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A new species of suckermouth catfish (Mochokidae: *Chiloglanis*) from the Rio Mongo in Equatorial Guinea

RAY C. SCHMIDT[1,2] & CHRISTIAN BARRIENTOS[3]
[1]*Biology Department, Randolph-Macon College, Ashland, VA 23005, USA*
[2]*Smithsonian Research Associate, National Museum of Natural History, Division of Fishes, Washington, DC 20560, USA*
[3]*Wildlife Conservation Society, Equatorial Guinea. Edificio Candy Vista Mar Of. 208 Bata Litoral, Equatorial Guinea*

Abstract

A recent expedition surveyed freshwater fishes throughout the continental portion of Equatorial Guinea (Rio Muni). This portion of the Lower Guinean ichthyoprovince is relatively unknown with very few collections occurring since the 1960s. Sampling in the Rio Mongo, a tributary to the Rio Wele, yielded two *Chiloglanis* species; one putatively ascribed to the widespread species *C. cameronensis*, and the other species having similarities with *C. harbinger* described from the Lokoundje River in Cameroon. Morphometric analyses between the specimens from Rio Mongo and paratypes of *C. harbinger* confirm that they are distinct species and should be described as such. Here we describe *Chiloglanis mongoensis* **sp. nov.**, a narrow endemic species only known from one locality in the Rio Mongo. We provide measurements from paratypes of *C. harbinger* and emphasize the need for further expeditions in the area.

Key words: Endemism, specimen collection, allometric correction, biodiversity

Introduction

The Lower Guinea ichthyofaunal province stretches from the mouth of the Niger River to the mouth of the Congo River. This diverse province contains over 575 species of fishes with many being endemic to the area (Stiassny *et al.* 2007). The inland waters of continental Equatorial Guinea remain some of the least explored in the region. Early collections, mostly in the coastal plain, resulted in the description of several species of note (*e.g.*, *Enteromius potamogalis* Cope, 1867) and extended the ranges of fishes collected in Cameroon (Pappenheim 1911). More recent studies mainly focused on coastal rivers and streams, but also included areas within Monte Alen National Park and tributaries to the Ntem River in the northeastern corner of the country (Román 1971; Lasso *et al*, 1998). Despite these recent efforts specimens from these studies are largely unavailable to contemporary researchers.

The noted diversity within the province, paucity of material available in natural history collections, and the necessity of topotypic material to resolve taxonomic uncertainty within the African barbs (Schmidt & Bart 2015; Hayes & Armbruster 2017) provided the bases to propose an expedition to the region. A National Geographic Society funded expedition to the region in June and July of 2017 sampled fishes across the country to provide an updated baseline of the diversity of freshwater fishes in the country and highlight areas where further expeditions are needed. Putative *Chiloglanis cameronensis* Boulenger, 1904 were collected at several localities within the Rio Wele (formerly Rio Benito before independence) drainage. In the Rio Mongo, a tributary to the Rio Wele, another *Chiloglanis* species was collected in addition to *C. cameronensis*. This species was similar to *Chiloglanis harbinger* Roberts, 1989 described from the Lokoundje River in Cameroon, but appeared to differ in some morphological and meristic aspects. Given the high degree of endemism observed in *Chiloglanis* species from western, eastern, and southern Africa (Friel & Vigliotta 2011; Schmidt *et al* 2014; Schmidt *et al* 2015; Morris *et al.* 2016; Schmidt *et al.* 2016; Schmidt *et al.* 2017b) a thorough comparison of these newly collected specimens with type material of *C. harbinger* was warranted. After conducting morphological analyses it is clear that specimens collected in the Rio Mongo in Equatorial Guinea are distinct from *C. harbinger* and this new species is formally described. This discovery empathizes the need for further ichthyological exploration and highlights the possible discovery of more narrow endemic species in the region.

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Material and methods

A National Geographic Society funded expedition (# WW-055R-17) collected fishes from across continental Equatorial Guinea for several weeks in June and July of 2017 (Fig. 1). Specimens were collected by seine, dipnet, and electrofisher. At each locality representative voucher specimens were photographed and fin and muscle tissues were collected and stored in 95% ethanol for later genetic analyses. Voucher specimens and other specimens were fixed in 10% formalin for several days, washed, and ultimately stored in 75% ethanol. Specimens are deposited in the Smithsonian Institution National Museum of Natural History Division of Fishes (USMN). Institutional abbreviations follow Sabaj (2016).

Measurements and counts follow Schmidt *et al.* (2015; 2017b) and were taken with digital calipers or with a stereoscope equipped with an ocular reticle. A principal component analysis using the covariance matrix of log-transformed measurements, Mann-Whitney U tests on relative measurements, and descriptive statistics were completed in MYSTAT (SYSTAT Software Inc.). Shape variation within principal components strongly correlated to size (*e.g.,* PC1) were assessed through reduced-major axis (RMA) regression lines in the SMATR package in R (Warton *et al.* 2006). Meristic variables correlated to size were also assessed through RMA. This analysis reveals if the allometric trajectories (*i.e.,* the slope) are similar for each group and if there are significant intergroup differences (*i.e.,* elevation) that are a result of other variables beyond size after allometric correction (Sidlauskas *et al*. 2011; Schmidt *et al.* 2019). A more detailed description of this analysis and its utility in morphological studies can be found in Sidlauskas *et al*. (2011). Between group differences in PC2 were analyzed with one-way ANOVA in MYSTAT. The mitochondrial marker, Cytochrome c oxidase subunit I (CO1), was sequenced from the two representatives of the new species with published primers and protocols (Sullivan *et al.* 2008). These sequences and associated metadata (*e.g*., photographs and trace files) were uploaded to the Barcode of Life Database (BOLDsystems.org) and are publicly available. These sequences are part of an ongoing effort to barcode the freshwater fishes of Equatorial Guinea.

Results

The morphological analyses revealed clear separation between paratypes of *Chiloglanis harbinger* and the three specimens of the putative new species from the Rio Mongo in Equatorial Guinea. One specimen from Equatorial Guinea was missing the dorsal fin and was removed from the analyses. The principal component analysis clearly separates *C. harbinger* and the new species along PC1 and PC2 (Fig. 2). PC1 was strongly correlated to standard length while PC2 was weakly correlated to standard length (Pearson's correlation = 0.99 and 0.046 respectively). The RMA of PC1 to the log-transformed standard length (not shown) showed that the slopes were equal (P-value = 0.1865), but the differences between the y-intercepts (*i.e.,* elevation) were not significant (P-value = 0.1004). If you include the fourth specimen and remove all variables associated with the dorsal fin from the analysis the difference between the y-intercepts approaches statistical significance (P-value 0.0675). The morphological characters unequally contribute to the variation observed within PC1 suggesting that the variation is not purely isometric and that shape variation is also a factor (Table 1).

The difference in PC2 values between *C. harbinger* and the new species in Equatorial Guinea is significant (P-value 0.02) with adipose-fin height, eye diameter, body depth at anus, premaxillary tooth-patch length, maxillary barbel length, and adipose fin to caudal peduncle length contributing to variation along the component (Table 1). The meristics were largely similar between *C. harbinger* and the new species from Equatorial Guinea, but there is a clear difference in the number of total premaxillary teeth. Plotting the number of total premaxillary teeth to morphometric PC2 readily separates *C. harbinger* from the new species (Fig. 3A). While correlated to standard length (Pearson's correlation = 0.83), the RMA of the log-transformed number of premaxillary teeth to log SL shows that *C. harbinger* and the new species have equal slopes (P-value = 0.5029) and significantly different elevations (P-value 0.0446); suggesting that the differences in number of premaxillary teeth between the groups is not based solely on the size of the specimens (Fig. 3B). The Mann-Whitney U tests showed that the relative measurements (percentage of standard length) of many morphological characters were significantly different between *C. harbinger* and the new species from Equatorial Guinea (Table 1). Eye diameter, dorsal-spine length, adipose-fin base length, and adipose-fin height are some characters that are significantly different between paratypes of *C. harbinger* and the new species in Equatorial Guinea and assist in diagnosing the new species (Table 1).

TABLE 1. Component loadings from principal components analysis on log-transformed linear measurements and statistics from Mann-Whitney U Test on relative (% of standard length) measurements from *Chiloglanis harbinger* paratypes (n=9) and the new species in Equatorial Guinea (n=4). Mandibular teeth were damaged in many *C. harbinger* and were removed from the analysis. Bolded values contribute most to the variation in PC2 and are significantly different in the U test.

	Component Loadings		Mann-Whitney U Test (p-value)
	PC1	PC2	
percent variation	78.3%	6.4%	
Standard length (mm)	0.0577	0.0027	
Head length	0.0583	0.0148	0.0896
Head depth (maximum)	0.0449	0.0053	**0.0136**
Body depth at anus	0.0335	**0.0262**	**0.0055**
Occipital shield width (minimum)	0.0299	0.0039	0.0896
Prepectoral length	0.0611	0.0003	0.4404
Predorsal length	0.0482	0.0042	0.0790
Prepelvic length	0.0637	0.0032	0.1228
Preanal length	0.0609	0.0053	0.6434
Eye diameter (horizontal)	0.0022	**0.0264**	**0.0055**
Orbital interspace	0.0383	0.0054	**0.0206**
Snout length	0.0495	0.0162	**0.0251**
Premaxillary tooth-patch width	0.0674	-0.0032	**0.0206**
Premaxillary tooth-patch length	0.0565	**-0.0207**	0.0641
Mandibular tooth row width	**	**	0.2888
Anterior nares interspace	0.0666	-0.0064	**0.0308**
Posterior nares interspace	0.0558	-0.0119	0.3152
Maxillary barbel length	0.0408	**-0.0217**	0.7576
Medial mandibular barbel length	0.1152	-0.0185	**0.0308**
Lateral mandibular barbel length	0.1247	-0.0067	**0.0206**
Mouth width	0.0583	0.0101	0.4404
Oral disc width	0.0540	0.0143	**0.0055**
Oral disc length	0.0613	0.0115	1.0000
Upper lip length	0.0469	0.0163	0.2801
Lower lip length	0.0658	-0.0056	0.6434
Pectoral-spine length	0.0713	-0.0019	0.1649
Pectoral-fin length	0.0736	-0.0071	**0.0136**
Width at pectoral-fin insertion	0.0535	0.0092	**0.0055**
Length of postcleithral process	0.0548	-0.0147	0.8774
Pelvic-fin length	0.0798	-0.0018	**0.0308**
Depth at dorsal-fin insertion	0.0436	0.0093	**0.0136**
Dorsal-spine length	0.0404	0.0144	**0.0126**
Dorsal-fin length (longest ray)	0.0684	0.0013	0.3092
Dorsal-fin base length	0.0585	0.0003	0.3092
Dorsal fin to adipose-fin length	0.0426	0.0049	0.1655
Adipose-fin base length	0.0343	0.0190	**0.0206**
Adipose fin to caudal-ped length	0.0688	**-0.0228**	**0.0136**
Adipose-fin height	0.0131	**0.0812**	**0.0055**
Anal-fin length (longest ray)	0.0542	-0.0051	1.0000
Anal-fin base length	0.0684	-0.0086	0.5371
Lower caudal-fin lobe length	0.0504	-0.0007	0.2801

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TABLE 1. (Continued)

	Component Loadings		Mann-Whitney U Test (p-value)
	PC1	PC2	
Upper caudal-fin lobe length	0.0554	0.0001	0.1228
Fork Length	0.0598	0.0010	0.7576
Caudal-peduncle depth (minimum)	0.0540	0.0133	0.2170
Caudal-peduncle length	0.0474	-0.0089	0.8774

Chiloglanis mongoensis sp. nov.

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Figures. 1, 2, 3, 4; Table 2

Holotype. USNM 446973, male ALC, 28.0 mm SL; Equatorial Guinea, Centro Sur, Rio Mongo near Mosumu, 251 m, 1.72809° N, 10.08800° W, 2017 Equatorial Guinea expedition team, 2 July 2017.

Paratypes. MRAC 2019.010.P.0001, Male ALC, 34.8 mm SL, voucher number EqGui2017_328, collection information the same as the holotype. —USNM 446974, female ALC, 26.0 mm SL, collection information the same as the holotype. —USNM 446975, Female ALC, 33.1 mm SL, voucher number EqGui2017_329, collection information the same as the holotype.

Diagnosis. *Chiloglanis mongoensis* is readily distinguished from all other valid species of *Chiloglanis* with the exception of *C. marlieri* and *C. harbinger* in possessing 28–30 (14+14 – 15+15) mandibular teeth in one row. *Chiloglanis mongoensis* is distinguished from *C. marlieri* in possessing a longer dorsal spine (1.8 times into head length versus 3.1 in *C. marlieri*). *Chiloglanis mongoensis* is distinguished from *C. harbinger* in having fewer premaxillary teeth (99–116 versus 150–224) arranged in fewer rows (4–5 versus 7), a longer dorsal spine (9.0–9.7 versus 7.8–9.0% SL), a deeper body at anus (14.0–16.0 versus 11.7–13.8% SL), a larger eye (3.7–4.6 versus 2.9–3.5% SL), and a higher adipose fin (2.6–3.9 versus 1.6–2.3% SL; Tables 2 and 3).

TABLE 2. Morphometric measurements and meristics of *Chiloglanis mongoensis* (n=4; holotype and 3 paratypes). Standard length expressed in mm. All other measurements expressed in percent SL. Meristic data for holotype are identified by a "*".

MORPHOMETRICS	Holotype	Range	Mean±%SD
Standard length (mm)	28.0	26.0–34.8	
Head length	32.9	32.8–36.5	35.1±1.8
Head depth (maximum)	17.5	16.1–17.5	16.8±0.7
Body depth at anus	14.6	14.6–16.0	15.1±0.6
Occipital shield width (minimum)	6.1	5.4–6.1	5.7±0.3
Prepectoral length	31.4	31.4–34.1	32.9±1.2
Predorsal length	39.3	39.3–41.1	40.1±0.9
Prepelvic length	60.0	60.0–64.9	62.4±2.0
Preanal length	76.4	76.4–79.3	77.7±1.2
Eye diameter (horizontal)	4.6	3.7–4.6	4.1±0.4
Orbital interspace	9.2	8.2–9.2	8.6±0.5
Snout length	22.1	22.1–25.6	23.8±1.4
Premaxillary tooth-patch width	18.9	18.6–18.9	18.8±0.2
Premaxillary tooth-patch length	5.1	4.4–5.1	4.7±0.3
Mandibular tooth row width	5.6	5.6–6.0	5.9±0.2
Anterior nares interspace	5.6	5.5–5.7	5.6±0.1
Posterior nares interspace	5.1	4.4–5.3	4.9±0.4
Maxillary barbel length	5.6	4.5–5.6	5.0±0.5

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TABLE 2. (Continued)

MORPHOMETRICS	Holotype	Range	Mean±%SD
Medial mandibular barbel length	1.0	0.8–1.0	0.9±0.1
Lateral mandibular barbel length	1.3	1.1–1.4	1.3±0.1
Mouth width	12.2	12.2–13.4	12.8±0.5
Oral disc width	26.5	26.3–27.2	26.6±0.4
Oral disc length	23.0	23.0–26.3	24.3±1.6
Upper lip length	5.6	4.9–5.7	5.4±0.4
Lower lip length	9.7	8.6–10.4	9.5±0.8
Pectoral-spine length	14.3	13.3–14.3	13.7±0.4
Pectoral-fin length	20.7	19.6–21.9	21.0±1.0
Width at pectoral-fin insertion	26.4	26.3–28.5	27.1±1.0
Length of postcleithral process	10.2	9.0–11.5	10.1±1.1
Pelvic-fin length	11.7	11.7–12.3	12.1±0.2
Depth at dorsal-fin insertion	17.3	16.8–17.6	17.1±0.4
Dorsal-spine length	9.7	9.0–9.7	9.3±0.4
Dorsal-fin length (longest ray)	12.2	10.7–12.4	11.5±0.8
Dorsal-fin base length	10.7	10.3–10.8	10.6±0.3
Dorsal fin to adipose-fin length	23.0	20.5–23.0	22.1±1.4
Adipose-fin base length	20.9	20.7–22.5	21.3±0.8
Adipose fin to caudal-ped length	11.2	10.4–11.7	11.1±0.5
Adipose-fin height	2.6	2.6–3.9	3.1±0.6
Anal-fin length (longest ray)	13.3	13.1–15.4	13.8±1.1
Anal-fin base length	7.1	6.9–7.7	7.2±0.4
Lower caudal-fin lobe length	20.9	19.4–22.0	20.5±1.2
Upper caudal-fin lobe length	18.4	16.0–19.8	18.3±1.6
Fork Length	14.3	13.8–16.5	15.3±1.4
Caudal-peduncle depth (minimum)	9.2	8.2–9.2	8.5±0.5
Caudal-peduncle length	15.8	14.4–15.8	15.1±0.7
MERISTICS			
Mandibular tooth rows	1–2;		
Mandibular tooth count (total)	29–46; 34*		
Mandibular tooth count (functional anterior row)	6–29; 6*		
Mandibular tooth count (posterior replacement row)	14–28; 28*		
Primary premaxillary teeth (total)	99–116; 100*		
Pectoral-fin count	I, 8*(1); I, 9(3)		
Pelvic-fin count	i, 6*(4)		
Dorsal-fin count	II, 4(1); II, 5*(2)		
Anal-fin count	iii, 4(2); iii, 5*(2)		
Caudal-fin count	i, 7, 8, i*(4)		

Description. Morphometrics and meristics for holotype and paratypes of *Chiloglanis mongoensis* are summarized in Table 2. Dorsal, lateral, and ventral views (Fig. 4) illustrate body shape, fin shape and placement, oral disc size and shape, size of premaxillary tooth pads and mandibular tooth row, and length of maxillary and mandibular barbels.

A moderate to diminutive *Chiloglanis*; 34.8 mm maximum standard length observed in four collected specimens. Body dorsally depressed anteriorly; laterally compressed posteriorly. Pre-dorsal convex; sloping ventrally towards posterior nares; pre-orbital convex; sloping ventrally sharply anterior of nares. Post-dorsal body gradually sloping towards the caudal fin. Pre-anal profile largely horizontal to convex; post-anal profile concave. Small unculiferous tubercles present on body; concentrations higher near head. Lateral line complete; arising just dorsal to the horizontal level of orbit and sloping ventrally to midlateral along the side of the body towards the caudal peduncle. Urogenital papillae sexually dimorphic; elongated in males; reduced and separated from anus by shallow invagination in females.

Head depressed. Gill membranes broadly united. Gill openings restricted; opening near horizontal level of pectoral-fin terminus to level of orbit. Occipital-nuchal shield covered and visible through skin. Eyes moderate; located just posterior to mid-head length; horizontal axis longest; without free margins. Anterior and poster nares positioned mid-snout; anterior nares set further apart than posterior nares. Nares with raised rims; posterior nares with elongate anterior flaps.

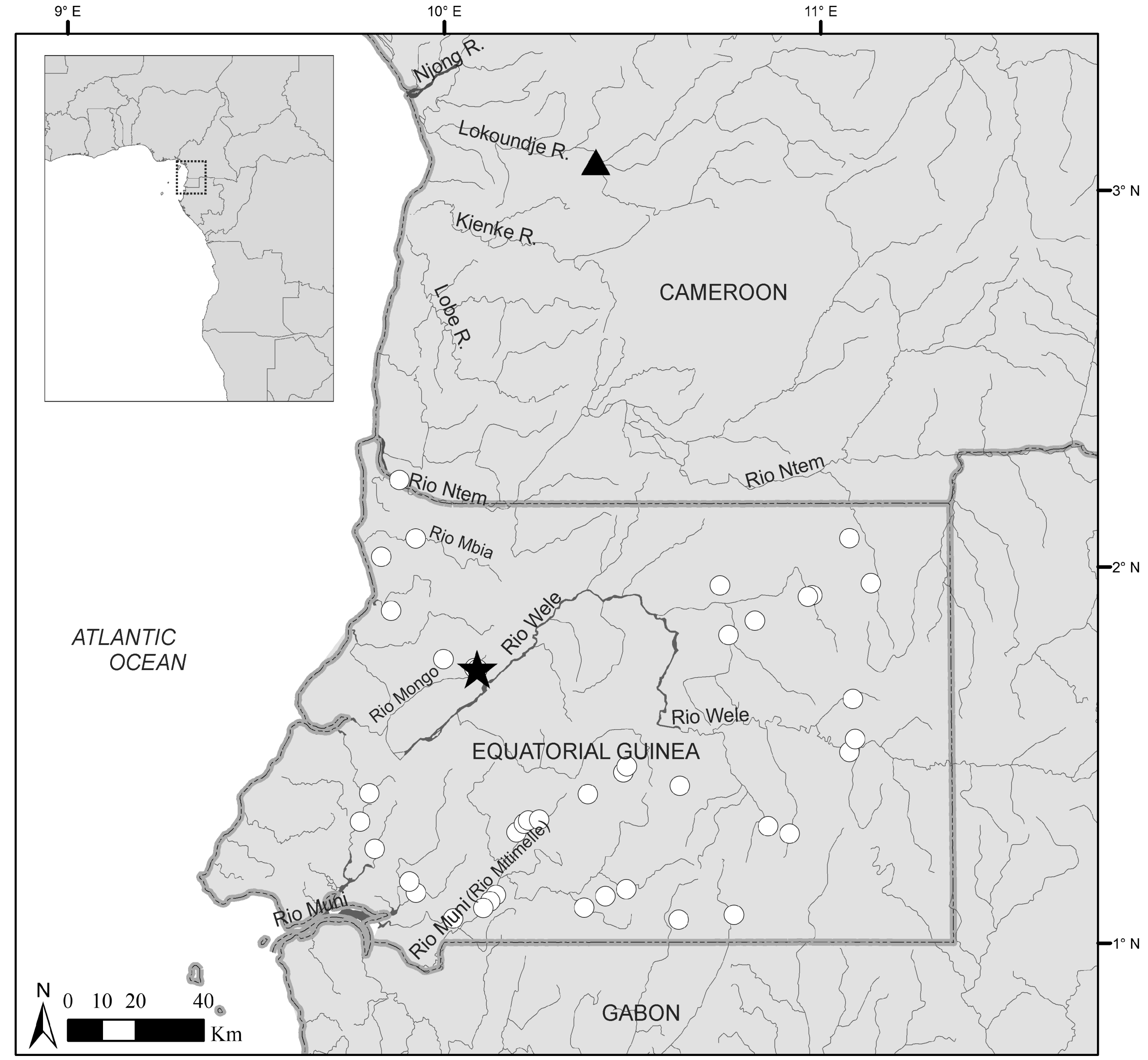

FIGURE 1. Type localities of *Chiloglanis harbinger* (triangle) and *Chiloglanis mongoensis* (star). All other localities sampled during 2017 expedition shown in white circles.

Mouth inferior; upper and lower lips united to form oral disc. Oral disc large (width 26.3–27.2% SL); wider than long and covered in papillae. Barbels in three pairs; maxillary barbels originating from posterolateral region of the disc just past mid-length; unbranched and short (4.5–5.6% SL). Lateral and medial mandibular barbels short; incorporated into lower lip and positioned on both sides of midline cleft on posterior margin of the oral disc. Lateral mandibular barbel usually longer (1.1–1.4% SL) than medial mandibular barbel (0.8–1.0% SL). Primary premaxillary teeth "S" shaped with exposed brown tips; 99–116 teeth in 4 or 5 scattered rows on two ovoid tooth patches. Secondary premaxillary teeth small and scattered on posterior surface of premaxillae. Tertiary teeth small and needle-like; in a row near midline of dorsal edge of toothplate. Mandibular teeth "S" shaped; 1 or 2 rows; bunched near midline. Functional rows and replacement rows usually contain 14+14 or 15+15 brown-tipped teeth.

Dorsal-fin origin in anterior third of body; origin just posterior to vertical of pectoral-fin origin. Dorsal fin with small spinelet, spine, and 4 or 5 rays. Dorsal spine short (9.0–9.7% SL); anterior margin smooth with two notches distally; posterior margin smooth. Adipose fin base length long (20.7–22.5% SL) and low (height 2.6–3.9% SL); margin convex. Caudal fin forked; rounded lobes; lower lobe longer than upper lobe; count i, 7, 8, i. Anal-fin origin posterior to origin of adipose fin; extending just beyond adipose-fin terminus; margin convex; no sexual dimorphism observed; count iii, 4 or 5. Pelvic-fin origin posterior to the vertical of midpoint between dorsal-fin terminus and adipose-fin origin; margins convex; not reaching anal-fin origin; count i, 6. Pectoral fin with mostly smooth spine; two small notches on distal edge of anterior margins; relatively short (13.3–14.3% SL); count I, 8–9. Postcleithral process not sexually dimorphic. Sexual dimorphism in body size and density or shape of unculi not observed in the four type specimens.

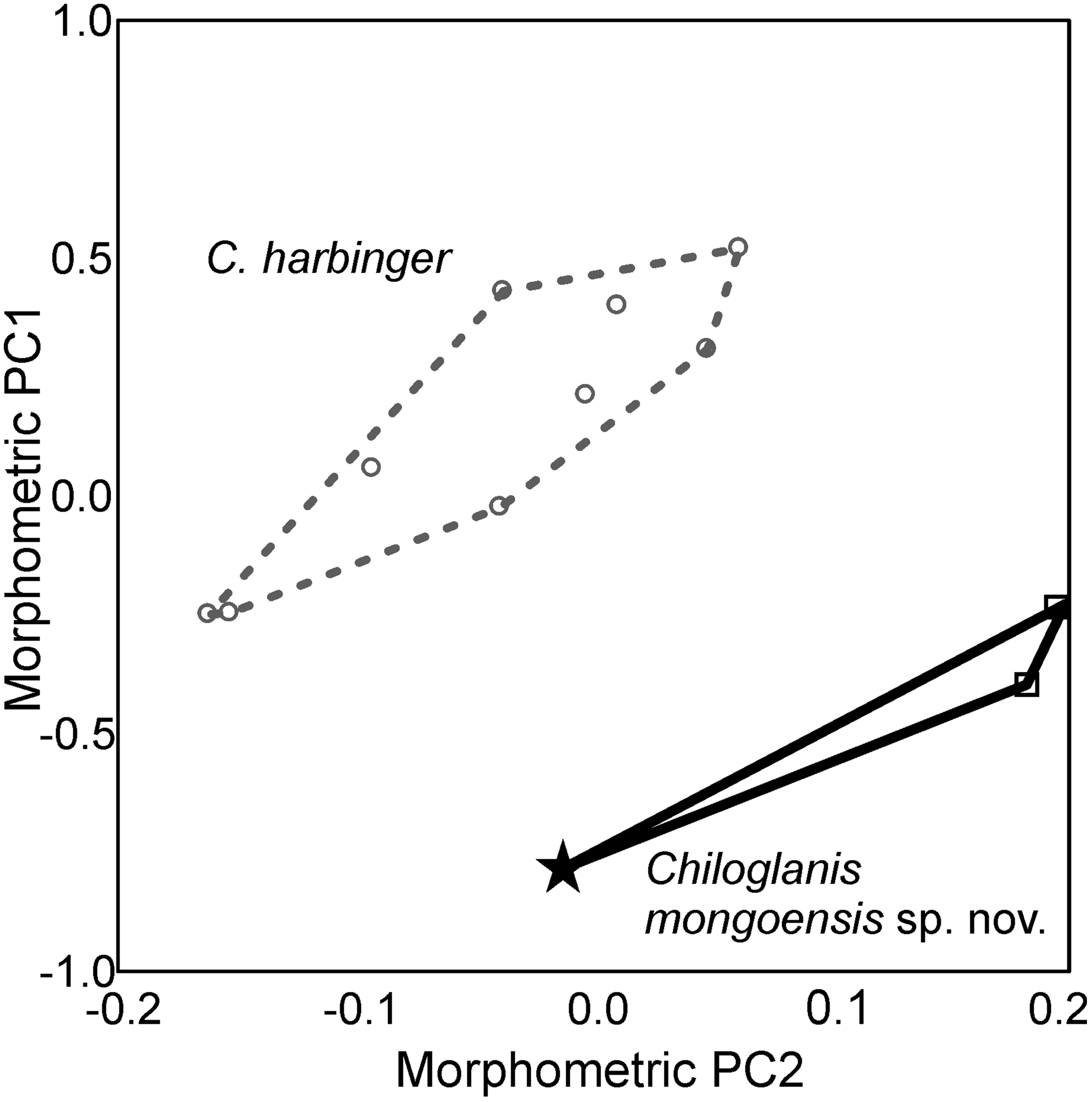

FIGURE 2. Scatterplot of PC1 versus PC2 from principal component analysis of 44 log-transformed measurements from 12 specimens. Holotype of *Chiloglanis mongoensis* denoted by star.

TABLE 3. Morphometric measurements and meristics of *Chiloglanis harbinger* paratypes (n=9). Standard length expressed in mm. All other measurements expressed in percent SL.

MORPHOMETRICS	Range	Mean±%SD
Standard length (mm)	33.9–44.1	
Head length	30.8–34.4	33.2±1.0
Head depth (maximum)	14.3–16.4	15.6±0.6
Body depth at anus	11.7–13.8	12.8±0.8
Occipital shield width (minimum)	4.8–5.8	5.3±0.3
Prepectoral length	32.4–35.4	33.6±1.0
Predorsal length	36.6–40.1	38.6±1.2
Prepelvic length	63.1–65.1	64.0±0.6
Preanal length	76.1–81.0	78.2±1.6
Eye diameter (horizontal)	2.9–3.5	3.1±0.2
Orbital interspace	7.4–9.1	7.8±0.5
Snout length	20.8–23.1	22.0±0.7
Premaxillary tooth-patch width	18.6–21.3	19.8±0.7
Premaxillary tooth-patch length	4.5–5.8	5.1±0.4
Mandibular tooth row width	4.6–7.0	6.2±1.1
Anterior nares interspace	5.2–6.5	6.0±0.4
Posterior nares interspace	4.5–6.6	5.2±0.6
Maxillary barbel length	4.5–5.8	5.0±0.4
Medial mandibular barbel length	0.8–1.6	1.2±0.2
Lateral mandibular barbel length	1.2–2.1	1.8±0.3
Mouth width	11.9–14.1	12.6±0.7
Oral disc width	23.2–25.9	25.0±1.0
Oral disc length	22.3–25.8	24.3±1.0
Upper lip length	3.9–6.5	5.0±0.8
Lower lip length	8.9–10.1	9.6±0.4
Pectoral-spine length	13.0–15.9	14.6±1.0
Pectoral-fin length	21.8–24.1	22.6±0.7
Width at pectoral-fin insertion	25.3–26.0	25.6±0.2
Length of postcleithral process	9.0–11.4	10.2±0.8
Pelvic-fin length	12.0–14.7	13.2±1.0
Depth at dorsal-fin insertion	14.7–17.0	15.6±0.8
Dorsal-spine length	7.8–9.0	8.4±0.4
Dorsal-fin length (longest ray)	10.7–12.7	12.0±0.6
Dorsal-fin base length	9.7–11.6	10.8±0.7
Dorsal fin to adipose-fin length	18.3–22.7	20.7±1.7
Adipose-fin base length	15.9–21.1	18.2±1.6
Adipose fin to caudal-ped length	11.4–13.9	12.7±1.0
Adipose-fin height	1.6–2.3	1.9±0.2
Anal-fin length (longest ray)	12.0–14.6	13.4±0.8
Anal-fin base length	6.8–8.8	7.6±0.8
Lower caudal-fin lobe length	17.9–20.5	19.6±0.7
Upper caudal-fin lobe length	15.8–18.3	17.5±0.8
Fork Length	13.4–16.9	15.0±1.1
Caudal-peduncle depth (minimum)	7.1–9.5	7.9±0.8
Caudal-peduncle length	13.4–16.0	14.9±0.9

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TABLE 3. (Continued)

MORPHOMETRICS	Range	Mean±%SD
MERISTICS		
Mandibular tooth rows	1–2	
Mandibular tooth count (total)	30–47; many damaged	
Mandibular tooth count (functional anterior row)	20–30; many damaged	
Mandibular tooth count (posterior replacement row)	27; many damaged	
Primary premaxillary teeth (total)	150–224	
Pectoral-fin count	I, 9(4); I, 10(5)	
Pelvic-fin count	i, 6(9)	
Dorsal-fin count	II, 4(2); II, 5(7)	
Anal-fin count	iii, 4(1); iii, 5(6); iii, 6(2)	
Caudal-fin count	i, 7, 8, i(9)	

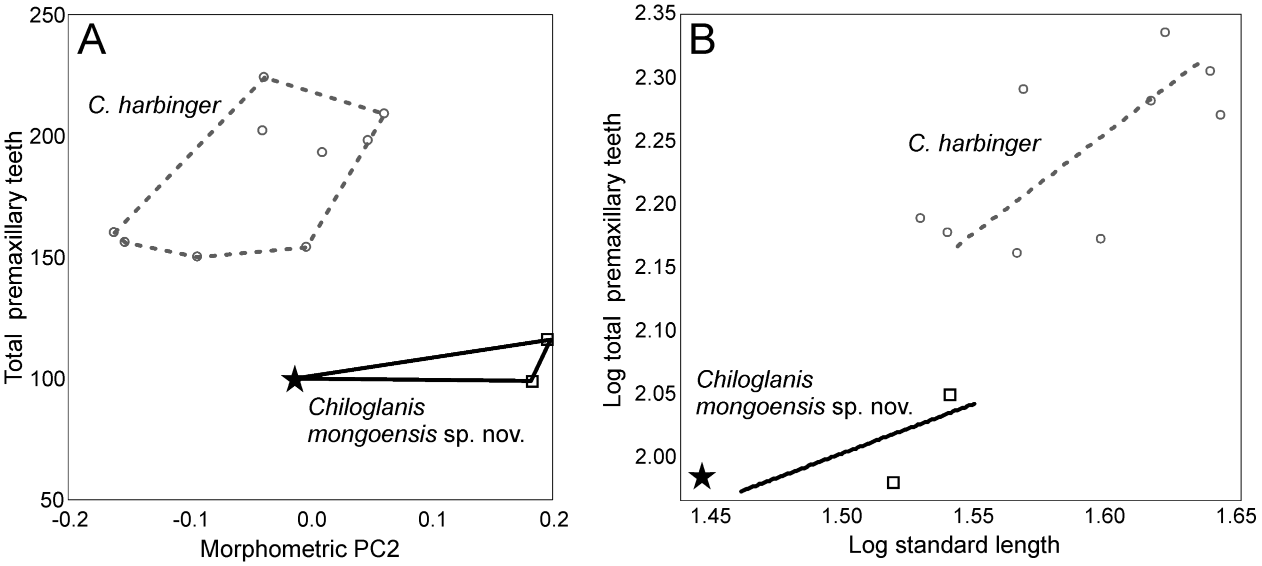

FIGURE 3. Scatterplot of total numbers of premaxillary teeth versus PC2 from principal components analysis of 44 log-transformed measurements (A). Reduced-major axis regression of log-transformed total number of premaxillary teeth on log-transformed standard length (B). Trendlines are shown for each species; slopes for each species are equal (p-value = 0.5029) and the y-intercept (*i.e.*, elevation) between each species are significantly different (p-value = 0.0446). Holotype of *Chiloglanis mongoensis* denoted by star.

Coloration. Live coloration: body with a light brown to cream ground color, nearly uniformly overlain with medium to dark brown melanophores. Typical coloration of preserved specimens is shown in Figure 4. Dorsal view: cream ground color overlain with medium to dark brown melanophores; lighter areas pre-orbit, at origin of dorsal fin, and origin and terminus of adipose fin. Lateral view: Cream ground color overlain with medium brown melanophores; mostly uniformly distributed along sides above midline and sparser ventrally. Lighter small circular areas along sides just anterior to lateral line; light areas dorsal to anal-fin terminus and ventral to adipose-fin terminus. Ventral surface cream; few melanophores scattered along bases of pectoral, pelvic, and anal fins.

Pectoral and dorsal spines and rays cream-buff to translucent. Base of dorsal fin cream with scattered melanophores. Dorsal-fin rays with melanophores uniformly arranged on distal half; membranes cream to translucent. Base of pectoral fin cream with scattered melanophores; rays with scattered melanophores on distal half; membranes cream. Pelvic fin cream with few melanophores on rays. Anal-fin base cream with scatter melanophores; rays with few scatter melanophores; membrane translucent. Adipose fin cream to translucent; scattered melanophores more numerous along base. Caudal fin cream to translucent; dark brown melanophores scattered at base and in distal two-thirds of upper and lower lobe.

Etymology. The specific epithet refers to the Rio Mongo, a tributary to the Rio Wele in Equatorial Guinea, where the species is presumed endemic.

Distribution. *Chiloglanis mongoensis* is only known for the type locality. Upstream from the bridge crossing the Rio Mongo cascades down a bedrock outcrop that is ~3-4 meters high and ~10 meters long. Standing on this very slippery bedrock we were able to collect several specimens of *C. cameronensis* and *C. mongoensis* from cracks in the bedrock with the electrofisher. After 30 to 45 minutes we collected four *C. mongoensis* and five *C. cameronensis* specimens. Though collected in the same microhabitat; it seems likely that further, more focused, collections would reveal that these two species are occupying different habitats within the Rio Mongo. In co-occurring *Chiloglanis* species from the Upper Guinea Forest streams in Guinea, Conakry one species is usually found in woody debris or submerged roots while the other occupies the cobble and larger rocks in the riffles and runs (Schmidt *et al.* 2017b). *Chiloglanis mongoensis* or *C. cameronensis* specimens were not collected in a small tributary to the Rio Mongo, but the stream was shallow, substrate was mostly sand and gravel, and there was little flow.

FIGURE 4. *Chiloglanis mongoensis*, a new species, holotype, USNM 446973, male ALC, 28.0 mm SL; Equatorial Guinea, Centro Sur, Rio Mongo near Mosumu, 1.72809° N, 10.088° W; in dorsal, lateral, and ventral views. Photographs by S. Raredon

Discussion

Several morphological characters and the total number of premaxillary teeth clearly diagnose *C. mongoensis* from *C. harbinger* and the remaining *Chiloglanis* species. Additionally, performing an allometric correction with the RMA regression in SMATR improves the resolution of this analysis, and while the elevations of PC1 were not significantly different between *C. mongoensis* and *C. harbinger* it seems likely that these results would change with the addition of more specimens. This allometric correction allows one to observe and test intergroup differences that may be overlooked by removing PC1 from the analysis and can aid in the delineation of morphologically cryptic species (Sidlauskas *et al.* 2011; Bart *et al*. 2019; Schmidt *et al.* 2019). This study also shows the utility of RMA regression for determining the diagnostic value of size-correlated meristic variables. There is no genetic material available from *C. harbinger*, but genetic divergence is observed among populations of *Distichodus notospilus* in the coastal plain rivers in Equatorial Guinea (*e.g.,* Rio Mbia) and those in southern Cameroon (Schmidt unpublished). Preliminary evidence suggests that this pattern of divergence among fishes in these short coastal rivers also occurs in *Amphilius* spp. *Enteromius* spp. and *Opsaridium* spp. (Schmidt unpublished). Similar patterns of divergences occur in the coastal rivers of the Upper Guinean forests (Schmidt *et al.* 2016), Kenya and Tanzania (Schmidt *et al.* 2017a), and South Africa (Chakona *et al.* 2013). Published barcodes from *C. mongoensis* (GenBank accession numbers MN015674 and MN015675) are now available and should advance studies on the freshwater diversity in the region.

In describing *Chiloglanis harbinger* Roberts (1989) selected the specific epithet suggesting that *C. harbinger* was foreshadowing the number of teeth in *Atopochilus* and *Euchilichthys*; so too does *C. mongoensis* herald future discoveries in the region. The discovery of the narrow endemic *C. mongoensis* and the existence of *C. harbinger* suggests that there are more *Chiloglanis* species to discover in Lower Guinea province. Targeted and increased collecting efforts in the province, notably in coastal plain rivers and streams, are necessary to further discover and describe these and other narrow endemic species. Discoveries are likely in other groups of fishes in the region as well (*e.g.,* small African barbs, mountain catfishes, alestids, and lampeyes) as demonstrated with a recently described narrow endemic barb species from Gabon (Mipounga *et al.* 2019). Only known from one locality, *Chiloglanis mongoensis* is a species of conservation concern as logging and exploitative activities are increasing in the region and the government is discussing options for hydropower projects on the Rio Wele. Additional sampling in the Rio Mongo and other tributaries on the lower Rio Wele is needed to fully determine the range of this new species, but an assessment of this new species is ongoing and will be submitted to the IUCN Red List of Threatened Species (IUCN 2019). The discovery and description of *C. mongoensis* and other undescribed species found during this expedition underscores just how crucial collecting natural history specimens is to documenting and preserving freshwater biodiversity in the area and across tropical Africa (Rocha *et al.* 2014). Further expeditions in the region are necessary to more fully understand the diversity and endemism in these freshwater fishes and to elucidate the processes that facilitated this diversity.

Additional material examined. *Chiloglanis harbinger* CAS 47469, Paratypes, 9 ALC, 33.9–44.1 mm SL; Cameroon, Lokunje (Lokoundje) River, near Bipindi, 3.074504° N, 10.403839° W; A.I. Goode, 17 February 1936.

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