched dorsal-fin ray longest. In males, tip of dorsal-fin rays, excluded last one and unbranched rays, with very small and slender hooks, directed outward and backward (Fig. 11), one pair on each segment, until 8 pairs on each ray.

Anal-fin with iv-v, 18-21 rays (holotype = iv,21). Posterior margin almost straight; in some specimens, two or three branched rays produced forming a small lobe. Anal fin of males bearing small hooks on all branched rays, directed outward and scarcely curved dorsally; one pair of hooks on each segment, until 10 pairs on each ray (Fig. 13).

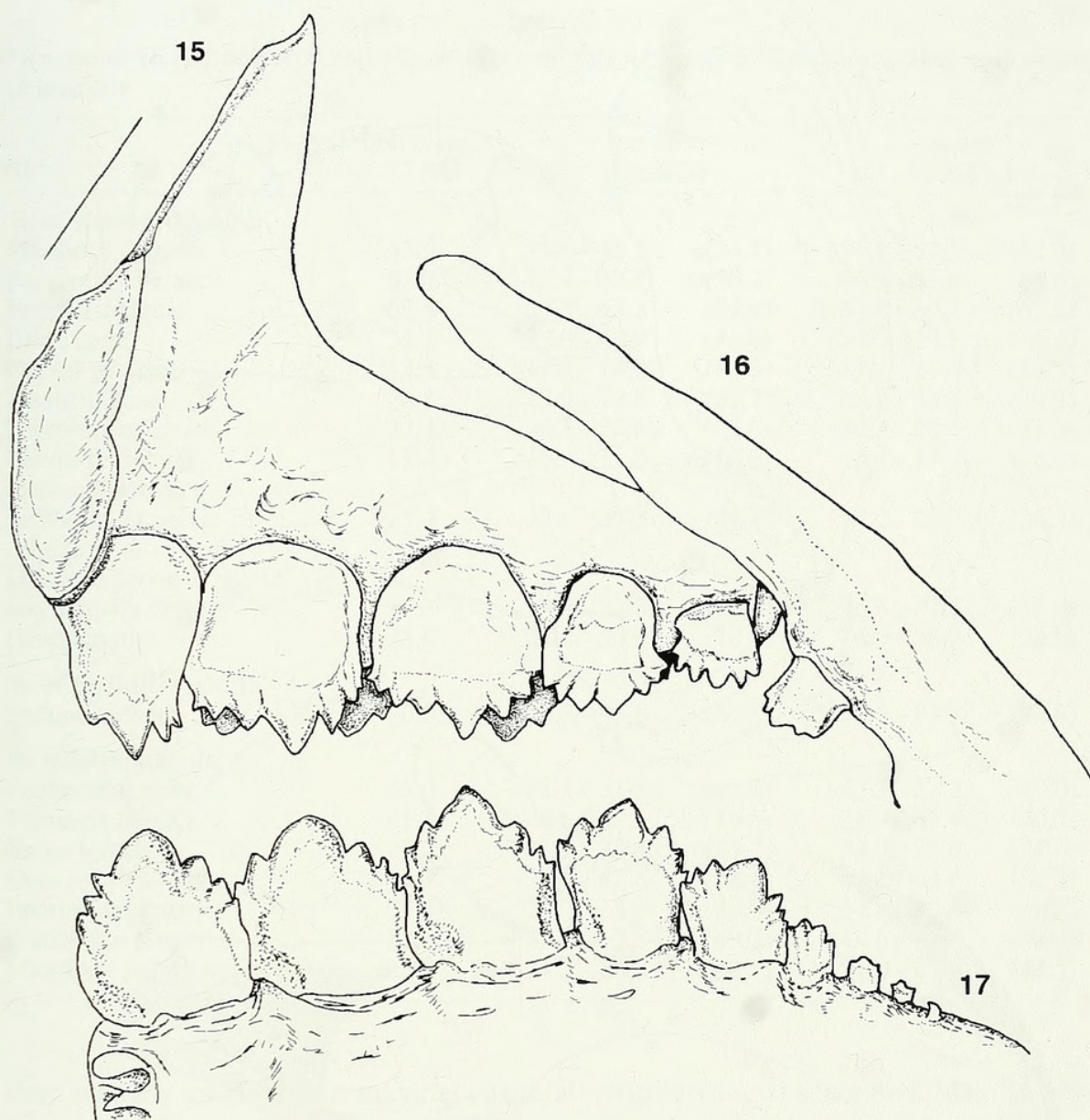
One unbranched and 9 branched principal caudal-fin rays in upper lobe; 8 branched and 1 unbranched principal rays in lower lobe; lower lobe usually larger. In mature males, few very slender hooks occurring on distal tips, especially on middle caudal-fin rays (Fig. 14). Hooks more numerous on upper lobe, no more than 7 pairs on each ray.



FIGS 11-14

Figs 11, 13-14. *Astyanax troya* sp. n., male, 81.5 mm SL, left view. 11, third dorsal-fin ray; 13, detail of hooks on posterior branch of third anal-fin ray; 14, detail of hooks on middle caudal-fin rays of the lower lobe. Fig. 12. *Astyanax leonidas* sp. n., male, 42.2 mm SL, left view of third branched anal-fin ray. Scale = 0.5 mm.

Pectoral-fin with i,10-12 rays (holotype = i,12). Posterior margin of pectoral fin straight or scarcely rounded. Few very small and slender hooks on tips of three or four first branched rays in large males.

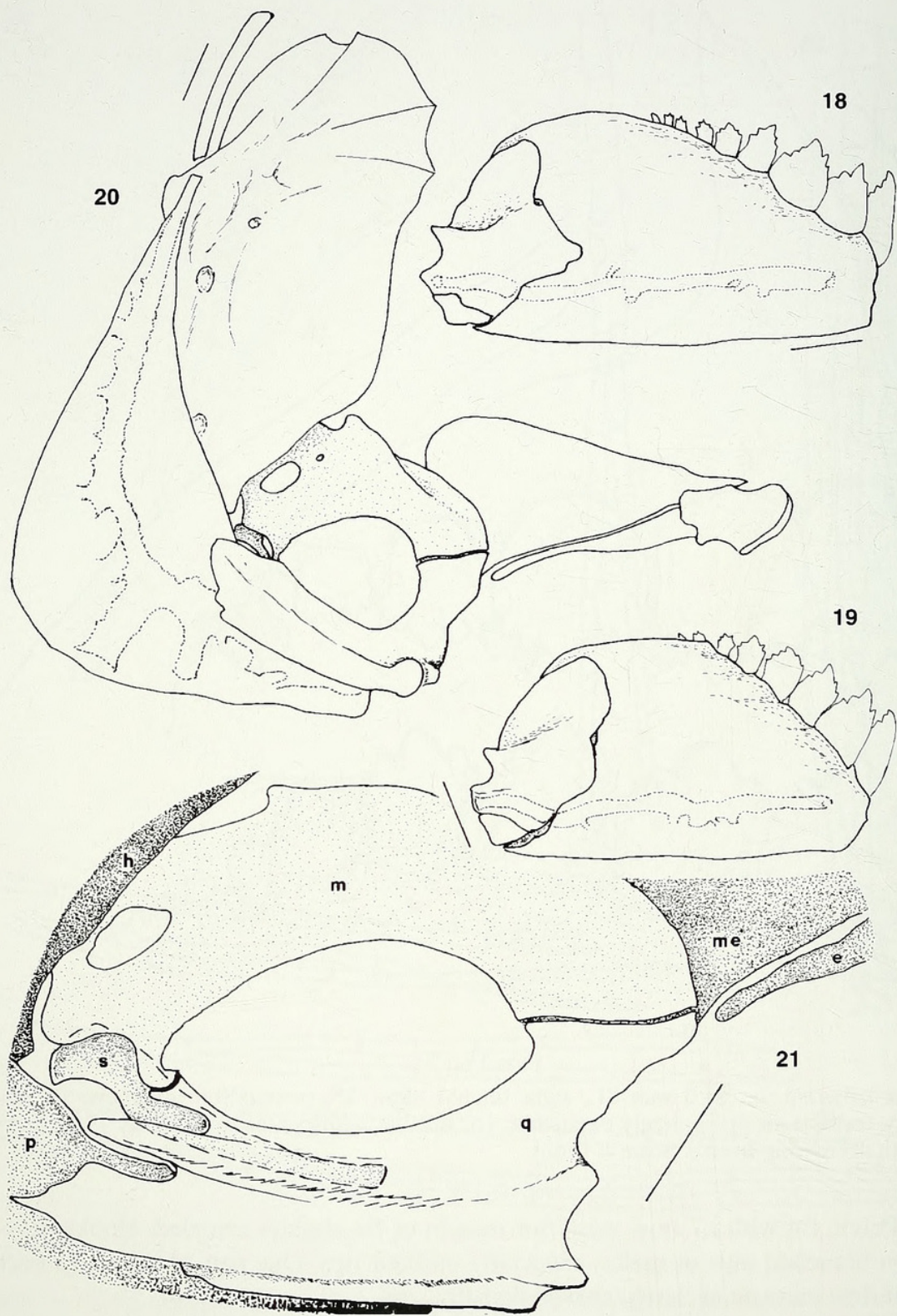


FIGS 15-17

Astyanax troya sp. n., 81.5 mm SL, right lingual view. 15, premaxilla, inner row of premaxillary teeth, with tips scarcely expanded; 16, maxilla with pentacuspoid tooth; 17, dentary with teeth decreasing in size. Scale = 1 mm.

Pelvic fin with i,7 rays, posterior margin of fin slightly rounded. Hooks developed on branched rays of males, especially on their tips. One pair of hooks on each segment, few pairs on each ray, curved dorsally.

Head length moderate, mouth terminal, horizontal; snout short. Lower jaw slightly longer than upper jaw. Premaxilla with short ascending process, and long alveolar process. Premaxilla with two series of teeth, each tooth with a central cusp larger. Outer row with 4 to 6 tetracuspoid or pentacuspoid teeth. Inner series of premaxilla with 5 teeth (5 specimens with 4) very gently expanded distally; symphyseal tooth slender, with 5 cusps; remaining teeth with 5 to 8 cusps (Figs 7, 15), central



FIGS 18-21

Figs 18-19. Lower jaw, right external view, scale = 1 mm. 18, *Astyanax troya* sp. n., 76.0 mm SL; 19, *A. ojiara*, 71.0 mm SL. Figs 20-21: *A. troya* sp. n., 81.5 mm SL, external view of right suspensorium. 20, scale = 1 mm; 21, detail of the posteroventral metapterygoid process suturing with medial process of quadrate; scale = 0.5 mm; **e**, ectopterygoid; **h**, hyomandibula; **me**, mesopterygoid; **m**, metapterygoid; **p**, preopercle; **q**, quadrate; **s**, symplectic.

TABLE 2

Morphometrics of holotype and 17 paratypes of *Astyanax troya*. Minima, maxima, and means in brackets

SL	holotype 73.8	females 71.6-82.4	males 72.8-81.4
% of standard length			
Predorsal distance	53.6	51.6 - 55.3 (53.2)	50.4 - 54.6 (52.9)
Preventral distance	52.0	47.4 - 52.2 (50.2)	46.0 - 51.8 (48.6)
Preal anal distance	69.3	65.4 - 73.3 (69.4)	61.8 - 69.7 (67.3)
Body depth	34.1	33.0 - 40.9 (36.6)	34.0 - 40.1 (36.1)
Dorsal-fin base	13.5	12.4 - 14.9 (13.5)	11.7 - 14.4 (13.5)
Anal-fin base	26.8	22.9 - 28.6 (25.7)	23.9 - 28.8 (26.3)
Pectoral-fin length	22.3	20.1 - 23.6 (22.1)	20.3 - 23.4 (21.9)
Pelvic-fin length	17.4	15.3 - 18.3 (16.5)	15.4 - 19.3 (16.8)
Distance between pectoral and pelvic-fin origins	25.4	22.6 - 27.3 (24.6)	23.2 - 25.7 (24.3)
Distance between pelvic and anal-fin origins	19.3	17.4 - 23.8 (20.5)	16.5 - 22.1 (19.9)
Head length	28.8	27.5 - 30.9 (28.2)	26.9 - 30.0 (28.5)
% of peduncle length			
Peduncle depth	90.8	76.3 - 95.6 (87.8)	70.0 - 93.5 (82.6)
% of head length			
Peduncle length	46.0	41.4 - 51.5 (45.1)	43.3 - 52.2 (49.0)
Peduncle depth	41.7	36.6 - 42.1 (39.6)	38.9 - 43.1 (40.5)
Snout length	26.2	22.9 - 28.4 (25.7)	24.7 - 28.9 (27.0)
Eye	38.4	35.0 - 42.6 (38.1)	35.1 - 44.6 (38.2)
Interorbital length	31.4	29.7 - 33.3 (30.9)	27.6 - 33.4 (30.2)
Postorbital length	52.1	43.2 - 53.8 (49.2)	44.6 - 52.1 (49.5)
Maxillary length	25.8	21.2 - 26.6 (24.1)	21.0 - 27.6 (23.5)

cusps scarcely longer than remaining cusps, all cusps arising at same line. Maxilla with long anterodorsal and laminar processes, always surpassing vertical through anterior orbital margin; one pentacuspoid maxillary tooth (two specimens without maxillary tooth); maxillary tooth broad and low (Figs 5, 16). Dentary with 8-10 teeth decreasing in size anteroposteriorly; those teeth with broad bases, and central cusps larger. Symphyseal tooth narrower, with 7 cusps. Second tooth with 7 or 8 cusps, third to fifth teeth with 6 or 7 cusps; sixth to eighth teeth pentacuspoid or tricuspid, ninth tooth tricuspid or unicuspid- and tenth tooth when present- unicuspid (Figs 17-18).

Eye large, interorbital area convex. Six infraorbitals well developed; third infraorbital not reaching sensory tube of preopercle. Scales cycloid, with several radii on posterior field. Lateral series with 34-37 perforated scales (1 ex. = 34, 2 ex. = 35, 11 ex. = 36, 4 ex. including holotype = 37); lateral line running on lower half of caudal peduncle. Five or 6 scales between dorsal-fin origin and lateral line; 5 scales between lateral line and ventral-fin origin. Fifteen or sixteen scales around caudal peduncle. Ten to twelve scales forming a regular row between supraoccipital process and dorsal-fin origin. Nine to twelve rectangular scales placed on anal-fin base,

covering all unbranched and nine to twelve branched anal-fin rays. Scales covering basal fifth of caudal lobes. Pelvic axillary scale present, bearing one or two hooks in its posterior inner area in large males.

Osteological characters: In three cleared and stained specimens, first arch bearing 17-18 gill-rakers: 1 on hypobranchial, 1 on cartilage, 9 on ceratobranchial, and 6-7 on epibranchial. Four branchiostegal rays. Eleven or twelve (2 ex.) pairs of ribs. Vertebral counts including Weberian apparatus and CU1+PU1 as one element: 30 (2 ex.) and 31; fourteen (2 ex.) or sixteen precaudal vertebrae. Four anal-fin rays on first pterygiophore of same fin. Caudal fin bearing 11-12 dorsal and 9-10 ventral procurent rays.

Pterosphonoid bone with a median crest, horizontally placed. Posterior arm of metapterygoid with a curved ventral process, directed anteriorly, suturing with a dorsomedial process of quadrate and also with symplectic (Figs 20-21).

Coloration upon capture: Upper half of body darker, wide lateral band gray ending in a caudal spot, lower half silvery. Some specimens with a blotch dark, on central area of dorsal fin, and anterior margin of this fin white. Basal half of caudal lobes red, middle caudal rays faint gray, caudal fin margin hyaline or black. First rays of anal fin white, base of anal-fin red or faint red, and most specimens with anal-fin margin black. Pelvic fin redish near its origin.

Color of alcohol preserved specimens: Background pale, dorsal region of flanks and head darker, one black midline along body on dorsum. Rounded to sub-circular humeral spot well developed, bounded by a clear area, and extended ventrally by a narrow band of small black chromatophores. Second lateral spot well developed or faint. Deep dark lateral band extending from second humeral spot to caudal peduncle, covered on posterior half by other superficial band of gray chromatophores.

Two or three first dorsal rays with black chromatophores; dark chromatophores forming a spot on tip of dorsal-fin rays in most males. Large black chromatophores on distal margin of anal fin, forming a faint band in some specimens. Middle caudal-fin rays black; tip of caudal-fin rays with dark chromatophores. Pectoral and pelvic fins hyaline, few chromatophores along ray surfaces.

Chromatophores completely covering scales surface on upper half of flank, although leaving a marginal light area, forming a reticulate pattern; limit of scales bounded by black minute chromatophores. Many specimens with chromatophores on central region of scales, appearing as two or three rows of lines on lower half of flanks.

Dorsum of head black; also, premaxilla, maxilla, antorbital, infraorbitals 4, 5, and 6 and middle lower jaw with numerous black chromatophores. Most specimens with dark chromatophores on inner opercular surface, forming a spot.

Etymology. The specific epithet refers to the mythological Troya, in allusion to the name of the genus *Astyanax*, who was one of the sons of Hector, prince of Troya.

Distribution. *Astyanax troya* is known from the arroyos Cuñapirú Chico, Cuñapirú, and Tabay, in Misiones, Argentina. Only one specimen was found in the main course of the río Paraná, near Eldorado (Fig. 9).

DISCUSSION

The most complete systematic revision of the genus *Astyanax* was made many years ago by Eigenmann (1921, 1927). Subsequently, Géry (1977) followed that classification; therefore, a recent revision of the genus is still pendant.

Astyanax ojiara, discovered in the río Uruguay basin, northeast of Argentina, was the first described species of the genus having hooks on all fins of males (Azpelicueta & García, 2000). In this paper, *A. leonidas* and *A. troya*, other two species with the usually known hooks on the pectoral, pelvic, and anal fins, are described from the río Paraná basin. Both new species also have hooks on the caudal fin; besides, *A. troya* – as *A. ojiara* – has hooks on the dorsal fin of males which are absent on the same fin of *A. leonidas*.

The number of perforated scales in the lateral line and anal-fin rays of *A. leonidas* and *A. troya* resemble those of *A. eigenmanniorum*. *Astyanax leonidas* differs from *A. eigenmanniorum* in the shape of premaxillary teeth, and the presence of very small hooks on caudal fin of males. *Astyanax troya* is differentiated from *A. eigenmanniorum* by the shape and number of dentary teeth, the shape of premaxillary teeth, and the hooks developed in all fin of males (Figs 2-8, 11-17 of present paper, and figure 7 of Azpelicueta & García, 2000).

Astyanax leonidas is distinguished from *A. ojiara* by the following features: the slender and deep maxillary tooth bears 3-4 cusps (vs. a very broad tooth with 7 cusps); the interorbital is narrower (26.9-30.4 vs. 31.0-35.6 % of HL); the anal-fin base is shorter (21.8-27.1 vs. 27.6-34.6 % of SL); the snout is shorter (20.3-25.0 vs. 24.5-30.9 % of HL), and the body depth is lower (30.2-35.3 vs. 34.0-40.0 % of SL).

Astyanax ojiara and *A. troya* share several features as dentary teeth decreasing in size anteroposteriorly, hooks on all fins of males, and also on pelvic axillary scale of large males. Nonetheless, *A. troya* has one pentacuspoid maxillary tooth (vs. heptacuspoid very broad), teeth of the inner premaxillary row scarcely expanded distally (vs. very expanded distally), relatively short anal-fin base (22.9-28.8 vs. 27.6-34.6 % of SL), and large eye (35.0-44.6 vs. 29.1-37.2 % of HL). As consequence of the large eye in *A. troya*, the snout, interorbital distance, and postorbital length are comparatively smaller in this species than in *A. ojiara* (Table 2). Also, *A. troya* does not have sexual dimorphism in measurements such as that found in *A. ojiara*. Thus, the base of the dorsal fin is relatively shorter (12.4-14.9 vs. 13.8-17.2 % of SL), the caudal peduncle is longer (41.4-51.5 vs. 38.8-46.4 % of HL), and shallow (36.6-42.1 vs. 39.9-44.2 % of HL) in females of *A. troya* (See table 2). In males, the length of pelvic fin is scarcely shorter in *A. troya* than that present in *A. ojiara*. Also, the length of the maxilla is relatively longer in *A. troya* (21.2-26.6 vs. 21.0-24.5 % of HL in females; 21.0-27.6 vs. 22.0-25.4 % of HL in males) such as is the length of the snout plus maxilla (36.2-42.2 vs. 32.0-38.4 % of HL in females; 39.0-42.1 vs. 37.1-40.6 % of HL in males).

Astyanax leonidas is distinguished from *A. troya* by its robust body, with the dorsal profile slightly curved or straight, different from the ventral profile which is curved. *Astyanax troya* has a concave area very well marked at supraoccipital level, and both profiles are similarly curved or the dorsal profile of body is much curved.

The shape of the teeth in both new species is different. *Astyanax leonidas* presents a slender and long maxillary tooth whereas that tooth of *A. troya* is broad and low (Figs 4, 5). In *A. leonidas*, the premaxillary teeth of the inner row have the central cusp notably longer than the remaining ones and the lateral cusps originate at different levels whereas the central cusp of *A. troya* is scarcely longer and the remaining cusps arise at the same line (Figs 6, 7). The dentary teeth of *A. troya* are also broad –similar to those of premaxilla- and gradually decrease in size anteroposteriorly (Fig. 17). *Astyanax leonidas* has four large teeth, one median tooth and three or four very small ones (Fig. 8). The central cusp of those teeth is notably longer than the remaining ones. Also, the body is lower (30.2-35.3 vs. 33.0-40.9 % of SL).

Sexual dimorphism appear in many characids; hooks develop in different fins of males (Azpelicueta & García, 2000), but they have been reported in all fins of *A. ojiara* and *A. troya* only. Excluding the dorsal fin, hooks are present in all fins of *A. leonidas*. The specimens examined of *A. ojiara* were collected at the end of fall and most specimens, even those with small size, had fins plenty of hooks. Specimens of *A. leonidas* were collected in spring and the examined females were at the end of the spawning period; at that moment, the males had hooks well developed. *Astyanax troya* was captured in winter and spring and neither males nor females were mature, although ovaries were filled with oocytes. In spite of the large size, few males of *A. troya* had well developed hooks.

Among characiforms, the contact between ectopterygoid and quadrate occurs in different degrees. Absence of overlapping between both bones may be observed in the figure 20, but the ectopterygoid reaches the quadrate in one specimen of *A. troya* whereas always overlaps in *A. leonidas* and *A. ojiara*. Also, the anterodorsal margin of quadrate and the anteroventral margin of metapterygoid of *A. troya* overlap in different lengths.

Posteriorly, the metapterygoid of *A. troya* has a ventral process, curved and directed anteriorly, suturing to the slender inner process of quadrate (Figs 20, 21), and a curved symplectic. The largest specimens of *A. ojiara* (71 mm SL) and *A. leonidas* (45.6 mm SL) have short metapterygoid process. Currently, both processes suture together via cartilage in many characiforms, and also in other large specimens of *Astyanax* examined (among others, *A. eigenmanniorum*, *A. asuncionensis*, and *A. alleni*, Azpelicueta, 1979) although the same suture is present in other species of *Astyanax* yet undescribed.

Astyanax ojiara, *A. leonidas*, and *A. troya* share a deep dentary (Figs 18, 19), and hooks on caudal fin. Also, *A. troya* and *A. ojiara* present hooks on dorsal fin and the pelvic axillary scale of large males. An encompassing study of the species presently included in the genus *Astyanax* will demonstrate if they constitute a natural group.

KEY FOR SPECIES OF *ASTYANAX* WITH HOOKS ON CAUDAL-FIN RAYS

- 1 Dorsal-fin rays of males with hooks, dorsal profile concave over supra-occipital area, dentary teeth decreasing in size gradually antero-posteriorly . . 2
- Dorsal-fin rays of males without hooks, dorsal profile straight or slightly curved, large dentary teeth followed by several small ones . . *A. leonidas*
- 2 Maxillary tooth broad, with five cusps; anal-fin base 22.9-28.8 % of SL, eye diameter 35.0-44.6 % of HL *A. troya*
- Maxillary tooth broader than deep, with seven small cusps; anal-fin base 27.6-34.6 % of SL, eye diameter 29.1-37.2 % of HL *A. ojiara*

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REFERENCES

- ALMIRÓN, A. E., CASCIOTTA, J. R., AZPELICUETA, M. de las M. & CIONE, A. L. 2001. A new species of *Hypobrycon* (Characiformes: Characidae) from Uruguay basin in Misiones, Argentina. *Neotrópica* 47: 33-44.
- AZPELICUETA, M. de las M. 1979. Anatomía comparada craneana y cintura pectoral de peces Characiformes. *Doctoral Thesis Nro. 372, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata*, 100 pp.
- AZPELICUETA, M. de las 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: 245-257.
- AZPELICUETA, M. de las M. & ALMIRÓN, A. E. 2001. A new species of *Bryconamericus* (Characiformes, Characidae) from Paraná basin in Misiones, Argentina. *Revue suisse de Zoologie* 108: 275-281.
- CASCIOTTA, J. R., GOMEZ, S. E. & TORESANNI, N. I. 2000. *Gymnogeophagus che*, una nueva especie de la familia Cichlidae de la cuenca del Río Paraná (Perciformes, Labroidae). *Revista del Museo Argentino de Ciencias Naturales Bernardino Rivadavia, nueva serie* 2: 53-59.
- EIGENMANN, C. H. 1921. The American Characidae. *Memoirs of the Museum of Comparative Zoology, Harvard University* 43: 209-310.
- EIGENMANN, C. H. 1927. The American Characidae. *Memoirs of the Museum of Comparative Zoology, Harvard University* 43: 311-428.
- 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 de Ciências e Tecnologia da PUCRS, série Zoologia, Porto Alegre* 13: 65-88.
- GÉRY, J. 1977. Characoids of the world. *T. F. H. Publications, Inc., Neptune City*, 672 pp.
- 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.



Azpelicueta, María de las Mercedes., Casciotta, Jorge R., and Almirón, Adriana. 2002. "Two new species of the genus *Astyanax* (Characiformes, Characidae) from the Paraná river basin in Argentina." *Revue suisse de zoologie* 109, 243–259. <https://doi.org/10.5962/bhl.part.79588>.

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