

A New Species of Air-breathing Catfish (Clariidae: *Clarias*) from Salonga National Park, Democratic Republic of the Congo

MAXWELL J. BERNT¹ AND MELANIE L.J. STIASSNY¹

ABSTRACT

A new species of air-breathing catfish, *Clarias monsembulai*, is described from Congo River tributaries within and bordering the Salonga National Park (Democratic Republic of the Congo). The new taxon is recognized by its exceptionally long, white barbels, which lend a superficial resemblance to *Clarias buthupogon*, from which it differs in characters of the cleithrum and pigmentation patterning. We suggest placement of this species into the subgenus *Clarioides* but note the current dearth of morphological data to unite members of this group. We additionally discuss the validity of the subspecies *Clarias angolensis macronema*.

INTRODUCTION

Air-breathing catfishes of the genus *Clarias* (Siluriformes: Clariidae) are widespread throughout Africa and tropical Asia with 60 currently recognized species, 31 of which are endemic to African freshwaters (Froese and Pauly, 2022). African *Clarias* have a complex taxonomic history and species-level identification is notoriously difficult (Teugels, 1986; Hanssens, 2009). Despite increasing rates of description of numerous African taxa in recent years (Lundberg et al., 2000; Skelton and Swartz, 2011; Snoeks et al., 2011), no new *Clarias* have been described from the continent since 1980.

A barrier to clarification of clariid taxonomy and nomenclature is that there have been few attempts to diagnose the largest genus, *Clarias*. Boulenger (1907) defined the genus on the basis

¹ American Museum of Natural History, Department of Ichthyology, New York.

of four features: (1) dorsal fin single, formed entirely of articulated rays (i.e., the absence of an adipose fin); (2) eye with a free border; (3) pectoral and ventral fins well developed; and (4) sides of head protected by bony shields. None of these features, however, is unique to *Clarias*. At present, the genus may be functionally defined as any clariid lacking a free adipose fin or with an adipose fin that does not exceed one fourth the height of the dorsal fin; and possessing an anterolaterally expanded, superficial suprapreopercle that contacts the sphenotic (fig. 1A). Two other nominal taxa, *Bathyclarias* and *Xenoclarias*, share these features but *Bathyclarias*, which is endemic to Lake Malawi, has been shown to descend from *Clarias gariepinus*, rendering that species paraphyletic (Agnèse and Teugels, 2001; Van Steenberge et al., 2020). Therefore, despite any autapomorphies that may be ascribed to *Bathyclarias*, it does not form an independent lineage from *Clarias*. The monotypic *Xenoclarias*, endemic to Lake Victoria, was differentiated from *Clarias* by Greenwood (1958) on the basis of the reduced size of its suprabranchial organ. Although *Xenoclarias eupogon* has yet to be included in any formal phylogenetic analysis, Teugels (1986) reported substantial inter- and intraspecific variation in the size and complexity of the suprabranchial organ of many species of *Clarias*. And in view of the wide range of variability/plasticity of this feature, Teugels and Adriaens (2003) suggest that *Xenoclarias* is also likely synonymous with *Clarias*.

The osteology of most clariid species remains poorly documented, and it is not yet clear whether the differential diagnosis given here separates *Clarias* from all species currently included within *Clariallabes*. However, from the material available for examination it does appear that the latter genus is distinguished by a reduced ossification of the neurocranium, including a wide separation of the suprapreopercle from the sphenotic (fig. 1B), but the degree of reduction in these features has not been described for all species.

The current taxonomy of African *Clarias* is based primarily on the extensive revisionary work of Teugels (1986), which included 70 synonymizations and the recognition of six subgenera: *Anguiloclarias*, *Brevicephaloides*, *Clarias*, *Clarioides*, *Dinotopteroides*, and *Platycephaloides*. These subgenera are distinguished mainly based on external features, particularly the location, size, and orientation of serrations on the pectoral spines. Whether these subgenera correspond to clades has been questioned (Roberts, 1989; Hanssens, 2009), and the most recent phylogenetic hypotheses (Agnese and Teugels, 2005; Jansen et al., 2006; Devaere et al., 2007) have been inconclusive in this regard. None of these molecular phylogenies included sampling of more than a few taxa within each subgenus and all show substantial incongruence at the species level.

Given its wide scope, Teugels' revision relied predominantly on external morphometrics and meristics to delineate *Clarias* species. With the further examination of additional features of internal anatomy and use of molecular data, we anticipate major restructuring of the current taxonomy and systematics within Clariidae (M.J.B., in prep.), as well as the likely documentation of considerable previously unrecognized diversity. This is particularly the case for poorly sampled regions throughout the continent, and one such region is the Cuvette Centrale of the Congo basin (Stiassny et al., 2011). Reporting on ichthyological surveys conducted between 2006 and 2010 in and around Salonga National Park, Monsembula Iyaba and Stiassny (2013)

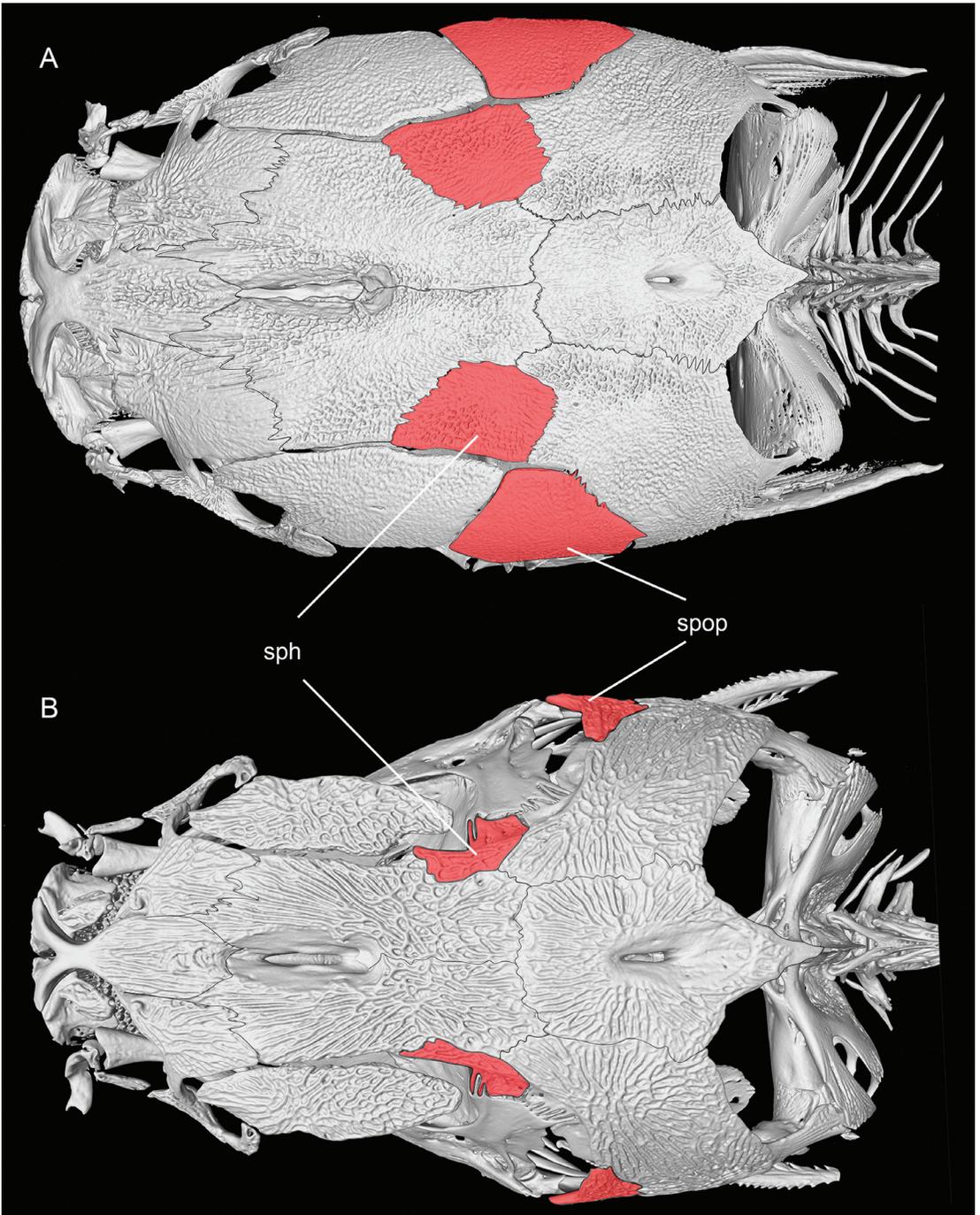


FIGURE 1. Computed tomography scans showing dorsal view of the skull of **A**, AMNH 59064 *Clarias laevis* and **B**, AMNH 274797 *Clariallabes melas* with the suprapreopercle (spop) and sphenotic (sph) highlighted in red.

documented the presence of six species of *Clarias*: *C. angolensis*, *C. buthupogon*, *C. gabonensis*, *C. pachynema*, *C. platycephalus*, and *C. theodora*.

A recent reexamination of that material revealed the presence of only three described species of *Clarias*: *C. angolensis*, *C. buthupogon*, and *C. gabonensis*, all of which are considered members of the subgenus *Clarioides* (Teugels, 1986). A detailed assessment of samples originally assigned to *C. buthupogon* revealed several lots that could not be assigned to that or any described *Clarias* species. Further examination identified this taxon as a new species diagnosably distinct from congeners in the possession of extremely long, creamy white barbels, an absence of fine, pale spots scattered over the body, and by the shape and extent of exposure of the cleithrum. Here we provide a formal taxonomic description of the new species, describe aspects of its osteology, and discuss *Clarias* taxonomy and the utility of the currently recognized subgenera.

MATERIALS AND METHODS

Twenty-six linear measurements and seven meristic counts were taken following Teugels (1986). Total length (TL), standard length (SL), dorsal fin length, anal fin length, and all barbel lengths were measured to the nearest millimeter with a flexible tape measure or ruler. All other measurements were made to the nearest 0.1 mm using digital calipers.

We examined the osteology of six specimens of the new taxon using computed tomography (CT). Scans were performed at the Microscopy and Imaging Facility at AMNH using a GE Phoenix v|tome|x with a 180 kV Nano Tube (General Electric, Fairfield, CT, USA). Scan resolution ranged from 10.6 to 24.3 μm . Beam energy was 120 kV and 166 mA. Scans were reconstructed using Phoenix datos|x (General Electric, Wunstorf, Germany) and were rendered and edited using VGStudio Max 3.3.4 (Volume Graphics, Heidelberg, Germany). Counts of vertebrae and dorsal and anal fin-rays were made from radiographs taken with a DSX-Pro digital X-ray. Osteological nomenclature follows Adriaens and Verraes (1998). Institutional abbreviations follow Sabaj (2019).

Clarias monsembulai, new species

Figures 2–5, table 1

Clarias buthupogon (in part): Monsembula Iyaba and Stiassny (2013).

HOLOTYPE: AMNH 244176, 1, 226 mm SL, Democratic Republic of the Congo, Equateur, Salonga National Park, Luilaka River at Ilenge, 2°35' 47"S, 21°34' 36"E. R.J.C. Monsembula Iyaba, 11 November 2007.

PARATYPES: AMNH 244163, 1, 244 mm SL; Yenge River ca. Boyenga, 1°03'50"S, 20°44'44"E; AMNH 252236, 3, 164–193 mm SL; small stream at Katanyongo, near Salonga National Park, 2°08'10.7"S, 21°07'9.5"E; AMNH 244162, 1, 183 mm SL; Salonga River at Watsikengo; AMNH 252219, 2, 187–231 mm SL; Salonga National Park at Bekongo, 1°54'42.74"S, 20°51'11.35"E; AMNH 244164, 1, 127 mm SL, Luilaka River, beach at Monkoto; AMNH 252267, 1, 179 mm



FIGURE 2. Lateral view of *Clarias monsembulai* new species, holotype AMNH 244176, 226 mm SL. Luilaka River at Ilenge, Salonga National Park. Scale bar = 1 cm.

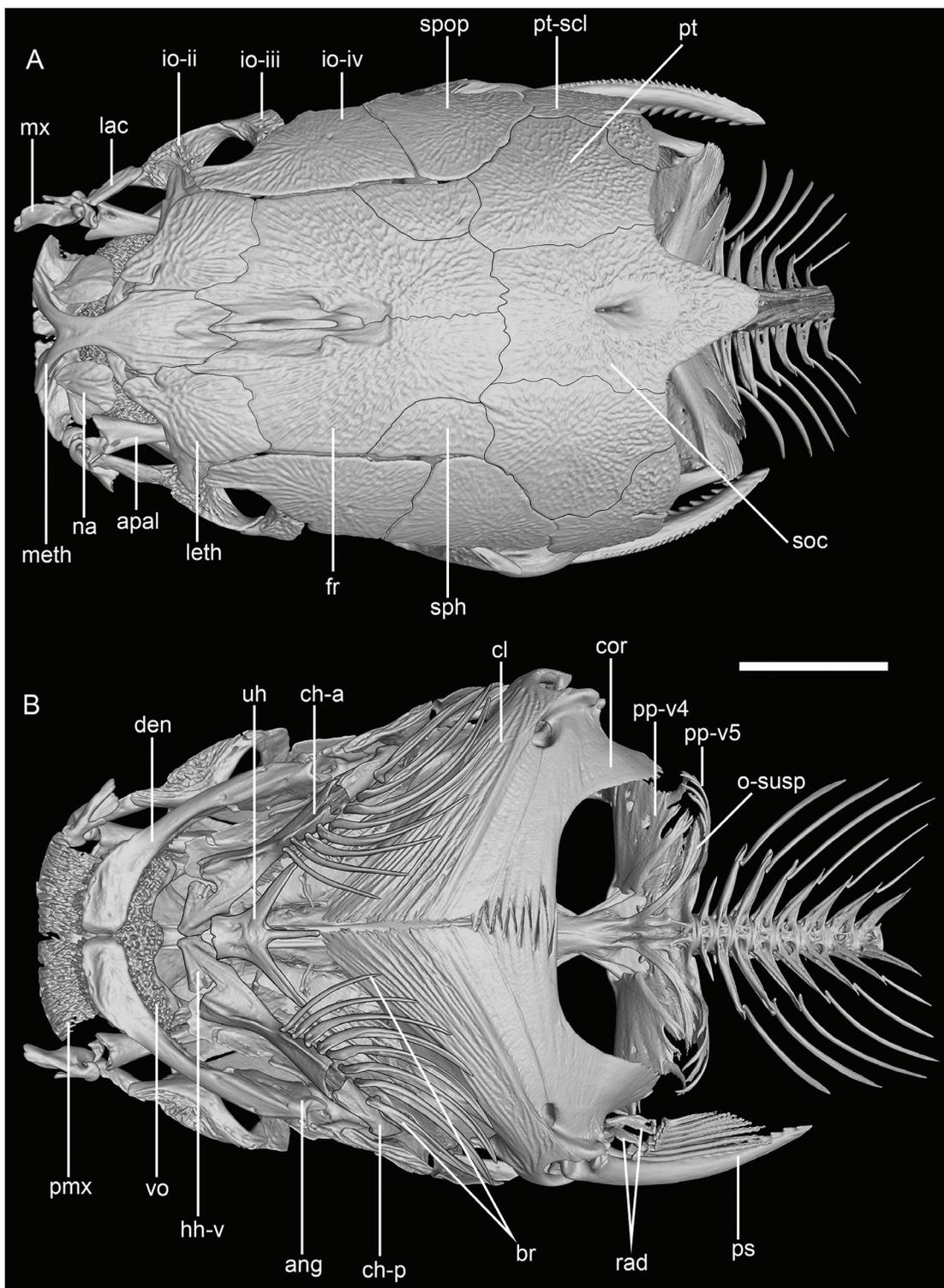
SL, Mpongo, large stream ca. 2 kilometers from Luilaka River, near Salonga National Park, 1°55'19.9" S, 20°51'49.8"E; AMNH 252222, 1, 167 mm SL; Luilaka River at Lokaka in Salonga National Park, 2°0'24.9"S, 20°58'6.2"E; RMCA 2022-019-P-0001-0002, 2, 143–172 mm SL, Salonga River at Watsikengo.

NONTYPE SPECIMENS: AMNH 242721, 14, 54–81 mm SL, small tributary of Luilaka River near Monkoto in Salonga National Park, 1°45'0"S, 20°40'49.9"E.

DIAGNOSIS: *Clarias monsembulai* can be distinguished from all congeners, with the exception of *C. buthupogon*, by its exceptionally long maxillary barbels (60% of standard length or greater) vs. maxillary barbels less than 60% SL (usually considerably less). It differs from *C. buthupogon* in the absence of fine, pale spots over the surface of the body and by an exposed bony surface of the cleithrum reaching 14%–20% of head length (vs. cleithrum deeply imbedded in soft tissue with only a narrow bony ridge visible externally). *Clarias monsembulai* can be further differentiated from *C. angolensis*, the species with which it shares closest phenotypic similarity, by longer nasal barbels (37%–51% SL vs. 22%–34% SL), longer internal mandibular barbels (29–37% SL vs. 16–27% SL), longer external mandibular barbels (45%–57% SL vs. 24%–40% SL); and by the coloration of maxillary barbels which are white or cream-colored distally over more than half of their length (vs. brown or gray over more than half their length).

DESCRIPTION: Morphometrics summarized in table 1. Maximum observed total length 270 mm (standard length 244 mm). Head broad, depressed with slightly convex dorsal profile, snout rounded. Anterior nares tubular, medial to posterior nares and nasal barbels. Mouth subterminal, lips and bases of barbels papillose. Four pairs of barbels, all extending beyond dorsal fin origin. Barbels rounded at base, becoming flat, ellipsoid in cross section. Body cylindrical between head and anal fin origin, becoming laterally compressed posteriorly.

Dorsal fin with 80–86 rays, originating a short distance (less than 10% SL) behind supraoccipital process. Anal fin with 57–61 rays, origin nearly equidistant from snout tip and caudal fin base. Dorsal and anal fins not confluent with caudal fin. Pectoral fin with robust spine and 10–12 rays. Spine sharply pointed with slight posterior curve. Strong serration present on both



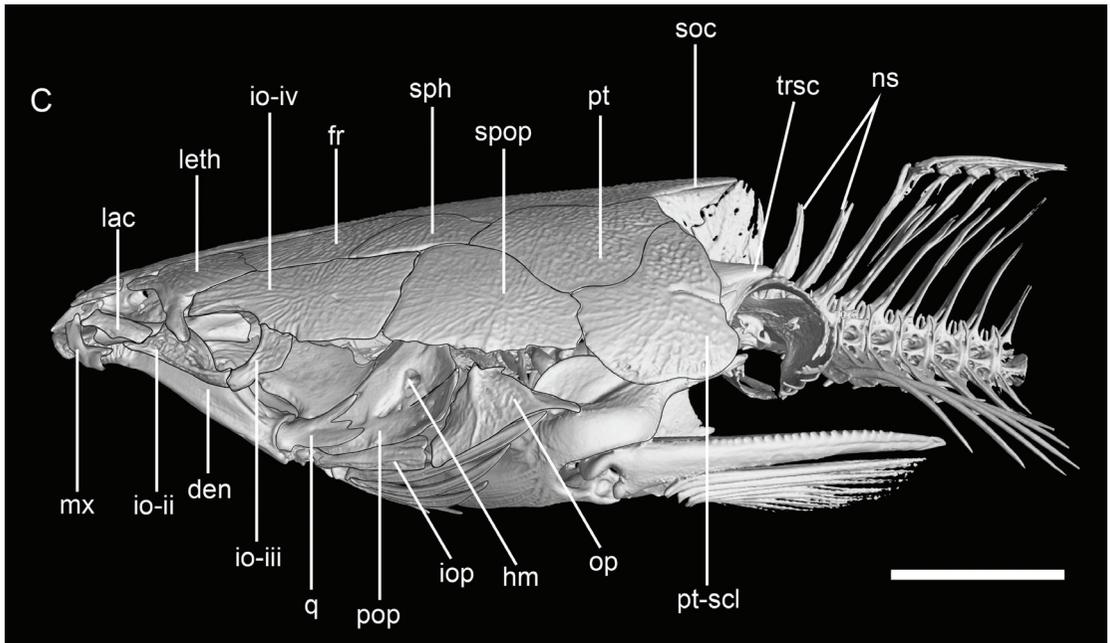


FIGURE 3. Computed tomography scan reconstruction of the skull and pectoral girdle of *Clarias monsembulai* (at left and above), AMNH 252267, 179 mm SL in **A**, dorsal; **B**, ventral; and **C**, lateral views. Abbreviations: **ang**, anguloarticular; **apal**, autopalatine; **br**, branchiostegal rays; **ch-a**, anterior ceratohyal; **ch-p**, posterior ceratohyal; **cl**, cleithrum; **cor**, coracoid; **den**, dentary; **fr**, frontal; **hmv**, ventral hypohyal; **hm**, hyomandibula; **io-ii**, infraorbital ii; **io-iii**, infraorbital iii; **io-iv**, infraorbital iv; **iop**, interopercle; **lac**, lacrimal; **leth**, lateral ethmoid; **meth**, mesethmoid; **mx**, maxilla; **na**, nasal; **ns**, neural spines; **op**, opercle; **o-susp**, os suspensorium; **pmx**, premaxilla; **pop**, preopercle; **pp-v4**, parapophysis of 4th vertebra; **pp-v5**, parapophysis of 5th vertebra; **ps**, pectoral spine; **pt**, pteryotic; **pt-scl**, posttemporo-supracleithrum; **q**, quadrate; **rad**, radials; **soc**, supraoccipital; **sph**, sphenotic; **spop**, suprapreopercle; **trsc**, transcapular process; **uh**, urohyal; **vo**, vomer. Scale bars = 1 cm.

anterior and posterior margins. Serrae angled proximally, larger on posterior margin, increasing in number with body size. Pelvic fins present on all specimens examined, with six rays. Caudal fin rounded, with 18–22 rays.

Elements of skull and pectoral girdle shown in figure 3. Neurocranium robustly ossified. Fourth infraorbital contacting suprapreopercle in all specimens examined (80–244 mm SL). Frontal fontanel long and narrow (knife shaped). Supraoccipital fontanel narrowly oblong, supraoccipital process sharply pointed in both juveniles and adults.

Premaxillary and vomerine tooth plates similar in width, about 30% of head length. Premaxillary teeth villiform. Vomerine toothplate with short posterior median process, teeth subgranular. Dentary teeth villiform, extending over half of dorsal surface, nearly reaching coronoid process. First branchial arch with 16–18 slender gill rakers. Second and fourth arches diverticulate, forming arborescent suprabranchial organ (fig. 4). Rosette on second arch with few branches, not overlapping larger, more extensively, branched rosette on fourth arch. Respiratory organ occupies approximately one fourth of suprabranchial chamber volume. Seven or eight branchiostegal rays. Urohyal trifurcate, lateral processes longer than posteromedial pro-

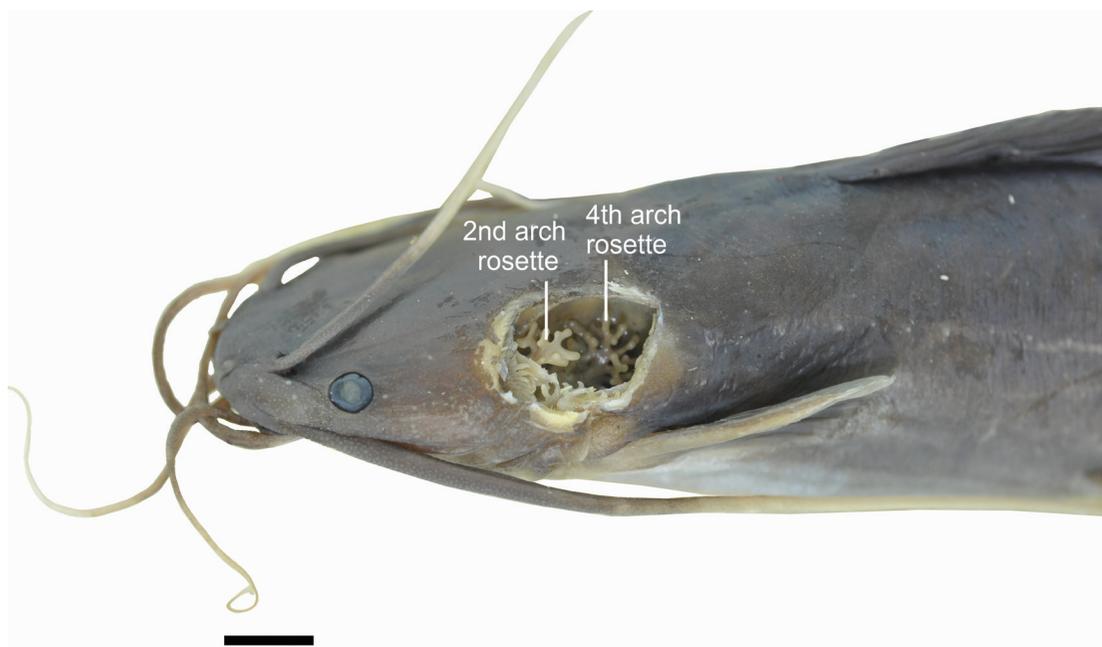


FIGURE 4. Suprabranchial organ of *Clarias monsembulai*, AMNH 244162, 165 mm SL (suprapreopercle removed). Scale bar = 1 cm.

cess. Cleithrum superficial, visible externally as striated bony band at isthmus (fig. 5). Coracoid with single circular foramen at margin with cleithrum near articulation with pectoral spine.

Parapophyses of fourth and fifth vertebrae expanded, forming hourglass-shaped Weberian apparatus encapsulating bilobed gas bladder. Posterolateral processes of os suspensorium forming ventral floor of Weberian capsule. Fifty-eight to 61 (mode = 60) vertebrae posterior to first four vertebrae comprising Weberian apparatus. Two free neural spines between skull and first dorsal-fin pterygiophore. First rib articulated with seventh vertebra, 12 ribs present. No fusion of caudal fin hypurals.

COLORATION: Preserved specimens are dark brown dorsally, fading to light brown, gray, or cream colored ventrally. Some lighter colored specimens exhibit a faint mottling of irregular dark brown markings over a slightly lighter background. Fins uniformly dark brown. Barbels brown at base, becoming creamy white over most of their length. Underside of head pale, but with band of dark pigment above fleshy furrow between mandibular barbels and isthmus. Lateral line visible as a series of small regularly spaced white pores extending from the base of the head to the base of the caudal peduncle. Pores of the secondary canals of the lateral line system form a regular pattern over the flanks, but these pores are not readily visible against the darkly pigmented skin.

DISTRIBUTION: The species is currently known only from the Momboyo, Luilaka, Salonga, and Yenge river systems within the Cuvette Centrale of the middle Congo River Basin (fig. 6). However additional collecting throughout the region will likely extend this range (E. Decru, personal commun.).

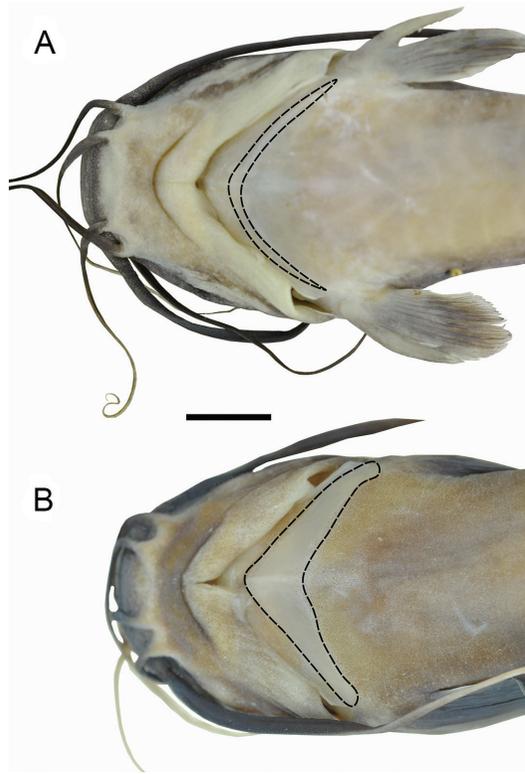


FIGURE 5. Exposed cleithrum (demarcated by dashed line) of **A**, *Clarias buthupogon*, AMNH 227571, 162 mm SL and **B**, *Clarias monsembulai*, AMNH 244162, 183 mm SL. Scale bar = 1 cm.

ETYMOLOGY: Named in honor of Raoul Monsembula Iyaba (professor of biology, University of Kinshasa) for collecting the type series of this species, and in recognition of his substantial contributions to central African ichthyology.

DISCUSSION

Clarias monsembulai is phenotypically most similar to *C. angolensis*, so we tentatively suggest it also be placed within the subgenus *Clarioides*. Teugels (1986) recognized seven species in *Clarioides*: *C. agboyiensis*, *C. albopunctatus*, *C. angolensis*, *C. buettikoferi*, *C. buthupogon*, *C. gabonensis*, and *C. macromystax*. The subgenus was diagnosed by the presence of robust serrations on both anterior and posterior margins of the pectoral spines in combination with an irregular distribution of secondary neuromast openings of the sensory canals over the body. Hanssens (2009), however, asserts that what Teugels identified as secondary neuromasts are actually small spots of pale pigmentation and that *Clarioides*, like the members of other subgenera, have regularly arranged neuromasts. Hanssens also notes that at least one species of *Clarioides*, *Clarias angolensis* (the type species for the subgenus), lacks the diagnostic pigmentation patterning of pale spots over the body. Given the absence of this pattern in *C. angolensis*, there are currently no characters to unambiguously unite the members of *Clarioides*. *Clarias*

Table 1. Summary of morphometric and meristic data for *Clarias monsebulai*.

| | Holotype | Range | <i>n</i> | Mean |
|-------------------------------------|----------|-----------|----------|-------|
| Total length | 250 | 62–270 | 27 | |
| Standard length (SL) | 226 | 53–244 | 27 | |
| Head length (%SL) | 23 | 23.0–25.6 | 13 | 0.2 |
| Head width (%SL) | 17.5 | 16.8–18.2 | 13 | 0.7 |
| Head depth (%SL) | 10.6 | 9.2–11.8 | 13 | 0.6 |
| Snout length (%HL) | 33.6 | 31.1–34.9 | 13 | 0.4 |
| Interorbital distance (%HL) | 45.4 | 41.0–45.9 | 13 | 3.8 |
| Eye diameter (%HL) | 8.5 | 7.6–9.3 | 13 | 132.0 |
| Maxillary barbel length (%SL) | 64.2 | 60.7–77.9 | 13 | 78.4 |
| Nasal barbel length (%SL) | 42.9 | 36.8–50.8 | 13 | 62.0 |
| Int. mandibular barbel length (%SL) | 36.3 | 28.9–37.4 | 13 | 95.4 |
| Ext. mandibular barbel length (%SL) | 49.6 | 45.0–57.3 | 13 | 56.0 |
| Predorsal length (%SL) | 30.4 | 22.5–30.4 | 13 | 95.0 |
| Preanal length (%SL) | 49.5 | 46.5–51.9 | 13 | 82.3 |
| Prepelvic length (%SL) | 44.2 | 40.0–45.5 | 13 | 42.9 |
| Prepectoral length (%SL) | 19.6 | 18.8–21.1 | 13 | 19.8 |
| Dorsal fin length (%SL) | 73.5 | 63.6–76.5 | 13 | 69.7 |
| Dorsal fin–caudal fin (%SL) | 0.8 | 0.1–2.2 | 13 | 1 |
| Occipital process–dorsal fin (%SL) | 7.9 | 5.5–7.9 | 13 | 6.4 |
| Pectoral spine length (%SL) | 9 | 5.8–11.6 | 13 | 9.8 |
| Pectoral fin length (%SL) | 13.8 | 10.2–13.8 | 13 | 12.7 |
| Pelvic fin length (%SL) | 8.6 | 8.2–10.0 | 13 | 9.2 |
| Anal fin length (%SL) | 46.9 | 44.5–51.2 | 13 | 48.3 |
| Caudal fin length (%SL) | 10.8 | 10.6–14.2 | 13 | 12.5 |
| Body depth at anus (%SL) | 16.6 | 14.8–18.0 | 13 | 16.5 |
| Caudal peduncle depth (%SL) | 5.6 | 5.2–6.2 | 13 | 5.7 |
| Gill rakers | 15 | 14–18 | 6 | 16 |
| Anal fin rays | 53 | 53–64 | 8 | 60 |
| Dorsal fin rays | 78 | 78–86 | 8 | 81 |
| Pectoral fin rays | 10 | 10–12 | 8 | 12 |
| Pelvic fin rays | 6 | 6 | 8 | 6 |
| Branchiostegal rays | 8 | 7–8 | 6 | 8 |
| Vertebrae | 61 | 58–61 | 10 | 60 |

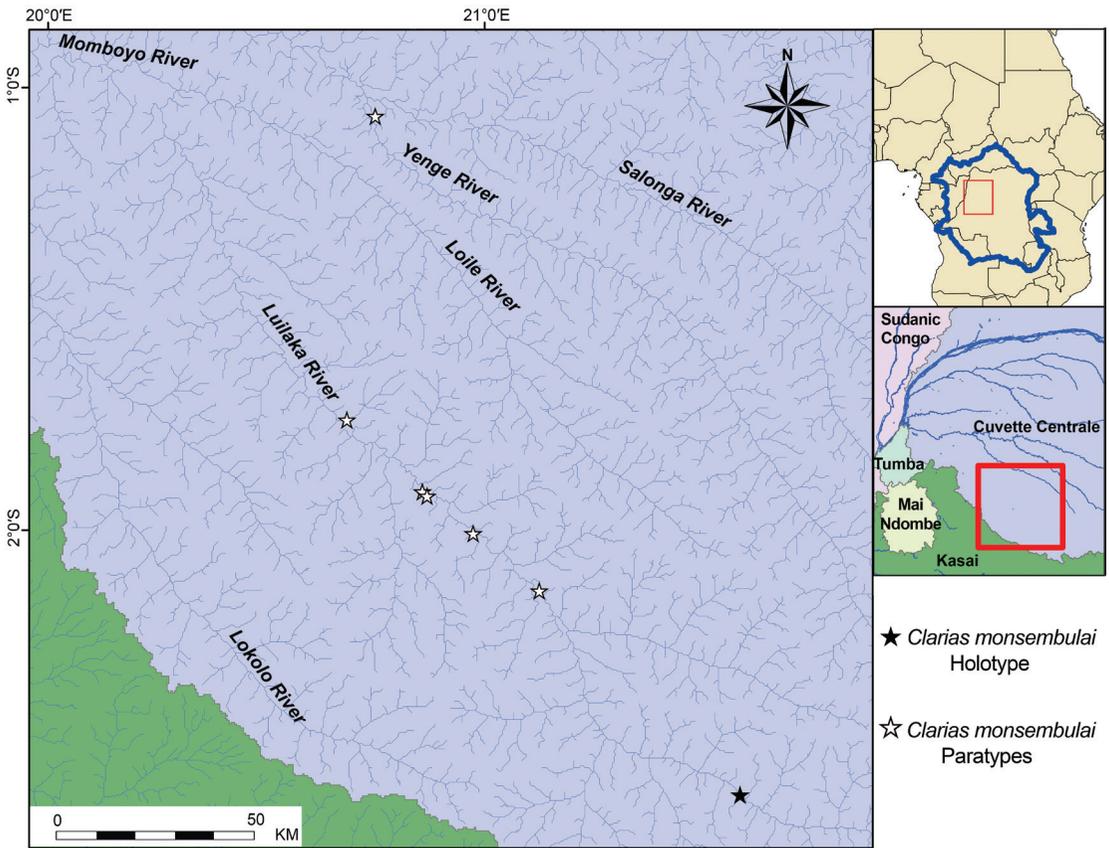


FIGURE 6. Collection localities of *Clarias monsembulai* within the Congo River Basin (upper inset). Coded regions of the map (lower inset) correspond to the freshwater ecoregions of the world obtained from www.feow.org.

monsembulai similarly lacks the fine white spotting pattern of most *Clarioides* and as such, neither of these species match the current diagnosis for *Clarioides*.

One solution to this problem would be to transfer these two taxa to the subgenus *Anguilloclarias*. This latter subgenus includes nine species, which like *Clarioides* have serration on both sides of the pectoral spine. However, as the name implies, Teugels erected *Anguilloclarias* to include the more elongate species of *Clarias* (i.e., those with a head length of 17%–25% SL). Although these values are not completely exclusive to *Anguilloclarias*, neither *C. angolensis* nor *C. monsembulai* are elongated, and both show similar ratios to other members of *Clarioides* (HL 22%–27% of SL). The maxillary barbels of these two species are also substantially longer than those of most species in *Anguilloclarias*, while most *Clarioides* species have distinctly longer barbels than members of other subgenera. Additionally, as *C. angolensis* is the type species of *Clarioides*, this new group of 11 species would necessarily take on that name, while the remaining six species from *Clarioides* sensu Teugels (1986) would require a new subgenus name.

An alternative noted by Hanssens (2009) would be to merge *Anguilloclarias* with *Clarioides* (the latter name having priority). If merged, the subgenus would be comprised of 17 species.

Aside from the single character they share, there is little evidence to suggest that these species form a clade. While the molecular phylogeny of Agnese and Teugels (2005) suggests that *Clarioides* is monophyletic (the four species sampled form a clade), the analysis did not include *C. angolensis*. The morphological phylogeny of Devaere et al. (2007) places *C. pachynema* (*Anguilloclarias*) and *C. buthupogon* (*Clarioides*) as sister taxa, but these are the only representatives of either subgenus included. Molecular phylogenies of both Agnese and Teugels, 2005, and Jansen et al., 2006, do not find their sampled representatives of *Anguilloclarias* to be monophyletic. Given these uncertainties, we elect to maintain the subgenera as defined by Teugels (but noting *C. angolensis* and *C. monsembulai* as exceptions within *Clarioides*) until more phylogenetic data are available.

Furthermore, among the other subgenera of *Clarias*, it should be noted that *Brevicephaloides*, *Clarias*, and *Platycephaloides* are defined by morphometric characters of head length and/or head width as a percentage of standard length. *Platycephaloides* overlaps with both *Brevicephaloides* and *Clarias* on both these characters. Therefore, five of the six subgenera cannot be unambiguously distinguished. Undoubtedly, the currently recognized subgenera of *Clarias* need to be carefully reevaluated in light of robust phylogenetic data. Until these data are available, however, this classification is of questionable utility and should be interpreted with caution.

The other members of *Clarioides* from the Congo River basin (and the only other *Clarias* species documented from Salonga National Park) are shown in figure 7. As Teugels (1986) described, *C. buthupogon* has two color variants: one marbled with a lighter background (fig. 7B) and one more uniformly dark (fig. 7C). We observe a nearly continuous range of variation between these two phenotypes with no obvious geographic pattern to their distribution. *Clarias monsembulai* has the longest barbels of any known species in the genus. The maxillary barbels in our type series average 69.3% of standard length. Those of *C. buthupogon* tend to be somewhat shorter, averaging 63.5% of standard length, though the ranges overlap. Despite Teugels' confusion over the function of these spots and their absence in *C. angolensis* (discussed in Hanssens, 2009), we find this character to be readily detectable in all our specimens of *C. buthupogon* regardless of the variable underlying skin color. Hanssens (2009) also discussed the importance of the cleithrum in distinguishing *C. angolensis*, *C. buthupogon*, and *C. gabonensis*. This character allows the robust differentiation of these species, which were not clearly diagnosed in Teugels (1986). In addition to distinguishing *C. monsembulai* from *C. buthupogon*, this character is also reported in the clariid descriptions of Boulenger and is therefore exceptionally useful in matching specimens to older descriptions.

The ambiguity in assigning *Clarias angolensis* to a subgenus may result in some confusion with members of *Anguilloclarias*, particularly with *Clarias pachynema*. Like *C. angolensis*, *C. pachynema* has a dusky brown coloration with no other distinguishing pigmentation patterns, and both species have pectoral spines that are robustly serrated on both margins. However, we find that the maxillary barbels of *C. angolensis* extend beyond the pelvic fin origin (often extending beyond the length of the entire pelvic fin), while in *C. pachynema* the maxillary barbels are much shorter, never reaching the pelvic fin origin. Additionally, the cleithrum of *C. pachynema* is externally visible only as a narrow strip of bone (similar to *C. buthupogon*, fig.



FIGURE 7. Species of the *Clarioides* subgenus from the Congo River basin: A, AMNH 250869 *Clarias angolensis*; B, AMNH 227571 *Clarias buthupogon*, marbled variant; C, AMNH 274802 *Clarias buthupogon*, dark variant; and D, AMNH 268382 *Clarias gabonensis*. Scale bars = 1 cm.

5A) compared with the thicker band seen in *C. angolensis* (Hanssens, 2009, fig. 8C). We also note that while there is some overlap, *C. angolensis* is largely restricted to the Congo River basin whereas *C. pachynema* is found mostly in the Lower Guinean ecoregion.

Considering the extensive synonymization within *Clarias*, we consider it important to further differentiate *C. monsebulai* from the nominal species synonymized with both *C. angolensis* and *C. buthupogon*. There are three junior synonyms of *Clarias angolensis*: *C. brevinuchalis*, *C. confluentus*, and *C. curtus*. *Clarias brevinuchalis* (Lönnerberg and Rendahl, 1922) was originally synonymized with *C. angolensis* by David (1935) without any explanation. Further evaluation of this synonymy is problematic in that the type specimen is apparently lost. Teugels (1986) noted that characters such as head length and the serration of the pectoral spine would place the taxon within *Clarioides* and that if that subgeneric placement is assumed, then the morphometric and meristic data available in the original description fall within the range of *C. angolensis*. However, the description includes an illustration of the head of *C. brevinuchalis*, which shows a relatively wide or “sole-shaped” anterior fontanelle, while *C. angolensis* and *C. monsebulai* have a distinctively narrow “knife-shaped” fontanel. The illustration also shows relatively short barbels, with the nasal barbels not exceeding the length of the head and the maxillary barbels not reaching the origin of the dorsal fin. These characteristics readily distinguish *C. brevinuchalis* from *C. monsebulai* for which nasal barbels exceed 130% of the head length and maxillary barbels which always extend far beyond the dorsal fin origin. We do not find that Teugels (1986) makes a convincing case that *C. brevinuchalis* is conspecific with *C. angolensis*, but also do not find sufficient evidence to recognize its novelty or closer affinity to another *Clarias* species.

Clarias confluentus was described by Nichols and La Monte (1933) on the basis of a single specimen with the anal and dorsal fins confluent with the caudal fin. After examining a radiograph of the specimen, Teugels (1986) concluded that the condition of the caudal region (short, irregularly shaped, and partially fused hypurals) was either teratological, or the result of regrowth after an injury. The holotype specimen (AMNH 12340) is otherwise readily identifiable as *C. angolensis* and its uniformly dark barbels distinguish it from *C. monsebulai*.

Clarias curtus was described by Matthes (1964) from the Kululu River in the Middle Congo basin based on 22 specimens. In examining the type series, Teugels (1986) identified three of the paratypes as *C. camerunensis* but found the remaining 19 specimens to be *C. angolensis*. The original description states that the maxillary barbels of the holotype are 2.03× the length of the head, which is within the range observed in *C. angolensis* but shorter than in *C. monsebulai* (2.6–3.4× head length). Teugels (1986) did not provide measurements of the barbels for the rest of the type series, but explicitly noted that they are “relatively short.”

Of the junior synonyms of *Clarias buthupogon*, *C. lindicus* was described by Boulenger (1920) from the Lindi River near Bafwasende. Teugels (1986) considered the type to be conspecific with *C. buthupogon*, only noting that the morphometrics largely agreed. The type specimen has a uniform brown coloration (lacking pale spots) with dark brown to black barbels. The exposed cleithrum is about 15% of head length. These characteristics are typical of *Clarias angolensis*, rather than *C. buthupogon*, so we suggest *C. lindicus* is more accurately regarded as

a junior synonym of the former. The barbel length reported by Teugels (228.7% HL) is also consistent with *C. angolensis* (121%–243% HL) but is shorter than we observe in *C. monsembulai* (260%–339% HL).

Clarias obscurus was described by Poll (1948) from Lake Mweru. Poll's illustration of the type shows long, but uniformly dark maxillary barbels. Teugels (1986) reported morphometrics and meristics for the holotype and two paratypes of *C. obscurus* that fall within the range of *C. buthupogon* and therefore proposed the synonymy. The description also notes that the "clavicles" (interpreted to be the cleithra) are hidden under the skin, which is consistent with *C. buthupogon*, but not *C. monsembulai* nor *C. angolensis*.

Clarias zygouron described by Nichols and Griscom (1917) presents a case much like *C. confluentus* in which the species was described on the basis of the fusion of the dorsal and anal fins with the caudal. David (1935) recognized the condition of the caudal region to be aberrant and Teugels (1986) showed via radiograph that the last vertebra is deformed and that the hypurals are absent. Our examination of the type (AMNH 6698) showed the specimen to be otherwise readily identifiable as *C. buthupogon* with fine white spots over the body and a deeply imbedded cleithrum.

OBSERVATIONS ON FOWLER'S *Clarias angolensis macronema*: Given the close morphological similarity between *C. angolensis* and *C. monsembulai*, it should be noted that Fowler (1949) described a subspecies of *C. angolensis* (*C. angolensis macronema*) on the basis of its distinctively long barbels. Fowler's description included six specimens from the vicinity of Oka, presumably within the Kouyou or Mbessi River systems in the Republic of Congo. The new subspecies was stated to differ from "Congo specimens" of *C. angolensis* by longer barbels as well as slightly more dorsal and anal-fin rays, and differences in coloration. Teugels (1986), through correspondence with J.E. Böhlke (who had access to the type material), concluded that the specimens were conspecific with *C. buthupogon*. However, upon our examination of the type series, we found it to contain three distinct species—*C. angolensis*, *C. buthupogon*, and *C. gabonensis*. The holotype (ANSP 71903, illustrated in Fowler, 1949) is *C. angolensis*. Of the two lots of paratypes, ANSP 71904 contains one specimen of *C. angolensis* and two of *C. buthupogon*; and ANSP 71905 contains two specimens of *C. buthupogon* and one of *C. gabonensis*.

It seems apparent that Fowler's perception of subspecific variation in *C. angolensis* was based at least in part on the interspecific diversity in his sample. However, given the identity of the holotype, Teugels' synonymization of the subspecies with *C. buthupogon* was invalid. We compared the two *C. angolensis macronema* specimens to a sample of 56 *C. angolensis* and did not find them to differ notably in maxillary barbel length (fig. 8) or in other morphometrics. Teugels (1986), however, in a sample of 58 specimens of *C. angolensis* (including the holotype), reports a range of maxillary barbel length from 105%–195% of head length, while our sample ranges from 121%–248% head length. Given this discrepancy and the wide geographic range of *C. angolensis*, it is possible that there are patterns of morphological variation that would warrant the recognition of subspecies and we therefore elect to maintain *C. angolensis macronema* as valid pending further analysis.

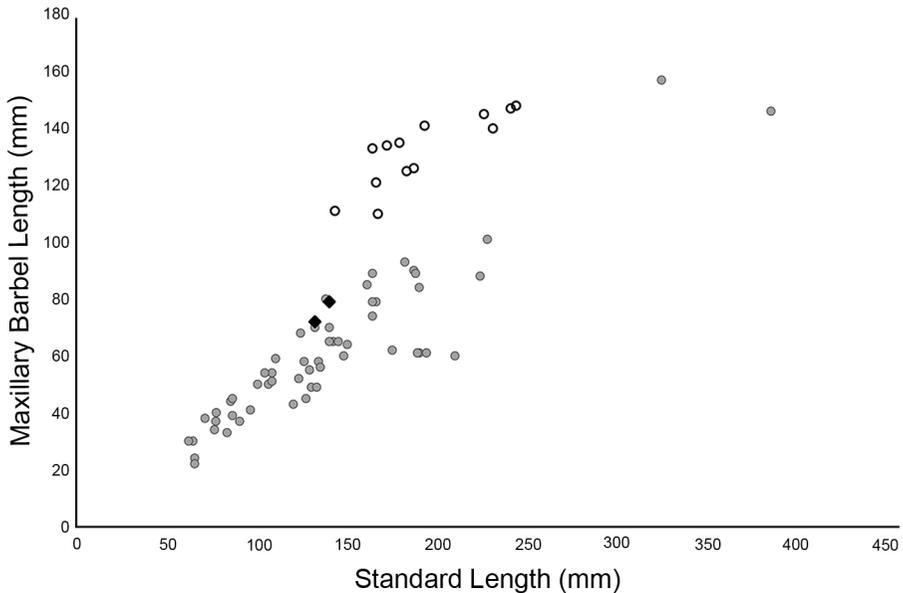


FIGURE 8. Maxillary barbel length plotted against standard length for *Clarias monsembulai* (open circles), *Clarias angolensis* (shaded circles), and two type specimens of *Clarias angolensis macronema* (diamonds).

COMPARATIVE MATERIAL EXAMINED:

Bathyclarias nyasensis: Malawi: AMNH 31912, 1, 311, Lake Malawi, Monkey Bay, Bweyawayani.

Clariallabes longicauda: Republic of Congo: Niari: AMNH 258882, 1, 116, Tributary of the Mandoro River, 2°17'38.61"S, 12°51'56.8"E.

Clariallabes teugelsi: Republic of Congo: Brazzaville: AMNH 237590, 5, 101–149, the rapids market at the confluence of the Congo and Djoue Rivers.

Clarias albopunctatus: Central African Republic: AMNH 228558, 4, 70–131, Control Zone of Sangba, Bouhou River (Oubangui drainage).

Clarias angolensis: Central African Republic: AMNH 230585, 1, 196 SL 219 TL, Control Zone of Sangba, Kpata River, tributary to Boungou River. Democratic Republic of the Congo: Mai-N'dombe: AMNH 258015, 5, 52–86, River Escalier, tributary of the Mai-N'dombe River, 3°55'44.6"S, 15°57'1.2"E. AMNH 251808, 2, 71–141, small side stream flowing into Bambou River, small tributary of the Kasai River, 2°29'22.9"S, 16°29'52.4"E. AMNH 255143, 3, 100–134, Mai-N'dombe River, below camp at Nganda Banga above second rapid (rotenone into small stream (Mai Petrol) flowing into main channel, 3°56'54.5"S, 15°59'20.3"E. AMNH 254035, 1, 161, Mai-N'dombe River main channel, immediately downstream of Chute 2. AMNH 259352, 1, 182, Mai-N'dombe River. AMNH 259352, 1, 108, Mai-N'dombe River at R. AMNH 255119, 1, 77, Second small stream flowing into the Lufimi River, 3°57'25.3"S, 15°59'53.2"E. Bas Congo: AMNH 247057, 8, 49–160, Liau Stream, above small falls near confluence with Congo River, downstream of Luozi, 5°0'21.4"S, 14°5'43.69"E. AMNH 246651, 5, 54–132, Zinga River, about 200 meters from confluence with Congo River, 4°

55°16.4"S, 14°10'28.2"E. AMNH 237573, 1, 104, Adjacent to Inga rapid just below Inga intake canal, small branch of main channel flowing over boulder terrace and into sandy, grassy depression. Equateur: AMNH 244172, 1, 190, Salonga National Park, Luilaka River at Bekongo. Haut-Uélé: AMNH 6679, 1, 138, Bomokandi River at Poko, 3°9'N, 26°53'E. Kinshasa: AMNH 250869, 12, 34–164, large stream flowing into main channel of N'Sele River, 4°22'58"S, 15°42'48.7"E. AMNH 250890, 9, 19–85, small creek flowing into N'Sele River, 4°22'56.6"S, 15°42'29.3"E. AMNH 250859, 5, 81–119, small stream flowing into main channel of N'Sele River, 4°22'25"S, 15°42'53"E. AMNH 237587, 3, 73–104, N'dolo, Dokolo island, port in Kinshasa. AMNH 257968, 2, 107–114, Mai-N'dombe tributary chute 1, 3°57'12.9"S, 15°55'08.7"E. AMNH 259305, 1, 166, Riviere Lifushila, tributary to the Mai-N'dombe River, 4°16'43.6"S, 15°58'18.6"E. AMNH 254896, 1, 71, Mai-N'dombe River, opposite bank to C-11-012, 3°57'12.7"S, 15°54'55.6"E. AMNH 245543, 1, 175, Tshienge River, Kin Market. AMNH 246425, 1, 135, Tshienge River, Kin Market. Kasai: AMNH 9211, 2, 164–187, Luluabourg (Kananga). AMNH 253228, 2, 145–150. Lukumbi Kumbi River at Katumanga, 6°00'16.8"S, 22°31'32.2"E. Kongo Central: AMNH 255261, 5, 48–138, Riviere Zodi, 5°12'47.9"S, 15°34'24.8"E. AMNH 257143, 2, 86–96, Riviere Binkuktiti, 5°12'43.1"S, 15°34'21.8"E. Republic of Congo: Brazzaville: AMNH 237589, 13, 92–210, Les Rapides market at confluence of the Congo and Djoue Rivers. AMNH 239545, 5, 95–194, Market at Les Rapides, Lower Congo River. AMNH 239544, 1, 142, Djoué River, below dam. Lékoumou: AMNH 256549, 1, 228, river towards Lebayi on forest trail, Zanaga, 2°39'52.3"S, 13°34'46.6"E. Likouala: AMNH 59575, 2, 325–386, Epena District, Lake Tele. AMNH 239546, 1, 224, Lake Tele Community Reserve, Likoula Aux Herbes, Q'Mokenfu.

Clarias batrachus: Indonesia: USNM 44980, 1, 93, Java.

Clarias buthupogon: Central African Republic: AMNH 227571, 7, 68–155, Mapoyo Creek into Yobe River (Sangha River Basin). Democratic Republic of Congo: Bandundu: AMNH 242545, 5, 65–136, Inogo on Lac Mai-N'dombe, 1°54'26.64"S, 18°16'53.58"E. AMNH 274802, 1, 166, Lomomo River near confluence with M'Fimi (Mai-N'dombe), 2°45'19.74"S, 17°55'55.80"E. AMNH 274800, 2, 241–243, Main channel near Mutali Village, large seine across wide channel into reeds, 2°40'18.96"S, 17°44'12.12"E. AMNH 274801, 6, 61–129, Tshe River near confluence with M'Fimi, 2°44'39.98"S, 17°42'40.76"E. Equateur: AMNH 249792, 1, 174, Lomako River at Isake 0°52'46"N, 20°47'41"E. Kinshasa: AMNH 260655, 1, 175, Congo River, upstream of confluence with Yana River, 4°1'30.2"S, 15°36'43.9"E.

Clarias camerunensis: Equatorial Guinea: USNM 447871, 146, Rio Mayang, Rio Muni Drainage, 1°8'2.7"N, 9°55'27.7"E. Gabon: Moyen-Ogooue: AMNH 230276, 12, 54–252, small stream called Mikouma River.

Clarias gabonensis: Democratic Republic of Congo: Equateur: AMNH 244171, 1, 205, Salonga National Park, Luilaka River at Bekongo. AMNH 252230, 1, 264, Salonga National Park at Lokaka, 2°0'24.9"S, 20°58'6.2"E. Mai-N'dombe: AMNH 269902, 4, 176–198, Nioki Harbor, Nioki (Mai-N'dombe), 2°44'10.9"S, 17°40'47.5"E. Republic of Congo: Brazzaville: AMNH 239551, 1, 204, Kintele Market. Kouilou: AMNH 263123, 2, 141–165, Kivouba River, 4°37'8"S, 12°10'0.8"E. Niari: AMNH 258824, 1, 166, Lipia River, Mayoko, 2°16'8.16"S, 12°49'8"E.

Clarias garipepinus: Benin: AMNH 235815, 2, 146–147, Mono River at Agbannankin.

Democratic Republic of Congo: Bas Congo: AMNH 246957, 55, 16–342, Luozi River, about 2 km from Luozi, 4°55′1.4″S, 14°5′29.4″E.

Clarias jaensis: Republic of Congo: Niari: AMNH 264353, 1, 253, tributary of the Nyanga River west of Mayoko. AMNH 264352, 1, 219, Léala River (tributary of Louessé River), 2°13′27.8″S, 12°49′9.8″E.

Clarias laeviceps: Liberia: AMNH 59064, 4, 183–304, small stream in mountainside, 1 km east, 12 km north of Zigida, Wologizi Mountains, St. Paul's River drainage.

Clarias liocephalus: Uganda: AMNH 216262, 2, 106–181, Lake Nabugabo to Juma River (Lake Victoria drainage).

Clarias pachynema: Cameroon: AMNH 236519, 4, 117–189, Pont Soò, confluence of Soò and Fala Rivers, Nyong Basin. Gabon: Haute-Ogooue: AMNH 211416, 2, 170–173, Mopia, Franceville. Ogooue-Ivindo: AMNH 263005, 2, 46–77, Bale Creek on border of Ivindo National Park at Impassa. Republic of Congo: Kouilou: AMNH 258345, 2, 126–130, Npakou (Emissaire Lac Ndembo), 4°21′14.6″S, 11°38′15.2″E.

Clarias platycephalus: Democratic Republic of Congo: Kasai Occidental: AMNH 247473, 1, 269, Tshina River, 6°12′6″S, 22°44′4.2″E.

Clarias stappersii: Democratic Republic of Congo: Orientale: AMNH 6492, 1, 220, Dungu River at Faradje, Uele River drainage, (Ubangi, Middle Congo River).

Zambia: Luapula: CUMV 91263, 1, 165, Lwela River at bridge on Mansa-? Road, 11°33′25.2″S, 29°10′10.2″E.

Clarias theodorae: Zambia: Western Province: AMNH 215586, 5, 83–192, Barotse floodplain, 1 km west of Sefula.

Clarias werneri: Uganda: AMNH 216263, 2, 165–176, Lake Nabugabo.

Dinotopteris cunningtoni: Tanzania: CUMV 82794, 1, 242, Lake Tanganyika, Jakobsen's Beach near Kigoma, 4°54′36.39″S, 29°35′51.96″E.

Heterobranchus longifilis: Central African Republic: AMNH 230730, 1, 266, Bamingui River, Bamingui-Bangoran National Park, 7°30′N, 19°50′E.

Xenoclarias eupogon: Uganda: AMNH 71860, 4, 174–200, Lake Victoria, east of Dagusi Island.

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