Zootaxa 1244: 41–55 (2006)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

1244

Three new species of the seasonal killifish genus *Simpsonichthys*, subgenus *Hypsolebias* (Teleostei: Cyprinodontiformes: Rivulidae) from the rio Paracatu drainage, rio São Francisco basin, Brazil

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Abstract

Three new species of the neotropical seasonal killifish genus *Simpsonichthys* are described from the middle rio Paracatu drainage of the middle rio São Francisco basin, Brazil. *Simpsonichthys virgulatus* is a typical member of the *S. notatus* species group, diagnosed by the derived A-pattern frontal squamation and presence of blue spots on distal margin of the dorsal fin in males. It is similar to *S. trilineatus* and *S. auratus* in having the anterior portion of the flanks golden, with dark brown to black blotches in males, and differs from those species by having more blotches on the flank, bars present on the caudal peduncle, and hyaline pectoral fins in males. *Simpsonichthys fasciatus* is similar to *S. alternatus* and *S. delucai* in having the combination of anal fin rounded in males and anal fin spatula-shaped in females, but differs in having the dorsal-fin origin anteriorly positioned and a dark gray to black stripe on the distal margin of dorsal fin in males. *Simpsonichthys gibberatus* differs from all other congeners by the pronounced and convex profile of the anterodorsal portion of the body in females.

Key Words: Annual fish, killifish, Cyprinodontiformes, Rivulidae, *Simpsonichthys*, rio São Francisco, systematics, taxonomy, new species

Resumo

Três novas espécies do gênero neotropical *Simpsonichthys* são descritas para a drenagem do médio rio Paracatu da bacia do médio rio São Francisco, Brasil. *Simpsonichthys virgulatus* é um membro típico do grupo de espécies *S. notatus*, o qual é diagnosticado pelo padrão derivado de escamação frontal A e pela presença de manchas azuis na margem distal da nadadeira dorsal em machos. Ela é similar a *S. trilineatus* e *S. auratus* por possuir porção anterior de flanco dourada com manchas

Accepted by C. Gilbert: 30 May 2006; published: 26 Jun. 2006

castanho escuras a negras em machos, e difere delas por possuir mais manchas em flanco, barras no pedúnculo caudal e nadadeira peitoral hialina em machos. *Simpsonichthys fasciatus* é semelhante a *S. alternatus* e *S. delucai* por possuir a combinação de nadadeira anal arredondada em machos e nadadeira anal em forma de espátula em fêmeas, diferindo delas por possuir origem de nadadeira dorsal posicionada anteriormente e uma faixa cinza escura a negra na margem distal da nadadeira dorsal em machos. *Simpsonichthys gibberatus* difere de todos os outros congêneres pelo perfil acentuado e convexo da porção antero-dorsal do corpo em fêmeas.

Introduction

Simpsonichthys de Carvalho is the most diversified genus of seasonal aplocheiloid killifishes, comprising 44 valid species (Costa, 2005, 2006). Species of *Simpsonichthys* occur over a vast neotropical area, including the Amazonas, Paraná-Paraguay, and São Francisco river basins of northeastern, central, and eastern South America, and in several other smaller coastal rivers basins (Costa, 2006). The greatest diversification is concentrated in the rio São Francisco basin, with 19 endemic species (Costa, 2005, 2006). Six species (*S. trilineatus* (Costa & Brasil, 1994); *S. auratus* Costa & Nielsen, 2000; *S. similis* Costa & Hellner, 1999; *S. alternatus* (Costa & Brasil, 1994), *S. delucai* Costa, 2003; and *S. zonatus* (Costa & Brasil, 1990)) are endemic to the rio Paracatu and rio Urucuia drainages, two adjacent drainages constituting the southwestern portion of the rio São Francisco basin. Among them, four species form two well corroborated clades (*S. trilineatus* and *S. auratus*, and *S. alternatus* and *S. delucai*), with all four hypothesized to be more closely related to species of *Simpsonichthys* endemic to the rio Tocantins basin than to congeners occurring in other parts of the rio São Francisco basin (Costa, 1996, 2003, 2006). Three new species belonging to these clades were collected by the second author in the middle rio Paracatu drainage, and are herein described.

Material and methods

Measurements and counts follow Costa (1995). Measurements are presented as percentages of standard length (SL), except for those related to head morphology, which are expressed as percentages of head length. Fin-ray counts include all elements; numbers of vertebrae, gill-rakers, and pectoral, pelvic and caudal-fin rays were recorded only from cleared and stained specimens. The compound caudal centrum was counted as a single element. Osteological preparations were made according to Taylor and Van Dyke (1985). The term "seasonal fish" is according to Costa (2002). Terminology for frontal squamation follows Hoedeman (1958) and for cephalic neuromast series follows Costa (2001). The abbreviation c&s denotes specimens cleared and stained for bone and cartilage. Material is deposited in MCP, Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do

Rio Grande do Sul, Porto Alegre, Brazil; and UFRJ, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.

***Simpsonichthys virgulatus*, new species**
(Figs. 1–2)

Material examined

Holotype. UFRJ 6336, male, 41.5 mm SL; Brazil: Estado de Minas Gerais: Município de Unaí, temporary lagoon about 7 km from ribeirão Entre Rios, rio Paracatu drainage, rio São Francisco basin, about 16º49'30"S 46º30'00"W, altitude about 530 m; G. C. Brasil, 26 May 2005.

Paratypes. UFRJ 6337, 10 males, 39.2–52.7 mm SL, 23 females, 28.9–33.9 mm SL; UFRJ 6338, 3 males, 39.2–43.7 mm SL, 3 females, 28.8-32.7 mm SL (c&s); MCP 39931, 2 males, 40.2–42.6 mm SL, 3 females, 29.1–31.8 mm SL; all collected with holotype.

Diagnosis

Similar to *S. auratus* and *S. trilineatus* and distinguished from all other congeners in having the following combination of characters: frontal squamation A-patterned (*vs.* E-patterned), anterior portion of flank golden with dark brown to black blotches in males (*vs.* never a similar color pattern), and dark gray spots on the entire flank in females (*vs.* never a similar color pattern). Distinguished from *S. auratus* and *S. trilineatus* by having more black blotches on anterior portion of flanks in males (7–13, *vs.* 3–5), dark brown bars on the whole caudal peduncle in males (*vs.* entire caudal peduncle purplish brown in *S. auratus*, and caudal peduncle light brown with three purplish brown stripes in *S. trilineatus*), and pectoral fins hyaline in males (*vs.* ventral portion of pectoral fin pale red).

Description

Morphometric data appear in Table 1. Males larger than females, the largest male examined 52.7 mm SL; largest female 33.9 mm SL. Dorsal profile convex from snout to end of dorsal-fin base, approximately straight on caudal peduncle. Ventral profile convex from lower jaw to end of anal-fin base, nearly straight on caudal peduncle. Body deep, compressed, greatest body depth at level of pelvic-fin base. Snout blunt. Urogenital papilla cylindrical and short in males; urogenital papilla protuberate in females, posterior border slightly overlapping anterior portion of anal fin, urogenital opening transverse.

Tip of both dorsal and anal fins pointed in males; tip of dorsal fin slightly pointed, and tip of anal fin rounded in females; dorsal and anal fins short in females. Short filamentous rays on tip of both dorsal and anal fins in males, tip of filaments reaching vertical through caudal-fin base. Anterior and posterior rays of dorsal-fin rays, including rays on tip of fin, unbranched; median rays branched. Caudal fin rounded. Pectoral fins elliptical. Posterior

margin of pectoral fins reaching vertical between base of 2nd and 4th anal-fins ray in males, between pelvic-fin base and anus in females. Tip of each pelvic fin reaching between base of 2nd and 3rd anal-fin rays in males, between urogenital papilla and base of 2nd anal-fin ray in females. Pelvic-fin bases medially in contact. Dorsal-fin origin anterior to anal-fin origin in males, anal-fin origin on vertical between base of 2nd and 3rd dorsal-fin rays; dorsal-fin origin posterior to anal-fin origin in females, on vertical between base of 2nd and 3rd anal-fin rays. Dorsal-fin origin between neural spines of vertebrae 7 and 9 in males, between neural spines of vertebrae 10 and 12 in females. Anal-fin origin between pleural ribs of vertebrae 8 and 9 in males, between pleural ribs of vertebrae 9 and 10 in females. Dorsal-fin rays 20–21 in males, 14–16 in females; anal-fin rays 19–20 in males, 16–18 in females; caudal-fin rays in both sexes 25–27; pectoral-fin rays in both sexes 12–13; pelvic-fin rays in both sexes 5–6.

TABLE 1. Morphometric data of *Simpsonichthys virgulatus*, *S. fasciatus* and *S. gibberatus*.

	S. virgulatus		*S. fasciatus*		*S. gibberatus*	
	males (n = 10)	females (n = 10)	males (n = 10)	females (n = 8)	males (n = 5)	females (n = 5)
Standard length (mm)	39.2–52.7	28.9–33.9	16.8–20.0	15.4–16.7	20.6–27.9	17.9–21.9
Percents of standard length						
Body depth	32.2–36.8	33.5–36.7	34.4–37.1	30.3–35.0	30.7–32.8	30.1–31.0
Caudal peduncle depth	14.8–17.3	13.7–15.6	14.5–16.3	13.5–14.5	13.2–14.4	12.3–13.6
Predorsal length	45.9–50.4	61.2–64.6	50.9–56.0	61.4–65.2	46.6–50.1	61.2–65.3
Prepelvic length	44.6–50.0	53.4–58.8	46.4–50.8	52.7–56.3	46.8–52.0	52.5–53.8
Length of dorsal-fin base	34.3–39.6	21.6–23.7	31.4–34.7	19.4–22.3	38.2–39.7	23.1–25.9
Length of anal-fin base	31.7–35.6	19.7–22.5	33.5–36.0	21.7–24.9	28.5–33.6	20.8–23.6
Caudal-fin length	31.5–34.4	29.8–31.9	36.3–41.4	35.1–41.3	37.4–39.1	34.9–38.8
Pectoral-fin length	22.6–27.3	21.9–24.3	25.8–28.2	24.1–28.3	30.1–31.7	27.8–30.8
Pelvic-fin length	9.3–11.0	8.9–11.9	8.1–9.8	8.0–10.5	9.5–11.2	8.9–10.8
Head length	28.3–30.2	29.8–32.6	32.5–35.2	34.1–36.7	31.1–33.9	33.5–37.6
Percentages of head length						
Head depth	102.9–110.3	96.0–102.0	88.6–96.6	83.6–92.3	88.0–96.4	84.1–88.4
Head width	69.1–74.5	67.1–74.5	61.3–64.9	60.9–64.6	63.1–73.7	63.4–66.3
Snout length	13.9–15.6	12.7–14.8	10.0–12.6	10.8–12.8	11.8–16.6	11.9–14.0
Lower jaw length	20.6–23.1	17.2–19.3	16.9–19.1	14.3–16.6	16.7–22.7	15.8–18.3
Eye diameter	26.5–30.5	29.8–33.3	36.5–39.5	35.8–39.3	29.8–35.5	33.3–35.5

Scales large, cycloid. Body and head entirely scaled, except on ventral surface of head. Trunk squamation extending slightly onto middle of anal-fin base. Scales extending onto anterior fifth of caudal fin. Frontal squamation A-patterned; E-scales slightly overlapping medially; row of scales anterior to H-scale, just posterior to rostral regions; single

supraorbital scale. Longitudinal series of scales 26–28; transverse series of scales 8–9; scale rows around caudal peduncle 12. Minute contact organ on each scale of anteroventral portion of flank in males. Small papillate contact organs on upper surface of dorsal-most ray of pectoral-fins in males.

Cephalic neuromasts: supraorbital 11–13, parietal 3, anterior rostral 1, posterior rostral 1, infraorbital 2 + 18–19, preorbital 3, otic 2, post-otic 1–3, supratemporal 1, median opercular 1, ventral opercular 2, preopercular 15–16, mandibular 12, lateral mandibular 5–7, paramandibular 1. One neuromast on each scale of lateral line. Two neuromasts on caudal-fin base.

Basihyal subtriangular, the greatest width about 55 % of length; basihyal cartilage about 15 % of total length of basihyal. Six branchiostegal rays. Second pharyngobranchial teeth 2–3. Gill-rakers on first branchial arch 3 + 9. Vomerine teeth absent. Dermosphenotic absent. Ventral process of posttemporal long. Total vertebrae 27–28.

FIGURE 1. *Simpsonichthys virgulatus*, UFRJ 6336, male, holotype, 41.5 mm SL (one week after collection); Brazil: Minas Gerais: Unaí: middle rio Paracatu drainage.

FIGURE 2. *Simpsonichthys virgulatus*, UFRJ 6337, female, paratype, 29.6 mm SL (one week after collection); Brazil: Minas Gerais: Unaí: middle rio Paracatu drainage.

Coloration

Males: Sides of body golden, with rounded dark brown to black rounded blotches on anterior portion of flanks and 4–7 dark brown bars on posterior portion of flanks; vertical rows of light green dots along whole flank, sometimes coalesced to form vertical lines, alternating with narrow dark orangish brown stripes on anterior portion of flanks. Dorsum light brown, venter yellowish white. Sides of head light brown to greenish golden on opercular region. Scale margins of posterodorsal portion of head side dark orangish brown. Iris light yellow, with dark reddish brown bar through center of eye. Unpaired fins dark yellowish brown, with light green dots; rows of greenish blue short vertical lines along distal margin of dorsal fin. Pelvic fins yellowish brown. Pectoral fins hyaline.

Females: Sides of body light yellowish brown, with dark gray spots; spots above anal-fin base usually elongate, forming short bars; 3–4 spots on anterocentral portion of flank black, often coalesced to form stripe. Dorsum pale brown, venter pale golden. Opercular region greenish golden. Iris light yellow, with gray bar through center of eye. Unpaired fins hyaline, with black small spots on basal region; small light blue spot on posterior margin of anal fin, just posterior to fin base. Paired fins hyaline.

Distribution

Known only from the type locality, ribeirão Entre Ribeiros floodplains, rio Paracatu drainage, rio São Francisco basin, Unaí, Estado de Minas Gerais, Brazil (Fig. 3).

Habitat

Simpsonichthys virgulatus was collected in an isolated seasonal lagoon, with an area about 3,000 m^2, and maximum depth about 0.8 m. The water was tea-colored, pH 7.9–8.1, temperature of the air 30.5°C, and temperature of the water 23.1°C, at 2:00 PM. The region is an area with typical savannah vegetation, the Cerrado. No other fishes were found there. This locality is about 15 km (in a straight line) from the mutual type localities of *S. fasciatus* and *S. gibberatus* (see below).

Etymology

From the Latin *virgulatus* (with stripes of different colors), in reference to the male color pattern.

***Simpsonichthys fasciatus*, new species**
(Figs. 4–5)

Material examined

Holotype. UFRJ 6339, male, 19.7 mm SL; Brazil: Estado de Minas Gerais: Unaí, temporary pool about 2 km from the right bank of rio Preto, rio Paracatu drainage, rio São Francisco basin, about 16º41’30”S 46º30’00”W, altitude about 550 m; G. C. Brasil, 15

April 2005.

Paratypes. UFRJ 6340, 4 males, 16.8–20.0 mm SL, 3 females, 15.7–16.3 mm SL; UFRJ 6341, 2 males, 17.6–18.6 mm SL, 2 females, both 15.7 mm SL (c&s); all collected with holotype. UFRJ 6372, 5 males, 16.4–19.4 mm SL, 2 females, 15.4–16.7 mm SL; MCP 39436, 3 males, 18.4–18.8 mm SL; UFRJ 6377, 1 female, 15.9 mm SL; same locality; G. C. Brasil, 14 Feb. 2006.

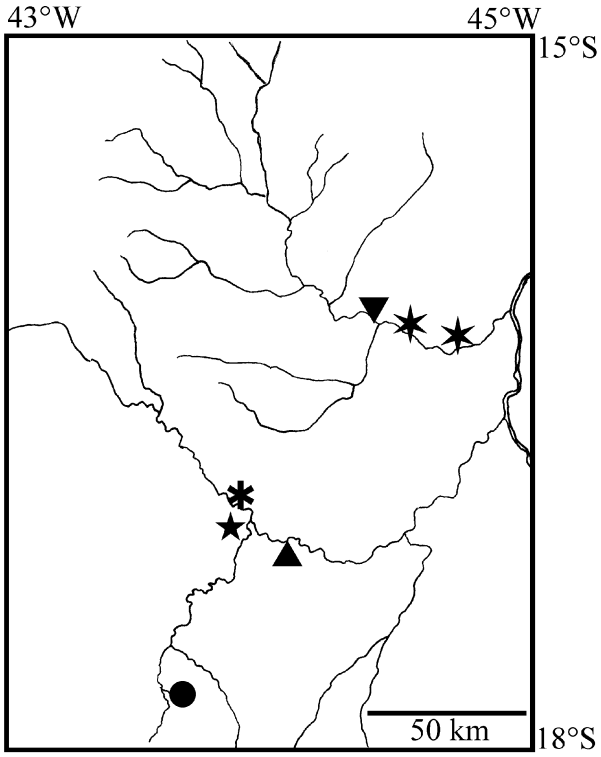

FIGURE 3. Geographic distribution of species of *Simpsonichthys*, subgenus *Hypsolebias*, in the southeastern portion of the rio São Francisco basin, Brazil: asterisk: *S. virgulatus*; five-tip star: *S. fasciatus* and *S. gibberatus*; six-tip stars: *S. similis*; triangle: *S. trilineatus* and *S. alternatus*; inverted triangle: *S. delucai*; dot: *S. auratus*.

Diagnosis

Similar to *S. alternatus* and *S. delucai*, and distinguished from all other congeners in having the following combination of characters: anal fin rounded in males (*vs.* pointed), anal fin elongated, spatula-shaped in females (*vs.* short, nearly semicircular), and oblique bars on dorsal fin in males (*vs.* never with a similar color pattern). *Simpsonichthys fasciatus* differs from *S. alternatus* and *S. delucai* in usually having dorsal-fin origin just anterior (occasionally slightly posterior) to anal-fin origin, on a vertical through base of 2nd anal-fin ray (*vs.* dorsal-fin origin on a vertical between base of 3rd and 5th anal-fin rays), and a dark gray to black stripe on distal margin of dorsal fin in males (*vs.* dark red distal stripe).

Description

Morphometric data appear in Table 1. Males larger than females, the largest male examined 20.0 mm SL; largest female examined 16.7 mm SL. Dorsal profile slightly concave on head, convex from nape to end of dorsal-fin base, nearly straight on caudal peduncle. Ventral profile convex from lower jaw to end of anal-fin base, approximately straight on caudal peduncle. Body moderately deep and compressed, greatest body depth at level of pelvic-fin base. Snout blunt. Urogenital papilla cylindrical and short in males; urogenital papilla protuberate in females, posterior border slightly overlapping anterior portion of anal fin, urogenital opening transverse.

Tip of dorsal fin pointed and tip of anal fin rounded in both sexes; anal fin long, spatula-shaped in females. Short filamentous rays on tip of dorsal fin in males, tip of longest filament reaching vertical through caudal-fin base. Most dorsal-fin rays unbranched. Caudal fin subtruncate in males, rounded in females. Pectoral fins elliptical. Posterior margin of pectoral fins reaching vertical between base of 4th and 6th anal-fins ray in males, through urogenital papilla in females. Tip of each pelvic fin reaching between base of 1st and 2nd anal-fin rays in males, reaching urogenital papilla in females. Pelvic-fin bases medially in contact. Dorsal-fin origin usually slightly anterior (sometimes posterior) to anal-fin origin, on vertical between base of 1st and 2nd anal-fin rays in males, and between base of 3rd and 4th anal-fin rays in females. Dorsal-fin origin between neural spines of vertebrae 7 and 8 in males, between neural spines of vertebrae 10 and 11 in females. Anal-fin origin between pleural ribs of vertebrae 7 and 9 in males, between pleural ribs of vertebrae 8 and 9 in females. Dorsal-fin rays 19–20 in males, 13–14 in females; anal-fin rays 20–21 in males, 17–19 in females; caudal-fin rays 22–24 in both sexes; pectoral-fin rays 12 in both sexes; pelvic-fin rays 6 in both sexes.

Scales large, cycloid. Body and head entirely scaled, except on ventral surface of head. Scales extending slightly onto middle of anal-fin base, and onto anterior fifth of caudal fin. Frontal squamation E-patterned; E-scales overlapping medially; no row of scales anterior to H-scale; two small supraorbital scales. Longitudinal series of scales 24–25; transverse series of scales 8–9; scale rows around caudal peduncle 12. Minute contact organ on each scale of anteroventral portion of flank in males. Small papillate contact organs on upper surface of dorsalmost ray of pectoral-fin in males.

Cephalic neuromasts: supraorbital 11–13, parietal 3, anterior rostral 1, posterior rostral 1, infraorbital 2–3 + 18, preorbital 3, otic 2, post-otic 2, supratemporal 1, median opercular 1, ventral opercular 1–2, preopercular 13–15, mandibular 10–12, lateral mandibular 4–5, paramandibular 1. One neuromast on each scale of lateral line. Two neuromasts on caudal-fin base.

Basihyal subtriangular, the greatest width about 50 % of length; basihyal cartilage about 35 % of total length of basihyal. Six branchiostegal rays. Second pharyngobranchial teeth 3. Gill-rakers on first branchial arch 3 + 10. Vomerine teeth absent. Dermosphenotic absent. Ventral process of posttemporal long. Total vertebrae 25–26.

FIGURE 4. *Simpsonichthys fasciatus*, UFRJ 6339, male, holotype, 19.7 mm SL (one week after collection); Brazil: Minas Gerais: Unaí: middle rio Paracatu drainage.

FIGURE 5. *Simpsonichthys fasciatus*, UFRJ 6339, female, paratype, 15.9 mm SL (one week after collection); Brazil: Minas Gerais: Unaí: middle rio Paracatu drainage.

Coloration

Males: Side of body light pinkish gray, with 9–10 reddish brown bars. Dorsum light brown, venter yellowish white. Sides of head yellowish gray; narrow red pigmentation on scale margins of posterodorsal portion of head; opercular and infraorbital regions golden. Iris light yellow, with brown bar through center of eye. Dorsal fin light greenish blue, with 6–8 oblique dark reddish brown bars; dark gray to black stripe on distal margin of fin. Anal fin light greenish blue, becoming light yellowish gray on anterior portion, with 5 oblique dark reddish brown bars; distal portion of fin dark orangish red. Caudal fin light greenish blue, with 4 dark reddish brown bars. Pelvic fins reddish brown. Pectoral fins hyaline.

Females: Sides of body light brownish gray, usually with round black spot on anterocentral portion of flanks, sometimes two spots or spots absent; often faint gray bars

on ventral portion of caudal peduncle. Dorsum light brownish gray, venter light gray. Opercular region pale greenish golden. Iris light yellow, with gray bar through center of eye. Fins hyaline.

Distribution

Known only from the type locality, middle rio Preto drainage, itself a part of the rio Paracatu drainage, rio São Francisco basin, Unaí, Estado de Minas Gerais, Brazil (Fig. 3).

Habitat

Simpsonichthys fasciatus was collected in a small and shallow seasonal pool, area about 20 m^2, and maximum depth about 0.4 m. At 10:00 AM on 26 May 2005, the water was clear, pH 5.7, temperature of the air 29.0°C, temperature of the water near the surface 23.1°C, and temperature of the water near the bottom 20.8°C. *Simpsonichthys gibberatus* was also collected in this same biotope. Other fish species found but not preserved were: *Astyanax* sp., *Characidium* sp. and *Synbranchus* sp.

Etymology

From the Latin *fasciatus* (with vertical bars), in reference to the male color pattern on the flanks and unpaired fins.

***Simpsonichthys gibberatus*, new species**
(Figs. 6–7)

Material examined

Holotype. UFRJ 6373, male, 27.9 mm SL; Brazil: Estado de Minas Gerais: Unaí, temporary pool about 2 km from the right bank of rio Preto, rio Paracatu drainage, rio São Francisco basin, about 16º41'30"S 46º30'00"W, altitude about 550 m; G. C. Brasil, 14 Feb. 2006.

Paratypes. UFRJ 6374, 5 males, 20.6–26.4 mm SL, 6 females, 17.9–21.9 mm SL; UFRJ 6375, 4 males, 20.1–26.7 mm SL, 2 females, 21.3–21.5 mm SL (c&s); MCP 39437, 2 males, 18.9–19.2 mm SL, 2 females, 19.0–19.8 mm SL; all collected with holotype.

Diagnosis

Differs from all congeners by the unusual body morphology in females, in which there is a pronounced convexity of the dorsal profile in the region comprising the posterior portion of the head and the anterior portion of trunk, resulting in the greatest body depth at the level of the posterior margin of the opercle. *S. gibberatus* is also distinguished from all other species of the genus by the combination of the following features: frontal squamation A-patterned (*vs.* E-patterned), no distinctive rows of bright spots on distal margin of the dorsal fin in males (*vs.* row of bright blue spots present), gray bars on the flanks in females (*vs.* dark gray spots).

Description

Morphometric data appear in Table 1. Males larger than females, the largest male examined 27.9 mm SL; largest female examined 21.9 mm SL. Dorsal profile convex from snout to end of dorsal-fin base, approximately straight on caudal peduncle. Ventral profile convex from lower jaw to end of anal-fin base, nearly straight on caudal peduncle. Body moderately deep, compressed, greatest body depth at level of pelvic-fin base in male, at level of posterior margin of opercle in females. Snout blunt. Urogenital papilla cylindrical and short in males; urogenital papilla protuberate in females, posterior border slightly overlapping anterior portion of anal fin, urogenital opening transverse.

Tip of both dorsal and anal fins pointed, with short filamentous rays in males and tip of longest filament reaching vertical through caudal-fin base. Dorsal and anal fins rounded in females, anal fin slightly lengthened. Most dorsal-fin rays unbranched. Caudal fin rounded. Pectoral fins elliptical. Posterior margin of pectoral fins reaching vertical between base of 6th and 8th anal-fins ray in males, and base of 3rd anal-fins ray in females. Tip of each pelvic fin reaching between base of 3rd and 4th anal-fin rays in males, reaching urogenital papilla in females. Pelvic-fin bases in contact medially. Dorsal-fin origin anterior to anal-fin origin, anal-fin origin on vertical between base of 4th and 5th dorsal-fin rays in males, between base of 1st and 3rd dorsal-fin rays in females. Dorsal-fin origin between neural spines of vertebrae 6 and 7 in males, between neural spines of vertebrae 11 and 12 in females. Anal-fin origin between pleural ribs of vertebrae 7 and 9 in males, between pleural ribs of vertebrae 10 and 12 in females. Dorsal-fin rays 21–26 in males, 15–17 in females; anal-fin rays 18–20 in males, 16–18 in females; caudal-fin rays 27–29 in both sexes; pectoral-fin rays 13–14 in both sexes; pelvic-fin rays 6 in both sexes.

Scales large, cycloid. Body and head entirely scaled, except on ventral surface of head. Trunk squamation extending slightly onto middle of anal-fin base. Scales extending onto anterior fifth of caudal fin. Frontal squamation A-patterned; E-scales overlapping medially; no row of scales anterior to H-scale; two small supraorbital scales. Longitudinal series of scales 25–27; transverse series of scales 8–9; scale rows around caudal peduncle 12. Prominent contact organ on each scale of anteroventral portion of flank in males. No contact organs on pectoral-fins.

Cephalic neuromasts: supraorbital 13–15, parietal 2–3, anterior rostral 1, posterior rostral 1, infraorbital 2–3 + 17–23, preorbital 3, otic 2, post-otic 2, supratemporal 1, median opercular 1, ventral opercular 1–2, preopercular plus mandibular 27–33, lateral mandibular 5–9, paramandibular 1. One neuromast on each scale of lateral line. Two neuromasts on caudal-fin base.

Basihyal subtriangular, the greatest width about 70 % of length; basihyal cartilage about 25 % of total length of basihyal. Six branchiostegal rays. Second pharyngobranchial teeth 1–2. Gill-rakers on first branchial arch 2 + 9. Vomerine teeth absent. Dermosphenotic absent. Ventral process of posttemporal long. Total vertebrae 27–28.

FIGURE 6. *Simpsonichthys gibberatus*, UFRJ 6373, male, holotype, 27.9 mm SL (ten days after collection); Brazil: Minas Gerais: Unaí: middle rio Paracatu drainage.

FIGURE 7. *Simpsonichthys gibberatus*, UFRJ 6374, female, paratype, 19.9 mm SL (ten days after collection); Brazil: Minas Gerais: Unaí: middle rio Paracatu drainage.

Coloration

Males: Sides of body light golden, with 9–11 light brown bars and horizontal series of small bright greenish blue spots; often dark gray to black spot on anterocentral portion of flanks. Dorsum light brown, venter yellowish white. Sides of head light golden to reddish brown on scales margins of dorsoposterior portion of head, with small greenish blue spots on center of scales; infraorbital region light golden. Iris light yellow, with reddish brown bar through center of each eye. Unpaired fins dark gray almost black, with small light blue spots; pale blue line on posterior margin of caudal fin. Pelvic fins dark gray. Pectoral fins hyaline.

Females: Sides of body light brownish gray, with 11–13 pale gray bars and 1 or 2 round black spot on anterocentral portion of flanks. Dorsum light brownish gray, venter light gray. Opercular region pale golden. Iris light yellow, with gray bar through center of eye. Fins hyaline.

Distribution

Known only from the type locality, middle rio Preto drainage, a part of rio Paracatu drainage, rio São Francisco basin, Unaí, Estado de Minas Gerais, Brazil (Fig. 3).

Habitat

Same as described for *S. fasciatus.*

Etymology

From the Latin *gibberatus* (with humped back), an allusion to the lateral profile of the anterodorsal portion of the body in females.

Discussion

In the most recent phylogenetic study (Costa, 2006), *Simpsonichthys* was divided into five subgenera: *Xenurolebias* Costa, *Ophthalmolebias* Costa, *Simpsonichthys* de Carvalho, *Spectrolebias* Costa & Nielsen, and *Hypsolebias* Costa. *Hypsolebias* is the most speciose clade of *Simpsonichthys*, including 24 species divided into four main clades: the *S. magnificus* species group, the *S. notatus* species group, the *S. flammeus* species group, and the *S. antenori* species group (Costa, 2006).

Simpsonichthys virgulatus possesses the frontal squamation A-patterned (Fig. 8) and a row of small bright blue spots on the distal margin of the dorsal fin in males, which are synapomorphic features for the *S. notatus* species group (Costa, 2006). This clade includes *S. notatus* (Costa, Lacerda & Brasil, 1990), *S. radiosus* Costa & Brasil, 2004; *S. similis* Costa & Hellner, 1999; *S. trilineatus*, *S. auratus*, *S. stellatus* (Costa & Brasil, 1994), *S. rufus* Costa & Nielsen, 2001; and *S. nielseni* Costa, 2005. Among them, *S. virgulatus* shares, along with *S. trilineatus* and *S. auratus*, the presence of flanks bright golden, with rows of black round blotches in males (Costa, 2006). However, another derived feature described by Costa (2006) for the clade including *S. trilineatus* and *S. auratus* (*i. e.*, brownish red pigmentation on the pectoral fin in males), is not present in *S. virgulatus*, suggesting that *S. trilineatus* is more closely related to *S. auratus* than to *S. virgulatus*.

Simpsonichthys fasciatus is a miniature species, only reaching a maximum adult size of about 20 mm SL. Individuals maintained in aquaria by the second author did not exceed this size after 10 months. This species is a member of the clade defined by Costa (2006) as the *S. flammeus* species group, diagnosed by having spatula-shaped anal fin in females. This clade includes *S. flammeus* (Costa, 1989); *S. brunoi* Costa, 2003; *S. multiradiatus* (Costa & Brasil, 1994), *S. alternatus* and *S. delucai*. Among them, *S. fasciatus* is closely related to the clade including *S. alternatus* and *S. delucai*, which is diagnosed by the rounded anal fin in males and oblique bars on the dorsal fin in males.

Simpsonichthys gibberatus may be considered a member of the *S. notatus* species group, since it shares the apomorphic A-patterned frontal squamation with species of this

assemblage. This supposed phylogenetic position is reinforced by the presence of a black spot on the anterocentral portion of the flank in some males, a condition also occurring in several species of the *S. notatus* group (i. e., *S. notatus*, *S. radiosus*, *S. similis*, *S. trilineatus*, *S. auratus*, and *S. virgulatus*). However, some incongruence to this hypothesis in noted by the absence of a row of small bright blue spots on the distal margin of the dorsal fin in males, a synapomorphy of the *S. notatus* group (Costa, 2006), and the possession of gray bars on the flank in females, a condition considered plesiomorphic for *Simpsonichthys* and not occurring in other members of the *S. notatus* group (Costa, 2006).

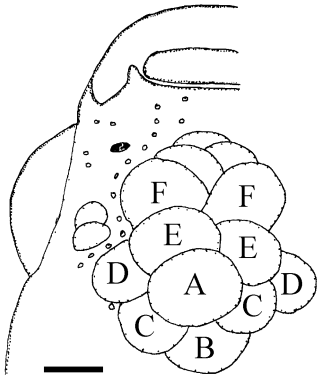

FIGURE 8. Diagrammatic representation of the A-patterned frontal squamation, in which all margins of the A-scale are free: *Simpsonichthys radiosus*, male, UFRJ 6017. Scale bar 1 mm.

Acknowledgments

This study was supported in part by CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico - Ministério de Ciência e Tecnologia) and FAPERJ (Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro). The manuscript benefited from the suggestions made by three referees. Thanks are also due to C. Gilbert for the editorial support and useful comments.

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