

***Garra allostoma*, a new species of
Cyprinid fish
from highlands of the Niger basin
in Cameroun**

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ABSTRACT

Two species of *Garra* with reduced mental disc are recognized in Africa: *G. cf. quadrimaculatus* from Ethiopia and Chad basin, and *G. allostoma* new species from the Cameroun highlands of Niger basin. All other African *Garra* have a well developed disc. Species tentatively identified in West Africa include *G. waterloti* from Guinea highlands of Senegal and Niger basins; *G. trewavasae* from Bauchi plateau, Niger basin; and *G. sp. undet.* from Cameroun highlands of Niger basin. *G. allostoma* and *G. sp. undet.* have nearly identical coloration in life and occur sympatrically. *G. allostoma*, with simple rostral cap, reduced horny sheaths on jaws, and gut only as long as body, feeds on insects, while *G. sp. undet.*, with tuberculate fimbriae on rostral cap, relatively massive jaws with enlarged horny sheaths, and gut length five times that of body, feeds on plants.

KEY WORDS: Fishes — Cyprinidae — *Garra* — Africa — New species — Taxonomy — Fresh water.

RÉSUMÉ

GARRA ALLOSTOMA, UNE NOUVELLE ESPÈCE DE CYPRINIDAE DES RÉGIONS MONTAGNEUSES
DU BASSIN DU NIGER AU CAMEROUN

Il existe deux espèces africaines de *Garra* avec un disque mentonnier réduit : *G. cf. quadrimaculatus* connu d'Éthiopie et du bassin du Tchad, et *G. allostoma*, une nouvelle espèce des régions montagneuses du bassin du Niger au Cameroun. Toutes les autres espèces africaines de *Garra* ont un disque mentonnier bien développé. Ces dernières espèces seraient représentées en Afrique de l'Ouest par *G. waterloti* des régions montagneuses des bassins du Sénégal et du Niger en Guinée, *G. trewavasae* du plateau Bauchi au Nigeria (bassin du Niger), et *G. sp. ind.* des régions montagneuses du bassin du Niger au Cameroun. *G. allostoma* et *G. sp. ind.*, ont une coloration très voisine sur le vivant et sont sympatriques. *G. allostoma*, avec un lobe rostral simple, une membrane cornée peu développée aux mâchoires, et un intestin seulement aussi long que le corps, se nourrit d'insectes, alors que *G. sp. ind.* avec des denticules tuberculés sur le lobe rostral, des mâchoires relativement fortes avec une membrane cornée bien développée, et un intestin cinq fois plus long que le corps, se nourrit de végétaux.

MOTS-CLÉS : Poissons — Cyprinidae — *Garra* — Afrique — Espèces nouvelles — Taxinomie — Eaux douces.

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INTRODUCTION

The rheophilic cyprinid fish genus *Garra* Hamilton, 1822 (type species *Cyprinus lamta* Hamilton, 1822, by monotypy) is distributed across the lower latitudes of Asia from Borneo and China to India and the near East, and in much of tropical Africa. In the systematic study of the genus by MENON (1964) 37 species are recognized, with 8 in Africa. The section on *Garra* in Checklist of African Freshwater Fishes (LÉVÊQUE & DAGET, 1984) follows closely identification of species and their synonymy by MENON. Adding two species not treated by him, *G. congoensis* Poll, 1959 and *G. lancrenonensis* Blache and Miton, 1960, 10 species are recognized in Africa. Six are reported from northeast Africa (Ethiopia and Somalia), one from east Africa, two from Congo basin, and three from West Africa. In West Africa *Garra* occurs mainly in the Sanaga and Niger basins. It is present in the Senegal but is otherwise unknown from coastal drainages west of the Niger. It occurs in coastal drainages of the République du Congo but apparently not in the Ogooué basin (Gabon).

Garra has not been reported previously from the Niger basin in Cameroun. In 1980 the author collected two species in the River Menchum, a tributary of the Niger in the Bamenda highlands of western Cameroun. One species is a typical *Garra*, with characteristic fimbriate rostral cap and papillose or tuberculate mental disc; such a disc is not found in any other cyprinid genus. The other species has a simple, non-fimbriate rostral cap and relatively small, non-tuberculate mental disc, and at first glance looks like a *Barbus*. Yet the peculiarities of its color pattern and possession of 9 + 9 principal caudal fin rays instead of 10 + 9 as found in all African cyprinids except *Garra* clearly indicate its relationships are with *Garra*, in which two species in Asia and one or two in Africa are known with reduced mental disc.

The *Barbus*-like *Garra* from the Menchum differs from all previously known species and is here described as a new species. The typical *Garra* is not readily identifiable with species previously known from the Niger basin (*G. waterloti*, *G. trewavasae*) and may also represent a new species. Pending studies of species identification, geographical distribution, and geographical variation of African *Garra* based on adequate collections, it is designated *Garra* sp. undet. Menchum.

Coloration of the two species from the Menchum is remarkably similar. Two peculiar features, shared with some other African *Garra*, are particularly notable. First, the anteriormost scale in the longitudinal series of pored scales bearing the lateral line canal is darkened, sometimes almost black; imme-

diately in front of this scale, at the upper corner of the gill cover, is a small pale area which in life is a gleaming red spot. This is the only vivid coloration, and was observed in all or nearly all specimens of both species collected in the Menchum. Thus it is not size or sex related. Similar spots were present in live *Garra* observed by me in the Sanaga and Congo basins. The second color feature found in African *Garra* and in both Menchum species is a series of four oblique black marks on the proximal part of the dorsal fin, one centered on each interradial membrane between the second through sixth branched rays. Such marks, constant in number and position, are present in all specimens of both species from the Menchum. A similar but fainter mark is sometimes present on the proximal part of the anal fin, on the interradial membrane between the second and third branched ray. The interradial membranes and parts of fin rays adjacent to these black spots are relatively devoid of pigment, so when the dorsal fin is erect they stand out clearly. Caudal fin and paired fins are dusky overall, without distinctive marks.

An example of confusion in systematics of *Garra* is provided by *Garra quadrimaculata* (Rüppell, 1836), described in the same article with *G. hirticeps* (Rüppell, 1836). Although both species were figured in lateral view, Rüppell provided no description or figure of the mouth and mental disc. These are the earliest *Garra* described from Africa. While noting the possibility they might be different sexes of one species, RÜPPELL treated them as distinct species, reporting the sympatric occurrence of the species in Abyssinian streams, and allopatry of *G. hirticeps* in streams on the eastern slopes of the Tarantes. GÜNTHER, with no other information than that provided by RÜPPELL, identified *G. hirticeps* as a male because of the tubercles or warts on its snout and placed it as a synonym of *G. quadrimaculata*. BOULENGER (1909:344, 351, fig. 265) identified and figured *G. quadrimaculata* as the sole African species of *Garra* with reduced mental disc. Following GÜNTHER, he included *G. hirticeps* in the synonymy of *G. quadrimaculata* but with a question mark. BOULENGER's identification of *G. quadrimaculata* as having a reduced mental disc may be attributed to inspiration or intuition, as nothing in the original description provides this information and there is no indication BOULENGER examined the type specimens. MENON (1964) regarded *G. quadrimaculata* as having a highly variable development of the mental disc and placed *G. hirticeps* as its synonym without a question mark. Thus GÜNTHER (1868), BOULENGER (1909), and MENON (1964) all made unwarranted assumptions about the identity of these two species named and described by RÜPPELL, without examining the types, perpetuating for well over a century

what MAX POLL and other Belgian ichthyologists working on systematics of African freshwater fishes refer to as "une synonymie légère." As to the suggestion that *G. hirticeps* is the male of *G. quadrimaculata*, all specimens of Ethiopian *Garra* with reduced mental discs seen by me are non-tuberculate, as are most African species of *Garra*. In Asian species with tubercles on the head or snout, both species are usually tuberculate, sometimes females more so than males. Whether *G. quadrimaculata* and *G. hirticeps* are different or the same species is unclear, and it is also unclear whether they have reduced or well developed mental discs. Pending further study, including examination of the syntypes of *G. quadrimaculata*, *Garra* with reduced mental disc from Ethiopia should be referred to provisionally as *G. cf. quadrimaculata* (Rüppell, 1836); the only other *Garra* previously described from Africa with a reduced mental disc, *G. lancrenonensis* Blache and Miton, 1960 from Chad basin, is known only from the syntypic series of seven small juveniles and cannot at this time be distinguished adequately from *G. cf. quadrimaculata*.

Naming of soft mouthparts of *Garra* employed in this paper (Fig. 1) follows the nomenclature previously proposed by me for Cyprinidae (Roberts, 1982:60-61, fig. 6): rostral cap (always present, usually with tuberculate fimbriae); upper lip (probably present in very small individuals of all species, disappearing with growth in most species but not in all); horny sheath on each jaw (present in all species, usually but not always greatly enlarged and with a sharp cutting edge, especially on lower jaw); and lower lip (always present, divided into discrete lateral and medial portions by a constriction, both portions tuberculate in some species). In addition *Garra* has a mental pad or adhesive disc. This rounded or oval structure, occupying much of the isthmus posterior to the lower lip, may be smooth and entirely attached to the isthmus, or it may be heavily tuberculate along its anterior and posterior margins and largely free from the isthmus posteriorly. While some other cyprinid genera have a simple mental pad comparable to that found in some *Garra*, no other cyprinid genus has a tuberculate mental disc free from the isthmus. *Garra* typically have two pairs of barbels: anterior or rostral, and posterior or maxillary. In some Asian species the posterior pair is greatly reduced or missing; African species have both pairs.

Four very different sorts of specialized keratinous or horny structures occur in *Garra*: so-called breeding tubercles on the head or snout; tubercles or papillae on the rostral cap, lower lip, and mental disc; horny sheaths on upper and lower jaws; and unculiferous pads on the ventral surface of the paired fins.

Breeding tubercles, which may play a role in breeding behavior in some cyprinids but not in others, generally are conical and multicellular, and occur on the head and the snout in many species of Asia. They are especially large and numerous on the snout of large adults of *G. gotyla* and *G. nasula*, species with a large secondary rostrum on the snout. None of the African species have a secondary rostrum, and most lack tubercles on the head. Breeding tubercles on the dorsal surface of the paired fins, present in many rheophilic cyprinids, have not been observed in *Garra*. Tubercles of a different sort, although also horny, occur on the soft mouthparts. These, sometimes referred to as papillae, are particularly prominent on the rostral cap, lower lip, and mental disc in many *Garra*. They are well developed in *G. sp. undet. Menchum*, but virtually absent in *G. allostoma*. The papillae or tubercles on the rostral cap, lips, and mental disc probably bear numerous unicellular keratinous projections or unculi, involved in scraping filamentous algae and other periphyton from gravelly or rocky substrate upon which most species of *Garra* browse. Finally, horny adhesive pads occur on the ventral surface of the paired fins. These are extensive areas uniformly covered by unculi. In *Garra sp. undet.* and *G. allostoma* the distal portion of the first four of five pectoral fin rays bear prominent unculiferous pads. The largest are on the unbranched first two rays, the pads from the first to fourth or fifth ray progressively smaller as they are confined to more and more distal portions of successive rays. On branched rays a large unculiferous pad occurs on the unbranched portion basal to the bifurcation and continues uninterrupted onto the anterior branched portion of the ray; a separate and much smaller pad is confined to the posterior branched portion. This arrangement is typical of many rheophilic cyprinids and probably occurs in all *Garra*. On the pelvic fin of the two *Garra* from the Menchum unculiferous pads are poorly developed. The first unbranched ray bears a large pad comparable to that on the first pectoral fin ray but pads on successive pelvic fin rays are less noticeable.

***Garra allostoma* new species. Figures 1, 2.**

HOLOTYPE. — MNHN 1987-1626, 52.4 mm, Cameroun, Niger basin, rapids of R. Menchum below waterfall near Befang, Bamenda highlands, 10 March 1980, Tyson R. ROBERTS coll.

PARATYPES. — MNHN 1988-1627, 32: 20.6-62.5 mm, collected with holotype (4:23.0-31.7 mm stained and cleared for skeletal study).

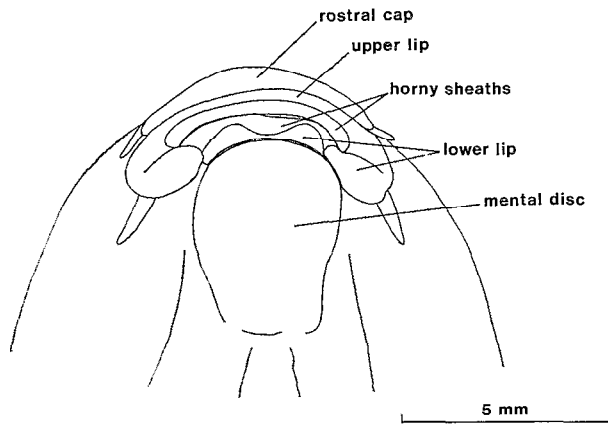


FIG. 1. — *Garra allostoma*, 62.5 mm, ventral view of head and mouth.

Garra allostoma, 62,5 mm, vue ventrale de la tête et de la bouche.

OTHER SPECIMENS. — MNHM 1988-1166, 6: 16.2-20.2 mm, tentatively identified as juvenil *G. allostoma*, collected with holotype.

DIAGNOSIS. — An insectivorous *Garra* with a terminal or subterminal mouth and curved or crescentic mouth opening superficially resembling a generalized *Barbus*; cheek below eye laterally expanded; rostral cap reduced, smooth (i.e., non-fimbriate and non-tuberculate); mental disc smooth, non-tuberculate, posterior border bound to isthmus; upper and lower lips well developed; lower lip non-tuberculate, divided into distinct lateral and medial portions by a constriction; medial portion of lower lip constricted near symphysis, so that it is bilobate; horny sheaths of upper and lower jaws not greatly enlarged, without trenchant cutting edge; pharyngeal teeth in two rows, 2 or 3,5. Absence of rostral fimbriae distinguished *G. allostoma* from all other *Garra*, and

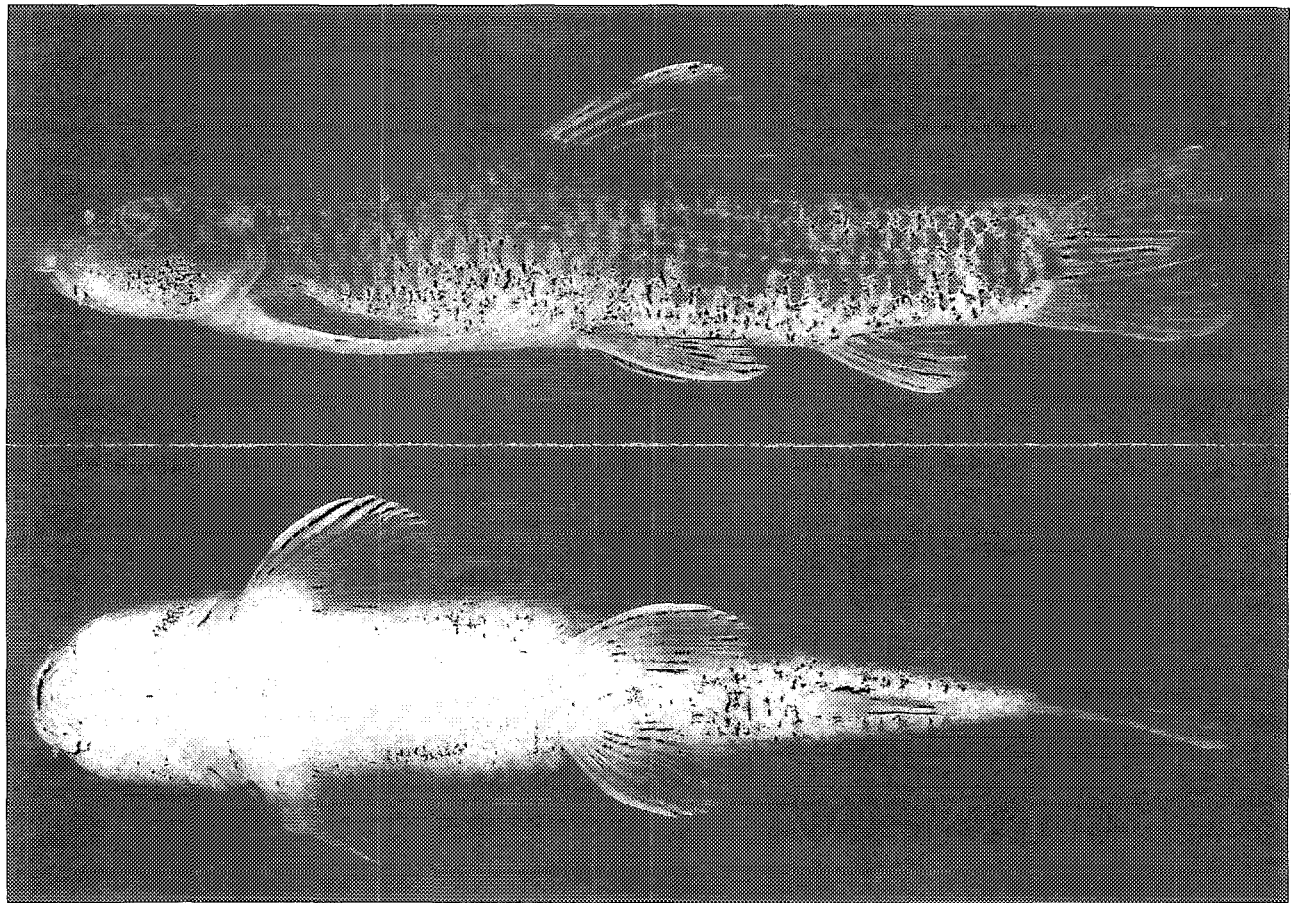


FIG. 2. — *Garra allostoma*, 52.4 mm holotype (MNHN 1987-1626).

having only two instead of three pharyngeal tooth rows distinguished it from all others for which the number of rows has been reported.

Proportional measurements and counts for *G. allostoma* and *G. sp. undet.* Menchum are given in Table I. *G. allostoma* has snout projecting very little; cheek expanded below eye, perhaps more than in any other *Garra*; dorsal surface anterior to dorsal fin scaleless, or with only a few scales embedded in skin just anterior to dorsal fin; breast and abdomen scaleless, or with a few scales just anterior to pelvic fin bases; vent advanced, three to five ventral rows of scales between it and anal fin origin.

In Asia, the near eastern *G. rossica* (Nikolsky, 1900) and *G. variabilis* (Heckel, 1843) have reduced mental discs (MENON, 1964; pers. comm. F. KRUPP, 1987). They differ from *G. allostoma* in having rostral cap with well developed tuberculate fimbriae, upper

lip absent, and vent almost immediately in front of anal fin (in *G. allostoma* vent well in advance, separated from anal fin origin by three or more large ventral scales). *G. rossica* further differs in lacking posterior barbels, and *G. variabilis* in having dorsum anterior to dorsal fin, breast, and abdomen fully scaled. In Africa two species have been recognized with reduced mental disc: *G. quadrimaculata* (Rüppell, 1836) from the highlands of Ethiopia and *G. lancrenonensis* Blache and Miton, 1960, from the Chutes Lancrenon, on a tributary of the upper Logone, Chad basin. The latter is known only from seven juvenile syntypes, MNHN 1959-227, 18.7-25.0 mm. I have compared them with samples from Ethiopia identified as *G. quadrimaculata* and find little difference. BLACHE and MITON remarked that *G. lancrenonensis* is very close to *G. quadrimaculata* from Lake Tana, but that it differs in form of the mental disc, which they described in *G. lancrenonensis* as "plus long que large, assez indistinct, réduit à une simple plaque à bord postérieur bilobé et sans membrane marginale libre." Comparing the type specimens with specimens of *G. cf. quadrimaculata* of comparable size from "Abyssinie" (MNHN 1905-243, 7: 8.8-25.9 mm) I find virtually no difference in the form of the mental disc for most of the specimens. Two specimens of *G. lancrenonensis* have a bilobate disc, a condition not seen in the present sample of *G. quadrimaculata*, but the others do not have a bilobate disc and are similar in all respects to the *G. cf. quadrimaculata*, thus I tentatively conclude that the two nominal species are conspecific. Pending examination of the syntypes of *G. quadrimaculata* and availability of additional material including adults from Chad basin, all *Garra* with reduced mental discs from Ethiopia and Chad basin may be referred to as *G. cf. quadrimaculata* (Rüppell, 1836).

Garra cf. quadrimaculata differs from *G. allostoma* in having rostral cap usually fimbriate (perhaps always fimbriate in well preserved specimens, at least of larger size); scales in lateral series 37-40 (vs. 35-36); and cheeks not laterally expanded below eyes.

Garra sp. undet. Menchum. Figure 3.

MATERIAL EXAMINED. — MNHM 1987-1625, 63: 17.8-82.8 mm, Cameroun, Niger basin, rapids of R. Menchum below waterfall near Befang, Bamenda highlands. 10 March 1980 (4: 27.0-34.2 mm cleared and stained) T. R. ROBERTS coll.

DIAGNOSIS. — These specimens, which may represent an unnamed species, have an exceptionally large rostral cap, with about 20 tuberculate fimbriae;

TABLE I

Morphometrics (as times in SL) and meristics of *Garra* from Menchum

Caractères morphométriques (exprimés par rapport à la LS) et méristiques des *Garra* de Menchum

	<i>G. allostoma</i>	<i>G. sp. undet.</i>
n : SL mm	8 : 42.3-62.5	12 : 37.8-82.8
head	3.8-4.2	3.9-4.3
snout	8.2-8.7	6.8-7.8
eye	18.7-21.0	18.9-24.4
interorbital width	9.7-10.7	7.9-8.9
anterior barbel	24.9-47.6	31.5-46.0
posterior barbel	29.0-47.6	50.4-86.8
ant. to post. barbel	19.7-23.8	12.6-16.7
rostral cap width	9.7-11.3	6.7-8.8
premental length	22.0-27.6	10.4-13.1
mental disc length	12.4-14.6	11.6-13.1
mental disc width	18.7-22.9	7.5-8.9
body depth	4.5-5.1	4.3-5.0
predorsal length	2.0-2.1	1.9-2.0
prepectoral length	4.0-4.6	4.0-4.6
prepelvic length	1.7-2.0	1.7-1.8
preanal length	1.3-1.5	1.2-1.3
caudal ped. depth	7.6-8.3	8.2-9.1
dorsal fin rays	iii7	iii7
anal fin rays	iii5	iii5
pectoral fin rays	ii12-14	ii12-13
pelvic fin rays	8	8
prin. caud. rays	9/9	9/9
lateral scales	35+1-2, 36+1	36-37+1-2
transverse scales	3-4/1/3	5-6/1/4
circumped. scales	16-18	15-18
gill rakers	10	10
pharyngeal teeth	2-3,5	1-2,3,5
vertebrae	23+12=35(1) 24+12=36(3)	25+10=35(1) 25+11=36(3)

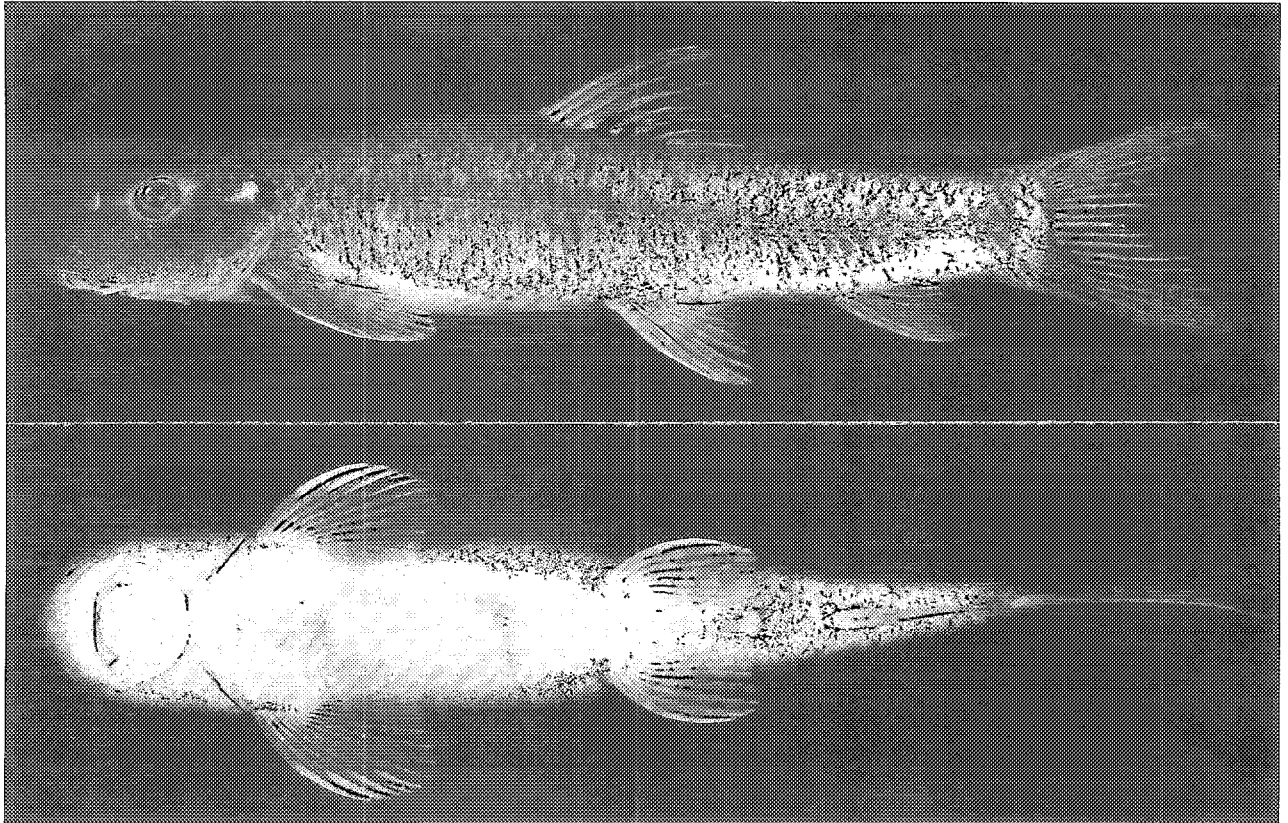


FIG. 3. — *Garra* sp. undet. Menchum, 53.0 mm (MNHN 1987-1625).

mouth distinctly inferior, its opening transverse; upper lip absent except in some under 25 mm; lower lip heavily tuberculate, laterally and medially; medial portion of lower lip uniformly swollen, not constricted near symphysis; mental disc large, anterior margin thickened and tuberculate, posterior margin tuberculate and free from isthmus; horny sheaths well developed, that of lower jaw with a sharp cutting edge; cheek below eye not laterally expanded; pharyngeal teeth in three rows, 1 or 2, 3, 5.

Garra from Guinea, including headwaters of the Senegal (MNHN 1987-639) as well as of the Niger (MNHN 1982-1167), are identifiable as *G. waterloti* Pellegrin, 1935 (type locality Banamanan, Kissidougou = Banama, R. Dele, Niger basin?, syntypes MNHN 1985-189 and 190 examined). *Garra waterloti* was placed by MENON (1964) as a junior synonym of *G. ornata* (Nichols and Griscom, 1917), described from a single 30 mm specimen from the Congo basin at Stanleyville. *Garra* of the Congo basin need

systematic revision based on adequate samples from throughout the basin and comparison with material from other basins. Until further study *G. waterloti* may be treated as a valid species. It differs from *G. sp. undet. Menchum* in having a relatively smaller head, smaller mental disc with tubercles on posterior border poorly developed, longer barbels, and more elongate body.

Garra trewavasae Monod, 1950, from Bargesh, Bautchi plateau, Nigeria MNHN 1950-75, 71.0 mm holotype) has snout weakly projecting, much less than in *G. sp. undet.*; cheek expanded, more than in *G. sp. undet.* but less than in *G. allostoma*; rostral cap weakly fimbriate; mental disc well developed but smaller than in *G. sp. undet.*; eye more posterior than in *G. sp. undet.*; and squamation anterior to dorsal fin and anterior to pelvic fins better developed (scales larger, more numerous, and more free from epidermis).

As expected from the differences in their soft mouthparts, *G. allostoma* and *G. sp. undet. Menchum*

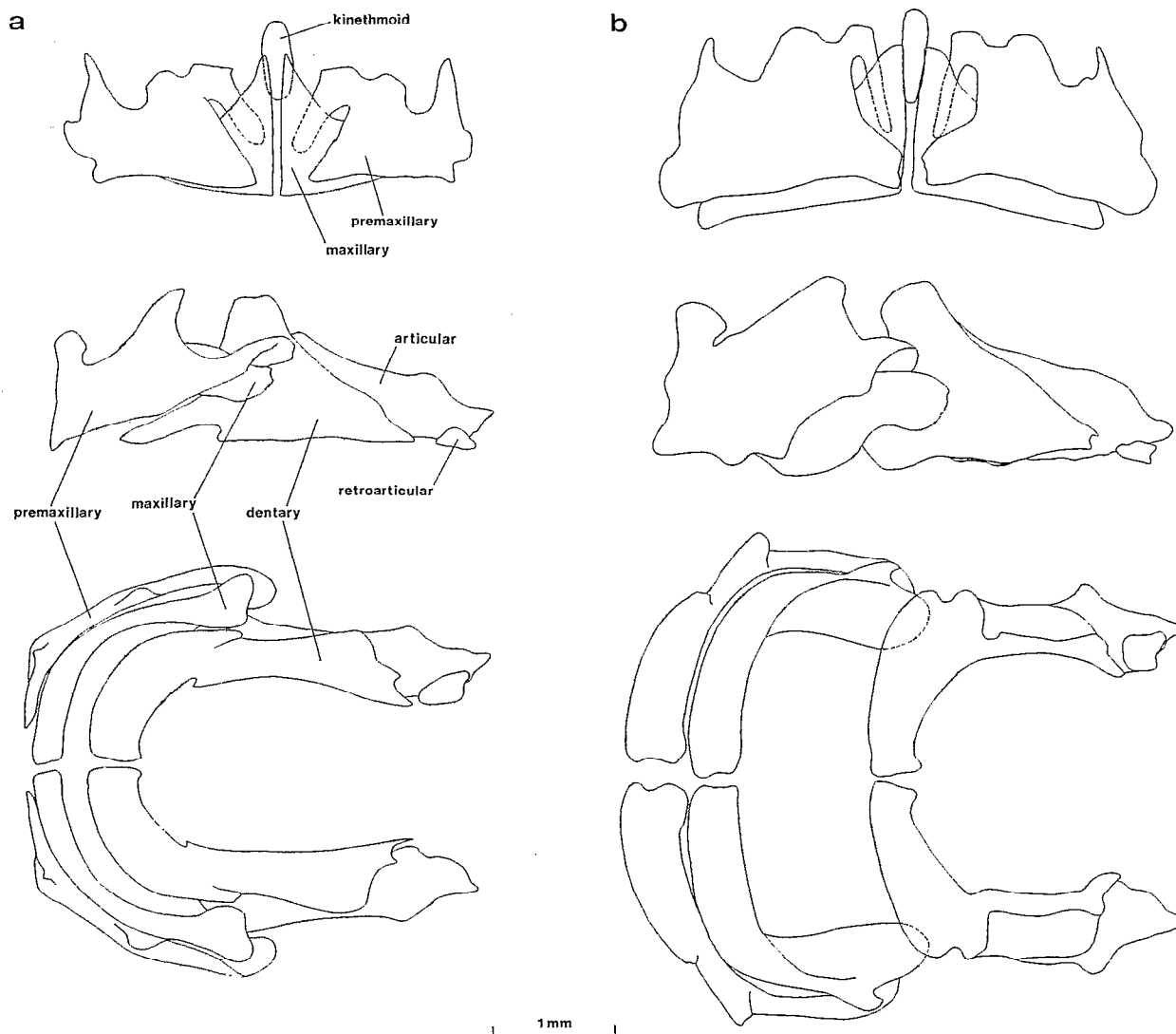


FIG. 4. — Jaws in frontal, lateral and ventral view: a: *G. allostoma*, 31.5 mm; b: *G. sp. undet.* Menchum, 31.7 mm (lower jaw displaced posteriorly in b).

Mâchoire en vue frontale, latérale et ventrale. a : *G. allostoma*, 31,5 mm; b : *G. sp. indet.* Menchum, 31,5 mm (mâchoire ventrale en position postérieure).

differ markedly in jaw structure, in shape as well as size of principal jaw bones (Fig. 4). In *G. sp. undet.* premaxillary, maxillary, and dentary are relatively massive. The anteromedial portions, supporting rostral cap and horny sheaths, are oriented at a right angle to the posterolateral portions, in conformity to the transverse mouth opening. The ventral surfaces are horizontally flattened. In *G. allostoma* the anteromedial portions are of relatively light construction, evenly curved, and with relatively narrow, rounded ventral surfaces.

Differences also occur in size and shape of the urohyal and glossohyal (Fig. 5). The urohyal of *G. sp. undet.* is relatively larger, with as longer posterodorsal projection and relatively broad ventrolateral wings. The glossohyal, on the other hand, presumably because its movement is limited due to dense fibrous connective tissue internal to the rigid mental disc, is relatively small and narrow. That of *G. allostoma* is larger and laterally expanded anteriorly.

Garra allostoma and *G. sp. undet.* were collected in

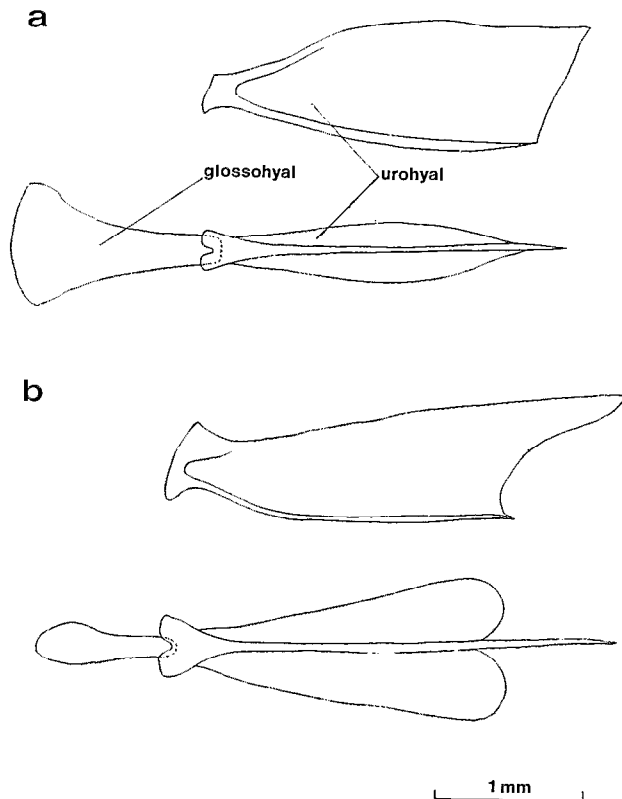


FIG. 5. — Urohyal in lateral view and urohyal and glossohyal in dorsal view. a: *G. allostoma*, 31.5 mm; b, *G. sp. undet.* Menchum, 31.7 mm.

Urohyale en vue latérale et urohyale et glossohyale en vue dorsale.
a : *G. allostoma*, 31,5 mm; b : *G. sp. indet.* Menchum, 31,7 mm.

rapids with predominantly rocky, gravelly, or coarse sandy bottom, in a steep, forested ravine approximately 100 to 300 meters downstream from a high waterfall. Individuals of the two species were closely associated, and no evidence was observed of habitat separation between them. Although none were in reproductive condition at the time of collection, presence of juveniles of both species of 18 mm or less suggests reproduction of both species just below the waterfall. While no collections were made in the Menchum above the waterfall, limited observations from a moving vehicle suggest that the river above the fall is a poor habitat for *Garra*. The waterfall appears to be an absolute barrier to upstream movement of any fish species, and a formidable if not impossible barrier to downstream movement. Hence it seems that *G. allostoma* and *G. sp. undet.* reproduce in close proximity to each other, and that

they live in virtually identical ecological conditions. No indication of phenetic or genetic intergradation of the two species has been observed in the 96 individuals sampled. All above 20.2 mm and some as small as 16 mm are identifiable to species according to presence or absence of a fimbriate rostral cap and mental disc with free posterior border. In juveniles under 25 mm, the mental disc of *Garra sp. undet.* is poorly developed and resembles that of *G. allostoma*. Very small *G. sp. undet.* also differ from larger individuals and resemble *G. allostoma* in having a relatively well developed upper lip. A few of the smallest specimens, excluded from the type series, are identified as *G. allostoma* even though the rostral cap has faint indications of what may be incipient rostral fimbriae. All *G. allostoma* above 20.2 mm have a smooth rostral cap. The rostral cap is fimbriate in all *G. sp. undet.* examined. Thus a 20.6 mm specimen clearly belongs to *G. allostoma*. It has a thin, non-fimbriate rostral cap; mental disc relatively small, without anterior tuberculate swelling and completely attached posteriorly. In the five smallest specimens of *Garra sp. undet.*, 17.8-20.6 mm, rostral cap is much thicker, fimbriate; mental disc swollen and with incipient tubercles anteriorly and free margin posteriorly. The gut of the 20.6 mm *G. allostoma* contained terrestrial and aquatic insects and had a total length of 20 mm. A 20.6 mm *G. sp. undet.* has gut length 70 mm, or 3.5X SL. In larger *G. allostoma* gut length remains about equal to body length, while in *G. sp. undet.* it increases to about 5X body length. Thus in two specimens of *G. allostoma* of 43.9 and 62.5 mm the gut is 55 and 70 mm long, respectively, whereas in *G. sp. undet.* of 52.2 and 66.3 mm its length is 284 and 376 mm or 5.5X SL. The striking differences in size and shape of jaw bones reported above are fully evident in the smallest specimens examined skeletally, *G. allostoma* of 23.0 mm and *G. sp. undet.* of 27.0 mm. These differences are strongly correlated with diet. Guts of five *G. allostoma* contained aquatic and terrestrial insects (including winged forms). For most of their length the guts were empty, insects occurring at irregular intervals; plant material absent. In five *G. sp. undet.* guts were uniformly filled for their entire length with vegetable matter and associated minute microscopic organisms, with no insects.

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