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Description of *Callopanchax sidibei* (Nothobranchiidae: Epiplatinae), a new species of killifish from southwestern Guinea, West Africa

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Abstract. A new species of the annual killifish genus *Callopanchax* (Nothobranchiidae: Epiplatinae) is described from coastal Guinea, West Africa. It is distinguished from its congeners by morphological and colour pattern characters including up to three irregular and interrupted horizontal stripes on blue flanks in males. A preliminary DNA study indicates that it is closely related with *C. occidentalis* and *C. toddi*, which is supported by the following apomorphic characters compared to the more distantly related *C. monroviae*: a dark red or black postopercular blotch and an origin of the dorsal fin anterior to or above the first ray of the anal fin. The species first turned up in commercial imports of ornamental fish from Guinea. The local collectors, the Sidibe family, are acknowledged for sharing their knowledge on this species and their support to the second author during his collections by naming it *Callopanchax sidibei*, new species. Currently it is only known from the type locality and is endemic to Guinea.

Résumé. Une nouvelle espèce annuelle du genre *Callopanchax* (Nothobranchiidae: Epiplatinae) est décrite des côtes maritimes de Guinée, Afrique de l'Ouest. Elle se distingue de ses congénères par certains caractères morphologiques et un motif coloré comptant jusqu'à trois bandes horizontales irrégulières et interrompues sur les flancs bleus chez les mâles. Une étude ADN préliminaire indique que ce taxon est proche de *C. occidentalis* et *C. toddi*. Ceci est également supporté par les caractères apomorphes suivants – comparés à *C. monroviae*, de parenté plus éloignée: tache post-operculaire rouge sombre ou noire, et origine de la nageoire dorsale au-dessus ou antérieure au premier rayon de la nageoire anale. L'espèce a été détectée en premier dans les importations commerciales d'espèces ornementales en provenance de Guinée. *Callopanchax sidibei* sp. nov. est dédiée à la famille Sidibe, engagée dans les collectes locales, pour avoir partagé ses connaissances et avoir aidé le second auteur durant sa mission de collecte. Cette espèce endémique de Guinée n'est actuellement connue que de la localité type.

Key words. Cyprinodontiformes, *Callopanchax sidibei*, new species, taxonomy, endemic, Upper Guinea.

INTRODUCTION

The nothobranchiid genus *Callopanchax* Myers, 1933 consists of four described species of which three are currently considered valid (Costa 2008; Romand 1985, 1992; Seegers 1997; Wildekamp 1996; Wildekamp & Van der Zee 2003). They are relatively large annual killifishes, reaching up to 90.0 mm in total length according to Wildekamp & Van der Zee (2003), living in the coastal plains from southwestern Guinea and Sierra Leone to western Liberia. *Callopanchax occidentalis* (Clausen, 1966) and *C. toddi* (Clausen, 1966) were described from Sierra Leone, the latter as a subspecies of *C. occidentalis*. Some years later two further species, *C. monroviae* (Roloff & Ladiges, 1972) from Liberia, and *C. huwaldi* (Berkenkamp & Etzel, 1980) from Sierra Leone, were formally described. The latter species is currently considered

a synonym of *C. occidentalis* by most authors (Costa 2008; Lazara 2001; Romand 1985; Wildekamp 1996; Wildekamp et al. 1986).

Callopanchax species are easily separated from all other species groups within the Epiplatinae by the large number of anal and dorsal fin rays and an origin of the dorsal fin anterior or slightly posterior to origin of the anal fin; in the remaining genera the dorsal fin inserts distinctly posterior to the anal fin origin. They share, with the remaining Epiplatinae, the frontal and preopercular neuromast pattern (Clausen 1966, 1967; Grimm 1974; Van der Zee 2002; Van der Zee & Wildekamp 1994), a red pigmentation pattern on the side of the head (Van der Zee 2002), and with *Archiaphyosemion guineense* (Daget,

Table 1. List of specimens used for DNA sequencing with voucher sample number, collection locality, country, and GenBank accession numbers. Accession numbers with * are published in Murphy & Collier (1997), with ** in Sonnenberg & Busch (2009). Aquarium strain means that the origin in nature for this sample is unknown.

Sample no.	species	Collection locality	Country	GenBank acc. no.
OCC GB	<i>Callopanchax occidentalis</i>	aquarium strain	Sierra Leone	U73242*
OCC1530	<i>Callopanchax occidentalis</i>	SL 03/11, Malai	Sierra Leone	GU553007
OCC1531	<i>Callopanchax occidentalis</i>	SL 89, Teme Yellah	Sierra Leone	GU553008
OCC1532	<i>Callopanchax occidentalis</i>	SL 03/19, Magbenta	Sierra Leone	FJ872034**
TOD1534	<i>Callopanchax toddi</i>	GM 97/26, Takhori	Guinea	GU553009
TOD1535	<i>Callopanchax toddi</i>	GM 97/24, Mola	Guinea	GU553010
cTOD1758	<i>Callopanchax</i> cf. <i>toddi</i>	GM 97/3, Mangata Badjana	Guinea	GU553011
SID1536	<i>Callopanchax sidibei</i>	GM 97/2, Bombokore	Guinea	GU553012
MON1533	<i>Callopanchax monroviae</i>	L 97, Paynesville	Liberia	GU553013
GER1381	<i>Scriptaphyosemion geryi</i>	SL 03/9, Robis 1	Sierra Leone	FJ872033**
GUI1404	<i>Archiaphyosemion guineense</i>	SL 93/37, Lenghe Curoh	Sierra Leone	FJ872031**

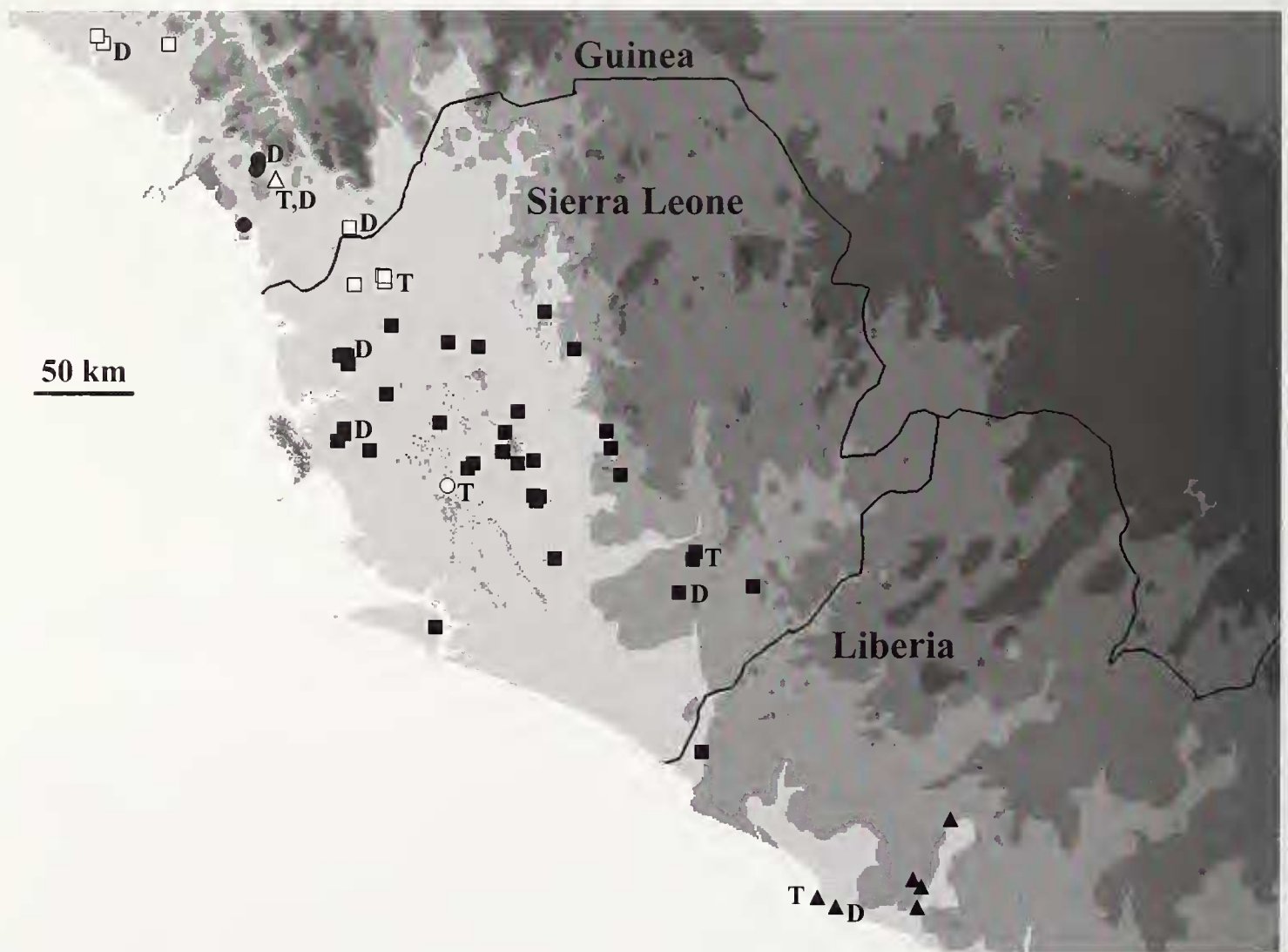


Fig. 1. Map of *Callopanchax* collection localities in coastal West Africa. The letter T indicates the respective type localities, D indicates origin of *Callopanchax* DNA samples used in this study. Black square = *C. occidentalis*, white square = *C. toddi*, black circle = *C. cf. toddi*, white circle = *C. huwaldi*, black triangle = *C. monroviae*, white triangle = *C. sidibei*.

Table 2. Uncorrected p-distances for the mitochondrial LSU sequences with pairwise exclusion of missing data among nine samples of *Callopanchax*, one of *Archiaphyosemion*, and one of *Scriptaphyosemion*. The upper triangle contains the linear geographic distances between the different collection localities of the sequenced *Callopanchax* specimens, except for OCC GB, which is according to Murphy et al. (1999) an aquarium strain of unknown origin.

sample	OCC GB	OCC 1530	OCC 1531	OCC 1532	TOD 1534	TOD 1535	cTOD 1758	SID 1536	MON 1533	GER 1381
OCC 1530	1.7	–	204 km	40 km	196 km	64 km	106 km	95 km	370 km	–
OCC 1531	1.5	1.7	–	185 km	396 km	245 km	301 km	289 km	175 km	–
OCC 1532	1.9	1.3	1.5	–	230 km	103 km	144 km	132 km	340 km	–
TOD 1534	6.6	5.8	6.8	6.6	–	154 km	97 km	110 km	565 km	–
TOD 1535	5.9	5.2	6.2	6.0	1.7	–	57 km	43 km	418 km	–
cTOD 1758	6.8	5.6	6.6	6.4	2.7	1.5	–	14 km	472 km	–
SID 1536	7.6	6.7	7.5	7.1	7.5	6.5	6.2	–	458 km	–
MON 1533	14.2	12.3	12.8	13.1	12.5	12.5	12.5	13.1	–	–
GER 1381	9.6	9.7	8.7	9.3	9.5	9.7	10.1	10.6	14.2	–
GUI 1404	11.9	10.8	11.3	10.8	10.8	10.8	11.6	12.4	14.8	9.4

1954) and *Scriptaphyosemion* Radda & Pürzl, 1987 a distinct constriction of the subdistal portion of the posterior arm of the parasphenoid (Costa 2009). The phylogenetic placement of *Callopanchax* within the Epiplatinae and its sister group relationship with *Scriptaphyosemion* is supported by molecular data (Murphy & Collier 1997; Murphy et al. 1999; Sonnenberg & Busch 2009).

In 1992 a scientifically unknown *Callopanchax* species turned up in a commercial import of ornamental fish from Guinea to the Netherlands. Its distinctness was first recognized by the unique colour pattern of this species (Busch 1993; Wildekamp 1996; Wildekamp & Van der Zee 2003) and was later supported by a study based on molecular data (Murphy et al. 1999). During several research trips in Guinea, the second author was able to collect specimens of this undescribed *Callopanchax*, which is herein described as *Callopanchax sidibei*, new species.

MATERIAL AND METHODS

The specimens on which the following description is based were deposited in the ichthyological collections of the Musée Royal de l'Afrique Centrale (MRAC), Tervuren, Belgium, and the Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK). Comparative material of the other species is listed below.

Measurements and counts are made as indicated in Sonnenberg & Busch (2009), transverse scale count was made between the anterior insertion of the pelvic fin and dorsal fin; the very small scales on the belly were not count-

ed. Digital X-ray images of the types and some specimens of the comparative material used for unpaired fin ray and vertebrate counts were made with a Faxitron LX-60 Digital Specimen Radiography System at the ZFMK. Caudal fin ray counts were only made from X-ray images and include all visible rays.

We prepared a preliminary DNA dataset of a fragment of the mitochondrial large ribosomal subunit (16S rDNA) for a small number of specimens, including three of *C. occidentalis* from Sierra Leone, one sequence of *C. occidentalis* from GenBank (accession number U73242, Murphy & Collier 1997), two specimens of *C. toddi* and one of *C. cf. toddi* from Guinea, one specimen of each *C. monroviae* and *C. sidibei*, new species, and, as an outgroup, *Archiaphyosemion guineense* and *Scriptaphyosemion geryi* (Lambert, 1958). The latter two are the type species of the respective genera. Specimens are listed with locality information and GenBank accession number in Table 1, methods for DNA extraction, amplification and sequencing of the 16S rDNA fragment are provided in Sonnenberg & Busch (2009), where also some of the sequences were published. Resulting sequences were aligned with ClustalX 1.8 (Thompson et al. 1997) and checked by eye in BioEdit 7.0.5.3 (Hall 1999). Sequences were tested for the anti-G bias characteristic of mitochondrial DNA (Zhang & Hewitt 1996). Uncorrected p-distances with the pairwise deletion of missing data were calculated in Mega 4.1 beta 3 (Tamura et al. 2007) and are given in Table 2.

Analyses of sequence data were made with PAUP 4.0b10 (Swofford 1998) by maximum parsimony and with Mr-Bayes 3.1.2 (Huelsenbeck & Ronquist 2001) by a



Fig. 2. A) Holotype of *Callopanchax sidibei*, male, ZFMK 41613, 58.5 mm SL. B) Paratype of *Callopanchax sidibei*, male, ZFMK 41614, 47.0 mm SL. C) *Callopanchax sidibei*, male with red dots in the anal and caudal fin, not preserved. D) Paratype of *Callopanchax sidibei*, female, ZFMK 41615, 55.4 mm SL.

Bayesian approach. Maximum parsimony analyses were done with the exclusion of uninformative positions, gaps were coded as a fifth character state, and heuristic tree searches were performed with random addition of sequences for 1,000 replicates. Bootstrapping was performed with the random addition of sequences for 100 replicates and 10,000 bootstrap replicates. Bayesian analyses were performed with the number of generations set to 10,000,000, with sampling every 1,000 generations, and the results of the first 1,000,000 generations were discarded as a burn-in time after checking that the runs had reached the stationary phase at this point of the analysis. We performed two runs for this dataset, one with two parameter models (Nst 2) and one with six parameter models (Nst 6), settings for rate=gamma and ngammacat=4. We chose to perform these two runs to check if there are serious differences in the results due to potential under- or overparametrization, especially because of the small dataset with large genetic divergences (Table 2). We consider only nodes with $\geq 75\%$ bootstrap support and $\geq 95\%$ posterior probabilities as supported by the data.

Additional information for the collection localities in Table 1 can be found in the comparative material list. Collection points in Figure 1 are from museum collection data

as accessed via Fishbase (Froese & Pauly 2009), from Huber (2007), and collection data of the second author. We adopted, as a species concept, the definition by Moritz et al. (2000) which „...recognize as species geographically bounded sets of populations that are distinct for morphological traits or are reproductively isolated from congeners, with or without corresponding molecular divergence...“.

RESULTS

Callopanchax sidibei, new species

(Fig. 2A–D, Table 3)

Roloffia sp. „Guinea, CI 92“: Busch (1993), p. 64.

Fundulopanchax species aff. *toddi*: Wildekamp (1996), pp. 212–213.

Callopanchax sp. Guinea: Wildekamp & Van der Zee (2003), pp. 381–383.

Callopanchax huwaldi (non Berkenkamp & Etzel, 1980): Neumann (2005), misidentification in fig. caption p. 48.

Holotype. ZFMK 41613, male, 58.5 mm SL, Guinea, Guinée maritime, Kindia region, small river and adjacent pools and ditches in a secondary forest (9°32.71' N,

Table 3. Morphometric and meristic data of *Callopanchax sidibei*. All measurements in percentages of standard length except standard length in mm. Fin ray counts were made on X-rays and include all visible rays. SD = standard deviation.

	Holotype	♂ Types mean	♀ Types mean	all Types mean	all Types range	all Types SD
Standard length	58.5	48.4	50.7	49.7	39.0–59.9	6.8
Total length	124.8	124.6	122.7	123.5	117.1–132.5	4.5
Head length	28.4	29.2	29.1	29.1	27.7–30.5	0.9
Predorsal fin distance	56.7	57.6	60.1	59.0	55.4–63.2	1.9
Prepelvic fin distance	54.1	52.0	52.7	52.4	49.1–56.6	2.0
Preanal fin distance	62.9	62.5	64.2	63.5	60.1–68.9	2.3
Greatest body depth	24.3	23.3	22.3	22.7	20.0–25.8	1.6
Depth of caudal peduncle	13.3	13.2	12.1	12.6	10.7–14.6	1.0
Length of caudal peduncle	23.1	21.6	22.1	21.9	17.8–25.1	1.7
Base of dorsal fin	28.3	28.2	25.7	26.8	23.5–30.7	1.9
Base of anal fin	23.2	23.1	18.2	20.3	17.6–24.6	2.6
Eye diameter	7.2	6.8	6.8	6.8	6.1–7.6	0.4
Interorbital distance	13.7	12.1	11.7	11.9	10.3–13.7	0.8
Dorsal fin rays	19	19.8	19.8	19.8	19–21	0.8
Anal fin rays	17	17.9	18.1	18.0	17–19	0.6
Dorsal / anal fin position	-2	-2.8	-3.2	-3.0	-2– -4	0.7
Caudal fin rays	33	32.0	31.8	31.9	29–34	1.2
Total number of vertebrae	33	33.1	32.6	32.8	32–34	0.7
Vertebrae with pleural ribs	15	15.2	14.8	15.0	14–16	0.7
Vertebrae with haemal spines	18	17.9	17.8	17.8	17–19	0.6
Lateral line scales	34+4	33.2+3.8	33.1+3.5	33.1+3.6	32–34+3–5	0.9+0.6
Transverse row of scales	12	11.2	10.8	11.0	10–13	0.8
Scales around caudal peduncle	16	15.9	15.8	15.9	15–16	0.4

13°14.51' W), close to the small village Bombokoré, about 3 km from the closest larger village Fandi, collection locality GM 08/2, E. Busch and B. Wiese, 25.10.2008, Figure 2A.

Paratypes. ZFMK 41614–41615, 1 male, 47.0 mm SL, 1 female, 55.4 mm SL, paratopotypes, collected with holotype, Figure 2B & D.

ZFMK 41616–41628, 5 males, 8 females, 39.0–58.9 mm SL, paratopotypes, collected with holotype.

MRAC 2010–02–P–1–5, 2 males, 3 females, 46.3–59.9 mm SL, paratopotypes, collected with holotype.

Diagnosis. *Callopanchax sidibei* (Fig. 2A–D) is, together with *C. toddi* (Fig. 3A–F) and *C. occidentalis* (Fig. 4A & B), distinguished from *C. monroviae* (Fig. 5A–C) by insertion of first dorsal fin ray slightly anterior to first anal fin ray versus a posterior insertion. The former three species are also distinguished from *C. monroviae* by a dark red to black postopercular blotch above insertion of pectoral fin versus absence and a dark or black blotch on the

anterior dorsal fin rays instead. The postopercular blotch is present in females of *C. sidibei*, *C. occidentalis*, and *C. toddi* but often only faint; the dark blotch on anterior dorsal fin in *C. monroviae* may not be visible in females. *Callopanchax sidibei*, *C. occidentalis*, and *C. toddi* males have an anal fin with a white or bluish-white margin and usually only a small number of red dots or blotches on fin center; no horizontal red band or only traces of red under the eye from lower lip to posterior border of opercle; postopercular red pigmentation on flank formed by up to three irregular red horizontal bands interrupted into blotches. Males of *C. monroviae* have a dark or dark-red anal fin margin, proximal red dots, blotches or broad vertical streaks, and streaks between fin rays on distal part of anal fin; a more or less complete red band from snout under the eye and often extending on side to origin of pelvic fin; postopercular red pigmentation consists of incomplete rows of small red dots on anterior side and less and irregularly distributed red dots or a pattern of incomplete and irregular vertical stripes on posterior side. Males of *C. sidibei* can also be distinguished from *C. monroviae* by



Fig. 3. A) Male of *Callopanchax* cf. *toddi*, Mangata Badjana, Guinea, collection locality GM 08/3 (= GM 97/3). B) Female of *Callopanchax* cf. *toddi*, Mangata Badjana, Guinea, collection locality GM 08/3 (= GM 97/3). C) Male of *Callopanchax toddi*, Mola, Guinea, collection locality GM 09/17 (= GM 08/4 & GM 97/24). D) Female of *Callopanchax toddi*, Mola, Guinea, collection locality GM 09/17 (= GM 08/4 & GM 97/24). E) Male of *Callopanchax toddi*, Lamayah, Guinea, collection locality GM 08/11. F) Male of *Callopanchax toddi*, Takhori, Guinea, collection locality GM 09/12 (= GM 08/9 & GM 97/26).

body colouration which is mainly blue to blue-green on sides and dorsally often a golden sheen to the anterior, versus anteriorly pale blue to blue-green and dorsal and posterior half of body reddish, reddish-brown or orange, or in the blue form body completely pale to grey-blue (Fig. 5A–C).

Callopanchax sidibe can be distinguished from males of *C. occidentalis* and *C. toddi* by up to three irregular and interrupted horizontal stripes on flanks, an absence of vertical dark red or reddish-brown stripes or broad blotches on sides and a mainly blue to blue-green body colour versus dark brown, brown or red vertical stripes or blotches

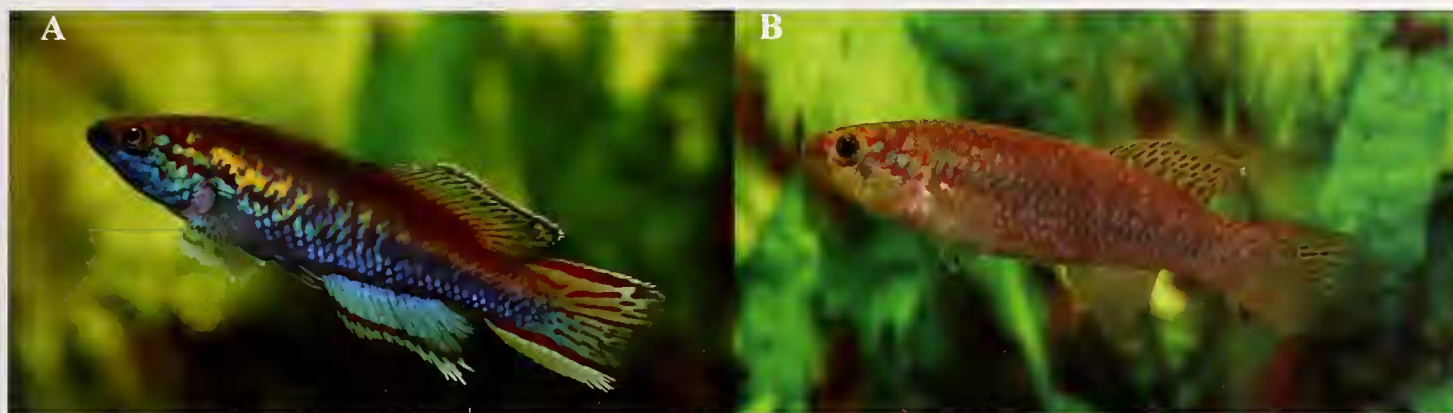


Fig. 4. A) Male of *Callopanchax occidentalis*, Malai, Sierra Leone, collection locality SL 03/11 (= SL 93/54). B) Female of *Callopanchax occidentalis*, Malai, Sierra Leone, collection locality SL 03/11 (= SL 93/54).

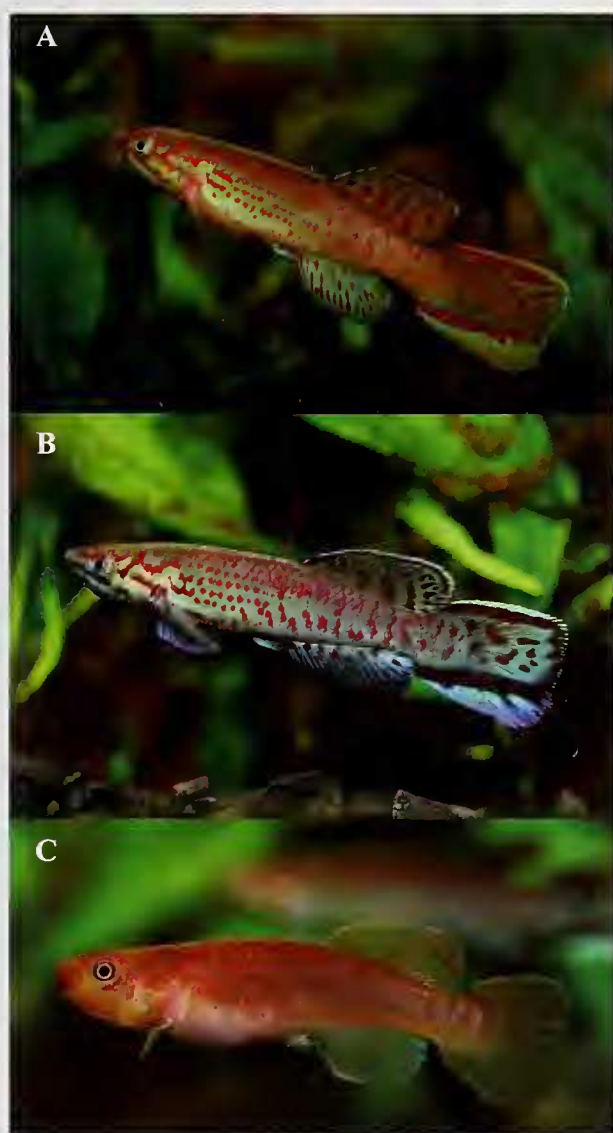


Fig. 5. A) Male of *Callopanchax monroviae*, aquarium strain from Paynesville, Liberia, collection locality L 97, red form. B) Male of *Callopanchax monroviae*, aquarium strain from Paynesville, Liberia, collection locality L 97, blue form. C) Female of *Callopanchax monroviae*, aquarium strain from Paynesville, Liberia, collection locality L 97.

and a more reddish brown or copper to golden body colour with blue only on ventral side. Exceptions are populations with rare blue males in *C. occidentalis* and, if valid, *C. huwaldi*, which show the same pattern as the 'typical' form but lack orange and yellow pigments, but not the red pigmentation and the dark vertical stripes or blotches on posterior side (e.g. Berkenkamp & Etzel 1980; Eberl 1999, pictures of *C. occidentalis* from Mabeimah on p. 65; Roloff 1976).

Large males of *C. sidibei* show only a slightly rugged anal and dorsal fin border and rounded or slightly pointed fin tips versus more pronounced rugged fin borders in most *C. occidentalis* and *C. toddi*, especially the posterior tip of the anal fin, which can show filamentous extensions.

Females of *C. sidibei* can be distinguished from *C. occidentalis* and *C. toddi* females by mid-laterally blue to blue-green coloured scales and the absence of the dark brown vertical stripes or blotches, similar as in males versus blue to blue-green coloured scales only on anterior side, often with short vertical dark blotches dorsally on side. They are distinguished from females of *C. monroviae* by their pigmentation pattern of red horizontal stripes with broad blotches versus more regular horizontal rows of small red dots and the absence of metallic blue to blue-green coloured scales on side in *C. monroviae*.

Description. See Fig. 2A–D for general appearance and Table 3 for morphometric and meristic data of the types. *Callopanchax sidibei* (Fig. 2A–D) shares with its congeners the following combination of diagnostic characters within the Epiplatinae: large and robust species, dorsal and anal fins with a high number of fin rays, origin of dorsal fin close to origin of anal fin. A species with strong sexual dimorphism, adult males usually larger, with larger fins and more colourful than females. Maximum ob-

served SL in males 59.9 mm, in females 59.0 mm. Body cylindrical, outline from tip of snout to posterior end of dorsal and anal fin convex, on caudal peduncle dorsally and ventrally slightly concave to nearly straight. Greatest body depth approximately at half distance between origins of pectoral and pelvic fins.

Snout slightly pointed, mouth directed upwards, lower jaw longer than upper jaw; many irregularly distributed unicuspid, slightly curved teeth of different size, a small number of larger ones on the outer row of upper and lower jaw. Closed frontal neuromast system in one groove, preopercular neuromast system with 5 pores.

Total number of vertebrae 32–34, number of vertebrae with pleural ribs 14–16, with haemal spines 17–19. The X-ray images indicate that in about half of the studied specimens the hypural plates are fused, as no gap or indication of overlap is visible.

Fins in males slightly larger than in females, base of dorsal mean value 28.2 % of standard length (SL) in males versus 25.7 % SL, base of anal in males 23.1 % SL versus 18.2 % SL in females. Dorsal and anal fin rounded or slightly pointed, no long filamentous extension, fin insertion in both sexes posterior to mid-body. In large adult males, dorsal and anal fin rays sometimes protrude from the fin membran, giving the impression of a rugged fin border. Papillae on anal fin rays in males. First 2–4 dorsal fin rays anterior of origin of anal fin. Dorsal fin rays 19–21, anal fin rays 17–19. Caudal fin rounded or slightly truncated, 29–34 fin rays. The single specimen with 29 caudal fin rays has a small gap between the anterior dorsally situated rays explaining the comparatively low value. Pectoral fin origin on ventral half of side, posterior of opercle, rounded, extending posteriorly, not reaching origin of pelvic fin. Pelvic fin small and slightly pointed, not or just reaching anal fin.

Scales cycloid, body and head entirely scaled except throat, scales dorso-anteriorly larger than ventrally and posteriorly, frontal squamation of G-type, scales on lateral line 32–34 + 3–5 on caudal fin base, not all scales along lateral line with small grooves in center. Transverse row of scales above pelvic fin 10–13, circumpeduncular scale row 15–16.

Live colouration. Males. (Fig. 2A–C) Dorsal from head to dorsal fin brown, some scales on back with red dots or scale borders, forming an irregular reticulated pattern to the end of the caudal peduncle; flanks blue to blue-green, dorsolaterally with a metallic copper or golden sheen on scales, belly blue to bluish-grey.

Red pigmentation pattern on head posterior of the eye typical for Epiplatinae (Van der Zee 2002) with two posterior directed horizontal red stripes, originating from one point posterior of the eye to posterior border of opercle, and two more or less complete vertical stripes dorsally.

On flanks three interrupted and irregular red stripes, upper and lower stripes only extending up to the posterior insertion of dorsal fin, only the middle stripe, positioned slightly above mid-line of body, extends to the end of the caudal peduncle, in some males the dorsolateral stripe only consists of a small number of red dots or red scale borders.

Posterior of the opercle and above insertion of pectoral fin usually 2–3 scales in two neighbouring rows with broad black or dark red margin, forming a black or dark red blotch.

Unpaired fins blue to blue-green, with white or, rarely, yellow-white margins and red submarginal stripe. Red pigmentation pattern on unpaired fins variable. Dorsal fin with red dots or short streaks between fin rays, below red submarginal band a whitish zone. Anal fin without or only with little red pigmentation beside submarginal red stripe, in some males a proximal row with a small number of red dots (Fig. 2C). Caudal fin in some males with red dots or blotches, lower white margin broader than upper and in some specimens slightly yellow-white. In males with a more rounded caudal fin shape marginal and submarginal stripes can be closed on posterior end of fin, in males with a more truncate fin shape they end on the posterior fin border (Fig. 2A–C). Pelvic fins bluish, with red submarginal and white marginal stripe, pectoral hyaline with a white or blue-white margin.

Females. (Fig. 2D) Body brown to light brown, dorsally darker than ventrally, sometimes with a golden colour sheen on anterior side. Scales dorsally and laterally with dark border, forming a reticulate pattern. Lateral red pigmentation pattern similar to males, usually less pronounced and paler. Broad dark brown to brownish-grey lateral stripe from posterior border of operculum above origin of pectoral fin to posterior end of caudal peduncle on upper half. This stripe is not always visible and especially pronounced in stressed specimens. On upper half of opercle, posterior of the eye, extending along the dark stripe on the side irregularly distributed scales with metallic blue or blue-green colour, with the highest density anteriorly. Fins except pectoral light brown and slightly hyaline, unpaired fins with a whitish margin, on dorsal and caudal with pale red submarginal line. Dorsal and caudal fin with red dots, on dorsal sometimes restricted to fin base. Pectoral fin transparent with whitish to light blue margin.

Preserved in ethanol. Males. Head dark grey, body dark brown to grey, some traces of red dots and blotches on side, belly whitish, beige, or greyish, a ventral dark stripe posterior to level of pectoral fin insertion to anterior origin of anal fin. Fins pale grey with a dark submargin and small whitish margin, except caudal fin with a ventral broad and dorsal thin whitish margin, posterior border dark brown to reddish.

Females. Head laterally and dorsally dark grey, chin with a dark blotch on ventral inner side of lower lip, body dorsally darker grey or brown, a dark stripe from posterior border of opercle to origin of caudal fin, dark stripe dorsally with a sharp border, ventrally diffuse; below this stripe brown, anterior ventral side and belly whitish to light brown, on side traces of red spots and blotches. Fins light grey with a dark border, sometimes with a small white margin, in dorsal and caudal fin traces of red spots, very rare with proximal single row of red dots in anal.

Etymology. The new species is named after Mr. Samba Sidibe and his family, who first collected this fish and made specimens available for the ornamental fish trade. It is named in acknowledgement of their high interest in this species, their effort for a sustainable use and protection of the habitat, and providing important information for the description.

Distribution and habitat. Currently *C. sidibe* is only known from the type locality close to the small village Bombokoré, despite some effort to find further occurrences of this species in the vicinity. Bombokoré is the spelling in the Sousou language, it might have a different spelling on maps or gazetteers.

The habitat is a depression with small water bodies, ditches and connected pools in a secondary forest adjacent to a small creek. The water in the creek is only slowly flowing and stagnant in pools and ditches. During the first collection in 1997, the second author measured an air temperature of 36°C, the water temperature in the creek was 27°C and 29°C in ditches, pH was about 5.2, conductivity 10 µS/cm. Water in the ditches was about 20–30 cm deep and clear, the bottom consists of sand and some stones with a layer of decaying leaves and wood with no aquatic vegetation. Herbaceous plants were found along the edges. *Callopanchax sidibe* and *Epiplatys fasciolatus* (Günther, 1866) were found in ditches and pools with standing water. In places with only grass and no leaf cover, only *Scriptaphyosemion geryi* was recorded.

During the collection in 2008, the depression was flooded. The stagnant or slowly flowing water was shaded by herbaceous vegetation and young trees on edges and some aquatic vegetation, especially *Nymphaea*. Air temperature

was 31°C, water temperature 27°C, water depth about 60–80 cm maximum. Interestingly the specimens caught in 2008 were of different size, from juveniles with about 2.5 cm total length to full grown adults, and in good condition, whereas in 1997 all were fully grown and showed first signs of ageing. During the last visits in 2008 and 2009 only a little human impact on the forest could be detected.

Callopanchax sidibe seems to prefer shaded areas of the water bodies with slow flowing or standing water. However, the life cycle of this species depends on the flowing water of the creek, because there is a seasonal connection between the creek and the pools and ditches. During the rain season the creek floods the depression and provides habitat, fresh water and food sources for the growing juveniles. Later, the inflow is reduced and isolated or partially connected pools and ditches are formed, which dry out during the dry season. Within these water bodies reproduction takes place and adult fish most likely die during the dry season. *Callopanchax sidibe* is, like its congeners (e.g. Scheel 1968; Wildekamp 1996), an annual species with eggs showing a prolonged development of 2–9 month, apparently an adaptation to temporary water bodies. However, some adults might move during the dry season into the flowing creek, which is supported by the observation of the local people.

DNA analyses. The complete alignment of the mitochondrial large ribosomal subunit for 11 specimens contains 530 bp including gaps, the sequence lengths without gaps ranges between 518–526 bp; the GenBank sequence (U73242) is 46 base pairs shorter, missing positions were filled with N. Of the 530 bp 133 are variable and 61 were parsimony informative, calculated without gaps. All sequences show an anti-G bias typical for mitochondrial sequences (Zhang & Hewitt 1996).

Calculated intraspecific p-distances for the samples of *C. occidentalis* as well as *C. toddi* and *C. cf. toddi* (Table 2) are higher than for the corresponding fragment in *Nimbapanchax* (Sonnenberg & Busch 2009), ranging from 1.3–2.7, which is in the range of the interspecific p-distances within the latter genus. Interspecific p-distances within *Callopanchax* range from 5.2–7.6 between *C. occidentalis*, *C. toddi*, and *C. sidibe*, and up to 14.2 with the inclusion of *C. monroviae*. Interestingly the intraspecific distances, even between geographically close collection localities, are comparatively high (Table 2).

In all resulting phylogenies, *C. monroviae* splits off first with respect to the remaining three taxa, which form an unresolved trichotomy (Fig. 6); this is congruent with the observed differences in colouration and morphology. As in Murphy et al. (1999), the distinct position of *C. sidibe*

is supported. However, these results should be seen as a first preliminary insight into the species relationships in *Callopanchax* as the dataset is currently too small for developing well supported, stable phylogenetic hypotheses, and should be expanded both in number of specimens and genes in further analyses, especially with regard to the large genetic distances between the species.

DISCUSSION

The distinctness of *Callopanchax sidibei* with regard to its congeneric species was recognized very early after the first commercial import to the Netherlands (Busch 1993; Wildekamp 1996), but nothing was known about its origin, distribution, and habitat. The second author was able to collect this species in 1997 with the help of the Sidibe family, who are engaged in the ornamental fish trade and were probably the first to export this species from Guinea. *Callopanchax sidibei* is currently only known from one locality; other *Callopanchax* collections in this area contain either *C. toddi* or *C. cf. toddi* (Fig. 1).

Interestingly in wild males two different caudal fin shapes exist: a more elongate and truncate form (Fig. 2A) and a shorter and rounded one (Fig. 2C), of which only the latter turns up in aquarium bred specimens. In general the red pigmentation pattern on the body and fins is quite variable (Fig. 2A–C).

As for *C. toddi*, currently no other colour morphs are known from *C. sidibei*, unlike the orange (or red) and blue phenotypes of *C. occidentalis* and *C. monroviae* (Fig. 5A–C, see also figures e.g. in Eberl 1999; Seegers 1997; Van den Nieuwenhuizen 1974; Wildekamp 1996). These colour morphs are usually sympatric with the more common form which is the blue morph in *C. monroviae* and the red in *C. occidentalis* (Berkenkamp & Etzel 2003; Wildekamp 1996; Wildekamp & Van der Zee 2003). One species, *C. huwaldi*, which is considered as junior synonym to *C. occidentalis*, differs from the latter species in external appearance only by the absence of yellow and orange pigments (see colour figure in Roloff 1976, p.523). There is still some discussion about the validity of the species; protein electrophoretic data and cross-breeding experiments by Berkenkamp & Etzel (2003) and Etzel & Berkenkamp (1981) show differences between the two species, but protein electrophoretic data by Romand (1985) do not differ. DNA data by Murphy et al. (1999) place *C. huwaldi* close to *C. occidentalis*, but the data set was too limited for further conclusions.

Up to now, several other collections from an area close to the type locality of *C. huwaldi* were made e.g. by the second author, which contained small numbers of blue

males between red ones. Roloff (1974) reported a sympatric occurrence of *C. occidentalis* and *C. toddi*, collected by Chaytor close to Njala, which is also within this area, and is most probably an occurrence of sympatric red and blue *C. occidentalis* males and not a sympatry of the reported species.

The second author was able to breed the red and the blue phenotype from Largo (SL 89) and Mabeimah (SL 93/46) several times in the aquarium and it seems that the blue phenotype is recessive with regard to the red, which is supported by the observation that the blue phenotype is usually rare in nature (pers. observation E. Busch). The females of both forms show no differences.

In case of *C. sidibei* it can be excluded that it is just a colour form of *C. toddi* or *C. occidentalis*. Beside differences in body colouration the red pigmentation pattern also differs from all populations of *C. toddi* and *C. occidentalis*, whereas in the cases of *C. monroviae* and *C. occidentalis*, including *C. huwaldi*, only the yellow and orange pigments are lost but the red pigmentation pattern is stable. This is also supported by DNA data, in which *C. sidibei* is placed as separate lineage related to *C. occidentalis* and *C. toddi* (Fig. 6 and Murphy et al. 1999).

The recent collections of the second author in Guinea provide additional information about the distribution of *Callopanchax*, and extends the areal of the genus further northwards along the coast (Fig. 1). It should be noted that several of the populations collected so far show combinations of characters, which do not agree with the current diagnoses of *C. toddi* and *C. occidentalis* (Clausen 1966; Wildekamp & Van der Zee 2003). Further studies will show whether these species are more variable than previously known, or if the divergent populations represent distinct units which might be accepted as separate species. These fishes are currently listed here as *C. cf. toddi* (see Fig. 1 and as example Fig. 3A & B).

COMPARATIVE MATERIAL

Callopanchax huwaldi: ZFMK 12663–12667, Sierra Leone, 20 km von Moyamba, Ngabu (8°10' N, 12°28' W).

Callopanchax monroviae: ZFMK 41629–41630, Liberia, Paynesville, L 97 (6°17' N, 10°43' W); ZFMK 41631–41634, aquarium bred, strain from Liberia, Paynesville, L 97 (6°17' N, 10°43' W); RS1533, DNA sample, aquarium bred, strain from Liberia, Paynesville, L 97 (6°17' N, 10°43' W).

Callopanchax occidentalis: ZFMK 41635–41643, first generation after collection, Sierra Leone, SL 89 Largo

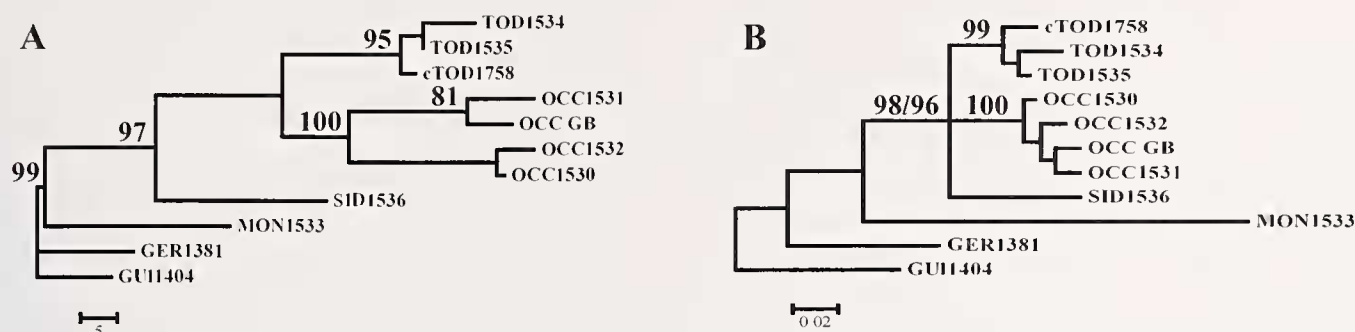


Fig. 6. Results of the maximum parsimony (A) and Bayesian (B) analyses of the mitochondrial large ribosomal subunit (16S) fragment. Numbers on nodes are bootstrap values in A and posterior probabilities in B. In the latter, the first values are from the analysis with $Nst=2$, the second values from the analysis with $Nst=6$, if both have the same value, only one value is given. Only for nodes with $\geq 75\%$ bootstrap support and $\geq 95\%$ posterior probabilities values are shown.

($8^{\circ}16'N$, $12^{\circ}09'W$); ZFMK 41644–41647, Sierra Leone, SL 89 Magbenta ($8^{\circ}24'N$, $12^{\circ}56'W$); ZFMK 41648–41654, aquarium bred strain from Sierra Leone, SL 89 Ngabu ($8^{\circ}15'N$, $12^{\circ}22'W$); ZFMK 41655–41657, Sierra Leone, SL 89 Romeni ($8^{\circ}53'N$, $12^{\circ}43'W$); ZFMK 41658–41671, Sierra Leone, SL 89 Teme Yellah ($7^{\circ}41'N$, $11^{\circ}25'W$); RS1531, DNA sample, Sierra Leone, SL 89 Teme Yellah ($7^{\circ}41'N$, $11^{\circ}25'W$); ZFMK 41672–41674, Sierra Leone, SL 89 Waanje River ($7^{\circ}50'N$, $11^{\circ}22'W$); ZFMK 41675, Sierra Leone, Ma Barie, SL 93/39 ($8^{\circ}25'N$, $11^{\circ}45'W$); ZFMK 41676–41681, Sierra Leone, Mogbomoh Village, Saspor Water, SL 99/12 ($8^{\circ}20'N$, $12^{\circ}49'W$); ZFMK 41682, Sierra Leone, Brama School, SL 03/7 ($8^{\circ}22'N$, $12^{\circ}58'W$); ZFMK 41683–41688, Sierra Leone, Malai, SL 03/11 ($8^{\circ}45'N$, $12^{\circ}56'W$); ZFMK 41689–41697, Sierra Leone, Rowala, SL 03/12 ($8^{\circ}47'N$, $11^{\circ}54'W$); ZFMK 41698–41704, Sierra Leone, Magbenta, SL 03/19 ($8^{\circ}24'N$, $12^{\circ}56'W$).

Callopanchax toddi: ZFMK 41705–41715, Guinea, Mola, GM 08/4 ($9^{\circ}20'N$, $12^{\circ}55'W$); ZFMK 41716–41723, Guinea, Takhori, GM 08/9 ($10^{\circ}09'N$, $14^{\circ}01'W$); ZFMK 41724–41728, Guinea, Katamara, GM 08/10 ($10^{\circ}11'N$, $14^{\circ}03'W$); ZFMK 41729–41735, Guinea, Lamayah, GM 08/11 ($10^{\circ}09'N$, $13^{\circ}44'W$); ZFMK 41736–41739, Sierra Leone, Sentai, SL 93/15 ($9^{\circ}04'N$, $12^{\circ}53'W$).

Callopanchax cf. toddi: ZFMK 41740–41744, Guinea, Gbetayah Moribayah, GM 08/1 ($9^{\circ}36'N$, $13^{\circ}20'W$); ZFMK 41745–41751, Guinea, Mangata Badjana, GM 08/3 ($9^{\circ}38'N$, $13^{\circ}19'W$); ZFMK 41752–41755, Guinea, Yirah, GM 08/8 ($9^{\circ}37'N$, $13^{\circ}19'W$); ZFMK 41756–41757, Guinea, Kabak, GM 08/12 ($9^{\circ}21'N$, $13^{\circ}23'W$); ZFMK 41758–41763, Guinea, Kabak, GM 08/13 ($9^{\circ}21'N$, $13^{\circ}23'W$).

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