

Nannocharax dageti, a new distichodontid from the Democratic Republic of the Congo and Zambia (Teleostei: Characiformes)

Fernando C. Jerep^{*,**}, Richard P. Vari^{*} and Emmanuel Vreven^{***}

Nannocharax dageti, new species, is described from southern tributaries of the Congo River basin in the Democratic Republic of the Congo and Zambia and the Kafue River basin of the Zambezi River catchment in Zambia. The new species is distinguished from its congeners by the pigmentation pattern consisting of vertically elongated, dark, rounded blotches overlapping a dark midlateral longitudinal stripe; the separation of the blotches in many cases from the dorsal saddles that extend to the middorsal line; the symmetrical coloration pattern on each caudal-fin lobe consisting of a dark spot on the base of each lobe and a series of dark spots forming a transverse narrow stripe across each lobe approximately one-third of the distance from the fin margin; a dorsal-fin origin situated anterior of the pelvic-fin origin; and the possession of 40 to 43 scales along the incompletely pored lateral-line series. *Nannocharax dageti* is apparently allopatric to other species of *Nannocharax* in southern tributaries of the Congo River.

Introduction

The genus *Nannocharax* Günther, 1867 consists of small-sized, typically elongate-bodied distichodontids inhabiting fast to slow-moving freshwater habitats across major portions of Africa (Daget, 1961; Vari, 2007; Dunz & Schlieven, 2009; Jerep & Vari, 2013). The geographic range of the genus extends from the Nile River basin in North Africa south across the sub-Saharan portions of the continent to the Zambezi and Okavango river basins. The Congo basin and the coastal

drainages of West Africa host the highest species-level diversity in *Nannocharax* (Daget & Gosse, 1984; Poll, 1973; Vari, 2007; Jerep & Vari, 2013, 2014) with the number of species of the genus attenuating away from those areas.

In his phylogenetic analysis of the family Distichodontidae, Vari (1979) proposed that *Nannocharax* and *Hemigrammocharax* Pellegrin, 1923 formed a monophyletic assemblage supported by a dozen synapomorphies. That author was unable to identify any derived features indicating that each genus was monophyletic and com-

* Division of Fishes, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20013-7012, USA. E-mail: fjerep@gmail.com; varir@si.edu

** Departamento de Biologia Animal e Vegetal, Centro de Ciências Biológicas, Universidade Estadual de Londrina, Londrina, PR, 86051-990, Brazil.

*** Royal Museum for Central Africa, Vertebrate Section, Ichthyology, Leuvensesteenweg 13, B-3080 Tervuren, Belgium; and Katholieke Universiteit Leuven, Laboratory of Biodiversity and Evolutionary Genomics, Charles de Beriotstraat 32, B-3000 Leuven, Belgium. E-mail: emmanuel.vreven@africanmuseum.be

mented that “the monophyly of each of these genera is open to question” (Vari, 1979: 332). Various researchers both prior and subsequent to that study (Roberts, 1967; Jubb & Gaigher, 1971; Vari & Géry, 1981; Coenen & Teugels, 1989; Jerep & Vari, 2013, 2014) similarly questioned whether the single character used by Pellegrin (1923) to delimit *Hemigrammocharax* from *Nannocharax* (the degree of poring of the lateral line – incomplete in *Hemigrammocharax* versus completely pored in *Nannocharax*) yielded natural assemblages of species. Most recently, Jerep & Vari (2014) demonstrated that loss of complete poring of the lateral line within the *N. ocellicauda* species complex occurred independent of the loss of poring elsewhere in the *Hemigrammocharax*-*Nannocharax* lineage defined by Vari (1979). In light of that morphologically based evidence those authors placed *Hemigrammocharax* as a junior synonym of *Nannocharax*. This course of action was also advocated by Arroyave et al. (2013) based on the results of their molecular analysis of the Distichodontidae, which incorporated a subset of the species in each genus. Under the more encompassing concept of *Nannocharax* proposed by these two sets of authors, that genus is diagnosed by the twelve synapomorphies of different body systems proposed by Vari (1979: 331) to the *Hemigrammocharax*-*Nannocharax* lineage. Ongoing revisionary and phylogenetic studies of *Nannocharax* in this expanded sense revealed an undescribed species of the genus from the southern tributaries of the Congo River basin in the Democratic Republic of the Congo and the Kafue River system within the Zambezi River drainage in Zambia. We herein describe the new species of *Nannocharax*, thereby increasing the species-level diversity of the genus to 40 species.

Material and methods

Measurements were taken point-to-point, when possible, on the left side of specimens under a microscope using a digital caliper to 0.1 mm. Body measurements are presented as percentages of the standard length (SL), and subunits of the head are presented as percentages of the head length (HL). Measurements and counts follow those utilized by Vari & Ferraris (2004) and Dunz & Schliewen (2009), with additional modifications as detailed in Jerep & Vari (2013). In the description, the number of examined specimens with a

particular count is indicated in parentheses, and the counts for the holotype in square brackets. Information about dentition, number and shape of infraorbitals, and number of branchiostegal rays was taken from two cleared and stained specimens prepared according to Taylor & Van Dyke (1985). Vertebral counts were taken from radiographs and include the four vertebrae of the Weberian apparatus and the terminal centrum. Museum abbreviations are as follows: AMNH, American Museum of Natural History, New York; ANSP, The Academy of Natural Sciences of Drexel University, Philadelphia; BMNH, Natural History Museum, London; CUMV, Cornell University Museum of Vertebrates, Ithaca; FMNH, Field Museum of Natural History, Chicago; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge; MHNG, Muséum d’Histoire Naturelle, Genève; MRAC, Musée Royal de l’Afrique Centrale, Tervuren; NRM, Naturhistoriska Riksmuseet, Stockholm; SU, former Stanford University collections at California Academy of Sciences, San Francisco; USNM, National Museum of Natural History, Smithsonian Institution, Washington; and ZSM, Zoologische Staatssammlung München, München.

Nannocharax dageti, new species

(Figs. 1–2)

Nannocharax macropterus: Bell-Cross, 1976: 115–116 [listed for upper Zambezi and Kafue river systems; brief description; photographed specimen]. – Bell-Cross & Minshull, 1988: 133–134 [listed for upper Zambezi and Kafue river systems; brief description; photographed specimen]. – Marshall, 2011: 128 [listed for upper Zambezi and Kafue river systems; brief description; biology; illustration of species].

Holotype. MRAC P-88846, holotype, 34.8 mm SL; Democratic Republic of the Congo: Kando, 10°48' S 26°13' E; T. de Caters, Sep–Oct 1953.

Paratypes. AMNH 261176, 2, 28.4–29.0 mm SL; CUMV 91305, 16, 23.9–34.6 mm SL (5, 27.2–34.6 mm SL); USNM, 427064, 4, 25.3–32.5 mm SL (2, c&s, 25.3–27.4 mm SL; out of CUMV 91305); Zambia: Northern Province: Chambeshi River drainage, Kanchibiya stream at bridge on Kasama-Mpika road; 11°29'44.1" S 31°16'46.5" E; R. Bills, A. Chilala & J. P. Friel, 13 Oct 2005. – BMNH



Fig. 1. *Nannocharax dageti*, MRAC P-88846, holotype, 34.8 mm SL; Democratic Republic of the Congo: Kando.



Fig. 2. *Nannocharax dageti*, CUMV 91303, 34.4 mm SL; Zambia: Northern Province: Samfa rapids at pontoon on Chambeshi River.

1972.8.4.18–32, 11 of 15, 21.8–39.1 mm SL (10 measured, 27.1–39.1 mm SL); Zambia; G. Bell-Cross. – CUMV 91303, 5, 30.1–34.4 mm SL, Zambia: Northern Province: Chambeshi River drainage, Samfa Rapids at pontoon on Chambeshi River; 10°51'07.5"S 31°10'02.2"E; R. Bills, Chilala & J. P. Friel, 11 Oct 2005. – MRAC P-96083.1136–96083.1139, 4, 26.8–29.9 mm SL; Zambia: Chambeshi River system, Lukupa River, approximately 28 km on road from Kasam to Luwingu; 10°10'49.9"S 30°57'45.4"E; L. de Vos, 20 Oct 1995. – MRAC P-142078–142081, 4, 35.5–44.2 mm SL; Zambia: Solwezi River, Kafue River system; 12°12'S 26°24'E; G. Bell-Cross, 8 Mar 1963. – MRAC P-144818–144821, 4, 32.2–41.9 mm SL; Democratic Republic of the Congo: Katanga: Kimilolo River, environs of Lubumbashi (formerly Élisabethville); M. Lips, Sep 1962. – MRAC P-144872–144873, 2, 26.6–27.9 mm SL; Democratic Republic of the Congo: Katanga: environs of Lubumbashi (formerly Élisabethville); M. Lips, 1963. – ZSM 41949, 3, 26.0–29.2 mm SL; Democratic Republic of Congo: Lualaba Province: Kasai River below and above Saipako Falls, 975 m asl, approximately 15 km by air NNW of Dilolo at

border with Angola; 10°33'09.8"S 22°18'35.7"E; E. Vreven, U. Schliewen, A. C. Manda, J. M. Kashala, B. K. Manda, E. Abwe, B. Muti, Ibrahim, 24 Jul 2012. – ZSM 41970, 1, 17.8 mm SL; Democratic Republic of Congo: Lualaba Province: Manga stream, above and below road bridge, tributary of Lwahu River, right bank tributary of Kasai River, 996 m asl, approximately 6.5 km by air NNE of Dilolo at border with Angola; 10°38'35.8"S 22°21'54.9"E; E. Vreven, U. Schliewen, A. C. Manda, J. M. Kashala, B. K. Manda, E. Abwe, B. Muti, Ibrahim, 27 Jul 2012.

Diagnosis. *Nannocharax dageti* is distinguished from all its congeners except *N. angolensis*, *N. gracilis*, *N. lineostriatus*, *N. luapula*, *N. macropterus* and *N. taenia* by the body coloration pattern of a series of vertically elongated, rounded blotches that overlie a longitudinal midlateral dark stripe but are largely separate dorsally from the saddles extending to the dorsal midline. *Nannocharax dageti* differs from *N. gracilis*, *N. luapula*, *N. macropterus* and *N. taenia* by possessing an incompletely pored lateral line (vs. completely pored lateral line) and a caudal fin with a symmetrical

coloration pattern on the lobes consisting of a dark spot at the base of each caudal-fin lobe not continuous with the dark spot over the base of the middle caudal-fin rays, and a series of dark spots forming a transverse stripe paralleling the distal margin of the fin about one-third the length of the lobe from its tip (vs. dark blotch on the base of the ventral caudal-fin lobe continuous with, or extending towards, the dark spot over the base of the middle caudal-fin rays and transverse stripe absent). *Nannocharax dageti* is distinguished from *N. angolensis* and *N. lineostriatus* by possessing 40–43 scales along the longitudinal line including the lateral line (vs. 34–39 in *N. angolensis* and 34–35 in *N. lineostriatus*); 36–41 pored scales along the lateral line (vs. 21–33 in *N. angolensis* and 6–9 in *N. lineostriatus*); and 38–40 vertebrae (vs. 36 in *N. angolensis* and 35–36 in *N. lineostriatus*).

Description. Morphometric data presented in Table 1. Body size small, maximum length of examined specimens 44.2 mm SL. Body elongate; becoming progressively compressed posteriorly to caudal peduncle. Dorsal profile of head rounded along anterior portion of snout; convex from that point to vertical through posterior naris,

slightly convex from that point to tip of supra-occipital spine. Profile of predorsal region of body straight to slightly convex to dorsal-fin origin. Body profile convex along dorsal-fin base, straight to slightly convex from insertion of last dorsal-fin ray to adipose-fin origin, and straight to slightly convex along caudal peduncle. Ventral profile of head convex along anterior portion of dentary; slightly concave to slightly convex from that point to isthmus. Ventral profile of body convex along ventral margin of pectoral girdle, variably convex from that point to pelvic girdle; convex to straight from pelvic-fin insertion to vertical situated anterior to urogenital papillae; concave along region of urogenital and anal openings, straight to convex from that point to anal-fin origin; then straight to slightly convex along anal-fin base to last anal-fin ray insertion and straight to slightly convex along ventral profile of caudal peduncle. Ventral surface of abdomen transversally rounded; ventral surface of pelvic girdle transversally flattened.

Head anteriorly pointed in lateral profile. Eye large; situated on lateral surface of head. Pupil ovoid with anterior emargination of iris. Mouth subterminal; positioned posteroventral of tip of

Table 1. Morphometrics of *Nannocharax dageti*. Range, mean and standard deviation (SD) include values for holotype and paratypes.

	holotype	N	range	mean	SD
Standard length	34.8	38	26.1–44.2	32.2	4.7
Percentage of standard length					
Head length	25.8	38	23.9–27.8	26.1	1.1
Predorsal length	43.2	38	42.0–46.7	44.2	1.2
Prepectoral length	26.6	38	24.2–29.6	26.6	1.2
Prepelvic length	44.7	37	43.8–51.4	46.6	1.5
Preanal length	73.2	38	69.9–75.8	72.7	1.4
Head width	10.9	38	10.1–11.9	11.0	0.4
Body width	11.9	38	9.1–12.8	10.8	0.9
Head depth	17.2	38	15.8–17.6	16.8	0.5
Body depth	19.8	38	18.2–23.4	20.5	1.3
Dorsal-fin length	25.7	38	19.9–26.4	23.5	1.5
Pectoral-fin length	26.1	38	21.9–26.2	24.2	1.1
Pelvic-fin length	24.0	37	18.9–26.7	23.2	1.7
Anal-fin length	19.2	38	14.5–19.2	17.1	0.9
Caudal-peduncle length	17.6	38	14.7–18.2	16.7	0.8
Caudal-peduncle depth	10.0	38	8.9–11.2	9.9	0.6
Percentage of head length					
Eye horizontal diameter	31	38	29–33	30.8	1.3
Snout length	30	38	24–32	30.1	1.7
Upper-jaw length	23	38	19–25	21.4	1.6
Interorbital width	19	38	19–24	20.8	1.3

snout tip at horizontal through ventral margin of eye. Premaxilla with single row of 4 teeth. Premaxillary teeth elongate, bicuspid, slightly distally expanded and gradually decreasing in size posteriorly. Posterior most premaxillary tooth approximately one-half size of tooth proximate to symphysis. Articulation between premaxillae syndesmotic. Dentary with single row of 5 or 6 teeth. Dentary teeth elongate, bicuspid and slightly distally expanded; gradually decreasing in size posteriorly with posterior most tooth approximately one-half size of symphyseal tooth. Contralateral dentaries immovably attached via syndesmotic articulation. Dentary lacking laterosensory canal segment and movably articulated posteriorly with anterodorsal region of anguloarticular. Maxilla toothless, transversely flat and posteriorly expanded. Ventral margin of maxilla slightly convex and posterior border rounded. Maxilla extending posteriorly approximately to vertical through anterior naris. Middle to posterior portions of maxilla located medial to anterior portion of first infraorbital when mouth closed. Anterior naris rounded, separated from posterior naris by flap of skin. Posterior naris semicircular. Infraorbitals 1 to 3 well developed and infraorbitals 4 to 6 poorly ossified or absent.

Dorsal-fin origin located anterior to middle of SL and slightly anterior to vertical through pelvic-fin insertion. Distal profile of dorsal fin slightly convex. First branched dorsal-fin ray longest; posterior rays decreasing progressively in size. Unbranched dorsal-fin rays ii (2), iii (30) or iv (6); branched rays 10 (10), 11 (25) or 12 (3) [iii,10]. Distal profile of pectoral fin slightly concave. Second branched ray longest and extending beyond rest of fin profile. Tip of pectoral fin falling short of, or slightly surpassing, pelvic-fin insertion. Pectoral fin with one unbranched (38) and 9 (4), 10 (17) or 11 (17) [i,10] branched rays. Distal profile of pelvic fin straight to slightly convex. Second branched pelvic-fin ray longest, extending beyond rest of distal profile of fin; remaining rays gradually decreasing in length. Tip of pelvic fin passing beyond urogenital opening but falling short of anal-fin origin. Pelvic fin with one unbranched (37) and 7 (35) or 8 (2) [i,7] branched rays. Adipose fin well developed with origin along vertical through insertion of penultimate or ultimate branched anal-fin ray. Distal profile of anal fin convex anteriorly and slightly concave posteriorly with first branched ray long-

est. Unbranched anal-fin rays ii (21) or iii (17); branched rays 7 (1), 8 (36) or 9 (1) [ii,8]. Caudal fin forked. Caudal lobes of similar size and distally pointed; scales bordering caudal-fin base smaller than body scales. Caudal-fin rays i,17,i (38) [i,17,i].

Scales ctenoid (sensu Roberts, 1993) with serrations formed by separate, distally narrowing ossifications along free margin of each scale. Lateral-line scale at vertical through dorsal-fin origin with ctenii formed of 20 independent ossifications along posterior margin of scale. Scales in humeral and dorsal regions of body just posterior to head smaller than remaining body scales. Longitudinal scale row including pored portion of lateral line with 40 (4), 41 (9), 42 (18) or 43 (7) [41] scales; posterior most one or two scales extending beyond point of flexure at posterior margin of hypural plate. Lateral line straight, incompletely pored with 36 (1), 37 (2), 38 (8), 39 (7), 40 (15) or 41 (5) [39] pored scales. One specimen with lateral-line absent on scales 33 to 35, poring then continuing until scale 41 and then again absent. Scale rows between dorsal-fin origin and lateral line 4 (9), 4.5 (18) or 5 (11) [4.5]. Scale rows between pelvic-fin origin and lateral line 4 (19), 4.5 (12) or 5 (1) [4.5]. Middorsal scales from tip of supraoccipital spine to dorsal-fin origin 9 (1), 10 (20), 11 (14), 12 (2) or 13 (1) [11]. Scales from posterior terminus of dorsal-fin base to adipose fin 10 (3), 11 (8), 12 (17) or 13 (10) [11]. Scales between anus and anal-fin origin 3 (12), 4 (21), 5 (4) or 6 (1) [5]. Scale rows around caudal peduncle 12 (38) [12]. Branchiostegal rays 4. Gill rakers 11 or 12 (2). Vertebrae 38 (6), 39 (31) or 40 (14) [39].

Coloration in alcohol. Overall ground coloration of head and body yellowish to tan (Figs. 1–2). Dorsal surface of head and snout dark from anterior portion of upper lip to tip of supraoccipital spine. Lateral surface of head with dark stripe running from tip of snout to anterior margin of eye. Patches of irregularly arranged, dark chromatophores over first infraorbital, infraorbital bones along posterior margin of eye and opercle. Ventral region of head unpigmented.

Dorsal region of body darker than ventral region. Scales on dorsal region of body with dark pigmentation along distal border resulting in overall reticulated coloration pattern. Six to 10 dark saddles along dorsal midline of body. Reticulated coloration pattern and saddles diffuse

in some individuals resulting in more homogeneous pigmentation pattern on dorsal portions of body. Midlateral surface of body with dark, midlateral longitudinal stripe. Stripe one scale wide and extending from posterior border of opercle to caudal-fin base. Series of 7 to 12 vertically elongated, rounded, dark blotches overlapping dark, midlateral longitudinal stripe. Lateral blotches extending up to two scales ventral of, and up to one scale dorsal of, lateral-line scale row (Figs. 1–2). Pattern of lateral blotches somewhat variable; restricted to region ventral to midlateral dark stripe in some individuals and to anterior region of body in one examined specimen. Ventral midline of body between anus and anal-fin origin with pronounced concentration of dark chromatophores. Base of anal fin with series of dark spots at insertion of each ray. Midlateral spot on caudal-peduncle small; extending slightly posteriorly over base of middle caudal-fin rays and sometimes anteriorly continuous with midlateral dark stripe.

Dorsal fin crossed by two, slightly arched, dark, longitudinal bands formed by series of dark spots on dorsal-fin rays. Bands situated at approximately one-third and two thirds of length of fin. Pectoral, pelvic and anal fins mostly hyaline, with scattered dark pigmentation on interradial membrane in some individuals. Adipose fin hyaline; but with small dark spot in some individuals. Coloration pattern of caudal-fin lobes symmetrical with dark blotch towards base of each lobe discontinuous from dark spot at base of middle caudal-fin rays. Each lobe with varying intensity pigmented, narrow, dark, transverse band formed by series of dark spots approximately one-third of distance from tip of lobe. Stripe paralleling distal profile of caudal fin other than for anterior inflexions near dorsal and ventral margins of fin with overall pattern across two lobes resembling number “3” (Fig. 2).

Distribution. *Nannocharax dageti* is known to inhabit the upper portions of the Congo (Lualaba), in Kasai and Luapula rivers in the Democratic Republic of the Congo. In Zambia, this species is distributed in the Chambeshi River basin, a tributary of the Luapula River (Congo River basin), and in the Solwezi River, a tributary of the Kafue River in the Zambezi River basin (Fig. 3).

Etymology. The species name, *dageti*, is in honor of the late Dr. Jacques Daget (1919–2009), for-

merly of the Muséum national d’Histoire naturelle, Paris, in recognition of his major contributions to our knowledge of African freshwater fishes.

Remarks. Although *N. dageti*, *N. angolensis* and *N. lineostriatus* are all resident in the southern tributaries of the Congo River basin, available evidence indicates that these species are allopatrically distributed. *Nannocharax angolensis* was described by Poll (1967) from the Cuilo (= Kwilu in the Democratic Republic of the Congo) and Chicapa (= Tshikapa in the Democratic Republic of the Congo) river basins, and *N. lineostriatus* from the upper Cuilo River, in Angola. The headwaters of the Chicapa and Cuilo rivers lie very close to each other in the environs of Alto Chicapa, but these systems drain to different portions of the Kasai River within the Democratic Republic of the Congo. Localities within the Kasai River basin where *N. dageti* is known to occur (ZSM 41949, 41970) lie significantly upstream from the mouths of the Chicapa and Cuilo rivers in the mainstream of the Kasai River.

Some individuals of *N. brevis* and *N. procatopus* may bear a longitudinal dark stripe in addition to vertical bars, with the sum of the consequent pigmentation pattern reminiscent of that of *N. dageti*. In *N. brevis* and *N. procatopus*, the lateral blotches are ventral extensions of the dark saddles on the dorsum of the body, whereas in *N. dageti* the lateral rounded blotch are most often separate from the dorsal saddles. Additionally, *N. dageti* has an incompletely pored lateral line contrary to the completely pored lateral line of *N. brevis* and *N. procatopus* and the dorsal-fin origin in *N. dageti* is positioned anterior to the vertical through the pelvic-fin origin contrary to being situated posterior to the vertical through the pelvic-fin origin in those two species.

Our studies identified only three species of *Nannocharax* from the Zambezi River basin: *N. machadoi* (Poll, 1967), *N. multifasciatus* Boulenger, 1923 and *N. dageti*. Bell-Cross (1976), Bell-Cross & Minshull (1988) and Marshall (2011) alternatively recorded *N. macropterus* Pellegrin, from the upper Zambezi and Kafue river basins. Based on the pigmentation pattern of the photographed specimen in Bell-Cross (1976) and Bell-Cross & Minshull (1988) and most of the counts presented by those authors, the specimens examined by those authors is tentatively equated with *N. dageti*. Bell-Cross (1976) and Bell-Cross &

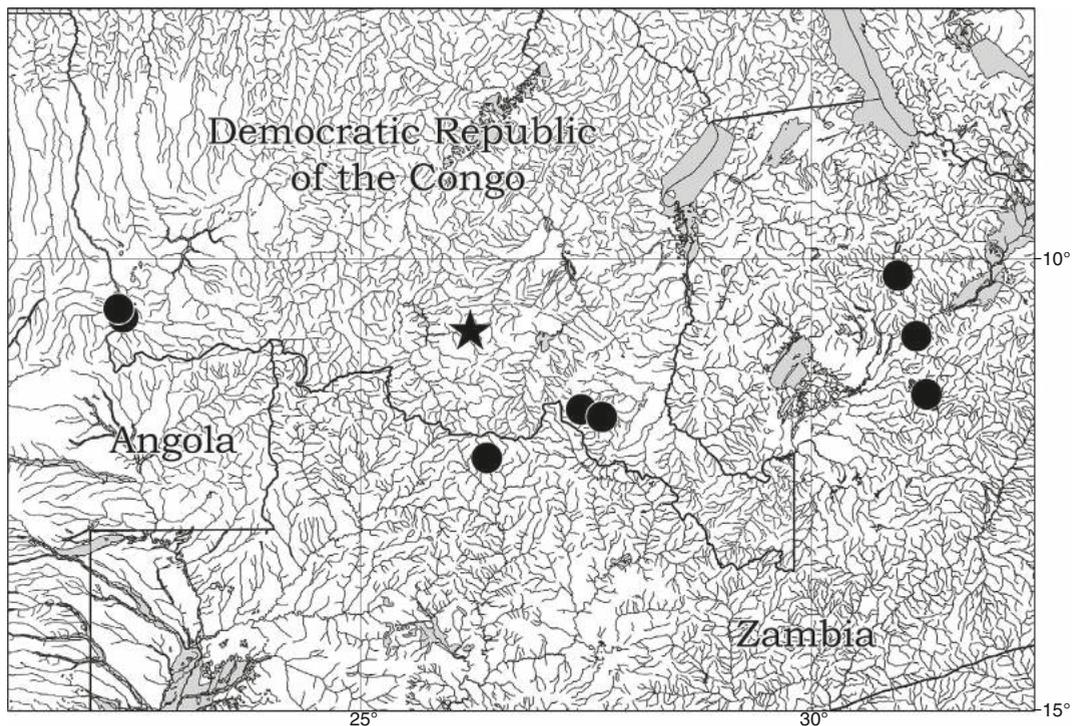


Fig. 3. Map of southern portion of Congo River system showing geographic distribution of *Nannocharax dageti* (★ = type locality) in the Democratic Republic of the Congo and Zambia. Some symbols may represent more than a single collecting locality and/or lot of specimens.

Minshull (1988) reported 15 or 16 circumpeduncular scales in their samples (vs. the 12 scales in *N. dageti*) and that the lateral line was completely pored in those specimens (vs. the presence minimally of several unpored scales at the rear of the lateral-line row in *N. dageti*). Nonetheless, our surveys of available samples of *Nannocharax* from the Zambezi River system failed to reveal any individuals of the genus with the coloration pattern of *N. dageti* plus the circumpeduncular scale count and complete lateral-line scale poring reported by Bell-Cross (1976), Bell-Cross & Minshull (1988) and Marshall (2011). We accordingly consider those citations to represent *N. dageti*.

Comparative material. *Nannocharax angolensis*: MRAC P-158822, 3 paratypes, 25.1–31.9 mm SL; Angola: poste de Cuilo, Xa-Ua, Luita River. – MRAC P-158828, paratype, 28.0 mm SL; Angola: Alto Chicapa, close to Cuilo headwater. – MRAC P-158829, paratype, 21.0 mm SL; Angola: near Chingufo, ditches in marshy Chicapa valley.

Nannocharax ansorgii: AMNH 228534, 3, 23.6–25.4 mm SL; Central African Republic: Chaîne Des

Bongos, control zone of Sangba, Bamingui River, at confluence with Ivingou River, 60 km downstream of Sangba base. – NRM 38317, 9, 16.2–21.2 mm SL; Gambia: MacCarthy Island, Gambia River drainage, ca 2 km NW of Bansang, Farida Creek.

Nannocharax brevis: CUMV 91688, 1, 38.3 mm SL; Central African Republic: Basee-Kotto, Oubangui River drainage, Oubangi River downriver from Mobaye. – CUMV 91690, 3, 39.1–50.7 mm SL; Central African Republic: Basee-Kotto, Oubangui River drainage, Oubangi River shoreline, at uncompleted bridge at Mobaye.

Nannocharax elongatus: CUMV 91667, 1, 50.6 mm SL; Central African Republic: Basee-Kotto, Oubangui River drainage, Oubangi River shoreline, at uncompleted bridge at Mohaye.

Nannocharax fasciatus: USNM 303754, 5, 26.2–32.3 mm SL; Cameroon: Southwest Province: Manyu, main Cross River downstream of Mamfe, at Mamfe River junction with Cross River. – USNM 303756, 2, 36.0–41.3 mm SL; Cameroon: Southwest Province: Manyu, Cross System, main Cross River approximately 23 km below Mamfe.

Nannocharax hastatus: CUMV 89072, holotype, 31.6 mm SL; Republic of the Congo: Cuvette-Ouest, Likouala River drainage, small canal around island in

Lékoli River, Odzala National Park.

Nannocharax intermedius: MCZ 32508, 1, 47.9 mm SL, Cameroon: Ja River at Bitye. SU 15579, 4, 39.0–45.5 mm SL; Cameroon: Menyoo River, Ntem River drainage, Ambam.

Nannocharax latifasciatus: USNM 303996, 3, 32.8–49.5 mm SL; Cameroon: Southwest Province: Manyu, Cross System, main Cross River downstream of Mamfe, Northern Munaya River at junction with Cross River.

Nannocharax lineomaculatus: MHNG 2433.045, 10 of 16, 21.9–32.6 mm SL; Central African Republic: Bamingui-Bangoran, river in Gounda, along route Ndele-Birao.

Nannocharax lineostriatus: MRAC P-159942–159944, 3 paratypes, 23.9–27.5 mm SL; Angola: Alto Cuilo, shores on pond of Cuilo River. – MRAC P-159945–159949, 5 paratypes, 17.6–19.4 mm SL; Angola: mare Tchifuca. – MRAC P-159950–159955, 6, 16.7–19.0 mm SL; Angola: Alto Cuilo, Tchifuca pond, left bank of Cuilo River. – MRAC P-159968, 1, 17.2 mm SL; Angola: Tchifuca pond.

Nannocharax machadoi: AMNH 215607, 10, 20.5–21.8 mm SL; Zambia: Western Province: Kataba Stream on Mongu-Senanga highway. – MRAC P-159969, 2 paratypes, 20.5–20.7 mm SL; Angola: Longa River, tributary of Luena River, Nharicumbi village.

Nannocharax macropterus: MCZ 48055, 2, 35.9–37.6 mm SL; Ghana: Ongwa and Prah Rivers at, or near, Twifu Prasu. – AMNH 247845, 1, 65.9 mm SL; Democratic Republic of the Congo: Kasai Occidental: Lulua, Nsanga Nyembo. – AMNH 247846, 2, 43.9–56.5 mm SL; Democratic Republic of the Congo: Kasai Occidental: Lulua, Ntumba Shambuyi.

Nannocharax maculicauda: CUMV 80621, 1, 30.6 mm SL; Gabon: Woleu-Ntem, Ngomo River where it crosses road from Oyem to Bitam. – CUMV 92350, 6, 30.1–34.1 mm SL; Gabon: Ogooué/Ivindo River drainage, rapids at Loa-Loa. – SU 55191, 2, 27.3–32.8 mm SL; Cameroon: Ebolowa, Ntem River system, Mfiande River. – SU 55672, 7, 29.1–35.4 mm SL; Cameroon: Nye River, tributary of Niobo River, tributary of Ntem River, at Alombo. – USNM 224524, 3, 23.5–28.7 mm SL (1c&s); Gabon: Ogooue Ivindo, still arm of upper Ivindo River opposite Bourassie at juncture of Djouah and Karouaga Rivers.

Nannocharax multifasciatus: AMNH 215614, 2, 31.2–31.5 mm SL; Zambia: Western Province: Litoya stream on Mongu-Senanga highway. – AMNH 217445, 4, 26.5–33.0 mm SL; Botswana: Ngamiland, Okavango River delta, Thamalakane River, at Matlapenang bridge.

Nannocharax niloticus: FMNH 54288, 2, 36.8–36.9 mm SL; Egypt: Nile River at Luxor. – AMNH 50826, 4, 29.3–37.7 mm SL; Egypt: Nile River.

Nannocharax occidentalis: CUMV 91678, 2, 26.9–38.5 mm SL; Central African Republic: Nana-Grébiz, Gribingui/Chari drainage, Grinbingui River at Kanga Bandoro.

Nannocharax ocellicauda: BMNH 1908.5.30.121–122,

2 syntypes; Cameroon: Ja River. – MHNG 2434.004, 10 of 17, 16.1–36.2 mm SL; Cameroon: Central South, Memou'ou River, 80 km W of Sangmelima, along route Ebolowa. – SU 55467, 2, 23.5–27.2 mm SL; Cameroon: Yaounde, where Mefo River empties into Nyong River. – SU 55681, 2, 24.1–25.6 mm SL; Cameroon: Congo River drainage, Sangmelima, Lobo River, tributary to Ja River. – SU 55682, 1, 30.3 mm SL; Cameroon: Centre-Sud, Congo River system, Lobo River, tributary to Ja River at Sangmelima. – ZSM 30035, 1, 23.7 mm SL; Cameroon: East Province: Sangha, lower Lobeke River, close to junction with Sangha River, 2°23'43.42"N 16°6'29.15"E.

Nannocharax parvus: MRAC 90-57-P-2159-161, 3, 31.8–40.4 mm SL; Congo: Brazzaville, Ngoombi River, tributary of Dola River, Loc Dinga basin.

Nannocharax procatopus: MHNG 1248.26, 1, 58.2 mm SL; Congo: Kalubadi, Lulua River.

Nannocharax pteron: ANSP 65560, holotype, 45.5 mm SL; Central African Republic: Tomi River, tributary of Ubangi, at Fort Sibut, Ubangi-Shari.

Nannocharax reidi: USNM 304046, holotype, 62.7 mm SL; USNM 375193, 16 paratypes, 34.3–59.0 mm SL 2 c&s; Cameroon: Cross River system, southern Munaya River draining northern Korup, on Basep River at junction with Munaya River.

Nannocharax rubensteini: CUMV 89502, holotype, 23.6 mm SL; Republic of the Congo: Cuvette-Ouest, Likouala River drainage, Lékoli River at Mboko dock, Odzala National Park.

Nannocharax rubrolabiatus: MRAC 95-22-P-1-7, 7, 45.4–59.8 mm SL; Cameroon: Mi River, tributary of Lom River, Sanaga River basin, Igoum.

Nannocharax schoutedeni: AMNH 241889, 5, 22.9–29.7 mm SL; Democratic Republic of Congo: Salonga National Park, Ifumu, Luilaka River, just downstream from Monkoto. – AMNH 241891, 14, 14.4–39.3 mm SL; Democratic Republic of the Congo: Salonga National Park, Luilaka River, Monkoto.

Nannocharax seyboldi: USNM 118757, holotype, 32.9 mm SL; Liberia: Bellyella. – USNM 118758, 3 paratypes, 34.8–41.3 mm SL; Liberia: Bromley.

Nannocharax taenia: CUMV 91682, 3, 29.6–31.2 mm SL; Central African Republic: Ouaka, Ouaka/Oubangui drainage, Mbourou River at AXMIN Ndassima mine camp. – CUMV 91684, 1, 35.0 mm SL; Central African Republic: Ouaka, Ouaka/Oubangui drainage, Baïdou River, above and below pontoon crossing.

Nannocharax uniozellatus: CUMV 89494, 7, 23.6–26.1 mm SL; Republic of the Congo: Cuvette-Ouest, Likouala River Drainage, Lékoli River, Odzala National Park. – CUMV 89495, 7, 20.2–26.9 mm SL; Republic of the Congo: Cuvette-Ouest, Likouala River drainage, small canal around island in Lékoli River, Odzala National Park.

Nannocharax usongo: USNM 303795, 1, 27.7 mm SL; Cameroon: Southwest Province: Manyu, main Cross River downstream of Mamfe, at Mam River junction with Cross River.

Nannocharax wittei: MRAC P-36247-36311, 65 co-types, 27.1–34.9 mm SL; Democratic Republic of the Congo: Kando River de Tenke.

Acknowledgments

We thank M. Stiassny and B. Brown (AMNH), J. MacLaine and O. Crimmen (BMNH), J. Friel (CUMV), M. Parrent (MRAC) and D. Neumann (ZSM) for assistance during visits to their institutions and/or loan of specimens. For assistance at USNM we thank S. Raredon who prepared Figure 1, J. Clayton and L. Palmer. This project was funded and supported by the National Museum of Natural History, Smithsonian Institution and the Herbert R. and Evelyn Axelrod Chair in the Division of Fishes, National Museum of Natural History.

Literature cited

- Arroyave, A., J. S. S. Stenton & M. L. J. Stiassny. 2013. Are characiform fishes Gonwandan in origin? Insights from a time-scales molecular phylogeny of the Citharinoidei (Ostariophysi: Characiformes). *PlosOne*, 8(10) E77269: 24.
- Bell-Cross, G. 1976. The fishes of Rhodesia. National Museum and Monuments of Rhodesia, Salisbury, 262 pp.
- Bell-Cross, G. & J. L. Minshull. 1988. The fishes of Zimbabwe. National Museum and Monuments of Zimbabwe, Harare, 294 pp.
- Coenen, E. J. & G. G. Teugels. 1989. A new species of *Nannocharax* (Pisces, Distichodontidae) from South-East Nigeria and West Cameroun, with comments on the taxonomic status of *Hemigrammocharax polli* Roman, 1966. *Cybium*, 13: 311–318.
- Daget, J. 1961. Note sur les *Nannocharax* (Poissons Characiformes) de l'Ouest African. *Bulletin de l'Institut Fondamental d'Afrique Noire, Série A*, 1: 165–181.
- Daget, J. & J. P. Gosse. 1984. Distichodontidae. Pp. 124–211 in: J. Daget, J. P. Gosse & D. F. E. Thys van den Audenarde (eds.), Check-list of the freshwater fishes of Africa. Musée Royal de l'Afrique Centrale, Tervuren and Office de la Recherche Scientifique et Technique Outre-Mer, Paris.
- Dunz, A. R. & U. K. Schliwen. 2009. Description of two new species of *Nannocharax* Günther, 1867 (Teleostei: Characiformes: Distichodontidae) from the Cross River, Cameroon. *Zootaxa*, 2028: 1–19.
- Jerep, F. C. & R. P. Vari. 2013. New species of *Hemigrammocharax* (Characiformes: Distichodontidae) from the northwestern Congo River basin. *Copeia*, 2013: 31–37.
- Jerep, F. C. & R. P. Vari. 2014. New species of *Nannocharax* (Characiformes: Distichodontidae) from the northwestern Congo River basin, with an appraisal of *Hemigrammocharax*. *Copeia*, 2014: 44–49.
- Jubb, R. A. & I. G. Gaigher. 1971. Check list of the fishes of Botswana. *Arnoldia*, 5: 1–22.
- Marshall, B. 2011. The fishes of Zimbabwe and their biology. *Smithiana Monograph*, 3: 1–290.
- Pellegrin, J. 1923. Les poissons des eaux douces de l'Afrique occidentale (du Sénégal au Niger). Gouvernement Général de l'Afrique Occidentale Française, Publications du Comité d'Etudes Historiques et Scientifiques, Paris, 373 pp.
- Poll, M. 1967. Contribution à la faune ichthyologique de l'Angola. *Publicações Culturais, Companhia de Diamantes de Angola (DIAMANG)*, Lisbon, 75: 1–381.
- 1973. Nombre et distribution géographique des poissons d'eau douce Africains. *Bulletin du Muséum National d'Histoire Naturelle*, 150: 113–128.
- Roberts, T. R. 1967. *Virilia*, a new genus of sexually dimorphic characid fish from West Africa with comments on characoids having an incomplete line. *Stanford Ichthyological Bulletin*, 18: 251–258.
- Taylor, W. R. & G. C. Van Dyke. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium*, 9: 107–119.
- Vari, R. 1979. Anatomy, relationships and classification of the families Citharinidae and Distichodontidae (Pisces, Characoidea). *Bulletin of the British Museum (Natural History), Zoology*, 36: 261–344.
- Vari, R. P. 2007. Distichodontidae. Pp. 412–465 in: M. L. J. Stiassny, G. G. Teugels & C. D. Hopkins (eds), *Poissons d'eaux douces et saumâtres de Basse Guinée, ouest de L'Afrique centrale (The fresh and brackish water fishes of Lower Guinea, West-Central Africa)*. Volume 1. Institut de Recherche pour le Développement, Paris, Muséum National d'Histoire Naturelle, Paris & Musée Royal de l'Afrique Centrale, Tervuren.
- Vari, R. P. & C. J. Ferraris. 2004. A new species of *Nannocharax* (Characiformes: Distichodontidae) from Cameroon, with descriptions of contact organs and breeding tubercles in the genus. *Proceedings of the Biological Society of Washington*, 117: 551–563.
- Vari, R. P. & J. Géry. 1981. *Nannocharax maculicauda*, a new species of African characid fish (Characoidea, Distichodontidae) with comments on the genus *Hemigrammocharax*. *Proceedings of the Biological Society of Washington*, 94: 1076–1084.

Received 4 November 2013

Revised 7 March 2014

Accepted 11 March 2014

