

***Astyanax goyanensis* (Miranda-Ribeiro, 1944), new combination and *Astyanax courensis*, new species (Ostariophysi: Characiformes): two Characidae from the upper rio Tocantins basin, Central Brazil**

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Astyanax goyanensis (Miranda-Ribeiro, 1944), new combination, is redescribed based on the type series and topotypes, and *A. courensis*, new species, is herein described. Both species were collected in the rio dos Couros basin, upper rio Tocantins basin, Chapada dos Veadeiros, Goiás State, Brazil. These species possess the characters and general body morphology of the species of the *Astyanax scabripinnis* species complex. The new combination of *Astyanax goyanensis* is supported by the absence of characters that define *Astyanacinus*. *Astyanax goyanensis* and *A. courensis* differ from their congeners by meristic and morphometric characters, and color pattern. *Astyanax goyanensis* has only seven pelvic-fin rays, an uncommon character in the species of this genus, and *A. courensis* possesses only three or four scale rows below the lateral-line, fewer than typical of the genus.

Astyanax goyanensis (Miranda-Ribeiro, 1944), nova combinação, é redescrita com base na série-tipo e topótipos, e *A. courensis*, espécie nova, é descrita. Ambas espécies foram coletadas na bacia do rio dos Couros, bacia do alto rio Tocantins, Chapada dos Veadeiros, Goiás, Brasil. Estes táxons possuem os caracteres e morfologia do corpo das espécies do complexo *Astyanax scabripinnis*. A transferência e nova combinação de *Astyanax goyanensis* devem-se a ausência de caracteres que definem *Astyanacinus*. *Astyanax goyanensis* e *A. courensis* diferem das congêneres por caracteres merísticos, morfométricos e padrão de colorido. *Astyanax goyanensis* possui apenas sete raios na nadadeira pélvica, caráter incomum nas espécies do gênero, e *A. courensis* possui apenas três ou quatro séries de escamas abaixo da linha lateral, menos do que típico do gênero.

Key words: Neotropical fish, *Astyanacinus*, *Astyanax scabripinnis* species complex, Chapada dos Veadeiros.

Introduction

The genus *Astyanax* Baird & Girard is one of the most speciose assemblages of characiform fishes, composed of almost thirteen dozen of valid species and distributed from southern United States to central Argentina (Lima *et al.*, 2003; Marinho & Lima, 2009; Eschmeyer & Fricke, 2010). The nominal species currently assigned to *Astyanax* probably do not represent a monophyletic entity (Weitzman & Malabarba, 1998; Vari & Castro, 2007). The genus is currently defined by a combination of characters proposed by Eigenmann (1921, 1927), as two rows of premaxillary teeth, five teeth in the inner premaxillary series, lateral line complete, adipose fin present, and caudal fin naked. Recently, Mirande (2009) included the

genus in an “*Astyanax* clade” based on the analysis of just some *Astyanax* species, including the type species of the genus, *Astyanax argentatus* Baird & Girard [= *A. mexicanus* (De Filippi)], according to Lima *et al.*, 2003], along with other genera listed among *incertae sedis* characids by Lima *et al.* (2003). In his morphology based phylogenetic hypothesis, Mirande (2009) found *Astyanax* as a non-monophyletic genus, a fact posteriorly supported by molecular data by Javonillo *et al.* (2010).

Astyanacinus was proposed by Eigenmann (1907:769) by differing from other characids mainly by “premaxillary with two series of teeth, snout and maxillary forming more than half the length of the head, lateral line complete, maxillary with about six teeth, maxillary-premaxillary border without a

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distinct angle". *Astyanacinus* is composed of four species: *A. goyanensis* Miranda-Ribeiro (upper rio Tocantins basin), *A. moorii* (Boulenger) (upper rio Paraguay basin), *A. multidentis* Pearson (upper rio Madeira basin), and *A. platensis* Messner (rio La Plata basin) (Eschmeyer & Fricke, 2010). The systematic placement of the genus is still uncertain, but according to Calcagnotto *et al.* (2005) hypothesis of Characiformes phylogeny, *Astyanacinus* is related to several *incertae sedis* genera of Characidae: *Astyanax*, *Inpaichthys* Géry & Junk, *Hemigrammus* Gill, *Hyphessobrycon* Durbin, and *Moenkhausia* Eigenmann. Javonillo *et al.* (2010) also presented a hypothesis of relationship for the major lineages of Characidae based on molecular data. In their parsimony analysis *Astyanacinus* forms a monophyletic lineage for two unidentified species, being more related to *Ctenobrycon* and *Inpaichthys* than to any *Astyanax* species (*A. mexicanus* and *A. cremnobates*).

Astyanacinus goyanensis was described by Miranda-Ribeiro (1944) based on eight specimens from "rio do Couro, Veadeiros, estado de Goiás [sic]". The original description is very poor, and some features presented are incomplete, not allowing the recognition of the species from other *Astyanax*. The author did not explain the reasons for describing the species as *Astyanacinus*, but might have employed the high number of maxillary teeth (five) and the maxillary size (about half-length of head); two characters used by Eigenmann (1907) to defined that genus but only found in the holotype.

In recent expeditions to tributaries from the upper rio Tocantins basin in the Chapada dos Veadeiros, including the rio dos Couros, new topotypes of *Astyanacinus goyanensis* were collected with a sympatric new species of *Astyanax* that is describe herein. The analysis of these specimens and the type series of *Astyanacinus goyanensis* allowed us to redescribed it in *Astyanax* according to Eigenmann's definition. These species also fit the definition of the *Astyanax scabripinnis* species complex proposed by Bertaco & Lucena (2006), as body deepest and heaviest in area proximate to middle of pectoral fins, head heavy, snout short, body depth smaller than 41% of SL (usually 30-33% of SL), lower number of branched anal-fin rays (13-21, usually 17-18, rarely 22-23), presence of one or two humeral spots, and a dark, midlateral body stripe extending to the tip of the middle caudal-fin rays; and they are the first representatives of the group to inhabit the Amazon basin.

Material and Methods

Counts were taken as described by Fink & Weitzman (1974), with exception of the number of scale rows below the lateral line which were counted from the scale row ventral to lateral line to the scale row nearest to the origin of first pelvic-fin ray. Counts of vertebrae, supraneurals, gill-rakers on the first arch, teeth, and procurrent caudal-fin rays were taken from cleared and stained specimens (c&s) prepared according to Taylor & van Dyke (1985). Maxillary tooth counts were also taken from alcohol preserved specimens. Vertebral counts

included the four vertebrae of the Weberian apparatus, and the terminal centrum was counted as a single element. Lower and upper jaws of c&s specimens were prepared for SEM (scanning electronic microscopy) by drying in acetone followed by gold metallization.

Measurements were taken point to point with a caliper on the left side of specimens whenever possible. Measurements are expressed as percents of standard length (SL) except for subunits of the head, which are recorded as percents of head length (HL).

The specimens examined are deposited in the Natural History Museum, London (BMNH), Museu de Ciências e Tecnologia, Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP), Museo Nacional de Historia Natural y Antropología, Montevideo (MNHM), Museo Nacional, Rio de Janeiro (MNRJ), Departamento de Zoologia, Universidade Federal do Rio Grande do Sul, Porto Alegre (UFRGS), and National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM).

Astyanax goyanensis (Miranda-Ribeiro, 1944), new combination Figs. 1-2

Astyanacinus goyanensis Miranda-Ribeiro, 1944:1-2 (original description, type-locality: "Rio do Couro, Veadeiros, estado de Goiás"; picture of holotype). -Fowler, 1948:34 (distribution). -Lima *et al.*, 2003:108 (maximum length and distribution). -Lima *et al.*, 2007:44 (type-locality and distribution).

Material examined. MNRJ 4129, holotype, female, 82.2 mm SL, rio dos Couros, Chapada dos Veadeiros, Goiás State, Brazil, 1929, R. Pfrimmer. MNRJ 2843, paratypes, 5 of 7, 59.4-84.8 mm SL, collected with the holotype. MCP 44402, topotypes, 20, 26.9-63.9 mm SL, UFRGS 11291, 80, 5 c&s, topotypes, 18.5-79.9 mm SL, small tributary of rio dos Couros at Parque Portal da Chapada, affluent of rio Tocantinzinho, upper rio Tocantins basin, 1135 m a.s.l, Alto Paraíso de Goiás, Goiás State, Brazil, 14°10'13"S 47°36'35"W, 10 Sep 2009, V. A. Bertaco, F. R. Carvalho & G. Frainer.

Additional material. Goiás State, Brazil, upper rio Tocantins basin, rio dos Couros basin. MCP 23937, 6, 22.1-61.5 mm SL, córrego Capão da Guabiroba tributary of rio dos Couros, Alto Paraíso de Goiás, 14°07'43"S 47°38'27"W, 4 Aug 1996, W. R. Koch, P. Milani & K. M. Grosser. UFRGS 9905, 19, 27.8-55.6 mm SL, córrego Rita Maria between Cavalcante and Minaçú, rio Paranã basin, Cavalcante, 13°45'16"S 47°27'18"W, 25 May 2008, F. C. Jerep & T. P. Carvalho. UFRGS 9935, 31, 2 c&s, 17.1-50.2 mm SL, córrego on road GO-239 between Alto Paraíso de Goiás and Parque Nacional da Chapada dos Veadeiros, Alto Paraíso de Goiás, 14°08'24"S 47°39'36"W, 25 May 2008, F. C. Jerep & T. P. Carvalho. UFRGS 9960, 12, 22.8-82.4 mm SL, rio das Cobras between Alto Paraíso de Goiás and Parque Nacional da Chapada dos Veadeiros, 14°09'39"S 47°37'55"W, 25 May 2008, F. C. Jerep & T. P. Carvalho.

Diagnosis. *Astyanax goyanensis* belongs to the *A. scabripinnis* species complex and is distinguished from all



Fig. 1. *Astyanax goyanensis*. (a) MNRJ 4129, holotype, female, 89.2 mm SL; rio dos Couros, Chapada dos Veadeiros, Goiás State, Brazil (anal-fin incomplete); (b) UFRGS 11291, topotype, male, 56.7 mm SL; small stream tributary of rio dos Couros at Parque Portal da Chapada, tributary of rio Tocantinzinho, upper rio Tocantins basin, Alto Paraíso de Goiás, Goiás State, Brazil.

species of this complex by the total number of pelvic-fin rays (7 vs. 8), except from *A. brachypterygium* Bertaco & Malabarba, *A. ita* Almirón, Azpelicueta & Casciotta, and *A. obscurus* (Hensel), Bertaco & Lucena (2010). It differs from *A. brachypterygium* by caudal peduncle length (14.1-18.5% SL, mean = 16.1 vs. 11.9-14.4, mean = 13.0), by the number of caudal-peduncle scales (14 vs. 16), and by the number of cusps of the premaxillary inner series and the larger dentary teeth (4-5 vs. 5-7); from *A. ita* by the number of branched anal-fin rays (13-16 vs. 20-24), number of humeral spots (2 vs. 1), and by the orbital diameter (20.2-33.2% HL, mean = 27.4 vs. 38.6-42.0, mean = 40.2); and from *A. obscurus* by the number of maxillary teeth (2-5 vs. 1), number of lateral line scales (35-37, mean = 36 vs. 37-39, mean = 38), and by the number of branched anal-fin rays (13-16, mean = 14.7 vs. 16-21, mean = 18.3). Furthermore, the lower number of the branched anal-fin rays in *A. goyanensis* distinguish it from its congeners of the species complex, except from *A. brachypterygium*, *A. cremnobates* Bertaco & Malabarba, *A. laticeps* (Cope), *A. intermedius* Eigenmann, *A. jenynsii* (Steindachner), *A. jordanensis* Alcaraz, Pavanelli & Bertaco, *A. microschemos*

Bertaco & Lucena, *A. totae* Haluch & Abilhoa, and *A. varzeae* Abilhoa & Duboc. It differs from most these species by the number of humeral spot (2 vs. 1), except *A. brachypterygium*, *A. cremnobates*, and *A. varzeae*. From these three species it differs by the number of cups in the premaxillary and dentary teeth (5-7 vs. 3-5), and by the caudal-peduncle length (14.1-18.5% SL, mean = 16.1 vs. 11.9-14.4, mean = 13.0, 11.0-14.9, mean = 13.1, 10.5-13.9, mean = 12.4, respectively), and additionally from *A. varzeae* by the number of lateral line scales (35-37, mean = 36 vs. 37-42, mean = 39).

Description. Morphometric data summarized in Table 1. Body compressed and elongate; greatest body depth usually immediately anterior to dorsal-fin origin. Dorsal profile of head between vertical through posterior nostril and tip of supraoccipital spine straight or slightly convex. Profile of body convex from tip of supraoccipital spine to base of last dorsal-fin ray, and slightly concave from that point to adipose-fin origin. Ventral profile of head convex. Ventral profile of body slightly convex from pectoral-fin insertion to anal-fin origin. Body profile along anal-fin base posterodorsally slanted.



Fig. 2. *Astyanax goyanensis*, UFRGS 11291, 59.2 mm SL. Scanning electronic microscopy images of the upper and lower jaws, left side, lateral view. Scale bar = 1 mm.

Caudal peduncle elongate and nearly straight to slightly concave along both dorsal and ventral margins.

Snout rounded from margin of upper lip to vertical through anterior nostrils. Head relatively small (one third of SL). Mouth terminal, lower jaw projecting slightly more than upper jaw. Maxilla extending posteriorly to vertical through anterior half of orbit, slightly curved, and aligned at angle of approximately 45 degrees relative to longitudinal body axis. Maxilla slightly widened anteroposteriorly.

Premaxilla with two tooth rows: outer row with three to five tri- to pentacusp teeth, central cusp longest. Five teeth in inner premaxillary row; teeth gradually decreasing in length from first towards fourth teeth with last tooth distinctly smaller: teeth with five to seven cusps with central cusp twice as long and broad as other cusps. Maxilla with two to five (five only in the holotype and one paratype) teeth with three to five cusps; central cusp longest. Three to four anteriormost dentary teeth larger, with five or seven cusps, followed by one medium-sized tooth with three to five cusps, and five to seven teeth with one to three cusps. Central cusp in all teeth two to three times as long and broad as other cusps. All cusp tips slightly curved posteriorly towards oral cavity (Fig. 2).

Dorsal-fin rays ii,9 (holotype with ii,8; three paratypes with i,9, seven topotypes with i,9, and ii,8 in two c&s specimens, $n = 32$); first unbranched ray approximately half length of second ray. Distal margin of dorsal fin nearly straight or slightly convex. Dorsal-fin origin anterior at middle of SL. Adipose-fin origin approximately at vertical through insertion of base of last anal-fin ray. Anal-fin rays ii-v, 13-16 (holotype with anal incomplete, 13, mean = 14.7, $n = 32$). First unbranched ray apparent only in c&s specimens. Anal-fin profile nearly straight in males, and smoothly concave in females. Anal-fin origin posterior to vertical through base of last dorsal-fin ray. Anal-fin rays of males bearing one pair of small bony hooks

along posterolateral border of each segment of lepidotrichia, usually along last unbranched ray to eighth anterior branched rays. Hooks more numerous along second through fifth branched ray, and usually located along posteriormost branch and distal 1/2 to 2/3 of each ray.

Pectoral-fin rays i,10-13 (mean = 12.0, $n = 32$). Tip of pectoral fin reaching pelvic-fin insertion in males and not reaching that insertion in females. Pelvic-fin rays i,6 ($n = 32$). Pelvic-fin origin slightly anterior to vertical through dorsal-fin origin. Tip of pelvic fin reaching anal-fin origin in males, falling short of that point in females. Caudal fin forked and unscaled, lobes similar in size, with 19 principal rays. Dorsal procurent rays 11-14, and ventral procurent rays 10-12 ($n = 7$).

Lateral line complete with 35-37 scales (mean = 36.0, $n = 32$). Scale rows between dorsal-fin origin and lateral line 6-7 (mean = 6.1, $n = 32$); 4-5 scale rows between lateral line and pelvic-fin origin (mean = 4.5, $n = 32$). Predorsal scales 11-14 (mean = 12.5, $n = 32$) usually arranged in regular series. Scale rows around caudal peduncle 14 ($n = 32$). Axillary scale on pelvic-fin origin extends posteriorly covering 2-3 scales. Scale sheath along anal-fin base 5-12 scales, in single series, covering base of anteriormost rays ($n = 30$).

Precaudal vertebrae 17-18; caudal vertebrae 17-18; total vertebrae 35 ($n = 7$). Supraneurals 5-7 ($n = 7$). Upper branch of gill-rakers 7-8, lower branch 11-12 ($n = 7$).

Color in alcohol. General body color yellowish-brown. Dark chromatophores scattered on lateral portion of head, more densely concentrated on snout and anterior border of eye. Lateral portion of body with scales bordered with dark pigment, forming slightly reticulate pattern. Body with black, pigmented, midlateral stripe extending from humeral region to base of middle caudal fin; faint dark pigmentation present on middle caudal-fin rays. Midlateral body stripe expanded dorsally and ventrally to caudal-fin base, forming small caudal spot. Two humeral spots: anterior spot conspicuous, vertically elongate, with superior portion wider, located over second to fourth vertical series of scales, extending over 2 to 3 horizontal series of scales above lateral line; and inferior portion of spot narrow, and extending over 1 to 2 horizontal series of scales below lateral line; posterior humeral spot diffuse, not ventrally surpassing lateral-line, extending over 2 to 3 horizontal series and 2 to 3 vertical series of scales. Region between spots pale. Fins with dispersed dark chromatophores (Fig. 1b). Specimens retained orange and yellowish pigment on all fins after several days fixation in formalin.

Color in life. The specimens immediately after capture presented overall golden body coloration. Fins yellowish-orange to red. Humeral spots faint black, and midlateral stripe and caudal-peduncle spot less conspicuous than after preservation. Caudal-fin middle rays black (Fig. 1b).

Sexual dimorphism. Males of *Astyanax goyanensis* are easily recognized by the presence of small bony hooks on the anal-fin rays (see Description). Also, males and females differ by anal-fin shape, which is nearly straight in males and concave in females.

Gill glands (Burns & Weitzman, 1996) were not found macroscopically on first gill arch in either males or females.

Distribution. *Astyanax goyanensis* is known from tributaries of the rio dos Couros, affluent of rio Tocantinzinho, and rio Paranã basin, upper rio Tocantins basin, Chapada dos Veadeiros, Goiás, Brazil (Fig. 3).

Ecological notes. The collection locality is around 1135 m above sea level. The rio dos Couros in that point has moderate riparian vegetation and it is typically between 10 and 15 m wide, and 1.5 m deep. Although presenting some rapids, the water is clear. The substrate is constituted by stones, rocks, and some stretches with mud. A natural 10 m high waterfall named Cachoeira São Bento is located downriver. All topotypes were collected on the stretch downstream from the waterfall in a small stream draining directly into the river (about 100 m from the channel river). The stream is about 0.8 m deep and 6 m wide, has transparent water with moderate vegetation covering the channel (trees and shrubs), and bottom with small stones, submerged logs and roots (Fig. 4b). No other fish species was collected with *A. goyanensis* in the stream. The rio dos Couros has several waterfalls, some with about 100 m height (Cachoeira de São Vicente and Catarata dos Couros). Stomach contents of five specimens contained fragments of allochthonous insect, fish scales, and vegetal organic matter (leaf parts). The stomachs were not full.

Astyanax courensis, new species

Figs. 5-6

Holotype. UFRGS 11499, 54.2 mm SL, female, rio dos Couros at Parque Portal da Chapada, tributary of rio Tocantinzinho, upper rio Tocantins basin, 1135 m a.s.l, Alto Paraíso de Goiás, Goiás State, Brazil, 14°09'58"S 47°35'43"W, 10 Sep 2009, V. A. Bertaco, F. R. Carvalho & G. Frainer.

Paratypes. Alto Paraíso de Goiás, Goiás State, Brazil, upper rio Tocantins basin, rio dos Couros basin. MCP 44403, 20, 26.0-59.2 mm SL, UFRGS 11290, 107, 5 c&s, 16.6-71.6 mm SL, UFRGS 11295, 5 (ethyl alcohol anhydrous), 23.4-29.5 mm SL, collected with the holotype. MCP 44404, 1, 44.0 mm SL, córrego Capão da Guabirola, tributary of rio dos Couros, 14°07'43"S 47°38'27"W, 4 Aug 1996, W. R. Koch, P. Milani & K. M. Grosser. UFRGS 9934, 5, 21.1-36.4 mm SL, córrego on road GO-239 between Alto Paraíso de Goiás and Parque Nacional da Chapada dos Veadeiros, 14°08'24"S 47°39'36"W, 25 May 2008, F. C. Jerep & T. P. Carvalho. UFRGS 11588, 38, 2 c&s, 18.7-48.2 mm SL, rio das Cobras between Alto Paraíso de Goiás and Parque Nacional da Chapada dos Veadeiros, 14°09'39"S 47°37'55"W, 25 May 2008, F. C. Jerep & T. P. Carvalho.

Diagnosis. *Astyanax courensis* belongs to the *A. scabripinnis* species complex and is distinguished from other species of this complex by the number of scale rows between lateral line and pelvic fin origin (3-4 vs. 5-6), except from *A. brachypterygium*, *A. burgerai* Zanata & Camelier, *A. goyanensis*, *A. intermedius* Eigenmann, *A. jenynsii*, *A.*

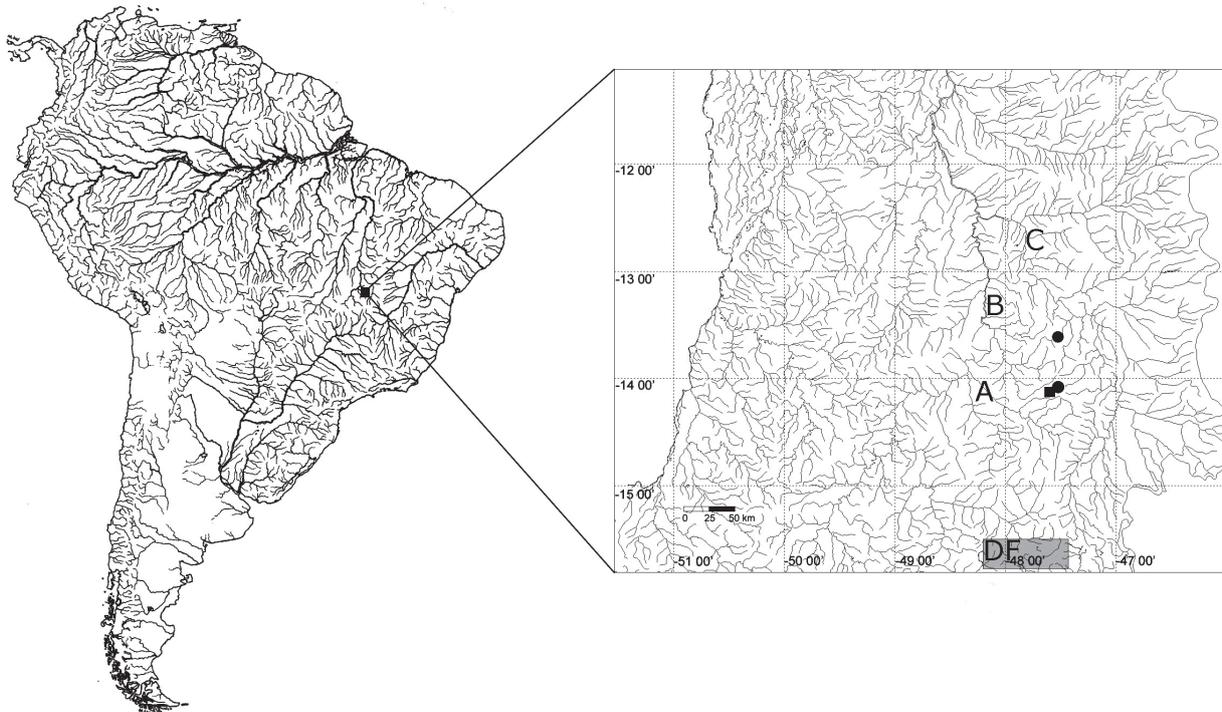


Fig. 3. Distribution of *Astyanax goyanensis* (circles) and *A. courensis*, new species (square), on upper rio Tocantins, Alto Paraíso de Goiás, Goiás State, Brazil. A, rio Tocantinzinho; B, rio Tocantins; C, rio Paranã; DF, Distrito Federal. Symbols can represent more than one lot or locality. Base map prepared by Marilyn Weitzman.



Fig. 4. (a) Rio dos Couros downstream from the Cachoeira São Bento, type-locality of *Astyanax courensis*, new species; (b) small stream tributary of rio dos Couros at Parque Portal da Chapada, locality of collection of *Astyanax goyanensis*.

microschemos, *A. rivularis* Lütken, *A. totae*, and *A. varzeae*. It differs from *A. brachypterygium*, *A. goyanensis*, and *A. totae* by head length (24.9–28.2% SL, mean = 26.6 vs. 27.8–33.2, mean = 29.9, 27.7–32.3, mean = 31.6, and 27.9–32.8, mean = 29.7, respectively), and by the number of humeral spots (1 vs. 2, except in *A. totae*, which has one). It differs from *A. burgerai* and *A. intermedius* by shape of the dentary teeth (abruptly decreasing in size after fourth tooth vs. teeth gradually decreasing in size posteriorly), and orbital diameter (24.9–31.9% HL, mean = 27.9 vs. 34.6–40.6, mean = 38.0, 32.5–47.8, mean = 39.0, respectively); from *A. jenymsii* by the number of branched anal-fin rays (15–17, mean = 15.8 vs. 13–15, mean = 14) and upper jaw length (40.6–50.0% HL, mean = 44.9 vs. 35.9–

39.5, mean = 37.4); from *A. rivularis* by body depth (27.4–33.1% SL, mean = 30.5 vs. 35.0–46.0, mean = 40.3), and by the number of humeral spots (1 vs. 2); from *A. varzeae* by the number of lateral line scales (35–36, mean = 35.4 vs. 37–42, mean = 39), caudal-peduncle length (13.6–16.9% SL, mean = 15.2 vs. 10.5–13.9, mean = 12.4) and orbital diameter (24.9–31.9% HL, mean = 27.9 vs. 30.9–44.5, mean = 37.9). Furthermore, it differs from *A. microschemos* and *A. totae* by the number of maxillary teeth (1 vs. 2–3 and 2–5, respectively). *Astyanax courensis* differs from only sympatric *Astyanax* species, *A. goyanensis*, by the number of pelvic-fin rays (8 vs. 7), and number of maxillary teeth (1 vs. 2–5), and by prepectoral distance (23.7–27.8% SL, mean = 26.4 vs. 27.7–32.0, mean = 30.4).



Fig. 5. *Astyanax courensis*, new species, UFRGS 11499, holotype, female, 54.2 mm SL; rio dos Couros at Parque Portal da Chapada, tributary of rio Tocantinzinho, upper rio Tocantins basin, Alto Paraíso de Goiás, Goiás State, Brazil.



Fig. 6. *Astyanax courensis*, new species, UFRGS 11290, 45.0 mm SL. Scanning electronic microscopy images of upper and lower jaws, left side, lateral view. Scale bar = 1 mm.

Description. Morphometric data summarized in Table 1. Body compressed and elongate; greatest body depth usually immediately anterior to dorsal-fin origin. Dorsal profile of head between vertical through posterior nostril and tip of supraoccipital spine straight or slightly convex. Profile of body convex from tip of supraoccipital spine to base of last dorsal-fin ray, and straight from that point to adipose-fin origin. Ventral profile of head convex. Ventral profile of body slightly convex from pectoral-fin insertion to anal-fin origin. Body profile along anal-fin base posterodorsally slanted. Caudal peduncle elongated, nearly straight to slightly concave along both dorsal and ventral margins.

Snout rounded from margin of upper lip to vertical through anterior nostrils. Head relatively small. Mouth terminal, lower jaw slightly projected over upper jaw. Maxilla extending posteriorly to vertical through anterior half of orbit, slightly curved, and aligned at angle of approximately 45 degrees relative to longitudinal body axis. Maxilla slightly widened anteroposteriorly.

Premaxilla with two tooth rows; outer row with four to six tri- to pentacuspoid teeth with central cusp longest. Five teeth in inner premaxillary row; teeth gradually decreasing in length from first towards fourth tooth with last tooth distinctly smaller: teeth with five to seven cusps with central cusp twice as long and broad as other cusps. Maxilla with one tooth (rarely two) with three to five cusps, and central cusp longest. Three to four anteriormost dentary teeth larger, with five or seven cusps, followed by one medium-sized tooth with three to five cusps, and then five to seven teeth with one to three cusps. Central cusp in all teeth two to three times as long and broad as other cusps. All cusp tips slightly curved posteriorly towards oral cavity (Fig. 6).

Dorsal-fin rays ii,9 ($n = 30$); first unbranched ray approximately half length of second ray. Distal margin of dorsal fin nearly straight or slightly convex. Dorsal-fin origin anterior at middle of SL. Adipose-fin origin approximately at vertical through insertion of base of last anal-fin ray. Anal-fin rays iii-v,15-17 (mean = 15.8, $n = 30$). First unbranched ray normally only apparent in c&s specimens. Anal-fin profile nearly straight in males, and smoothly concave in females. Anal-fin origin posterior to vertical through base of last dorsal-fin ray. Anal-fin rays of males bearing one pair of small bony hooks along posterolateral border of each segment of lepidotrichia, usually along last unbranched ray to sixth anterior branched ray. Hooks more numerous along second through fourth branched rays, and usually located along posteriormost branch and distal 1/2 to 2/3 of each ray.

Pectoral-fin rays i,10-12 (mean = 10.7, $n = 30$). Tip of pectoral fin not reaching the pelvic-fin origin in both sexes. Pelvic-fin rays i,7 ($n = 30$). Pelvic-fin origin slightly anterior to vertical through dorsal-fin origin. Tip of pelvic fin surpassing the urogenital opening in males, and only reaching that point in females. Caudal fin forked and unscaled, lobes similar in size, with 19 principal rays (one specimen with 17). Dorsal procurent rays 10-13, and ventral procurent rays 9-11 ($n = 7$).

Lateral line complete with 35-36 scales (mean = 35.4, $n = 30$). Scale rows between dorsal-fin origin and lateral line 5-6 (mean = 5.4, $n = 30$); 3-4 scale rows between lateral line and pelvic-fin origin (mean = 3.9, $n = 30$). Predorsal scales 11-13 (mean = 12.2, $n = 29$) usually arranged in regular series. Scale rows around caudal peduncle 14 ($n = 30$). Axillary scale on pelvic-fin insertion posteriorly extended covering 1-2 scales. Scale sheath along anal-fin base 5-8 scales, in single series, covering base of anteriormost rays.

Precaudal vertebrae 17-18; caudal vertebrae 17-18; total vertebrae 34-35 ($n = 7$). Supraneurals 5-6 ($n = 7$). Upper branch of gill rakers 6-7, lower branch 11-12 ($n = 7$).

Color in alcohol. General body color yellowish-brown. Dark chromatophores scattered on lateral portion of head, but more densely concentrated on snout and anterior border of eye. Lateral portion of body with scales posteriorly bordered by dark pigment and forming reticulate pattern. Body with black, pigmented, midlateral stripe extending from the upper border of the opercle to the caudal-fin base; dark pigmentation present on middle caudal-fin rays. Midlateral body stripe expanded dorsally and ventrally proximate to caudal-fin base, forming small caudal spot. Humeral spot conspicuous, vertically elongate with superior portion of spot wider, located over second to fourth vertical series of scales and extending over 2 to 3 horizontal series of scales above lateral line; and inferior portion of spot narrower, and extending over 1 to 2 horizontal series of scales below lateral line. Region just posterior to the humeral spot pale in some specimens. Fins with few dispersed dark chromatophores (Fig. 5). Specimens

Table 1. Morphometric data of holotype (H), paratypes, and non-types of *Astyanax goyanensis*, and holotype and paratypes of *Astyanax courensis*, new species, from the rio dos Couros basin, upper rio Tocantins basin, Alto Paraíso de Goiás, Goiás State, Brazil. The range of paratypes and non-types of *A. goyanensis* not includes the holotype, but of *A. courensis* includes.

	<i>A. goyanensis</i>						<i>A. courensis</i>				
	Paratypes			Non-types			Paratypes				
	H	N	Range	Mean	N	Range	Mean	H	N	Range	Mean
Standard length (mm)	89.2	5	59.4-84.8	66.2	32	44.4-83.8	59.5	54.2	30	33.2-72.3	48.2
Percents of standard length											
Predorsal distance	52.3	5	51.7-58.0	55.2	32	53.1-56.9	55.1	55.8	30	51.3-55.8	54.0
Prepelvic distance	48.6	5	49.7-52.9	51.2	32	49.7-55.4	52.0	50.4	30	47.1-51.3	49.6
Prepectoral distance	27.7	5	31.0-32.0	31.4	32	27.9-32.0	29.5	26.4	30	23.7-27.8	26.4
Preanal distance	65.2	5	65.6-73.7	69.1	32	66.1-71.5	68.4	69.1	30	65.0-70.8	68.2
Depth at dorsal-fin origin	31.9	5	31.2-36.6	33.4	32	29.2-34.9	32.9	33.1	30	27.4-33.1	30.5
Caudal-peduncle depth	10.3	5	11.3-12.2	11.6	32	11.3-13.1	12.1	12.8	30	10.9-12.8	11.8
Caudal-peduncle length	-	-	-	-	32	14.1-18.5	16.1	16.9	30	13.2-16.9	15.2
Anal-fin base	-	5	16.3-19.4	17.7	32	18.4-23.8	20.6	20.5	30	17.9-23.9	20.9
Dorsal-fin length	19.3	5	22.8-26.8	25.1	32	20.9-28.5	24.0	23.6	30	20.7-26.2	23.3
Pelvic-fin length	15.6	5	12.0-16.8	14.8	32	12.5-17.1	14.9	15.1	30	13.5-17.2	15.3
Pectoral-fin length	18.3	5	16.7-21.8	19.5	32	18.1-23.4	20.7	20.1	30	18.0-21.7	20.2
Head length	27.7	5	30.8-32.3	31.6	32	28.3-31.8	29.5	25.7	30	24.9-28.2	26.6
Percents of head length											
Snout length	27.5	5	23.0-27.2	25.2	32	21.4-27.2	23.6	24.7	30	21.9-27.1	23.7
Upper jaw length	51.5	5	47.5-50.0	48.9	32	43.6-50.9	46.6	45.2	30	40.6-50.0	44.9
Orbital diameter	27.6	5	25.2-33.2	29.1	32	20.2-30.3	25.8	26.9	30	24.9-31.9	27.9
Interorbital width	33.9	5	30.4-34.5	32.8	32	27.8-34.7	31.3	31.5	30	26.7-33.0	30.1

retained orange and yellowish pigment on all fins after several days fixation in formalin.

Color in life. Immediately after capture, specimens with overall golden body coloration and orangish to red fins. Humeral spot faint black. Midlateral stripe and caudal-peduncle spot less conspicuous than after preservation. Caudal-fin middle rays black, and median portion of lobes yellowish white.

Sexual dimorphism. Males of *Astyanax courensis* are easily recognized by the presence of small bony hooks on the anal-fin rays. Also, males and females differ by anal-fin shape, which is nearly straight in males and concave in females. Gill glands (Burns & Weitzman, 1996) were not found macroscopically on first gill arch in either males or females.

Distribution. *Astyanax courensis* is known from the rio dos Couros basin, tributary of rio Tocantinzinho, upper rio Tocantins basin, Alto Paraíso de Goiás, Chapada dos Veadeiros, Goiás State, Brazil (Fig. 3).

Ecological notes. See features about rio dos Couros in the ecological notes above. Most of the specimens were collected on the stretch downstream from the waterfall (Fig. 4a). Also it was observed few specimens on the stretch upstream of waterfall. Only four species were collected syntopically with *A. courensis*: *Characidium stigmatosum*, *C. aff. zebra*, *Gymnotocinclus anosteos* and *Trichomycterus* sp. Stomach contents of five specimen (UFRGS 11290) presented Plecoptera, Trichoptera, Chironomidae (Diptera), autochthonous and allochthonous insects, and digested vegetal organic matter. The stomachs were partially full.

Etymology. The specific name *courensis* is in reference to the type-locality, rio dos Couros, an important tributary of rio Tocantinzinho, upper rio Tocantins basin. An adjective.

Discussion

Astyanax goyanensis and *A. courensis* have the characters and general body morphology of the species of the *A. scabripinnis* species complex as discussed by Bertaco & Malabarba (2001) and established and delimited by Bertaco & Lucena (2006, 2010).

Astyanax goyanensis is herein recognized in *Astyanax* following the currently used definition of the genus proposed by Eigenmann (1927). Eigenmann (1907) distinguished *Astyanacinus* from *Astyanax* mainly by the “maxillary length more than half the length of the head” in the former, a character not found in *Astyanax goyanensis* (Table 1).

Due to the poor *Astyanacinus goyanensis* description by Miranda-Ribeiro (1944), some features were incorrectly reported. The holotype and some paratypes of *Astyanacinus goyanensis* lack several body scales, and the holotype’s anal fin is incomplete as previously mentioned in the original description, “lateral line counts for holotype (27?), and for seven paratypes (27-31)”. Despite of the lack of body scales in the type series of *Astyanacinus goyanensis*, the count of scales and/or marks in the lateral line revealed about 34-36, the same values found in the topotypes. The holotype of *Astyanacinus goyanensis* has five maxillary teeth and the maxillary length is slightly larger than half-length of head (51.5%, Table 1). These features must have induced the author to describe the species as integrant of *Astyanacinus* instead of *Astyanax*. The analyzed paratypes have 2(2), 3(2), and 5(1)

teeth at the maxilla and the maxillary length is smaller than half-length of the head (Table 1), as observed in all topotypes. At present, the lower jaw and caudal fin of the holotype (Fig. 1a) are broken, probably due to fixation/conservation and/or handling without caution, but the type specimen seemed to be on perfect conditions as shown the picture in the original description (Miranda-Ribeiro, 1944, fig. p. 3).

Astyanax goyanensis remained for almost six decades after its original description without citation or mention in any paper (except in Fowler, 1948). It was listed only recently in two check lists of freshwater fishes as *Astyanacinus goyanensis* by Lima *et al.* (2003, 2007), and its taxonomic characterization remains indefinite or questionable. Note that this species was not cited by Géry (1977).

All examined specimens of *Astyanax goyanensis* have seven pelvic-fin rays (i,6), a character uncommon in the genus, but variable in some species (i,6-7). Note that this count was not mentioned in the original description by Miranda-Ribeiro (1944). Among the *Astyanax scabripinnis* species complex this count can be found only in three species: *A. brachypterygium*, *A. ita*, and *A. obscurus* (see differences in the diagnosis above).

We analyzed the types and/or non type specimens of the remaining nominal species of *Astyanacinus*. *Astyanax goyanensis* differs from *Astyanacinus multidentis* Pearson and *Astyanacinus moorii* Boulenger by the number of lateral line scales (35-37 vs. 39-40), the number of scale rows at the caudal peduncle (14 vs. 18), the total number of transverse scales (12-13 vs. 15-16), the number of branched anal-fin rays (13-16 vs. 25-31), pelvic-fin rays (8 vs. 7), and humeral spot horizontally elongate vs. vertically elongate. Both *Astyanacinus* species have the midlateral region with transverse anteriorly directed V-shaped bars along myomere junctions, a character not found in the *Astyanax* species. The holotype (unique type known) of *Astyanacinus platensis* fits neither in the traditional definition of *Astyanacinus* nor *Astyanax*, but it has 17 maxillary teeth, 23 predorsal scales, and 20 scale rows around caudal peduncle; all these characters are not found in *Astyanax* and *Astyanacinus*, but are usually found in *Oligosarcus* species, another characiform genus.

The species of *Astyanacinus* and *Astyanax* are not well diagnosed, and the phylogenetic position of these genera within the characiform tree-of-life is not known. None of the characters used by Eigenmann are unique to the genera, and the actual number of valid species still remains questionable.

In addition to *Astyanax goyanensis* and *A. courensis*, only two additional species of *Astyanax* from the upper rio Tocantins basin have been described, *A. unitaeniatus* Garutti and *A. elachylepis* Bertaco & Lucinda. The former species belong to *A. bimaculatus* species group (*sensu* Garutti, 1995), and they are clearly distinguished from *A. goyanensis* and *A. courensis* by the horizontally elongate humeral spot (*vs.* vertically elongate), presence of two vertical dark bars in the humeral region (*vs.* absent), the number of branched anal-fin rays (17-21 *vs.* 13-16 and 15-17, respectively), and total pelvic-fin rays (8 *vs.* 7 in *A. goyanensis*). *Astyanax goyanensis* and *A.*

courensis differ from *A. elachylepis* by the number of lateral line scales (35-37 *vs.* 48-53) and branched anal-fin rays (13-16 and 15-17 *vs.* 22-27).

Recently, Garutti & Langeani (2009) redescribed *Astyanax goyacensis* Eigenmann (1908) from the rio Vermelho, a tributary of the rio Araguaia that belongs to Araguaia-Tocantins basin, Goiás State, and included on *Astyanax bimaculatus* species group. *Astyanax goyanensis* differs from *A. goyacensis* by shape of humeral spot (vertically elongate *vs.* horizontally ovate), and by the number of branched anal-fin rays (13-16 *vs.* 18-24), pelvic-fin rays (7 *vs.* 8), and the number of teeth and cups of maxillary (2-5 tri- to pentacuspis *vs.* 0-1 uni or tricuspis teeth). Although *A. goyacensis* possesses a very similar name to the species redescribed herein (*A. goyanensis*), this specific case of one-letter difference (“c” and “n”) is not included in the ICZN (1999) list of examples that characterize cases of homonymy (Article 57, paragraph 57.6; and Article 58).

The rediscovery of *Astyanax goyanensis* and the description of one new species, *A. courensis*, support the hypothesis that the upper rio Tocantins basin possesses a highly endemic ichthyofauna (Fisch-Müller *et al.*, 2001, 2005; Pereira & Lucinda, 2007; Bertaco & Carvalho, 2010), and the Tocantins-Araguaia ecoregion as a whole (*sensu* Abell *et al.*, 2008), showing a high number of endemic freshwater fish species. The Chapada dos Veadeiros region inserted in the Brazilian Cerrado, is one of the world’s biodiversity hotspots (Myers *et al.*, 2000; Silva & Bates, 2002; Klink & Machado, 2005), sheltering endemic species in Plantae (Irwin & Arroyo, 1973; Pastore & Cavalcante, 2008; Pastore & Marques, 2009), Trichoptera (Calor, 2008), Anura (Bockermann, 1975; Caramaschi & Cruz, 2000), Aves (Silva, 1997; Tubelis, 2009), and Mammalia (Bonvicino *et al.*, 2005). The lack of recognition of endemic species leads to their exclusion/forgetfulness from lists of threatened species, and the consequent absence of efforts and funds for their conservation and of the ecoregions that harbor them. Accordingly, we assert that there should be an increasing effort to record these forgotten species to compose a more realistic scenario of the Neotropical biodiversity.

Comparative material. In addition to the comparative material listed in Bertaco & Lucena (2006), the following specimens were analyzed: *Astyanacinus moorii*, BMNH 1892.4.20.50-51, 1 of 2 syntypes, 65.2 mm SL, “Chapala Plateau”, Mato Grosso, Brazil. MCP 37951, 3, ribeirão Figueira, rio Paraguay basin, Poconé, Mato Grosso, Brazil. MCP 15572, 5, 54.9-66.4 mm SL, tributary of rio Paraguay, Cáceres, Mato Grosso, Brazil. *Astyanacinus multidentis*, MCP 35017, 17, 2 c&s, 48.3-64.2 mm SL, MCP 35018, 6 of 28, 37.6-42.7 mm SL, tributary of rio Chapare, rio Madeira basin, Cochabamba, Bolivia. *Astyanacinus platensis*, MHN 762, holotype, 97.0 mm SL, laguna Tropa Vieja, Canelones, Uruguay. *Astyanax argentatus*, USNM 869, 12 of 28 syntypes, 41.1-60.7 mm SL, rio Nueces, Texas, United States. *Astyanax burgerai*, UFRGS 11035, 43, 18.0-35.4 mm SL, tributary of rio Una basin, Arataca, Bahia, Brazil. *Astyanax mexicanus*, UFRGS 9681, 15 of 50, 3 c&s, 41.2-63.8 mm SL, rio Ojo Frio, San Luis Potosi, Mexico. USNM 310224, 14, 52.8-67.4 mm SL, Guadalupe River, United States. *Astyanax varzeae*, MCP 40535, 14 paratypes, 43.9-72.0 mm SL, rio da Várzea, upper rio Iguazu basin, Tijucas do Sul,

Paraná, Brazil. *Astyanax* sp., UFRGS 11200, 41, 29.8-49.4 mm SL, rio Prata at Cachoeira do Prata, UFRGS 11201, 48, 27.6-54.7 mm SL, stream about 14 km N of Cavalcante; rio Paraná basin, Cavalcante, Goiás, Brazil.

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