AN ECOLOGICAL AND SYSTEMATIC SURVEY OF FISHES IN THE RAPIDS OF THE LOWER ZAÏRE OR CONGO RIVER

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CONTENTS

ABSTRACT. Rapids habitats at nine localities along the mainstream of the Zaire River between Kinshasa and Matadi were fished extensively with rotenone during low water, yielding over 7000 specimens belonging to 129 species. A total of 17 families are represented, the most speciose being Mormyridae (19 species), Cyprinidae (19), Cichlidae (17), and Mochokidae (16). Limnological and ecological observations are reported for the rapids habitats, and the adaptations and mode of reproduction of the fishes discussed.

Nineteen new species are described from the Lower Zaire rapids, belonging to the genera *Mormyrus, Alestes, Labeo, Bagrus, Chrysichthys, Notoglanidium, Gymnallabes, Chiloglanis, Lamprologus, Nanochromis, Steatocranus, Teleogramma,* and *Mastacembelus,* most of them with obvious modifications for life in the rapids. *Caecomastacembelus* is placed in the synonymy of *Mastacembelus,* and morphologically intermediate hybrids reported between blind, depigmented *Mastacembelus brichardi* and normally eyed, darkly pigmented *Mastacembelus brachyrhinus.* The genera *Campylomormyrus* (elephant-snouted mormyrids), *Steatocranus* and *Teleogramma* are fully revised. Of 16 nominal species of *Campylomormyrus,* only three are regarded as biologically valid. In addition to one new *Steatocranus* from the mainstream of the Lower Zaire River, two new species of this rheophilic cichlid genus are described from elsewhere in the Zaire basin, making a total of 21 new fishes described in this paper. *Leptotilapia* is placed in the synonymy of *Steatocranus,* which now comprises eight species. *Bryconaethiops yseuxi* is shown to be a valid species, and data on the number of mandibular tooth families are used to distinguish the closely related *Atopochilus guentheri* and *A. royauxi.*

Two ecological categories of highly specialized rapids fishes are recognized: strongly rheophilic or current-loving, comprising 58 of the species in our survey, and hyporheic or intrusive, comprising eight species which evidently avoid light as well as strong current by delving deeply into the interstices offered by jumbled piles of rocks, and perhaps, in some cases, burrowing into mud or loose rubble. The most consistent evolutionary modification of the rapids fishes is reduction (but not complete loss) of the eyes. Of 66 highly specialized rapids fishes, 26 are microphthalmic (with small or minute eyes superficial in position), five cryptophthalmic (eyes reduced in size and partially or completely covered over by skin and

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Bull. Mus. Comp. Zool., 147(6): 239–317, February, 1976

other tissues), and only one is anophthalmic (totally without eyes). The most startling discovery of the survey is a cryptophthalmic cichlid of the genus *Lamprologus*. This is the first reported blind species of percoid fishes.

Some relationships between the rapids fishes and the ichthyofauna of the Zaire basin and of Africa as a whole are pointed out in the discussion. The opportunities for speciation and adaptation provided by rapids habitats have contributed significantly to the diversity of the highly endemic ichthyofauna of the Zaire basin, a process much less noticeable elsewhere in Africa, where highly specialized rapids fishes are relatively few. A few rheophilic genera, namely *Campylomormyrus, Atopochilus,* and *Steatocranus,* presumably evolved in the Zaire basin, subsequently spreading to one or more river systems in the adjacent Lower Guinean and Nilo-Sudanic ichthyofaunal provinces. The great majority of species of rapids fishes in the Zaire basin are endemic, many of them apparently restricted to the 300-km stretch of the Lower Zaire River between Kinshasa and Matadi. Most of the rapids genera, however, are widely (if discontinuously) distributed in the Zaire basin, wherever suitable habitat occurs. Perhaps the most striking aspect of the taxonomic composition of the Zairean rapids fishes is the preponderance of Cichlidae, which contributed more than a third of the endemic rapids species and also more than a third of the total number of individual specimens taken during our rapids survey. Such predominance of Cichlidae is a noteworthy contrast to the situation in rich riverine faunas everywhere else in Africa, including low gradient rivers in the Zaire basin, where cichlid species, endemic or not, are always few in number and seldom contribute substantially to the numbers of individuals present. Evolution in rocky rapids habitats may well have contributed to preadapt Zairean cichlids, including *Lamprologus,* to explosive lacustrine evolution along the rocky shores of Lake Tanganyika.

ACKNOWLEDGMENTS

The fieldwork for this survey was conducted with a grant from the National Geographic Society; we are grateful to the Society's Committee for Research and Exploration for their support. Permission to collect and export specimens for study was granted by the Office National de la Recherche et du Développement of the Republic of Zaire, under the direction of Dr. Nguete Kikhela. The Société Nationale d'Electricité (SNEL) granted permission for us to collect at Inga. We were greatly assisted on numerous occasions by the citizens of Zaire. A number of missions provided accommodations and other forms of assistance at various times, especially the Catholic mission at Tumba and the Protestant missions in Luozi and Kibunzi. In Kinshasa we received much help from our friends M. and Mde. R. LeFer.

For consulting with us on the rapids fishes and for helping with the identification of a number of species we found particularly troublesome, we are indebted to our friend and colleague, Prof. Max Poll, who has been studying and publishing on the fishes of Zaire steadily since 1932. Mr. Gordon Howes responded with his characteristic promptness and thoroughness to our requests for information about types and other specimens housed in the British Museum. Drs. Ruth Turner and John Lawrence, of the Museum of Comparative Zoology, kindly identified mollusks and insects recovered from the guts of our fish specimens. The photographs of fishes were prepared by Mr. Alphonse Coleman and Miss Paula Chandoha in the photographic lab of the Museum of Comparative Zoology, and were paid for by a grant from the Milton Fund of Harvard University. Publication was assisted by a grant from the Wetmore Colles Fund.

For the loan of specimens in their care, we express our thanks to Dr. Donn E. Rosen, American Museum of Natural History; Drs. William N. Eschmeyer and Warren C. Freihofer, California Academy of Sciences; Dr. Thys van den Audenaerde, Musée Royale de l'Afrique Centrale; and Dr. Reeve M. Bailey, Museum of Zoology of the University of Michigan. We are indebted to Dr. Ethelwynn Trewavas, British Museum (Natural History), for reviewing the manuscript and providing constructive criticism.

INTRODUCTION

The Zaire or Congo basin, with an area of 3,822,000 km, lies at the heart of Africa.

About 37% of its catchment is in the northern hemisphere and 63% in the southern. The Upper Zaire River or Lualaba arises in Zambia and flows northward to Kisangani; its catchment lies south of the Equator and includes lakes Bangweulu, Moero, Kivu, and Tanganyika. The Middle Zaire River flows westward in a great arc from Kisangani to Kinshasa. Its catchment comprises all of the Zaire basin north of the Equator and roughly two-thirds of that to the south, and includes the entire Cuvette Centrale. The largest tributaries in the Zaire basin, the Ubangui (also spelled Oubangui, Ubanghi, and Ubangi) in the north and the Kasai in the south, are received by the Middle Zaire River. The Lower Zaire River extends from the outlet of Malebo Pool to the sea. Its catchment extends from 3 to 6° south and comprises only 2% of the total area of the Zaire basin. The largest tributaries of the Lower Zaire River—the Inkisi, Kwilu, and Mpozo—are insignificant compared to the Ubangui and Kasai.

The Upper Zaire River and its tributaries are beset by numerous rapids, including those at the Portes d'Enfer, near where the Lualaba receives the Luvua, and the Stanley Falls, a series of falls and rapids in the last 150 km of the Lualaba immediately upstream from Kisangani. Major rapids occur in the Ubangui and Kasai rivers and in the upper portions of most important tributaries to the Middle Zaire River. (In contrast, the mainstream of the Middle Zaire River and some of its tributaries that arise entirely within the Cuvette Centrale are devoid of rapids; the slope of the Middle Zaire River never exceeds 8 cm per km). Almost all tributaries of the Lower Zaire River are high gradient streams with numerous rapids. Some of the tributaries, such as the Inkisi, have major falls where they enter the mainstream of the Zaire River.

At Kinshasa, having flowed all but 450 of its 4,650 km length, the Zaire River encounters a barrier formed by a rocky sill and expands into Malebo Pool. For the next 300 km, as the river flows over the sill and on through a gorge in the Crystal Mountains, it is broken by numerous cataracts, with intermittent stretches of calm water. The last of the rapids, just upstream from Matadi, are about 130 km from the sea. Between Kinshasa and Matadi the river drops 270 m; the average slope of this portion is therefore 90 cm per km. Recent collections in rapids habitats near the fishing village of Kinsuka, a few km downstream from Kinshasa, resulted in the discovery of several highly specialized fishes, including an extraordinarily flattened, microphthalmic clariid catfish and a cryptophthalmic mastacembelid eel (Poll, 1959, 1966, 1973; Roberts, 1968).

In 1973, with a grant from the National Geographic Society, we made ecological observations and collections of fishes at previously unsampled rapids localities between Kinshasa and Matadi. Most of the rapids fishes hitherto known only from Kinsuka were found further downstream. Nineteen new species were discovered, including several microphthalmic catfishes, three more strange mastacembelids, and the first known blind cichlid. The descriptions of these new species and identifications of all other species taken at the mainstream rapids localities where we were able to collect are presented in this paper. In connection with this work we have revised the mormyrid genus *Campylomormyrus* and the cichlid genera *Nanochromis sensu stricto, Steatocranus* and *Teleogramma.* Three new rapids-inhabiting *Steatocranus* are described, one from the mainstream of the Lower Zaire River, one from the Mpozo, and one from a tributary of the Ubangui River. All other new species described in this paper are from mainstream rapids in the Lower Zaire River.

Poll (1959) reported a total of 117 fish species from Malebo Pool, all of which are now known to be widely distributed in the Zaire River. Our survey brings the total number of species collected in or near rapids habitats along the mainstream of the

Lower Zaire River to 147. Of these, 34 are unknown elsewhere and are presumably endemic to this section of the river. The Zaire basin is thought to have been an interior drainage through the Miocene and most of the Pliocene, perhaps forming an immense lake or a series of lakes in the Cuvette Centrale. According to this theory, Malebo Pool lies at the western end of the former drainage, which was captured in the late Pliocene or early Pleistocene by a Lower Guinean coastal river (Cahen, 1954; Howell and Bourlière, 1963; Roberts, in press). If this interpretation is correct, the endemic fishes in the Lower Zaire rapids must have evolved subsequently, since before then the rapids habitats would have been too small and unstable, and the coastal stream would have been inhabited by a Lower Guinean ichthyofauna, lacking in many of the characteristic Zairean genera which have given rise to the endemic rapids species. The zoogeographic relationships among the fish faunas of Lower Guinea, Angola, and the Zaire basin are discussed by Roberts (in press).

LIMNOLOGY

An introductory account of the limnology of the Zaire basin is given by Marlier (1973). At Malebo Pool the discharge of the Zaire River fluctuates from 23,000 to 50,000 cubic meters per second. This relatively stable flow of the Lower Zaire River is mainly attributable to the humidifying and spongelike properties of the forests which cover much of the Zaire basin and to the seasonally alternating contributions of the huge northern and southern tributaries of the Middle Zaire River. The high water level in the Zaire mainstream is seldom more than 3 m above the low water level. The amplitude of the annual fluctuation is 2.38 m in the upper Lualaba, 2.68 m at Kisangani, 1.81 m at Mbandaka, rises to 3.5 m in the "channel" or narrow section immediately upstream from Malebo Pool, and falls to a little over 2 m in Malebo Pool (Marlier, 1973:226). At certain places where the gorge of the Lower Zaire River narrows to several hundred meters the amplitude may greatly exceed 3.5 m. Bequaert and Clench (1936: 161) reported a difference of from six to eight meters at Matadi. Concerning the rise and fall of water level at the beginning of the rapids, Poll (1959:91) quoted Pierre Brichard to the effect that the water rises from at least two meters at the northern end of the île des Mimosas to more than ten meters at the southern end of the île du telephone. The île du telephone is a large island about 3 km below the beginning of the rapids, which divides the mainstream into two narrow channels; the île des Mimosas is not named on our maps, but is presumably the small island at the very beginning of the rapids, connected to the mainland by a cement causeway. (Brichard is the aquarium fish collector who originally discovered the blind mastacembelid and other rapids fishes described by Poll.) On the steep walls of the gorge near Wombe, we observed high water marks fully ten meters above the level at the time of our visit (Plate 1, a).

Temperature, dissolved O_2, pH and alkalinity were routinely taken at our collecting stations; data for the mainstream of the Lower Zaire River between Kinshasa and Matadi and its northern and southern tributaries are recorded in Table 1. At all mainstream localities the water temperature was higher than in the tributaries, dissolved O_2 was high, pH near neutral, and alkalinity extremely low. Phenolthalein alkalinity was always zero. The relatively high pH and alkalinity of the southern tributaries is attributable to the limestone formations in which they originate. Our O_2, pH and alkalinity measurements were made with a water analysis kit manufactured by Hach Chemical Co., Ames, Iowa (model AL–36B). Proceeding downstream from Gombe to Inga we encountered a progressive lowering of mainstream water temperatures from 29°C to 24.7°C. Perhaps the main factors which contributed to this

TABLE 1. TEMPERATURES AND WATER CHEMISTRY FOR NORTHERN AND SOUTHERN TRIBUTARIES AND MAINSTREAM OF ZAIRE RIVER BETWEEN KINSHASA AND MATADI, 23 JUNE–1 SEPTEMBER 1973.

Localities (n)	Temperatures °C		Dissolved O_2 (mg/l)	pH	Alkalinity[1]
	Water	Air			
Northern tributaries (11)	19.0–23.9	21.5–28.8	8.0–9.0	7.0–8.5	1–12
Southern tributaries (13)	21.0–24.5	22.0–31.0	7.0–9.0	6.5–9.0	1–14
Mainstream (7)	24.7–29.0	23.3–30.0	8.0	7.0–7.5	2–3

[1] Total (Methyl Orange) alkalinity in grains/gal $CaCO_3$.

drop of 4.3°C in 270 km are 1.) evaporative cooling enhanced by turbulence; and 2.) input of tributary water averaging about 5°C cooler than that of the mainstream. If this explanation is correct, the downstream cooling could be a year-round phenomenon.

Light penetration in the Lower Zaire River is generally poor due to turbidity and to humic coloring substances arising in the Cuvette Centrale. Visibility of less than 10 cm was encountered at a depth of 3 m in a gently circulating backwater near Tadi. Even in still waters from which the suspended material had settled visibility was usually less than one meter. Roberts (1968:127) observed dense growths of plants resembling eel-grass and sea-lettuce on rocks in side channels of the rapids near Kinsuka, and we noted their continued presence during a brief visit to the same area in 1973. Such a concentration of aquatic macrophytes in the rapids of the Lower Zaire River is atypical. We saw virtually no higher aquatic plants in mainstream rapids habitats further downstream except dead or dying water hyacinth (*Eichhornia*), all or most of which had originated upstream. Plant growth seemed to be restricted to rocks just below the surface of the water. The luxuriance of macrophytes in the side channels of the rapids near Kinsuka is perhaps related to the relatively clear waters flowing from Malebo Pool, and the low amplitude of water level fluctuation in these particular channels. Even more important may be nutrients arising from Kinshasa. Our overall impression of the Lower Zaire River between Kinshasa and Matadi is one of low productivity. Crocodiles and hippopotamus, which might contribute to nutrient cycling, appear to be rare. We saw no crocodiles or crocodile tracks along the mainstream, nor did we hear reports of crocodile attacks on man. We saw the tracks of only one hippopotamus, at Isangila.

Three forms of encrusting sponges, the shrimp *Atya gabonensis* Giebel, insects, and a number of molluscs were the only aquatic macroinvertebrates encountered in the field. Stomachs of a few fishes from the rapids were later found to include potamonid crabs. Almost all of the mollusks encountered in rapids habitats in the Lower Zaire River are specialized for attachment to rocks. The following gastropods, identified by Dr. Ruth Turner, were found in the guts of fishes collected in the rapids:

Ampulariidae
  Pila leopoldvilliensis Putzeys
Bulimidae
  Bulimus (*Parabithynia*)
Assimineidae
  Septariellina congolensis Bequaert and Clench
Melaniidae
  Cleopatra broecki Putzeys
  Cleopatra hargeri Smith
  Cleopatra cf. *langi* Pilsbry and Clench
  Potadoma wansoni Bequaert and Clench.

Steatocranus gibbiceps, the most abundant fish species in our rapids collections, is apparently specialized for feeding on gastropods, which it ingests whole and without crushing; *Septariellina congolensis*

TABLE 2. NUMBERS OF SPECIES AND OF SPECIMENS OF FISHES TAKEN AT NINE COLLECTING LOCALITIES IN THE RAPIDS OF THE LOWER ZAIRE RIVER.

R & S locality no.	2	19	29	35	28	26	57	38	41
Species	64	44	49	57	55	27	21	63	71
Specimens	630	215	943	1505	961	118	112	1611	1054

has been identified in its gut contents. An account of the rheophilic mollusks in the Lower Zaire River is given by Bequaert and Clench (1936; 1941).

COLLECTING METHODS AND LOCALITIES

Fishes were collected from rapids habitats at nine localities along the mainstream of the Lower Zaire River (Figure 1) from late June through mid-August, 1973, during the period of low water. (Throughout this paper, these localities will be considered in the same sequence, proceeding downstream from Kinshasa.) The numbers of species and of specimens taken at each locality are indicated in Table 2. The great majority of specimens were obtained using rotenone and dip-nets, usually with the aid of several locally recruited helpers. Dip-nets were made of woven-meshed, plastic fly-screen. At most localities the collection is a composite of two or more samples taken with rotenone. In a few instances additional specimens were obtained by other methods.

R & S 2. Near Gombe (or Ngombe), about 20 km downstream from Kinshasa. Lat. 4°24′S, Long. 15°10.5′E. Water 29.0°C. 23–25 June.

Shoreline and river bed exposed by low water; huge boulders 1–3 m in diameter interspersed with fine sand. Two rotenone samples were made among boulders along the edge of the mainstream, in strong current where recovery of fishes was only fair. Two additional samples were made, one in a broad, shallow stream, less than a meter deep, with swiftly flowing water over a rock rubble bottom, the other in a side channel 1–1.5 m deep, with a strong, surging current and jumbled rock bottom. A few specimens were seined from relatively calm water on a sandy beach where a small tributary entered the mainstream. Our first specimens of *Teleogramma depressum* and *Mastacembelus brichardi* came from this locality.

R & S 19 (Plate 1, a). Near Wombe, about 10 km N of Gombe-Matadi and 1 km downstream from mouth of rivière Luasi. Lat. 4°54′S, Long. 14°42′E. Water 28.5°C. 5 July.

Gorge with steep, deep sides. Edges of mainstream with large piles of huge boulders, high sand beaches. Some previous high water marks on emergent rock piles and on the walls of the gorge were as much as 10 m above water level on the day of our collecting, but what appeared to be the most recent high water mark was only 3 or 4 m higher. Two rotenone samples were taken among huge boulders at the outer edge of an extensive rock pile jutting into the mainstream. Recovery of fishes was poor because of the strong current and marked surge.

R & S 29 (Plate 1, b). Near Bulu, about 15 km downstream from Luozi. Lat. 5°1′S, Long. 14°1′E. Water 26.7°C. 15 July and 18–19 August.

On July 15 a large rotenone sample was taken in a pool with rock sides 2–3 m high or more, in a water depth to 1.5 m over a bottom of extremely irregular, continuous rock rubble. The pool was at the narrow end of a long cove which had a gently surging current rising and falling 15–20 cm every five or ten minutes. With a half dozen volunteers from Bulu we succeeded in capturing almost all of the fishes which appeared at the surface during the sam-

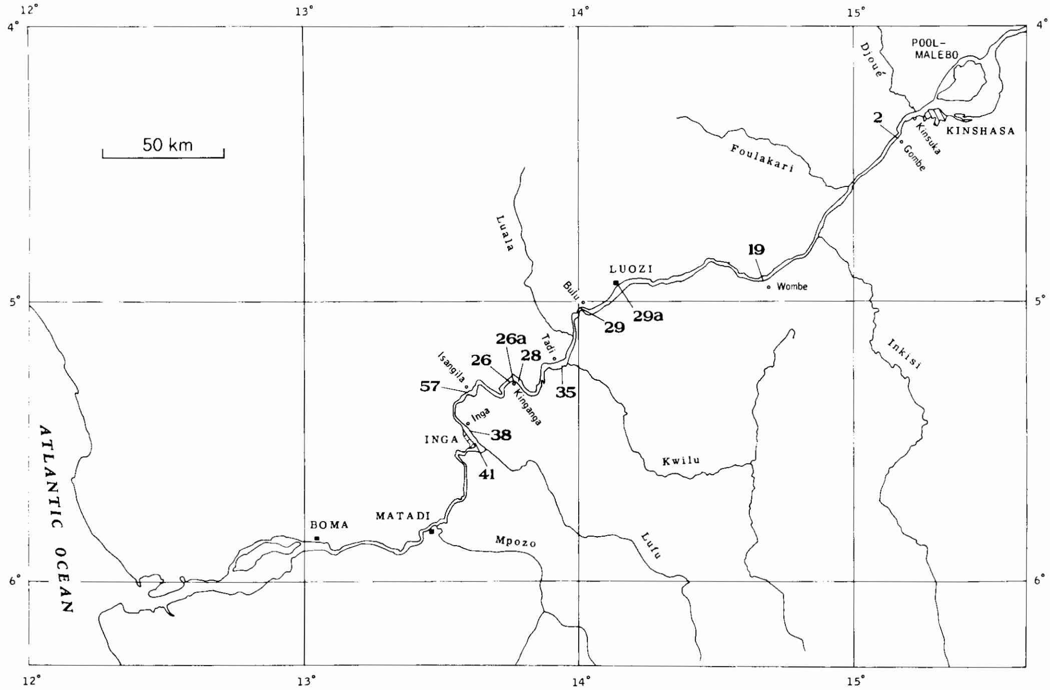

Figure 1. Map of Lower Zaire River, showing principal localities discussed in this paper.

pling. This pool yielded our one large series of *Mastacembelus crassus* and our only *Lamprologus lethops* and *Mastacembelus latens*. Two additional small rotenone samples were made, one on the edge of the mainstream current on the outside of the long cove, the other along a steeply shelving shore with hugh boulders and relatively calm water at the time of our collecting; recovery in both of these sites was poor. A few specimens were taken by seining on a sandy beach.

On August 18, a few days after the river had started to rise, this locality was revisited in an attempt to get another good rotenone sample and additional specimens of *Lamprologus lethops*. A sample was taken in the wide end of the long cove that had been partially sampled on July 15, but with poor results. The bottom at this end of the cove was mainly sand and mud, with only a few scattered rocks; water depth to 2 m. A second sample, taken about a kilometer downstream in a rocky cove broadly open to the strong mainstream current, was also poor because of the rising water. Returning to the long cove, a number of dead fishes were along the edge of the narrow end of the pool where the first *Lamprologus lethops* had been taken, and among them a dry and nearly complete specimen of this blind cichlid. A large number of clupeids and a few characins were taken in open water by fishing from a canoe at night with a large local dip-net used for fishing clupeids.

R & S 35 (*Plate 1, c*). Near Tadi, about 50 km downstream from Luozi. Lat. 5°14′S, Long. 13°56′E. Water 24.9°C. 21–22 July.

Long rocky points alternating with sandy embayments, because of vertically tipping sedimentary strata lying perpendicular to the river bed. One rotenone sample was made in a pool 1.5 m deep, with a bottom of rock rubble and sandy patches, which had become isolated from the mainstream not long before our visit. Fish were abundant and recovery good. Another rotenone sample was made in the narrow entrance to a long lagoon (Plate 1, c), where the water surged strongly over a rocky sill, in water .5 to 2 m deep. A dozen volunteers helped pick up fishes, and recovery was good. This sample site yielded our large series of *Notoglanidium pallidum.* A few large specimens of some of the commonest species were not preserved. A third rotenone sample was taken in a backwater up to 2 m deep with boulders 1–2 m in diameter and a silty or sandy bottom. Few fishes were present in this backwater, which yielded our only specimen of the completely eyeless clariid *Gymnallabes nops.*

R & S 28 (*Plate 1, d*). About 4–5 km upstream from Kinganga. Lat. 5°16′S, Long. 13°47′E. Water 27.4°C. 12 July.

At this locality we found an island perhaps 2 km long, 100–200 m wide, with a shallow valley running its full length and rocky sides rising to 20 m. An intermittent series of large pools, some of them largely dry, extended the length of the valley. A rise in water level of two or three meters would presumably cause a raging torrent to pass through this valley. A large rotenone sample was taken in a pool at the lower end of the island. The pool, about 50 m long and 30 m wide, was up to 1.8 m deep but mostly shallower, with an extremely irregular bottom of rock rubble. Water was gently flowing out of the pool through a much constricted, shallow connection to the mainstream, but otherwise the water in the pool appeared to be still. Recovery of fishes was only fair, because of the extremely rough bottom, and the presence of electric catfishes which had not entirely succumbed. A few large fishes were not preserved, including a 550-mm specimen of *Lates niloticus,* the only one that we saw in the rapids. Pick-up was curtailed by nightfall. One other rotenone sample was taken, in a small area on the edge of the mainstream on the outer side of the island (Plate 1, d). A strong current flowed through vertically tipped sedimentary rocks with knifelike edges in strata parallel to the current; depth .5–1 m. Recovery fair. Our first specimens of *Mormyrus iriodes* were obtained from fishermen near the island.

R & S 26. A few kilometers downstream from Kinganga, below the mouth of the rivière Grande-Pukusi. Lat. 5°20′S, Long. 13°43′E. Water 27.4°C. 11 July.

Two parallel points of obliquely tipping sedimentary strata, 7–10 m wide, extended about 50 m into the mainstream. A single rotenone sample was taken between the points, in water up to 2 m deep over a predominantly silty sand bottom. Fishes were small and few in number; recovery fair. The sample included three of our four specimens of the tiny cichlid *Nanochromis minor.*

R & S 57. Near Isangila. Lat. 5°18′S, Long. 13°36′E. Mainstream water temperature not recorded. 15 August.

The river bed near Isangila is very broad; low water exposed extensive rock piles, cobblestones, and sandy beaches. Less than a kilometer downstream from Isangila, a small tributary flowed into a braided channel, forming pools with rocky and sandy bottoms. Water flowing into these pools from the tributary was 20.5°C. At high water the pools would be covered by the mainstream. A rotenone sample was made in a pool 20 m in diameter and up to 2 m deep, and in the shallow braided channel which constituted its outlet and flowed into the mainstream about 200 m away. Rel-

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Plate 1

Zaire River between Kinshasa and Matadi at low water (late June through early August, 1973), looking downstream.

a. At Wombe. Excellent view of gorge. At high water river rises above rocks at center of picture and covers dark areas on base of cliffs. Collections were made at outer edge of rock-pile jutting into river (R & S 19). 23 June.

Plate 1

b. At Bulu. Mainstream to the left. About three or four weeks before river started to rise. A large collection was made at narrow end of large pool near center of picture (R & S 29). This pool is the type locality of *Notoglanidium pallidum*, *Lamprologus lethops*, *Mastacembelus crassus*, and *Mastacembelus latens.* 15 July.
c. Opposite Tadi. Near type locality of *Chrysichthys helicophagus* and *Gymnnalbes nops* (R & S 35). 21 July.
d. About 5 km upstream from Kinganga (R & S 28). 12 July.
e. A few kilometers upstream from Inga hydroelectric installation, on opposite side of river. Near type locality of *Chiloglanis carnosus*, *Nanochromis parilus*, *Nanochromis splendens*, and *Teleogramma depressum* (R & S 38). 1 August.
f. About a kilometer directly West of Inga hydroelectric installation. Portion of long channel from which bulk of specimens at R & S 41 were collected. This channel is the type locality of *Mormyrus cyaneus*, *Mormyrus iriodes*, *Labeo lividus*, *Bagrus caeruleus*, and *Mastacembelus aviceps.* 4 August.

atively few kinds of fishes were present; recovery fair.

A few kilometers downstream the river narrows considerably. At this point we found rocky promontories jutting well into the mainstream, with a series of high isolated pools, up to at least 5 m above the river level, which was near its lowest at this time. A rotenone sample was made in one large pool, which must have formed part of the mainstream rapids at high water, but it did not have any specialized rapids fishes. Recovery was good; pick-up was curtailed by nightfall, and some larger fishes were not preserved.

R & S 38 (*Plate 1, e*). Near village of Inga, a few kilometers upstream and on the opposite side of the river from Inga hydroelectric dam. Lat. 5°27.5′S, Long. 13°36′E. Water 24.7°C. 1 August.

A continuous rapids 10–12 km long commences near the village of Inga. This is probably the most extensive rapids in the Lower Zaire River. A large rotenone sample was made in a long, narrow side channel, .5 to 2 m deep, with a strong current. At the upper 20 m of the channel, separated from the mainstream only by a wall of rock, the channel was only 1–3 m wide, with a rocky bottom. Before re-entering the mainstream it expanded into a lagoon about 40 m wide and 2 m deep with sand and rock bottom. Fishes were abundant; recovery good. This site yielded our first specimens of *Mastacembelus aviceps.* Another sample was taken in a small, surging backwater open at its upper end to the strong mainstream current. The backwater had high rock walls, and except at very low water it must be covered by a terrific current. The backwater was 20 m long and 1 m deep, with an extremely rocky bottom. Fishes were abundant; recovery good. Large numbers of *Mormyrops engystoma, Stomatorhinus* sp. or spp., and *Steatocranus tinanti* were collected. A third rotenone sample was made in a pool about 100 m from the mainstream and connected to it by a narrow channel, with water slowly surging in and out; depth .5 to 1.5 m, bottom rocky with patches of sand. Fishes were small but numerous; recovery good.

R & S 41 (*Plate 1, f*). Near Inga hydroelectric dam. Lat. 5°31.5′S, Long. 13°37.5′E. Water 24.8°C. 4–6 August.

At the dam site a 50 m head of water is obtained for hydroelectric power in about 8 km indicating a drop of about 6 meters per kilometer. At high water the river is three or four kilometers wide, but at low water it is confined to a channel less than a kilometer wide. The low water channel is narrowest where it passes to the left bank of the "coude de Inga", where the main course of the river suddenly makes a 120° turn from southeast to due west. The resulting cataracts are awesome, leaping, and throwing spray high into the air. On the right bank of the coude, low water exposes a huge area of rocky river bed two or three kilometers wide, laced with a number of channels with flowing water.

A very large rotenone sample was taken from about one kilometer of a long channel, with moderate current, numerous pools, and a predominantly rocky bottom. The place where rotenone was initially applied is shown in Plate 1, f. At one point the channel flowed strongly for several meters underneath huge boulders; almost all of the *Mormyrus* and *Rheoglanis* taken at this locality came from under these boulders. Some fishes were so abundant that all of them could not be preserved, including two or three hundred *Gymnallabes tihoni*, and were distributed among the half-dozen volunteers assisting us. A few small rotenone samples were made in shorter stretches of nearby channels with sandier bottoms; these comprised relatively few specimens and did not include any additional species. Three discrete small rotenone samples were taken, all from small, isolated, rocky pools near the mainstream, with sandy bottoms, one a few kilometers upstream from our main sampling site, the other two several kilometers downstream. These small samples, which were combined in the field, include our only specimens of *Nanochromis consortus* and *Steatocranus glaber.* Our only Lower Zaire specimen of *Alestes comptus* was recognized in the field and came from the upstream sample.

TABULATION OF SPECIES COLLECTED FROM RAPIDS IN THE LOWER ZAIRE RIVER

In Table 3 are listed all species, and almost all specimens, of fishes collected by us in or near rapids habitats along the mainstream of the Lower Zaire River. The only other specimens obtained from the Lower Zaire River between Kinshasa and Matadi were a few large Mormyridae and *Synodontis* purchased from fishermen at Luozi (R & S 29a, MCZ 50566–50572), and some small fishes, mostly Clupeidae and Cyprinidae, captured at night near Kinganga (R & S 26a, MCZ 50573–50581).

Disposition of specimens. All of the specimens in Table 3 were initially catalogued into the fish collection of the Museum of Comparative Zoology as MCZ 50100–50565, except the holotype of *Bagrus caeruleus,* which was subsequently given MCZ 50582. A few specimens, all or almost all from large lots, were used for alizarin preparations; these retain the original MCZ catalog numbers. Paratypes of most of the new species have been sent to the Musée Royale de l'Afrique Centrale (Tervuren), British Museum (Natural History), and Smithsonian Institution.

A representative series from the collection has been designated for the Republique of Zaire, and the Directeur-general of the Office National de la Recherche et du Développment in Kinshasa has been so informed.

SYSTEMATICS

The authorities as well as the identifications of all species encountered during our mainstream rapids survey are cited in Table 3. In the present section we describe 19 new species from the Lower Zaire rapids, belonging to the genera *Mormyrus, Alestes, Labeo, Bagrus, Chrysichthys, Notoglanidium, Gymnallabes, Chiloglanis, Lamprologus, Nanochromis, Steatocranus, Teleogramma,* and *Mastacembelus.* The genera *Campylomormyrus, Nanochromis sensu stricto, Steatocranus,* and *Teleogramma* are fully revised, and two additional new species of *Steatocranus* described, one from the rivière Mpozo in Lower Zaire, the other from the rivière Mbomou in Ubangui. A lectotype is designated for *Nanochromis nudiceps.*

Caecomastacembelus is placed in the synonymy of *Mastacembelus*; intergrades, tentatively interpreted as interspecific hybrids, are reported between the cryptophthalmic, depigmented *Mastacembelus brichardi* and *Mastacembelus brachyrhinus,* its microphthalmic and darkly pigmented close relative. Systematic observations are also presented for the genera *Bryconaethiops* and *Atopochilus.* The rheophilic species *B. yseuxi,* hitherto placed in the synonymy of *B. microstoma,* is shown to be valid. Data are presented on the number of mandibular tooth families in *A. guentheri* and *royauxi,* a character which can be used to distinguish these closely similar species at all sizes.

Of the as yet unresolved systematic problems posed by our rapids material, two may be commented upon. A new *Amphilius* is to be described by Prof. Max Poll, to whom our material has been sent for study. Perhaps the outstanding problem is that represented by *Stomatorhinus,* of which a dozen species have been named, with little consideration for possible intraspecific variation. At several rapids localities we found two or three phena, but the distinctions between them were sometimes blurred by variability. We found it especially difficult to sort out the numerous juveniles obtained. In short, we feel that *Stomatorhinus* should be revised before any specimens are identified or additional new species described, and that the revision must be based on a good geographical representa-

TABLE 3. NUMBER OF SPECIMENS AND STANDARD LENGTH TO NEAREST MM OF ALL SPECIES OBTAINED AT NINE COLLECTING LOCALITIES ON THE LOWER ZAIRE RIVER. Species printed in boldface are dealt with in the systematics section of this paper. These specimens have received catalog numbers MCZ 50100–50565, 50582 in the fish collection of the Museum of Comparative Zoology, excepting the 550-mm *Lates niloticus* from R & S 28, which was not preserved.

	R & S 2	R & S 19	R & S 29	R & S 35	R & S 28	R & S 26	R & S 57	R & S 38	R & S 41
POLYPTERIDAE									
Polypterus ornatipinnis Boul. 1902	2:68–109				3:84–178			1:367	
CLUPEIDAE									
Microthrissa minuta Poll 1974			3:44–45	3:13–43	7:15–24		1:37		
Nannothrissa parva (Regan) 1917						1:21			
Odaxothrissa vittata Regan 1917	1:65		4:50–64		116:28–79	2:33–34	59:30–67		6:40–67
Poecilothrissa congica Regan 1917	1:38	1:41	73:45–54				6:28–55		8:30–50
Potamothrissa acutirostris (Boul.) 1909	1:29		2:63						
Potamothrissa obtusirostris Boul. 1909			59:56–65						3:37–57
MORMYRIDAE									
Campylomormyrus mirus (Boul.) 1898		1:104							
Campylomormyrus rhynchophorus (Boul.) 1898	6:48–113	11:29–135	3:105–169	1:365			1:105	5:55–86	21:41–99
Hippopotamyrus psittacus (Boul.) 1897		1:63							
Hippopotamyrus macrops (Boul.) 1909					1:170			1:71	
Marcusenius monteiri (Günther) 1873			2:82–101				10:100–114		
Mormyrops deliciosus (Leach) 1818	29:33–172	4:45–77	1:69	2:61–98	2:52–62	2:73–80		24:70–148	2:72–91
Mormyrops mariae (Schilthuis) 1891	6:112–265	2:135–150		5:87–175	4:142–274			8:30–289	3:194–288
Mormyrops engystoma Boul. 1898	7:76–156	33:57–160	3:91–159	47:35–168	34:59–160	1:97		2:120–125	5:68–137
Mormyrops masuianus Boul. 1898	3:85–196								
Mormyrus proboscirostris Boul. 1898	1:154							1:189	
Mormyrus bumbanus Boul. 1909	7:27–107	1:44	2:64–115					3:81–102	11:90–179
Mormyrus cyaneus new species				2:70–102				3:90–133	47:45–260
Mormyrus iriodes new species				1:86	4:217–270			1:73	15:62–160
Myomyrus macrodon Boul. 1898	1:61	2:52–55	21:18–135	49:22–148	14:42–136			43:20–183	25:40–209
Myomyrus pharao Poll & Taverne 1967	1:71	3:59–82	2:18–60	23:18–129	4:45–66			12:32–68	4:55–83
Petrocephalus simus (Sauvage) 1878	19:40–72	2:44–74		3:54–58	6:48–54				
Petrocephalus grandoculis Boul. 1920		1:58							
Pollimyrus plagiostoma (Boul.) 1898	2:107–108			3:159–172					12:69–150
Stomatorhinus sp. or spp.	3:65–90	21:17–72	36:25–94	179:27–92	80:18–86	5:16–45		34:23–96	40:19–94
CHARACIDAE									
Alestes macrolepidotus (Cuv. & Val.) 1849	13:17–93	1:63		15:33–66	5:51–64	8:50–76		18:46–151	
Alestes imberi Peters 1852		6:30–51	2:34–47			1:30	1:61	2:39–61	6:47–72

TABLE 3. (CONTINUED)

	R & S 2	R & S 19	R & S 29	R & S 35	R & S 28	R & S 26	R & S 57	R & S 38	R & S 41
Alestes liebrechtsii Boul. 1898			1:99	3:23–41		10:30–54			
Alestes comptus new species									1:55
Bryconaethiops yseuxi Boul. 1899	1:62	5:47–61						2:53–64	6:14–58
Hydrocynus lineatus Bleeker 1862							1:105		
Hydrocynus goliath Boul. 1898			1:39				1:83		
Micralestes acutidens (Peters) 1852						1:53			
Micralestes humilis Boul. 1899	4:22–48		4:41–51			2:30–38		1:46	2:30–47
DISTICHODONTIDAE									
Distichodus mossambicus Peters 1852					1:37			2:53–64	9:81–104
Distichodus antonii Schilthuis 1891	10:57–98	1:64	2:59–65	25:20–101	1:32	8:21–50		3:57–99	7:28–106
Distichodus lusosso Schilthuis 1891			1:52	12:29–48	3:32–42	3:25–29		1:35	2:41–63
Distichodus sexfasciatus Boul. 1897	5:16–43	2:71–78		4:23–47		2:19–23			
Distichodus atroventralis Boul. 1898	1:52			2:22–24		2:24–28			4:33–84
Distichodus fasciolatus Boul. 1898	1:44	1:19	3:42–64	6:24–53	6:33–42			9:35–69	4:39–54
Distichodus maculatus Boul. 1898							1:51		1:81
Nannocharax macropterus Pellegrin 1925	1:31								
CITHARINIDAE									
Citharinus congicus Boul. 1897							1:131		
Citharinus gibbosus Boul. 1899					8:77–128			4:69–120	
Citharinus macrolepis Boul. 1899							1:118		
CYPRINIDAE									
Barbus pleuropholis Boul. 1899					9:33–39				
Barilius weeksii Boul. 1909	1:56								
Barilius lujae Boul. 1909	5:33–98	6:11–14	18:11–34	7:10–16	4:11–24	2:10–20	8:28–33	5:19–89	30:8–77
Chelaethiops elongatus Boul. 1899	1:29		1:36		2:42–48				
Engraulicypris congicus Nich. & Gris. 1917	1:51								
Garra congoensis Poll 1959	8:17–37	3:16–33		7:18–36			1:70		7:38–62
Labeo barbatus Boul. 1898	20:53–103	2:54–77		8:53–80	11:42–70			11:56–74	1:55
Labeo lineatus Boul. 1898	1:173						1:136		2:93–100
Labeo macrostoma Boul. 1898				2:76–81				11:79–125	8:59–217
Labeo velifer Boul. 1898	5:71–173	1:71		2:60–86	3:49–67	2:39–49		5:56–82	1:71
Labeo cyclorhynchus Boul. 1899	1:128								
Labeo nasus Boul. 1899	7:52–158		26:18–57	10:37–91	7:29–78			52:22–158	19:27–201
Labeo variegatus Pellegrin 1901	14:53–89	2:62–68						5:58–82	

TABLE 3. (CONTINUED)

	R & S 2	R & S 19	R & S 29	R & S 35	R & S 28	R & S 26	R & S 57	R & S 38	R & S 41
Labeo greenii Boul. 1902				1:87				1:142	1:121
Labeo weeksii Boul. 1909	1:114								
Labeo sorex Nich. & Gris. 1917	13:27–124	3:26–121	34:19–44					11:35–185	11:58–123
Labeo lividus new species			10:57–89	5:53–89	1:72			4:60–79	6:74–239
Labeo undet. juv.	41:18–38			82:14–30	29:17–25	12:13–24			
Leptocypris modestus Boul. 1902	2:43–50		1:60						
Varicorhinus macrolepidotus Pellegrin 1928									13:100–161
BAGRIDAE									
Auchenoglanis occidentalis (Cuv. & Val.) 1840				2:40–45				1:146	
Bagrus ubangensis Boul. 1902	1:91								
Bagrus caeruleus new species	2:109–210								4:80–164
Chrysichthys cf. *cranchii* (Leach) 1818	3:21–124	4:14–59	3:13–85	29:17–85	5:23–112	5:19–21		37:22–153	4:98–181
Chrysichthys brevibarbus (Boul.) 1899					3:55–91				
Chrysichthys delhezi Boul. 1899	4:81–150	3:46–167		11:51–107	22:27–159		4:71–83	14:64–125	4:131–175
Chrysichthys longibarbus (Boul.) 1899			3:32–34		1:145			1:55	
Chrysichthys helicophagus new species				*6:71–103	2:66–80				1:91
Chrysichthys undet. (very small eyes)					1:81				
Notoglandium pallidum new species			2:20–53	26:19–83	1:73				
Rheoglanis dendrophorus Poll 1966									31:76–320
SCHILBEIDAE									
Eutropius grenfelli Boul. 1900	1:102	1:74							
Schilbe mystus (Linnaeus) 1762							1:85	6:65–103	1:109
AMPHILIIDAE									
Amphilius new species?	1:72			1:69				3:62–86	35:30–90
Doumea alula Nich. & Gris. 1917									47:51–112
Phractura lindica Boul. 1902								3:43–58	124:44–84
CLARIIDAE									
Clarias longibarbus David & Poll 1937	2:68–73	1:102	1:135	1:97			3:70–86		3:59–78
Gymnallabes tihoni Poll 1944			56:46–376	5:93–174				13:61–268	94:33–310
Gymnallabes nops new species				1:57					
Heterobranchus longifilis Cuv. & Val. 1840								1:345	

TABLE 3. (CONTINUED)

	R & S 2	R & S 19	R & S 29	R & S 35	R & S 28	R & S 26	R & S 57	R & S 38	R & S 41
MALAPTERURIDAE									
Malapterurus electricus (Gmelin) 1789	5:51–69	2:61–62	1:87	1:69	1:91			4:74–105	
MOCHOKIDAE									
Atopochilus guentheri Schilthuis 1891	4:28–89	3:21–135		4:56–106	2:65–67			2:58–70	26:57–230
Atopochilus royauxi (Boul.) 1902	4:69–201								1:185
Chiloglanis congicus Boul. 1920	2:35–40								13:48–87
Chiloglanis carnosus new species			26:21–58	1:32	7:32–47			16:24–58	27:20–61
Synodontis alberti Schilthuis 1891	2:45–50				2:65–74			5:77–93	
Synodontis greshoffi Schilthuis 1891	150:22–86	4:30–80		7:32–53	2:26–32	3:37–45		11:37–90	
Synodontis notatus Vaillant 1893		1:49	1:81				1:49	1:66	
Synodontis pleurops Boul. 1897		1:62							
Synodontis acanthomias Boul. 1899	74:28–125	6:29–104	1:48	9:33–102	11:28–138			2:55–131	
Synodontis caudalis Boul. 1899								1:51	14:52–89
Synodontis decorus Boul. 1899	3:49–86	3:33–60			3:40–46				1:89
Synodontis nummifer Boul. 1899					3:36–59				
Synodontis soloni Boul. 1899	31:26–93	4:27–58	2:48–56	1:55					3:62–74
Synodontis longirostris Boul. 1902			13:53–120	14:41–120	3:50–93			1:79	5:53–79
Synodontis nigriventris David 1936	1:25								
Synodontis brichardi Poll 1959				1:53					13:54–118
CENTROPOMIDAE									
Lates niloticus (Linnaeus) 1762					1:550				
CICHLIDAE									
Haplochromis demeusii (Boul.) 1899			4:35–50	8:35–68	7:16–64	12:12–55		42:22–101	10:16–88
Haplochromis polli Thys 1964	10:19–46								
Hemichromis bimaculatus Gill 1862									1:24
Lamprologus cf. *moquardii* Pellegrin 1903									24:9–50
Lamprologus werneri Poll 1959	24:30–66	17:13–60	3:27–43	72:14–74	80:12–76	5:15–46	6:41–71	220:15–70	14:18–62
Lamprologus lethops new species			2:27–88						
Nanochromis consortus new species									6:26–52
Nanochromis parilus new species		11:11–41	1:31	3:32–42	5:19–42	14:13–44		39:22–44	
Nanochromis minor new species				1:24		3:21–23			
Nanochromis splendens new species				61:13–45	87:14–42	5:9–34		171:16–45	28:15–43
Nanochromis undet.		2:16–29			1:27	2:36–41		4:32–41	1:25

TABLE 3. (CONTINUED)

	R & S 2	R & S 19	R & S 29	R & S 35	R & S 28	R & S 26	R & S 57	R & S 38	R & S 41
Steatocranus gibbiceps Boul. 1899	5:36–46	15:20–42	58:15–80	318:9–75	113:17–54	2:27–29		275:15–68	74:16–84
Steatocranus casuarius Poll 1939	10:12–66	12:20–55		76:10–62	37:15–66	3:20–40		94:15–77	3:14–64
Steatocranus tinanti (Poll) 1939	24:23–44	7:22–36		15:28–44				140:16–55	
Steatocranus glaber new species									19:11–53
Teleogramma gracile Boul. 1899			135:13–65	120:17–71					
Teleogramma depressum new species	18:32–60				17:24–76			64:17–90	19:29–95
Tylochromis lateralis (Boul.) 1898			1:28		14:21–145				
MASTACEMBELIDAE									
Mastacembelus cf. marchei Sauvage 1878				3:286–335	2:316–342				9:134–315
Mastacembelus congicus Boul. 1896	1:153							1:382	3:106–187
Mastacembelus paucispinis Boul. 1899							1:280	1:270	30:60–388
Mastacembelus brachyrhinus Boul. 1899			27:40–142				3:123–126		9:68–164
Mastacembelus brichardi (Poll) 1959	1:114	2:101–106	102:37–139	185:35–122	162:20–133			135:31–140	
Mastacembelus brachyrhinus × brichardi			6:26–145						
Mastacembelus crassus new species			177:35–158	14:54–123	1:75				
Mastacembelus latens new species			3:48–72						
Mastacembelus aviceps new species								17:40–112	10:50–125
TETRAODONTIDAE									
Tetraodon mbu Boul. 1899								1:179	

tion of population samples and re-examination of type material.

Conventions. Unless indicated otherwise in the accompanying text or tables, all measurements of specimen length are of standard length, and all proportional measurements are expressed as percent of standard length. The following abbreviations are used for institutions holding material examined:

MCZ Museum of Comparative Zoology
AMNH American Museum of Natural History
RGMC Musée Royale de l'Afrique Centrale
SU California Academy of Sciences (material formerly at Stanford University)
UMMZ University of Michigan Museum of Zoology.

Campylomormyrus **Bleeker 1874**

Type species: *Mormyrus tamandua* Günther 1864, by original designation.

Mouth tubular, snout longer than postorbital portion of head. Jaw teeth conical, truncate, or bicuspid, 2–8 in upper and 3–6 in lower jaw. Barbel well-developed. Nostrils closer to eyes than to end of snout. Circumorbital bones five. Lateral ethmoid bone absent. Dorsal fin moderately long, with 26–35 rays, its origin slightly more posterior than anal fin origin. Anal fin as long as, or slightly longer than dorsal fin, with 29–37 rays. Pectoral rays 11 or 12. Lateral line scales 70–95. Vertebrae 45–49.

Bones sharing in the elongation of the snout include the frontals, nasals, parasphenoid, articulars, and dentaries, all extending for almost the full length of the snout. The orbitosphenoid extends into the basal portion of the snout, while the mesethmoid lies distally. The tooth-bearing premaxillary and toothless maxillary bones are very short.

Treated as a synonym of *Gnathonemus* Gill 1862 by Boulenger, *Campylomormyrus* was recognized by Pappenheim (1907a, b) and has been reinstated by Taverne (1968a). Taverne restricted *Gnathonemus* (type species: *Mormyrus petersii* Günther 1862) to species with a moderately elongate snout; terminal or but slightly tubular mouth; fleshy, elongate, cylindrical mentum; four circumorbital bones; and 22–28 dorsal fin rays. Taverne revised the species of *Gnathonemus sensu stricto* and described its osteology. In another paper, Taverne (1968b) described the osteology of *Campylomormyrus* but did not revise the species.

Generic separation of *Campylomormyrus* and *Gnathonemus* is supported by the differences in their habitats. *Gnathonemus* are virtually absent from the largest rivers, occurring rather in secondary tributaries and even small forest streams three to five meters wide. They are also found in backwaters and forest swamps, habitats never occupied by *Campylomormyrus*. In general, the nature of the bottom in *Gnathonemus* habitats is largely determined by the surrounding terrestrial vegetation (usually forest). Submerged tree trunks, branches, and roots, and overhanging banks anchored by roots, are typical features, whereas rocks are absent. We have collected *Gnathonemus* on numerous occasions, but never in association with *Campylomormyrus*.

Campylomormyrus feed predominantly on aquatic insects. Matthes (1964:39) recorded *mirus* from lac Tumba with stomach contents of dead plant debris, decomposing animal debris, and larvae of *Povilla*, chironomids, and odonates. Stomach contents of the 104-mm *mirus* from Wombe, R & S 19, consisted exclusively of trichopteran larvae. A 202-mm *mirus* from Bangui (with a short, stubby barbel) had almost all Chironomidae, with a few trichopterans and small ephemeropterans. The 125-mm *mirus* from Bangui (with an elongate barbel) had trichopterans exclusively. In *rhynchophorus*, a 225-mm specimen from the rivière Mbomou had Simuliidae, Chironomidae, and trichopterans about equally abundant, and a few small ephemeropterans. Of particular interest are the stomach contents of the three large *rhynchophorus* from Luozi. Although their snout lengths are very different, all three had large numbers of trichopteran larvae and little else in their stomachs; the 376-mm specimen also had a few large ephemeropteran nymphs.

Of the 16 nominal species assigned to *Campylomormyrus* (Taverne, 1972:168–169), 14 are known only from the Zaire basin. Too much emphasis has been placed on snout form and slight differences in scale and fin-ray counts, without allowance for geographical or even individual variation. Population samples have seldom been collected, and most descriptions are based on one or a few specimens only, often either juveniles or exceptionally large adults. Our studies indicate there are only three biologically distinct species: *tamandua, mirus,* and *rhynchophorus.*

Remarks on taxonomic characters

Length. Boulenger, and sometimes Pellegrin and Poll, reported lengths as "longueur totale" without defining this measurement. In some instances (involving fishes other than mormyroids), Boulenger's "longueur totale" is apparently fork length. Lengths of specimens cited by other authors have been quoted to give a general indication of size, and thus no attempt has been made to determine them more precisely. Our own measurements of length are all standard length.

Snout length. Measured from tip of upper jaw to lower margin of eye.

Snout width. Horizontal width of snout taken midway between lower profile of head and tip of upper jaw.

Snout curvature. Measured from tip of upper jaw through middle of eye, expressed as degrees of departure from horizontal axis of body. As horizontal axis of body is often difficult to determine precisely, this measurement is approximate.

Dorsal and anal fin ray counts. These include three unbranched anterior rays, the first of which is small and likely to be overlooked. The last ray, usually thickened and sometimes split to its base, is counted as one.

Longitudinal scale rows. In *Campylomormyrus,* especially *C. rhynchophorus,* it is difficult to make an exact count of longitudinal scale rows. The scales are often covered with thick mucus which is difficult to remove without deranging them. Often the rows are slightly irregular, with gaps or smaller scales interposed, especially along the lateral line. Posteriorly the scales become larger and regularly overlapping, so counting them is relatively easy; but anteriorly scales are small, do not overlap as regularly, and spacing between them is variable. Our counts begin just above or above and slightly behind the gill opening and continue to the end of the hypural fan. They are generally repeatable by us to within five scales. Counts cited by other authors, and quoted here, may in some instances include scales beyond the end of the hypural fan.

Circumpeduncular scale count. This count has been almost invariably cited as 12, 16, 16–18, or 20. In some instances counts of 12 vs. 16 or of 16 vs. 20 were used to distinguish species. We find counts of 12 (occurring in all three species, but less commonly in *rhynchophorus*) are usually straightforward, but that counts above this number are more subjective and highly variable. If one merely doubles the count from top to bottom of the peduncle, counts of 16, 18, and 20 are readily obtained, but this procedure is an oversimplification and

→

Plate 2

a. *Campylomormyrus tamandua*, 128 mm. Ghana, Volta River at Dode (SU 63014).
b–c. *Campylomormyrus tamandua*, 74 mm. Ubangui River at Mobaye (MCZ 48184).
d. *Campylomormyrus mirus*, 113 mm. Bangui market (MCZ 48181).
e. *Campylomormyrus mirus*, 118 mm. Bangui market (MCZ 48181).

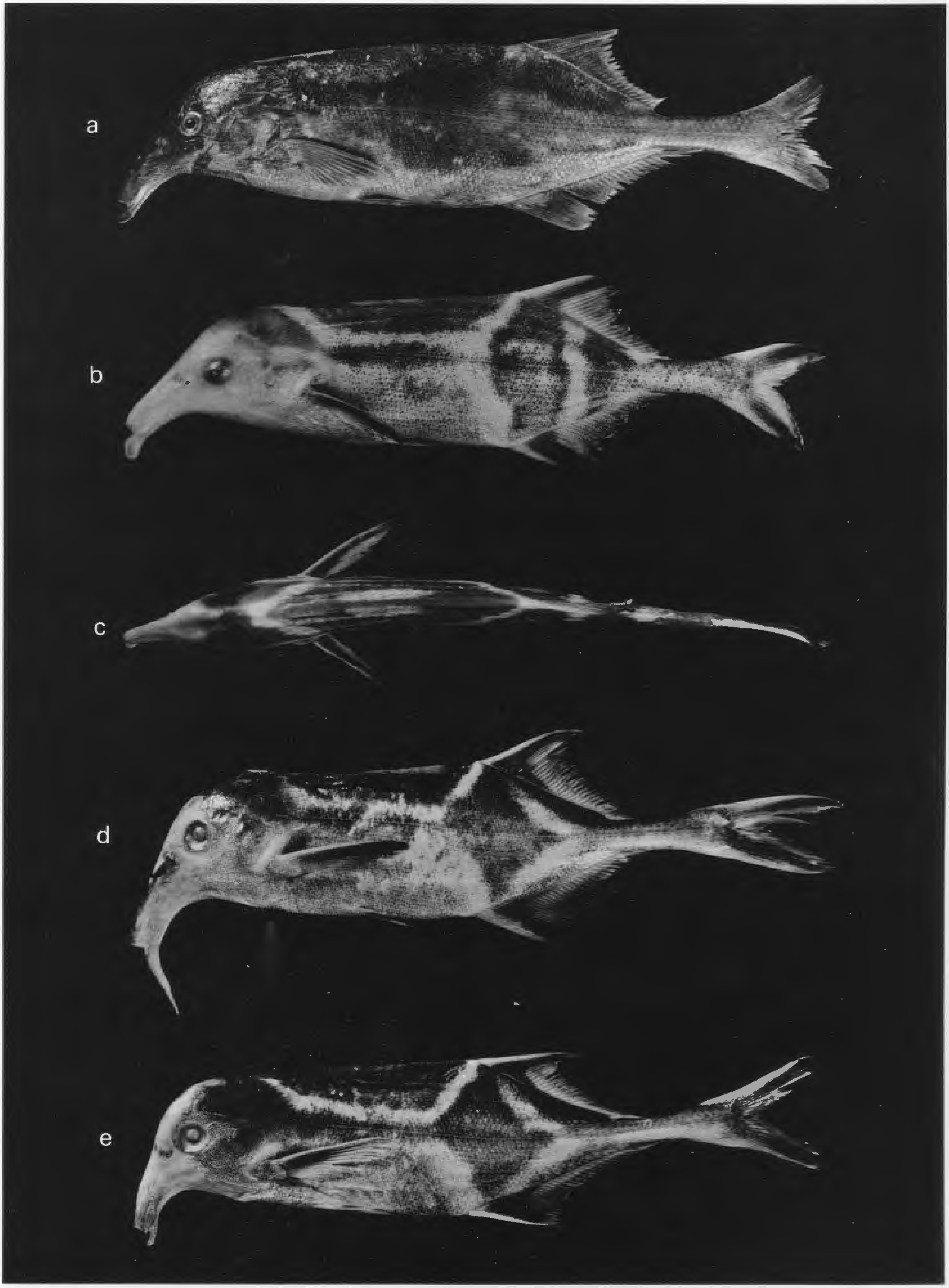

Plate 2

Plate 3

TABLE 4. RANGE OF VARIATION IN SOME MEASUREMENTS AND COUNTS IN *CAMPYLOMORMYRUS* OVER 50 MM IN STANDARD LENGTH.

	tamandua	*mirus*	*rhynchophorus*
Snout length	13–17	12–20	15–36
Snout width	4.4–6.1	3.8–7.3	2.8–6.3
Snout curvature	36–45°	46–82°	27–60°
Barbel length	2.6–4.4	1.5–18.8	2.1–4.0
Eye diameter	2.5–5.0	2.1–6.4	1.4–5.0
Body depth	21–28	19–34	20–28
LL scales	65–84	68–83	75–95
Peduncular scales	11–13	11–16	12–19
Dorsal fin rays	26–31	31–35	26–34
Anal fin rays	29–35	32–37	29–37

distorts the true variability of the character. In *rhynchophorus,* continuing the count all the way around the peduncle, we find specimens with every number from 12 to 19 (not any with 20, although this number has been reported frequently).

The extent of variation in some characters traditionally used by systematists is indicated in Tables 4 & 5. In *mirus* and *rhynchophorus,* snout length, width, and curvature, eye diameter, and body depth are extremely variable. Variation in form of snout and eye size is greatest among large adults in which the effects of allometric growth are most fully expressed. Depth of body and appearance of snout are markedly affected by "body condition" (apparently related to health and nutritional level). Thus, two specimens of *mirus* with snouts of almost identical length, one apparently in good condition, the other emaciated, were identified by Poll (1967) as different species.

A number of our measurements of snout and eye were taken directly from illustrations in the publications cited.

Campylomormyrus tamandua (Günther) 1864
Plate 2, a–c

Mormyrus tamandua Günther, 1864:22, pl. 2, fig. 1 (West Africa; [= Niger, Boulenger, 1909: 119]).

Diagnosis. Jaw teeth conical or truncate throughout life, never bifid. Snout length 13–17, snout curvature 36–45°; barbel short, 2.6–4.4.

TABLE 5. VARIATION IN COUNTS OF UPPER AND LOWER JAW TEETH IN *CAMPYLOMORMYRUS.*

	2 + 3	2 + 4	2 + 5	2 + 6	3 + 3	3 + 4	3 + 5	4 + 3	4 + 4	4 + 5	4 + 6	5 + 3	5 + 4	5 + 5	6 + 3	6 + 4	6 + 5	7 + 3	7 + 4
tamandua																			
(Ubangui) (n = 6)					3		1	1		1									
mirus																			
mentum long (n = 5)				2		1	1				1								
mentum short (n = 32)	1				3	15	2	1	5			2	1	2					
rhynchophorus																			
S. L. < 100 mm (n = 49)					4	31	2		11				1						
S. L. > 100 mm (n = 38)		1			1	12	1	1	10	2			6		1	1	1		1
Snout length < 25 (n = 21)					1	10	1		4	2			3						
Snout length > 25 (n = 17)		1				2		1	6				3		1	1	1		1

←

Plate 3

a. *Campylomormyrus mirus*, 98 mm. Bangui market (MCZ 48181).

b. *Campylomormyrus mirus*, 90 mm. Rivière Mbomou near Gozobangui, Central African Republic (MCZ 48180).

c–e. *Campylomormryus rhynchophorus*, 140, 172 and 168 mm. Rivière Mbomou near Gozobangui (MCZ 48182).

Coloration. This species exhibits a remarkable geographical color variation which has not been previously recorded. In the Volta basin, *tamandua* are usually uniformly dark brownish or even blackish, sometimes with a subtle violaceous quality (as in all mormyrids, mucus may alter coloration, generally by dulling it and at times providing a yellowish or greenish yellow caste), and no dark or light marks at all (Plate 2, a). In some specimens from the Volta, however, a dark or dusky lozenge-shaped mark extends from the origin of the dorsal fin to the middle of the anal fin base (such a mark occurs in many species of Mormyridae); specimens from the Benue River have similar coloration (Howes, personal communication). In the Zaire basin, *tamandua* are much more strikingly colored (Plate 2, b–c). The lozenge-shaped dark area on the posterior half of the body is always present, and its contrast enhanced by well-defined white bands framing it; anterior half of body with two white bands extending forward in parallel from the lozenge, diverging at the level of the pectoral fin insertion, the upper band passing obliquely forward along the nape, the lower obliquely downward across the margin of the gill opening. Dorsal surface of head and body with separate, paired, longitudinally oriented white marks (Plate 2, c); such marks are unrecorded for any other species of Mormyridae. In addition to our material from the Ubangui reported upon here, the American Museum of Natural History has numerous specimens from the Zaire basin, all with the distinctive coloration.

Range, habitat. This is the most widely distributed *Campylomormyrus,* present in the Volta, Niger, and Chad basins as well as the Zaire basin. In the Zaire basin, it has not been recorded from above Stanley Falls. Our specimens were all collected in or near rapids of large rivers. Although we did not collect this species in the mainstream of the Lower Zaire River, it is to be expected there. In the Upper Niger, where

TABLE 6. VARIATION IN *CAMPYLOMORMYRUS TAMANDUA.*

Locality	SL. mm	Snout length	Snout curv.	Eye diam.	Jaw teeth	LL scales	Ped. scales	Dorsal rays	Anal rays	Reference or cat. no. (no. of specimens)
Niger	ca. 250	17	43°	4.8	4 + 4	80	12	28	31	Günther, 1864 (holotype)
Upper Niger	72–178	15	44°	3.2	2–3 + 4	78–80	12	28–31	33–35	Daget, 1954
Chad basin	?–430	13–16	37–45°	2.5–3.4	2–4 + 3–4	80–84	12	29–30	32–34	Blache, 1964
Volta	114–173	15–17	43–50°	3.2–3.8	3 + 3–4	76–79	12	28–29	31–33	SU 63014 (7)
Ubangui	74–133	14–16		3.4–5.0	3–4 + 3–5	65–75	11–13	26–29	29–32	MCZ 48184-7 (6)

it is rare, it seems to occur only in portions of the mainstream with rocky bed (Daget, 1954:83). The report of Pappenheim (1907a) of *tamandua* from the Sanaga River is apparently based on an emaciated *rhynchophorus* with the snout much longer than in any *tamandua*.

Campylomormyrus mirus (Boulenger) 1898

Plates 2, d–e and 3, a–b

Gnathonemus mirus Boulenger, 1898:11–12, pl. 3, fig. 2 (Upoto, mainstream of Middle Zaire River below mouth of Itimbiri).
Gnathonemus elephas Boulenger, 1898:12, pl. 4, fig. 1 (Upoto).
Gnathonemus christyi Boulenger, 1920:13–14, fig. 4 (Leopoldville [= Kinshasa]).
Gnathonemus alces Boulenger, 1920:14–15, fig. 5 (below Stanley Falls).
Gnathonemus cassaicus Poll, 1967:77–78, fig. 26 (rio Luachimo at Dundo, Angola).

Diagnosis. Barbel length extremely variable, 1.5–18.8; this is the only species capable of developing an extremely elongate barbel (Plate 2, d). Jaw teeth bicuspid or truncate in juveniles and half-grown individuals, truncate or feebly notched in large adults. (In smaller specimens wear may obscure the tooth morphology, which can be verified by dissecting out one or more of the replacement teeth.) Snout length 12–20, curvature 46–82°. This is the only species in which the snout may point nearly straight down.

Snout. Length, width, and curvature of snout highly variable. The extremes in snout length are represented by the holotypes of *alces* (13) and of *christyi* (20). The recorded range of variation of snout length in *mirus* (Table 7) is now virtually continuous between these extremes. The widest snouts are in specimens with markedly elongate barbels, because of the well-developed musculature mobilizing the barbel. This musculature is feebly developed in specimens with short barbels. The 390-mm specimen from the Ja River figured by Steindachner (1914) has an exceptionally long barbel and a wider snout

TABLE 7. PROPORTIONAL MEASUREMENTS, SNOUT CURVATURE, AND COUNTS IN *CAMPYLOMORMYRUS MIRUS*.

Locality	No. of spec.	Length (mm)	Body cond.	Snout length	Snout width	Snout curv.	Length mentum	Eye diam.	Dorsal rays	Anal rays	LL scales	Ped. scales	Reference or cat. no.	Nomenclatural status or other comments
Upoto	1	320	ave.	19	5.6	55°	14.5	3.5	34	35	78	12?	Boulenger, 1898	Holotype of *mirus.*
Upoto	?	400	ave.	17	4.9	60°	1.7	3.3	31–35	33–37	70–80	12?	Boulenger, 1898	Types of *elephas.*
Kinshasa	?	320–375	ave.	20	4.4	82°	2.4	3.6	32–33	34–35	75–80	12	Boulenger, 1920	Types of *christyi.*
Stanley Falls	?	255–330	ave.	13	4.6	71°	3.7	4.8	31–34	33–35	70–75	12	Boulenger, 1920	Types of *alces.*
Dundo, rio Luachimo	?	113–169	ave.	20	6.5	50°	5.1	3.7	31	35	76	16	Poll, 1967	Types of *cassaicus.*
Riv. Ja, Cameroun	1	390	ave.	19	7.3	46°	18.8	2.6	31	34	83	12	Steindachner, 1914	Identified as *mirus.*
Rio Muita, Angola	1	250	thin	14	4.6	60°	3.4	3.4	31	34	75	12	Poll, 1967	Identified as *elephas.*
Rio Luachimo, rio Luendo	?	129–183	ave.	13.5	4.8	57°	2.1	4.2	32–34	34–35	80–81	12	Poll, 1967	Identified as *alces.*
Bangui market	3	112–136	ave.	19–20	5.8–6.2	61–63°	11.0–12.8	5.0	34	33–35	76–80	11–12	MCZ 48181	Resemble type of *mirus.*
Bangui market	14	98–202	ave.	15.5–18	3.8–5.9	55–75°	1.5–5.5	3.8–6.4	31–35	32–36	73–81	11–12	MCZ 48181	Resemble *elephas* & *christyi.*
Riv. Mbomou, Ubangui	4	57–90.5	plump	16–17	5.6–7.9	57–63°	2.6–3.1	5.2–5.5	31–32	32–34	68–72	12	MCZ 48180	Suggestive of *alces.*
Wombe, Lower Zaire R.	1	104	ave.	18	5.3	67°	5.0	5.2	33	35	72	12	MCZ 50165	
Luozi, Lower Zaire R.	1	265	ave.	15.5	4.6	55°	5.3	2.1	32	35	80	12	MCZ 50566	

than any other specimen. The extremes in snout curvature are represented by this specimen from the Ja (46°) and the holotype of *christyi* (82°). Specimens with elongate barbels have the least curvature.

Barbel. A series of *mirus* obtained at the Bangui market in June, 1971 includes three specimens in which the barbel is markedly elongate. In these as well as in the holotype of *mirus* and Steindachner's specimen from the Ja, the barbel is finely tapered. In the other 14 specimens from the Bangui market the barbel is either short and stubby or only slightly elongate. In several it shows signs of mutilation. In one of the Bangui specimens and in a 265-mm specimen from Luozi, the barbel is moderately elongate, with a tapered tip arising from a thickened basal portion, suggestive of partial regeneration toward a markedly elongate condition. On the other hand, it would appear normal for some individuals (including those with a very short snout) not to develop a markedly elongate barbel.

Color pattern. Color pattern as in Zaire *tamandua,* except dorsum between tip of snout and dorsal fin origin uniformly dark (without pairs of elongate light marks on head and midway between tip of snout and dorsal fin origin). Contrast between light and dark areas on both body and fins tends to be sharper than in *tamandua.* Contrast declining with growth, but basic features of color pattern plainly visible in a 265-mm specimen from Luozi.

Range, habitat. C. mirus is widely distributed in the Zaire basin. A specimen from the Benue River reported by Pappenheim (1907a) as *Campylomormyrus* ? *elephas* is almost certainly a *tamandua.* All reports pertaining to *mirus* are of specimens from the Zaire basin. Nichols and Griscom (1917:672) reported specimens from Avakubi, Faradje, Poko, and Stanleyville, all localities near large rivers with rocky beds, and noted that "quite a number were taken with poison in the stony sections of the Dungu River at Faradje." Matthes (1964:39) described the habitat of *elephas* as "lacs, grosses rivières, de préférence sur les fonds rocheux (latérite, au lac Tumba)"; his record of two large specimens from lac Tumba near Mabali is the only well-documented report of *Campylomormyrus* from a lake. The American Museum of Natural History has a 285-mm specimen, probably purchased from fishermen or market women, from "Lake Tanganyika," obtained 9 March by H. C. Raven (AMNH 11710).

Remarks on synonymy

elephas. The type specimens of *elephas,* except for their stubby barbels, are similar to the holotype of *mirus.* Boulenger (1898: 11) distinguished the two species as follows:

> D. 34; A. 35; longueur du museau 3 fois son moindre diamètre vertical; appendice du menton mesurant les 3/4 de la longueur du museau. . . . . . . *mirus*
>
> D. 33; A. 34–36; museau dirigé en bas, sa longueur 3 à 4 fois son moindre diamètre vertical; appendice du menton environ aussi long que l'oeil. . . . . . *elephas*

Apart from the difference in barbel, which is variable in *mirus,* the key characters are virtually identical. This is a good example of the narrow typological approach to species formerly in vogue in this group, and no one in the ensuing years since Boulenger proposed a better way to distinguish these two species.

cassaicus. The 169-mm holotype of *cassaicus* closely resembles our specimens of *mirus* with elongate barbels from Bangui, except that its barbel is only moderately elongate. In particular, the length, width, and curvature of the snout, as well as the proportions of the caudal peduncle, are closely similar, and the color pattern is typical of *mirus.* The circumpenduncular scale count of 16 is unusual for *mirus.* Specimens examined by us have 11 or 12.

Campylomormyrus rhynchophorus (Boulenger) 1898
Plates 3, c–e and 4, a–d

Gnathonemus rhynchophorus Boulenger, 1898:12–13, pl. 5, fig. 2 (Upoto).
Gnathonemus curvirostris Boulenger, 1898:13–14, pl. 6, fig. 1 (Matadi).
Gnathonemus numenius Boulenger, 1898:14, pl. 6, fig. 2 (Upoto).
Gnathonemus ibis Boulenger, 1902:25, pl. 4, fig. 5 (Banzyville, Ubangi).
Gnathonemus phantasticus Pellegrin, 1927:299–300 (Nanga Eboko, Sanaga R.).
Gnathonemus compressirostris Pellegrin, 1928a: 17–18, fig. 8 (Boma).
Gnathonemus rhynchophorus luapulaensis David and Poll, 1937:205, fig. 7 (rivière Luapula at Kabunda) (elevated to species by Poll, 1967).
Gnathonemus rhynchophorus lualabaensis David and Poll, 1937:206, fig 8 (Kabelwe [rivière Lufira?]) (elevated to species by Poll, 1967).
Gnathonemus bredoi Poll, 1945:49–50, fig. 5 (Pweto, "lac Moero").
Gnathonemus tshokwe Poll, 1967:83–84, fig. 29 (rio Luachimo at Dundo, Angola).

Diagnosis. Snout extremely variable in length and curvature, usually far longer than in any *tamandua* or *mirus;* barbel short, 2.1–4.0. Teeth invariably conical, even in large adults, unless truncated by wear. Scales relatively small: lateral line scale count about 75–95, circumpenduncular 12–19 but usually 16–19 (versus 84 or less and 11–13 or 16 in *tamandua* and *mirus*). Coloration plain compared to *mirus* and Zaire *tamandua.*

Counts and measurements of *rhynchophorus* are presented in Tables 8 and 9. Because so many nominal species have been placed in synonymy by us, the data are rather extensive. The two large series of specimens from Ubangui played a major role in the development of our concept of *rhynchophorus.* Both series exhibit extreme variability in eye size and snout length; some specimens resemble the types of *curvirostris, ibis, compressirostris,* or *tshokwe,* but there is gradation among these specimens and still others which resemble the types of *rhynchophorus.* Also of importance was the material from the Lower Zaire River, and especially the three large specimens from Luozi and one large specimen from Tadi (Plate 4). The snouts of these four differ so strikingly that a narrowly typological approach would dictate placing each in a separate species, but we are convinced they belong to just one species, *rhynchophorus.*

Dentition. In *rhynchophorus,* as in *tamandua,* the upper and lower jaw teeth are invariably conical, never bicuspid, and only truncate as a result of wear. Data on tooth counts are presented in Table 5. Specimens under 100 mm in standard length exhibit the least variation in tooth counts, with a strongly modal count of 3 + 4 (in 31 of 49 specimens). Specimens over 100 mm have a much greater range of tooth counts, and proportionately fewer specimens with 3 + 4 (12 of 38). The greatest variation in tooth counts occurs in specimens over 100 mm with snout lengths in excess of 25 percent of standard length (only two of 17 with 3 + 4). Examination of the data shows that virtually all of the increased variability in tooth counts in specimens over 100 mm is attributable to the moiety of specimens with the longest snouts. In specimens with snouts over 25, the upper jaw teeth number from 2 to 7, with few specimens having 3, whereas in specimens with snouts under 25 the variation in tooth counts is closely similar to that in specimens under 100 mm, with a strongly modal count of 3 + 4.

Color pattern. Posterior half of body marked by a dark, vertical band, elliptical in shape, and flanked anteriorly and posteriorly by narrow light bands. Anterior light band extends between origin of dorsal fin and origin of anal fin but does not continue onto fins. Caudal peduncle, fins, and anterior half of body more or less uniformly dark. Obvious in juveniles, the contrast between light and dark areas diminishes with growth, until in the largest specimens the banding has disappeared.

Range, habitat. C. rhynchophorus occurs in the Sanaga River and in large rivers in the upper, middle, and lower portions of

TABLE 8. PROPORTIONAL MEASUREMENTS, SNOUT CURVATURE, AND COUNTS IN *CAMPYLOMORMYRUS RHYNCHOPHORUS*.

Locality	No. of spec.	Length (mm)	Snout length	Snout width	Snout curv.	Eye diam.	Jaw teeth	Dorsal rays	Anal rays	LL scales	Ped. scales	Ref. or cat. no.	Nomenclatural status or other comments
Upoto, Middle Zaire R.	4	?–380	22	4.8	54°	2.9	5+4	28–31	31–35	75–85	18	Boul. 1898	Types of *rhynchophorus.*
Matadi, Lower Zaire R.	1	370	28	3.5	60°	1.9	3+4	32	36	90	16	Boul. 1898	Holotype of *curvirostris.*
Upoto	2	?–610	36	2.7	"25°"	2.3	7+4–6	32	36	79–81	16	Boul. 1898	Types of *numenius.*
Banzyville, Ubangui R.	2	150	26	2.3	56°	5.0	6–8+4	32–33	36–37	77–82	16	Boul. 1902	Types of *ibis.*
Nanga Eboko, Sanaga R.	1	440	>25?				3+5	28	31	80	12	Pell. 1927	Holotype of *phantasticus.*
Boma, Lower Zaire R.	1	165	15	3.5	55°	2.9	3+4	30	36	90	16	Pell. 1928a	Holotype of *compressirostris.*
Kabunda	1	170	>25?					29	33	82	16	David & Poll, 1937	Holotype of *r. luapulaensis.*
Kabelwe	1	97	<25					30	33	82	20	David & Poll, 1937	Holotype of *r. lualabaensis.*
Pweto	1	370	18	6.3	27°	3.2	3+5	27	30	"ca. 105"	20	Poll, 1945	Holotype of *bredoi.*
Dundo, rio Luachimo	1	268	30	4.4	48°	2.7	3+3	31	35	86	20	Poll, 1967	Holotype of *tshokwe.*
Rio Luachimo	4	107–170	26	5.2	48°	3.7	4–5+4–6	31–34	33–36	83–90	16–18	Poll, 1967	Identified as *rhynchophorus.*
Rio Luachimo	1	298	33	3.6	40°	2.8	6+4	31	35	85	16	Poll, 1967	Identified as *ibis.*
Rio Muita, Angola	1	220	24.5	5.8	69°	3.9	5+4	30	33	±81	16	Poll, 1967	Identified as *luapulaensis.*
Sakbayeme, Sanaga R.	3	219–249	18–20	4.0–5.3	40–67°	2.6–3.0	3–4+4	29–30	33–35	76–84	12–14	MCZ 35427, 47022	Resemble type of *rhynchophorus.*
Riv. Mbomou, Ubangui	24	43–225	19–32	4.4–7.6	33–56°	2.6–5.9	3–5+3–5	29–31	31–35	77–90	14–19	MCZ 48182	Gradation among specimens resembling types of *rhynchophorus, ibis, compressirostris, tshokwe.*
Bangui market	11	110–282	20–33	3.3–4.9	47–56°	2.5–4.5	3–7+3–5	30–33	32–37	78–95	12–19	MCZ 48183	Gradation among specimens resembling types of *rhynchophorus, curvirostris,* and *ibis.*
Gombe, Lower Zaire R.	6	48–113	15–21	4.7–6.1	45–53°	3.2–4.8	3–4+4–5	27–29	29–35	75–85	13–16	MCZ 50104	
Wombe, Lower Zaire R.	8+1	63–135 (130)	16–20 (31)	4.5–5.2 (3.6)	50–52° (53°)	3.5–4.3 (4.7)	3–4+3–5 (6+4)	27–32 (34)	29–33 (37)	82–84 (80)	15–16 (12)	MCZ 50166	130-mm specimen resembles type of *ibis.*
Bulu, Lower Zaire R.	2+1	105–169 (122)	17–19 (30)	4.4–5.3 (3.9)	47–48° (55°)	3.0–3.8 (4.3)	3+4 (4+4)	29 (32)	33 (37)	79–85	16–17 (13)	MCZ 50213	122-mm spec. resembles *ibis;* 105- & 169-mm specs. resemble *compressirostris.*
Luozi, Lower Zaire R.	1	321	16	3.7	40°	2.0	3+4	30	33	±95	13	MCZ 50567	Resembles *tamandua* except for higher LL scale count if large *tamandua* lack color pattern typical of juveniles and young adults.
Luozi	1	376	25	3.2	55°	1.4	3+4	32	36	±90	14	MCZ 50567	Resembles holotype of *curvirostris.*
Luozi	1	445	26	4.2	60°	1.6	2+4	30	37	±95	12	MCZ 50567	Resembles holotypes of *phantasticus, tshokwe.*
Tadi, Lower Zaire R.	1	365	32	3.5	55°	1.8	3+4	31	34	90	12	MCZ 50262	
Isangila, Lower Zaire R.	1	105	22	5.0	48°	4.2	5+4	32	36	81	16	MCZ 50404	Resembles holotype of *rhynchophorus.*
Inga, Lower Zaire R.	26	41–99	14–19	4.8–7.4	30–54°	3.6–5.7	3–5+3–4	26–31	31–35	76–85	15–18	MCZ 50423 & 50492	

TABLE 9. *CAMPYLOMORMYRUS RHYNCHOPHORUS.* VARIATION IN ANAL FIN RAY COUNTS COMPARED TO SNOUT LENGTH (SPECIMENS OVER 100 MM).

Snout length < 25 ($n = 21$)	1	1		6	7	4	2		33.76
Snout length > 25 ($n = 17$)		1	1	5	2	2	2	4	34.47
Number of anal fin rays	30	31	32	33	34	35	36	37	Ave.

the Zaire basin. Specimens collected by us have all come from rapids or sections of rivers with rocky or stony beds. Nichols and Griscom (1917:672–673) reported specimens from Avakubi, Faradje, Poko, Rungu, and Stanleyville, localities all on or near large rivers with rapids or coarse substrates, and specimens reported by Poll (1967) from Angola are almost all from rapids in the rio Luachimo. The Sanaga is a river noted for rapids; Sakbayeme is situated just below a long series of rapids, and Nanga Eboko just above another long series of rapids which includes the Chutes d'Etok. The type locality of *luapulaensis* is near Mambirima Falls, and the type locality of *lualabaensis* is presumably on or near the rivière Lufira, a Lualaba tributary noted for rapids. Pweto, the type locality of *bredoi*, is at the north end of lac Moero at the point where the lake is drained by the rivière Luvua. Major rapids occur within 20 or 30 km of Pweto, and large river habitat with coarse substrate probably occurs very close to town. If the type specimen was purchased at Pweto, it may well have come from the river. The species has not been reported from any other lacustrine locality.

C. rhynchophorus is not uniformly distributed in the mainstream of the Middle Zaire River. It is absent from the list of mormyrids from large river habitats in the vicinity of Ikela reported by Matthes (1964: 9). We do not have any information as to whether the streambed is rocky or stony at Upoto. It is generally supposed that rocks and stones are absent from streambeds in the Cuvette Centrale, but this need not necessarily be so. It is noteworthy that piles of large lateritic rocks occur along substantial portions of the shores of lac Inongo and lac Tumba.

Comment. A population sample from rapids in the rivière Mbomou, a tributary of the Ubangui River, yielded three *tamandua*, four *mirus*, and 24 *rhynchophorus*. The *rhynchophorus* have extremely variable snouts, but there is no indication whatever of intergradation among the three species. Data on these specimens are included in Tables 6–8.

Remarks on synonymy

numenius, ibis. The 610-mm holotype of *numenius* is the largest recorded specimen of *Campylomormyrus.* The unusually "straight" condition of its snout requires comment. No juveniles have been reported with the snout directed almost straight ahead. During six months of almost daily visits to the market in Kinshasa in 1963–64, the senior author observed numerous large specimens with the characteristic appearance of *numenius,* and determined that straightening of the snout was in all instances due to the manner in which the fish had been handled. Straightening occurs when fish are caught by a hook through the end of the snout; hefted or carried about by the snout; or laid out for sale by market women. Had this been known to Boulenger, he could hardly have failed to recognize the 150-mm holotype of *ibis* as a young *numenius.* The descriptions and figures of *numenius* and *ibis* agree closely except for the condition of the snout; in *ibis* the snout has been bent slightly backward. The difference in eye size is attributable to allometric growth. In *rhynchophorus,* as in many other mormyrids, the eye is relatively larger in young.

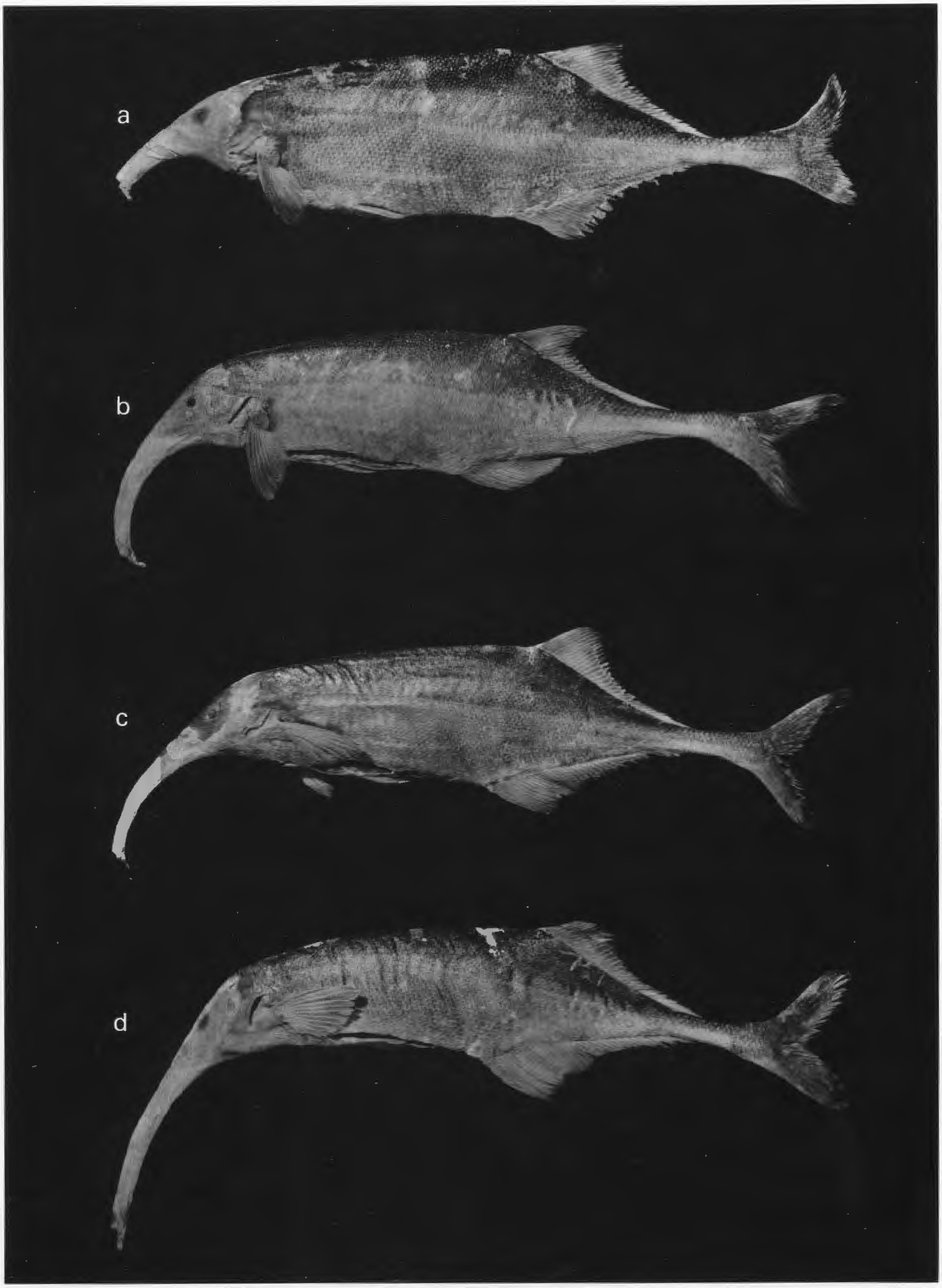

Plate 4

Nichols and Griscom (1917:672–673) reported *rhynchophorus* and *ibis* from Avakubi, Faradje, Poko, and Stanleyville (= Kisangani). They found the proportions of the snout variable in *ibis* (generally longer and more slender in large specimens), and concluded "it is difficult to draw the line between *rhynchophorus* and *ibis*, which are at best closely related." This conclusion is supported by our observations, which indicate they are indeed conspecific.

curvirostris, ibis, tshokwe. Except for its larger eye, the 268-mm holotype of *tshokwe* is very similar to the 370-mm holotype of *curvirostris*, as well as to the 298-mm specimen identified by Poll (1967) as *ibis*. Poll (1967:85) tabulated the following differences among the three species:

	curvirostris	*ibis*	*tshokwe*
Longueur museau/ hauteur minimum	11	8–12	8.5
Longueur museau/oeil	15	9	9
Longueur peduncule caudal/hauteur minimum	3.7	3	2.7
Ecailles peduncule caudal	16	16	20
Ecailles en l. l.	86	77–82	86

The information in this table is based on extremely few specimens—only one each of *curvirostris* and *tshokwe*—so that it does not allow for any variation. The characters, involving snout form, eye size, length and height of caudal peduncle, and scale counts, are subject to considerable individual variation in *Campylomormyrus*. In several samples of *rhynchophorus*, for example, circumpenduncular scale counts range from 14–19 or even 12–19, and longitudinal scale counts from 76–95. Poll (1967:67) stated that *ibis* might be a junior synonym of *curvirostris*, a conclusion supported by our observations. The two species have been distinguished chiefly on the basis of *curvirostris* having a smaller eye. Eye diameter varies from 1.4 to 5.0 in *rhynchophorus*, with large adults much more variable than juveniles due to allometric growth. Poll's data on the holotype of *tshokwe* agrees fairly closely with that which he presented for *ibis*, and thus it seems he had insufficient grounds to recognize *tshokwe* as new.

compressirostris. The holotype of *compressirostris* is representative of *rhynchophorus* with the snout at its shortest and most slender. Apart from snout length, no other characters have been advanced which will separate it from other nominal species synonymous with *rhynchophorus*. Some small series from the Lower Zaire mainstream are comprised mainly of such short-snouted individuals. They exhibit considerable variation in eye size. Their dorsal and anal fin-ray counts fall within the lower half of the range of these counts in *rhynchophorus*. David and Poll (1937:206) considered *compressirostris* a subspecies of *rhynchophorus*.

phantasticus. The length, thickness, and curvature of the snout in the 440-mm holotype of *phantasticus* is virtually identical with that in a 445-mm specimen of *rhynchophorus* from the Lower Zaire River at Luozi. A photograph of the anterior half of the holotype (Pellegrin, 1932) also shows 20–21 scales to the end of the pectoral fin and 8–9 scale rows above the lateral line immediately behind the head, counts which occur in *rhynchophorus* from the Zaire basin. Other characteristics of the holotype are well within the range of variation for *rhynchophorus*. Additional material from the Sanaga River collected by George Schwab (MCZ 35427, 47022) is closely similar to material from the Zaire basin.

bredoi, luapulaensis, and lualabaensis. C. bredoi is known only from the 370-mm

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Plate 4

a–c. *Campylomormyrus rhynchophorus*, 321, 445 and 376 mm. Zaire River at Luozi (MCZ 50567).
d. *Campylomormyrus rhynchophorus*, 365 mm. Zaire River at Tadi, about 50 km downstream from Luozi (MCZ 50262).

holotype obtained at Pweto. The holotypes of *luapulaensis* and of *lualabaensis* are the only other specimens of *Campylomormyrus* recorded from the Zaire basin above Stanley Falls. The exceptionally short and stocky snout of *bredoi* is unlike that in any other specimen reported in the literature or seen by us. Although Poll (1945) reported around 105 scales in the longitudinal series, the figure shows only about 90 scales to about where the end of the hypural should be and only 98 scales continuing well beyond this point onto the caudal fin. It should be noted that the 97-mm holotype of *lualabaensis* was characterized by an unusually short snout. Many specimens of *rhynchophorus* have the snout as short as in *lualabaensis* and *bredoi*, but only some with elongate snouts have the snout as wide as that of *bredoi*. In *luapulaensis* the snout is elongate and wide. These observations indicate that populations of *rhynchophorus* in this part of the Zaire basin are also subject to considerable individual variation in snout length and form.

Mormyrus Linnaeus 1758

Type species: *Mormyrus caschive* Linnaeus 1758 (ex Hasselquist 1757).

Mormyrus is distinguished from all other mormyrid genera by its long dorsal fin (originating on or in front of a vertical line through insertion of pelvic fins), in combination with an extremely short anal fin. The osteology of *Mormyrus* is compared with that of other genera by Taverne (1972). Some 20 species have been described (op. cit.: 163–164). Those in the Zaire basin have been revised by Reizer (1964). There are four species in our rapids collections, two of them new.

Mormyrus cyaneus new species
Plate 5, c

Holotype. MCZ 50497, 153.2 mm, R & S 41.
Paratypes. MCZ 50498, 46: 45.4–260 mm, R & S 41; MCZ 50430, 3: 90.3–132.6 mm, R & S 38; MCZ 50266, 2: 69.8–101.7 mm, R & S 35.

Diagnosis. A *Mormyrus* with a distinctively shaped snout, more elongate than the snout of *bumbanus* (Plate 5, d) but not nearly as elongate and slender as the snout of *rume* or *proboscirostris*. Coloration uniformly light blue, or uniformly blue on the body with the head dark blue or blackish blue; no iridescence. Dorsal rays 51–59, with a lower mode and mean than other *Mormyrus* from the Lower Zaire River (Table 10), or from anywhere else.

Mormyrus iriodes new species
Plate 5, e

Holotype. MCZ 50499, 160.1 mm, R & S 41.
Paratypes. MCZ 50500, 14: 62.2–151.5 mm, R & S 41; MCZ 50354, 4: 217–270 mm, R & S 28; MCZ 50431, 1: 72.7 mm, R & S 38; MCZ 50267, 1: 86.5 mm, R & S 35; MCZ 50569, 2: 252–263 mm, R & S 29a.

Diagnosis. A *Mormyrus* similar to the very distinctive species *ovis*, from which it differs in having a much smaller eye and an even more rounded snout, and possibly also in coloration. Live specimens with a pearly iridescence and delicate pinkish, violaceous and bluish-green reflections.

Comment. M. bumbanus, cyaneus, and *iriodes* were taken sympatrically at R & S 38, where *proboscirostris* was also present, and at R & S 41. All of the specimens of *Mormyrus* from these localities are readily recognizable as belonging to one or the other of the four species, i.e., there is no intergradation. The differences in the snout are evident in juveniles, which could be

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Plate 5

a. *Mormyrops mariae*, 130 mm, black phase. Zaire River at Inga (MCZ 50462).
b. *Mormyrops mariae*, 117 mm, white phase. Zaire River at Gombe (MCZ 50106).
c. *Mormyrus cyaneus* new species, holotype, 153.2 mm. Zaire River at Inga (MCZ 50497).
d. *Mormyrus bumbanus*, 149 mm. Zaire River at Inga (MCZ 50496).
e. *Mormyrus iriodes* new species, holotype, 160.1 mm. Zaire River at Inga (MCZ 50499).

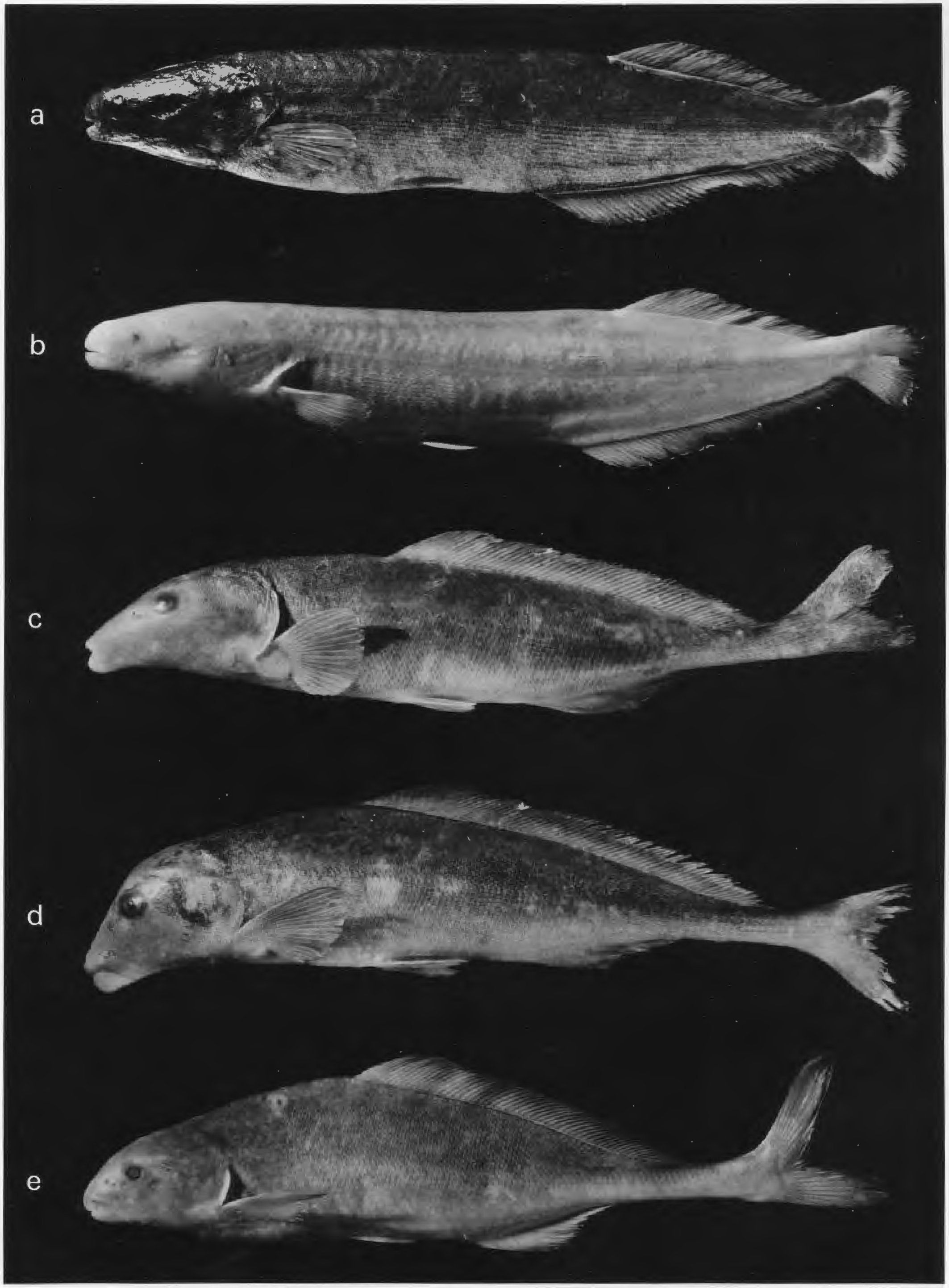

Plate 5

TABLE 10. FREQUENCY OF DORSAL FIN RAY COUNTS IN SEVERAL CLOSELY RELATED SPECIES OF *MORMYRUS* FROM THE ZAIRE BASIN.

	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
bumbanus (L. Zaire R.)[1]											1	1	1	3	7	4	4		1		
bumbanus (Ubangui)[2]											3		1	1	2	1	1	1	1	1	1
caballus (Cuvette Centrale)[3]							1			1	2		1	4	4	2		2		2	
cyaneus n. sp. (types)	2	3	7	16	9	2	8	3	1												
iriodes n. sp. (types)		1				3	4	4	2	2	2		1								
ovis (Ubangui)[4]				1	3	1				1											

[1] MCZ 50110, 50170, 50217, 50429, 50496. [2] MCZ 48200, 48202. [3] Data from Reizer, 1964. [4] MCZ 48204, 50587.

sorted into their respective species on this basis alone.

Alestes Müller and Troschel

There is a nomenclatural problem regarding the type species of *Alestes*, and the proper generic term for the fishes we refer to under this name should perhaps be *Myletes*, a problem we shall not attempt to solve here. Our rapids collections include four species, one of them undescribed.

Alestes comptus new species
Plate 6, a

Holotype. MCZ 50506, 55.0 mm, R & S 41.

Paratypes. MCZ 48232, 6: 44.8–63.0 mm, market at Bangui, Central African Republic, T. R. Roberts, May–June 1971.

Diagnosis. A moderately deep-bodied *Alestes* with 10 dorsal and 17 anal-fin rays; 23–26 scales in the lateral line series; 15 gill rakers on lower limb of first gill arch; outer premaxillary tooth row with 4 + 4 or 3 + 3 teeth nearly perfectly aligned with each other; coloration distinctive, with no tail-light in live individuals.

A. comptus superficially resembles *A. imberi*, but differs in numerous respects from that species. *A. imberi* taken at the same locality as the holotype, R & S 41, have a slightly wider head; nostrils further apart; a larger mouth; larger teeth; outer premaxillary tooth row with 4 + 4 teeth, but second tooth lying further inside than the others; and 19–20 gill rakers on lower limb of first gill arch. The squamation also differs: *comptus* has 10 predorsal scales (versus 8–9 in *imberi*), and larger and less numerous scales on the base of the anal fin (Figure 2). There are also important differences in coloration. Similar differences exist between the paratypes of *comptus* and specimens of *imberi* obtained at the market in Bangui at the same time.

Coloration. Due to its coloration, *comptus* was recognized as a distinct species the moment it was collected. The entire body is lighter-colored and less dusky than in *imberi.* Live *imberi* are characterized by a tail-light, a highly reflective spot on the dorsal surface of the caudal peduncle, immediately behind the adipose fin. In daylight this spot is usually bright orange. In preserved specimens it is represented by a light-colored, crescent-shaped spot, standing out clearly from the rest of the otherwise dark dorsal surface and from the black spots on the sides of the caudal peduncle which encroach upon it from below. The holotype of *comptus* had no tail-light when it was alive, and the preserved specimen has no indication of one. The dorsal surface, while darker than the rest of the body, is lighter than in *imberi,* and there is no light area atop the caudal peduncle. The black spot on the side of the peduncle is smaller than in *imberi,* and continues as a longitudinal band to the tips of the middle caudal rays. In *imberi* the spot continues onto the caudal base, but extends only half the length of the middle rays. In *comptus* the humeral spot is placed on the fifth,

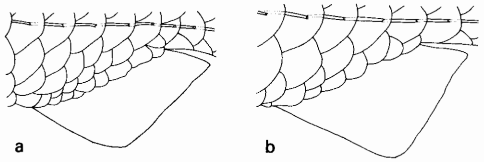

Figure 2. *Alestes*, squamation at base of anal fin: a. *imberi*, 53 mm; b. *comptus*, 55 mm.

sixth and seventh scale rows behind the upper angle of the gill cover, whereas in *imberi* it is on the fourth and fifth scale rows. In the 63.0-mm paratype, after three years in preservative, an iridescent golden band still extends from the eye to the base of the caudal fin; immediately below this golden band, and above the lateral line scales, an iridescent violet and bluish-green band extends from the opercle to a point above the anal fin origin. Such coloration has not been recorded for any other *Alestes*; it is suggestive of the iridescent coloration covering the entire body in mature male *Phenacogrammus interruptus*, a species endemic to the Zaire basin, and one of the most beautiful members of the family Characidae. The condition of the anal fin in this specimen indicates that it may have been taking on secondary male sexual characters.

Bryconaethiops **Günther 1873**

Type species: *Bryconaethiops microstoma* Günther 1873, by original designation.

Bryconaethiops constitutes a small group of closely related species, one in the Zaire basin and in two or three coastal drainages in Lower Guinea, the others restricted to the Zaire basin. The genus has been distinguished from *Alestes* on the basis of having three rows of premaxillary teeth instead of only two, but this distinction is not well defined. Many *Alestes* have the second tooth in the outer premaxillary tooth row inset, so that it lies between the outer and inner rows and constitutes a third row of the same nature as in *Bryconaethiops*. If the genus is to be retained, it should be defined on the basis of other characters.

Our rapids collections include a single species, previously known only from the holotype and erroneously consigned to synonymy.

Bryconaethiops yseuxi Boulenger 1899
Plate 6, b–c

Bryconaethiops yseuxi Boulenger, 1899: 82–83, pl. 37, fig. 2 (Haut-Congo).

Diagnosis. A small, highly rheophilic species of *Bryconaethiops* with pronounced sexual dichromatism, reduced cuspidation of inner premaxillary teeth, thin lower lip, and 11–13 gill rakers on lower limb of first gill arch.

Differences between *yseuxi* and the other known species of *Bryconaethiops* are summarized in Table 11.

Size at sexual maturity. Males mature at a larger size and grow larger than females. The largest known specimen, the 70-mm holotype, is a male with fully developed secondary sex characters. Our rapids material includes five mature males, 56–64 mm, with fully-developed secondary sex characters, and a 58-mm specimen in which the characteristic male coloration and dimorphism of the dorsal and anal fins are only partially developed. The largest female, a ripe specimen, is 53 mm; a gravid female is only 47 mm.

Coloration of preserved specimens. Females and immature males are very plain: body pale straw color, slightly dusky above (counter-shading); all fins whitish or clear. A faint humeral spot present in both sexes; in highly colored males it is almost obliterated by the general duskiness of the body.

Mature males are striking. Body very dusky. A continuous dark band, almost black, extends on ventral portion of body from behind pectoral fin insertion to end of anal fin base (similar coloration does not occur in any other African characid). Dorsal, pectoral, and pelvic fins dusky, tipped with black (dorsal filaments black). Anal

Plate 6

TABLE 11. COMPARISON OF *B. YSEUXI* AND OTHER *BRYCONAETHIOPS*.

	yseuxi	*microstoma*	*macrops*	*boulengeri*
Longest known standard length.	70 mm	160 mm	110 mm	140 mm
Condition of dorsal fin rays in mature males.	All or almost all prolonged as separate filaments.	As in *yseuxi*.	As in *yseuxi*.	Only anteriormost ray prolonged; none separate.
Sexual dichromatism.	Permanent.	Absent (even seasonally?).	Absent (even seasonally?).	Absent (even seasonally?).
Lower lip.	Thin, leaving premaxillary teeth largely exposed.	Thick, largely covering premaxillary teeth.	Thick, largely covering premaxillary teeth.	Thick, largely covering premaxillary teeth.
Cusps on anterior margin of teeth in inner premaxillary tooth row.	Usually absent.	Always present.	Always present.	Always present.
Number of gill rakers on lower limb of first gill arch.	11–13.	16–19.	17–19.	19–20.

fin with a dusky base, a white submarginal band, and a black margin. Caudal fin uniformly dusky.

Dentition. The small outer premaxillary teeth tend to retain a well-developed lateral cusp which is usually absent in the other species of *Bryconaethiops,* while the enlarged inner premaxillary teeth have lost the anterior cusps that are retained in the other species (Fig. 3).

As in other *Bryconaethiops,* the teeth on the left side of the upper and lower jaws usually lie slightly anterior to those on the right side. The number and size of the teeth, and the number of cusps they bear, are usually the same on both sides of the jaws. In instances in which there is an extra tooth, a larger tooth, or a tooth with more cusps on it, this usually occurs on the left side of the jaws. These statements hold for the upper jaw teeth illustrated in Figure 3. In the holotype of *yseuxi,* the two median teeth in the inner row on the right premaxillary have weakly developed cusps anteriorly, whereas those on the left premaxillary have none (personal communication from Gordon Howes). Such differences may in individual cases be attributable to differential wear on the teeth, but they are usually due to a fundamental bilateral asymmetry favoring the left side of the jaws. In the other species of *Bryconaethiops* the inner premaxillary teeth on both sides of the jaws invariably have well-developed anterior cusps.

Comments. This species was originally distinguished by Boulenger because of the elongate filamentous extensions of the dorsal fin rays in the holotype. Later, evidently recognizing the sexually dimorphic nature of this character, he stated that *yseuxi* was perhaps a synonym of *Bryconaethiops microstoma* (Boulenger, 1916:176). Nichols and Griscom (1917) treated it as a synonym

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Plate 6

a. *Alestes comptus* new species, holotype, 55.0 mm. Zaire River at Inga (MCZ 50506).
b–c. *Bryconaethiops yseuxi*, ♂, 57 mm, and ♀, 47 mm. Zaire River near Wombe (MCZ 50179).
d. *Labeo lividus* new species, holotype, 180 mm. Zaire River at Inga (MCZ 50524).
e. *Chrysichthys helicophagus* new species, holotype, 94.5 mm. Zaire River at Tadi (MCZ 50292).

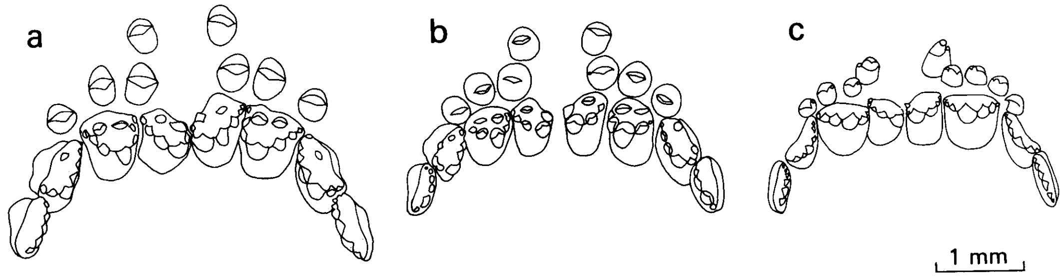

Figure 3. *Bryconaethiops*, premaxillary dentition: a. *microstoma*, 65 mm; b. *boulengeri*, 57 mm; c. *yseuxi*, 57 mm.

of *microstoma*; Poll (1939), evidently without having examined the holotype, concluded that it must be a synonym of either *microstoma* or *macrops*.

Labeo Cuvier 1817

Type species: *Cyprinus niloticus* Forskål 1775.

Our rapids collections include 11 *Labeo*, more species than any other genus except *Synodontis*. One of them is new.

Labeo lividus new species
Plate 6, d

Holotype. MCZ 50524, 180 mm, R & S 41.
Paratypes. MCZ 50525, 5: 74.1–239 mm, R & S 41; MCZ 50452, 4: 60.3–78.9 mm, R & S 38; MCZ 50232, 10: 57.5–87.9 mm, R & S 29; MCZ 50371, 1: 72.4 mm, R & S 28; MCZ 50287, 5: 53.1–89.1 mm, R & S 35.

Diagnosis. A *Labeo* with two pairs of well-developed barbels; barbels dull-colored, of the same hue as the skin of the head where they arise; length of posterior barbel consistently slightly less than diameter of eye, and length of anterior barbel about one-third to one-half that of posterior barbel; keratinous tubercles on head small, granular, white spots which project little or not at all above surface of head; adults dull blue dorsally and laterally, whitish ventrally; 37–39 scales in a lateral series to end of hypural plate, 20–24 (usually 24) around caudal peduncle; dorsal fin with 10 or 11 (usually 11) branched rays, its margin falcate.

Labeo lividus is apparently closely related to *L. barbatus*, which differs from it in having barbels dark or black in color, anterior barbel frequently as long or longer than posterior barbel, both barbels usually longer than eye diameter; eye more nearly superolateral in position; tubercles on head more strongly developed; and adults with back and sides pale-colored or dirty white, with indistinct darker vertical marks on the scales.

Lips. Rostral flap fimbriated. Inner surface of upper lip with numerous transverse plicae formed by minute, confluent papillae. Lower lip with numerous large, conical papillae which become larger and harder with growth. The lips are very similar in *barbatus*, except the papillae on the lower lip apparently do not become quite as large and hard.

Eye. Diameter of eye 4.6–9.4% in specimens from 53 to 239 mm, relative size of eye decreasing with growth. Position of eye lateral or slightly superolateral, less superolateral than in *barbatus*.

Squamation. There are 37–39 scales in a lateral series to end of hypural fan, plus two to four more pored scales extending onto base of caudal fin; 8–11 (usually 11) scales above lateral line; 6–8 (usually 7) scales between lateral line and pelvic fin insertion; and 20–24 (usually 24) scales around caudal peduncle. The dorsomedian scale row anterior to the dorsal fin is poorly developed, the scales small, irregularly positioned, and often with scaleless gaps between them; the first one or two dorsolateral scale rows anterior to the dorsal fin are also reduced in size. The squamation of *barbatus* is virtually identical, except that there are usually only 8 or 9 scales above lateral line, and usually 20 or 21 (rarely 24) scales around caudal peduncle.

Juvenile coloration. Except for the striking difference in the barbels, the coloration of juveniles is very similar to that in *barbatus.* The entire sides of the body exhibit a reticulate pattern of light and dark areas, parallel or complementary to the scales. The pattern is very similar in *barbatus*; there may be a difference in that the indistinct darker vertical marks on the scales characteristic of adult *barbatus* are sometimes more evident in juveniles of *barbatus.* The caudal peduncle bears a dark vertical blotch, surrounded by a poorly defined lighter area; two or three scale rows extending onto the caudal fin are also darkened. There is no indication of either red spots on the scales or of a dark midlateral stripe, characteristic features of juvenile coloration in some other species groups of *Labeo.*

Comments. *Labeo barbatus* and *L. lividus* differ considerably from most previously described *Labeo* with two pairs of barbels (cf. Poll and Gosse, 1963: 52–53). The most closely related species is perhaps *L. capensis,* endemic to the Orange River drainage in South Africa. Juvenile as well as adult *capensis* have distinctive coloration, and adults are further distinguished by a sharply rising nape and strongly compressed head (Jubb, 1967: 123–124, fig. 127, color plate 24). While adults of all three species have a rising nape, the condition is apparently least developed in *lividus,* with *barbatus* intermediate. Other African *Labeo* with two pairs of barbels as adults differ in having fewer scales in a lateral series (mostly 32–34), fewer circumpenduncular scales (usually 16), and different coloration. None of the species with a single pair of barbels as adults (some of which do have two pairs earlier in life) seem closely related to the group under consideration. In the Lower Zaire River the only other *Labeo* in which adults have bluish coloration on the back and sides are *nasus* and *sorex,* species with a median protuberance on the snout tip, and strongly developed tubercles on the head and snout (especially on the protuberance). Most (all ?) other *Labeo* in the Zaire drainage have tubercles more strongly developed than *lividus.*

There is no indication of intergradation between *barbatus* and *lividus* at the four rapids localities where we found them living together.

Bagrus **Cuvier and Valenciennes 1839**

Type species: *Silurus bayad* Forskål 1775.

Our rapids collections include two species of *Bagrus,* one of them undescribed.

Bagrus caeruleus new species

Holotype. MCZ 50582, 125.7 mm, R & S 41.
Paratypes. MCZ 50527, 3: 80.3–163.5 mm, R & S 41; MCZ 50141, 2: 108.9–210 mm, R & S 2.

Diagnosis. A *Bagrus* with occipital process widely separated from first interneural bone; anal fin with six or seven branched rays; eye small, decreasing in relative size with growth, from 3.7 to 2.6% in specimens from 80 to 210 mm; juveniles as well as adults bluish on the back and sides, with a darkened area in front of dorsal fin (more noticeable in juveniles), undersides of head and abdomen pale, and edges of upper and lower caudal fin lobes whitish.

Bagrus caeruleus is apparently closely related to *B. ubangensis,* which differs from it principally in having a larger eye, and the back and sides brownish, with small black spots (variable in position and number) especially on the adipose and caudal fins. There also seem to be slight differences in the proportions of the head, body depth, and caudal peduncle depth, but in many other respects the two species are quite similar (Table 12).

TABLE 12. DIFFERENCES IN PROPORTIONAL MEASUREMENTS BETWEEN FOUR *BAGRUS UBANGENSIS*, 91–114 MM, AND SIX *B. CAERULEUS*, 80–210 MM.

	caeruleus	*ubangensis*
Length of head (to insertion of gill cover).	28.6–31.1	28.2–29.7
Width of head.	20.4–23.5	19.2–20.2
Interorbital space.	9.2–10.3	8.5– 8.7
Eye diameter.	2.6– 3.7	5.0– 5.7
Width of body (at insertion of pectoral spines).	21.4–23.8	19.8–20.6
Depth of body (at dorsal fin origin).	17.4–20.3	14.1–15.5
Least depth of caudal peduncle.	10.4–11.7	8.2– 8.5

Comments. Apart from *B. docmac* in Lake Tanganyika, the only other nominal species of *Bagrus* in the Zaire basin is *B. lubosicus* Lonnberg 1924, from the rivière Lubozi, a tributary of the rivière Luala, in Lower Zaire. The 243-mm holotype of *lubosicus* should be re-examined to see if it is distinct from *ubangensis*. Its eye diameter, 7½ in head, probably occurs in *ubangensis* of comparable length. The description of its coloration agrees with that of *ubangensis*. Our largest *caeruleus*, 210 mm, has the eye 11 or 12 times in head, depending upon how head-length is measured, and the eye should be even smaller in larger specimens.

Bagrus caeruleus and *ubangensis* were collected together at one of our rapids stations (R & S 2); the differences between the two species are readily apparent in the specimens from this locality.

***Chrysichthys* Bleeker 1858**

Type species: *Pimelodus auratus* Geoffroy Saint-Hilaire 1809, by original designation.

Our rapids collections include six species of the bagrid catfish genus *Chrysichthys*, one of which we shall describe as new. The 81-mm *Chrysichthys* undet. from R & S 35 (MCZ 50378), if its very small eyes are characteristic, is probably also new, but we do not wish to describe it until more material becomes available.

Chrysichthys helicophagus new species
Plate 6, e

Holotype. MCZ 50292, 94.5 mm, R & S 35.

Paratypes. MCZ 50293, 5: 71.4–103.0 mm, R & S 35; MCZ 50377, 2: 66.3–79.8 mm, R & S 28; MCZ 50530, 1: 91.1 mm, R & S 41.

Diagnosis. A small-eyed, snail-eating *Chrysichthys*; dorsal profile of head moderately steep (much steeper than in *delhezi* and *cranchii*, in which the head is relatively depressed, and the mouth broader); palatal teeth restricted to widely separated, small narrow patches; gill rakers on first gill arch 7–8 + 1 + 12–14; color uniformly bluish grey or greyish blue.

Head 31.0–33.5. Eye 4.6–6.4. Snout 12.2–13.6. Interorbital 9.6–10.5. Depth of body 24.3–27.0. Depth of caudal peduncle 12.4–14.2. Dorsal spine 15.8–20.0. Pectoral spine 16.0–19.6. Base of adipose fin 13.4–15.9.

Barbels: nasal, 12.1–16.0; maxillary, 30.5–33.9; inner mandibular, 14.2–19.5; outer mandibular, 22.8–28.4.

Comment. In all six of our specimens of *helicophagus* the guts are well filled with gastropods, which they had ingested whole without crushing the shells: *Potadoma wansoni*, *Bulimus* (*Parabithynia*), and *Cleopatra hargeri*. Other *Chrysichthys* from the rapids usually have no mollusks in their guts; if present at all, they are few.

***Notoglanidium* Günther 1902**

Type species: *Notoglanidium walkeri* Günther 1902, by original designation and monotypy.

Notoglanidium pallidum new species
Plate 7, a–c

Holotype. MCZ 50236, 53.4 mm, R & S 29.

Paratypes. MCZ 50237, 1: 20.2 mm, R & S 29; MCZ 50294, 26: 19.3–82.5 mm, R & S 35; MCZ 50379, 1: 72.7 mm, R & S 28.

Diagnosis. N. pallidum is the only *Notoglanidium* which is microphthalmic and pallid in coloration. It further differs from its congeners in having a greatly depressed head and only 9–10 dorsal fin rays.

Head 29.5–33.6. Eye 1.3–1.6. Interorbital space 5.6–6.5. Maxillary barbel 10.8–16.2, inner mandibular barbel 14.2–28.2, outer mandibular barbel 38.5–47.1. Depth of body 11.8–16.3, width 23.0–24.9. Dorsal spine very short, 3.8–7.2, pectoral spine 9.1–11.5. Base of adipose 18.2–26.8. Predorsal length 35.9–37.7, preanal 66.7–73.1. Caudal peduncle length 16.0–17.8, depth 8.7–10.5. Dorsal fin with 9–10 branched rays, anal 6–8, pectoral 8. Principal caudal rays 7–8 + 9. Branchiostegal rays 8 + 8 (3) or 9 + 9 (1). Postweberian vertebrae 29–31. Coloration in life pallid pink; in preservative light dusky cream-color or greyish.

Comments. This species agrees with *Auchenoglanis* and *Notoglanidium* but differs from *Parauchenoglanis* in having a premaxillary tooth band narrow in lateral extent, large papillae on the lips, and an extremely folded pharyngeal epithelium. In *Parauchenoglanis* the premaxillary tooth band is much wider, the lips are but finely papillose, and the pharyngeal epithelium relatively simple. It differs from *Auchenoglanis* but agrees with *Notoglanidium* in having a dorsal fin with more than seven branched rays, eye without free border, a low adipose fin, and a rounded caudal fin. In many ways it somewhat resembles *Parauchenoglanis boutchangai* Thys 1965, a microphthalmic, dorsally flattened fish of uniformly dark brownish coloration and a relatively high dorsal fin with seven branched rays, known only from the rapids of the rivière Ngounié (Ogowé basin) near Lebamba, Gabon.

Gymnallabes Günther 1867

Type species: *Gymnallabes typus* Günther, 1867:111.

This genus was diagnosed by Boulenger (1911:270) as a "degraded, anguilliform *Clarias*, with the sides of the head unprotected by bone, even the postorbital shield being absent, the pectoral and ventral fins very small, no free border to the eye, and the dorsal and anal completely united with the caudal."

Gymnallabes typus is known from the southern parts of Nigeria and Dahomey (Daget and Iltis, 1965:168) but the kind of habitat is unrecorded. *G. alvarezi* Roman (1971:112–113, fig. 46), a very similar species, was based on a single specimen from the Río Kie, a tributary of the Río Ntem or Campo, near Ebebiyin in Guinea Ecuatorial. *G. tihoni* Poll 1944, the only other species referred to the genus, was described from rapids habitats near Kinsuka. The anatomy of this cryptophthalmic and remarkably flattened species has not been adequately compared with that of *typus*. Our colleague, Prof. Max Poll, has indicated that it may represent a new genus, a problem he is studying. Our rapids collections include numerous specimens of *tihoni*, and a single specimen of a closely related species which is completely depigmented and entirely without eyes. Pending the results of Prof. Poll's study we place this new species in *Gymnallabes*.

Gymnallabes nops new species
Plates 7, e and 8, a

Holotype. MCZ 50298, 57.0 mm, R & S 35.

Diagnosis. G. nops is closely related to *tihoni*, from which it differs most strikingly in being completely eyeless and depigmented. In *nops* the pectoral fins do not reach the dorsal fin origin, and the pelvics do not reach the anal origin, while in *tihoni* the pectorals and pelvics extend beyond the origins of these fins. In *nops* the innermost pelvic ray is longer than the outermost, while in *tihoni* it is extremely reduced. *G. nops* has more gill rakers, fewer rays in the dorsal and anal fins, and more precaudal vertebrae but fewer total vertebrae than *tihoni*. The body at the dorsal fin origin and the caudal peduncle are deeper in *nops* than in *tihoni*, and the pectoral spine is shorter; the distance from occipital

TABLE 13. PROPORTIONAL MEASUREMENTS AND COUNTS IN *GYMNALLABES TIHONI* AND *NOPS*.

	tihoni	*nops*
n: S. L. mm	5: 75.2–173.6	1: 57.0
Snout-occipital crest	11.3–14.3	13.9
Occipital crest-dorsal fin origin	4.0–6.25	11.1
Snout-anus	25.1–30.3	39.6
Body depth	5.40–6.86	8.77
Caudal peduncle depth	1.90–2.18	3.85
Pectoral fin	6.80–8.73	9.47
Pectoral spine	5.07–6.13	3.50
Dorsal fin rays	122 (n = 1)	75
Gill rakers on first arch	10–11	15
Precaudal postweberian vertebrae	10–11	15
Total postweb. vertebrae	67–73	57

bone to dorsal fin origin is almost twice as great in *nops*. The mandibular muscles extend further dorsally onto the head, leaving a narrower exposed cranial surface than in *tihoni* (compare the dorsal views in Plate 7).

Counts and measurements of *nops* and *tihoni* are presented in Table 13.

Comments. If our assumption that *nops* is an anophthalmic species is correct, then it is the only such species known from the Zaire rapids as all of the other fishes with reduced eyes are either microphthalmic or cryptophthalmic. Our only specimen was the lone *Gymnallabes* taken in a relatively quiet, silted backwater open to the mainstream. Of 168 *tihoni* in our collections, only one has the eyes missing, a 75-mm specimen from R & S 41. This eyeless individual has normal pigmentation, and agrees with *tihoni* in all counts and measurements; it has 11 postweberian precaudal vertebrae and a total of 67 or 68 postweberian vertebrae. Eyeless individuals have been reported in other species of Clariidae. David and Poll (1937:234) reported two eyeless individuals of the normally microphthalmic *Channalabes apus* among a sample of 68 specimens from Kunungu. (This species inhabits forest streams and swamps, sometimes burrowing into the masses of tree roots underneath overhanging banks.)

Atopochilus Sauvage 1878

Type species: *Atopochilus savorgnani* Sauvage 1878, by original designation.

Mochokids with lips forming an expanded oral disc. Premaxillary teeth in two series: an external series with spatulate crowns on the anterior portion of the oral disc, outside the buccal cavity, which works directly against the substrate; and an internal series with needlelike crowns, at the entrance to the buccal cavity, which works against the mandibular tooth series. Mandibular tooth series consisting of a single row of tooth families, increasing in number with age, and with six to eight teeth in each fully-formed tooth family; mandibular teeth with bifid crowns in young, crowns bifid in adults of some species, but becoming spatulate in adults of other species (no other mochokids develop bifid teeth).

Confined to the Zaire basin except for one apparently endemic species in the Ogowé basin and another in one or two coastal river basins in Tanzania, *Atopochilus* includes 13 nominal species (Poll, 1959: 106–107). Unfortunately, most descriptions have been based on one or a few specimens only, often either very small juveniles or the largest size of adult, and no attempt has been made to account for growth changes within species, which are considerable. Some grow to half a meter or more in standard length, and undergo sub-

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Plate 7

a–c. *Notoglanidium pallidum* new species, holotype, 53.6 mm. Zaire River at Bulu (MCZ 50236).
d. *Gymnallabes tihoni*, 75 mm. Zaire River at Tadi (MCZ 50297).
e. *Gymnallabes nops* new species, holotype, 57.0 mm. Zaire River at Tadi (MCZ 50298).

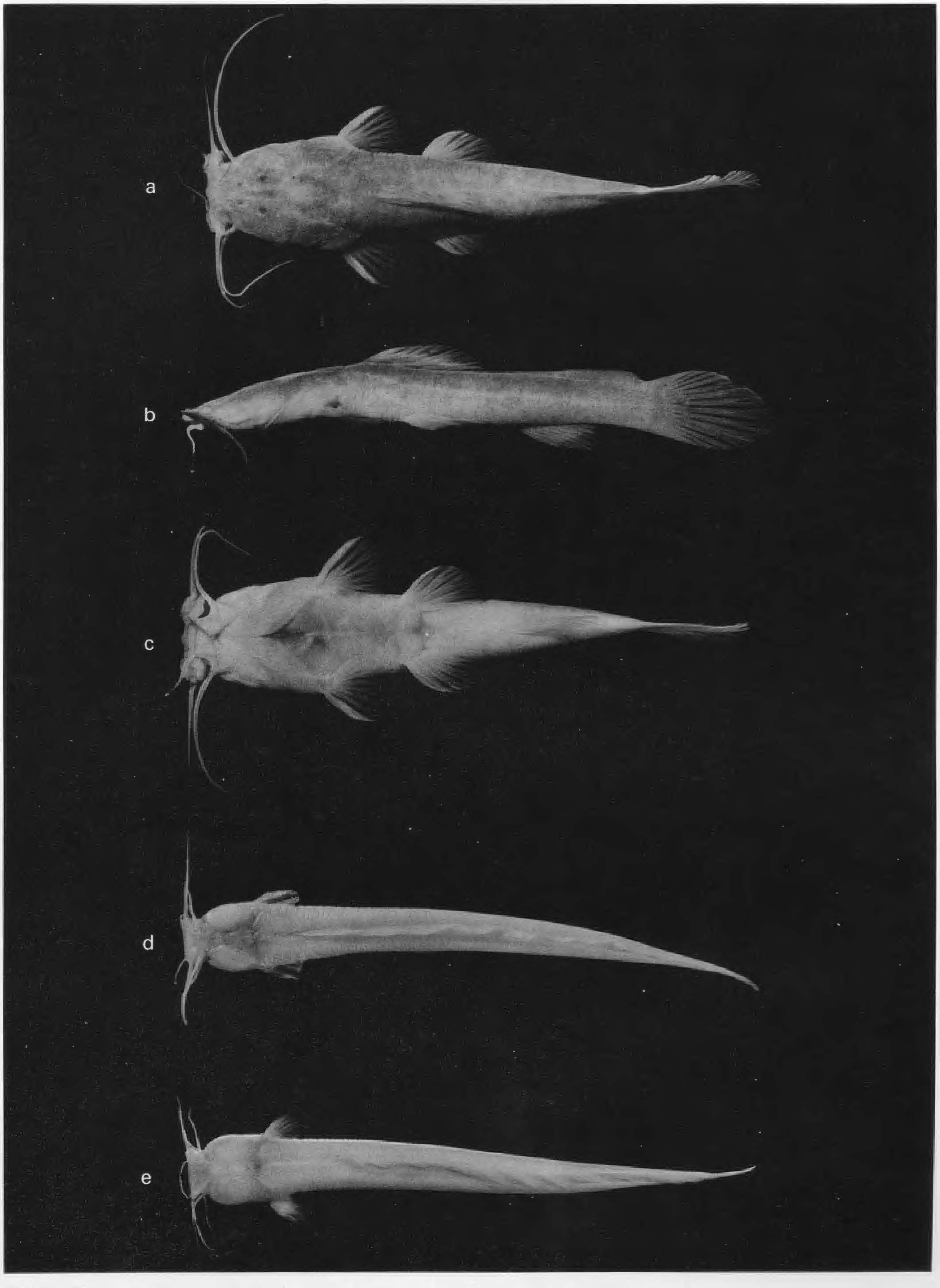

Plate 7

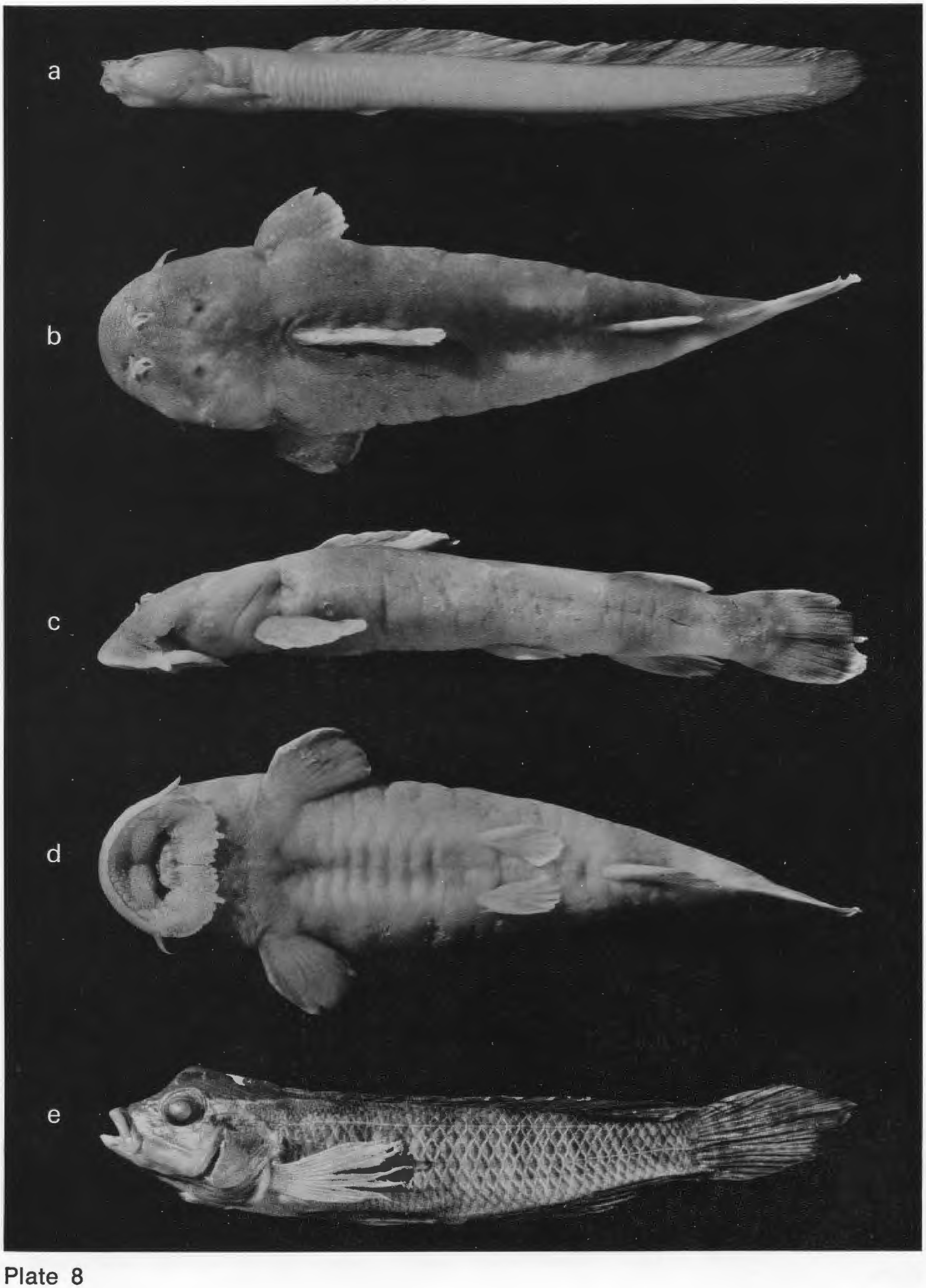

Plate 8

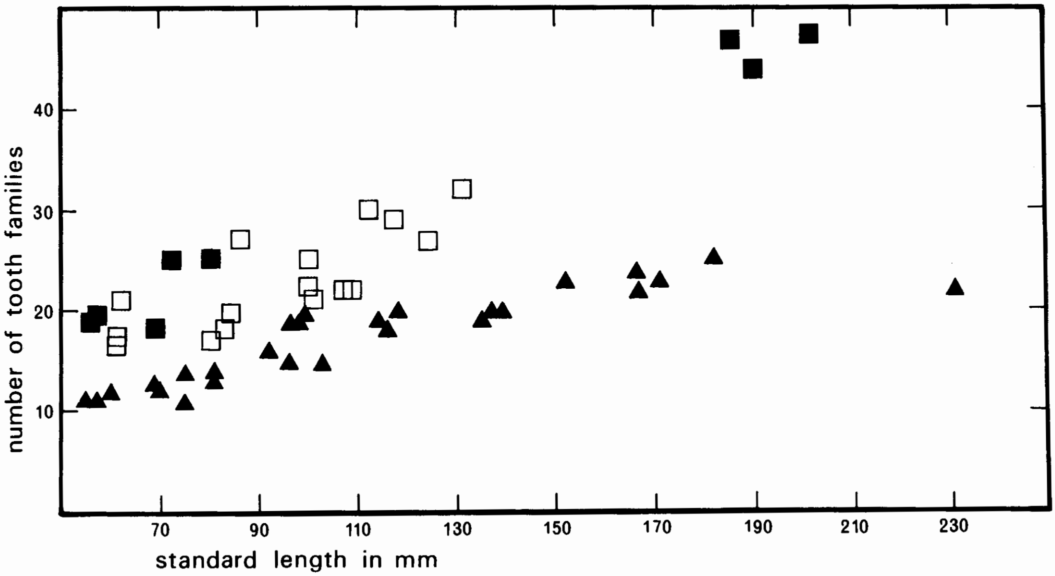

Figure 4. *Atopochilus.* Number of mandibular tooth families plotted against standard length. ▲ *guentheri*, Lower Zaire R. (MCZ 50147, 50194, 50300, 50381, 50463 and 50538); ■ *royauxi*, Lower Zaire R. (MCZ 47989, 50148 and 50539); □ *royauxi*, Ubangui (MCZ 48357 and 48358).

stantial allometry. There are also ontogenetic changes in dentition (Poll, 1967:258–263). The genus is badly in need of taxonomic revision, but this should be deferred until sufficient material has been collected to permit study of growth changes and other variation.

Body form varies greatly within the genus, from short, stocky species to elongate and greatly depressed ones. Our rapids collections include two species, *A. guentheri* and *A. royauxi*, in both of which adults have elongate and greatly depressed bodies. They are superficially very similar, and thus it is of interest that we found them sympatric at two localities. There are slight differences in coloration and in several proportional measurements (Table 14), but the surest way to distinguish them is by counting the mandibular tooth families. These range from 11 or 12 to 25 in *A. guentheri* of 57–230 mm, and from 18 or 19 to 47 in *A. royauxi* of 54–201 mm, and are always more numerous in *A. royauxi* at any given standard length. The number of mandibular tooth families in the two species is plotted against standard length in Figure 4. The data for *A. royauxi* include material from Ubangui. It is interesting to note that specimens from Ubangui may not differ from *A. guentheri* as sharply as do those from the Lower Zaire River. This is possibly an example of character displacement: *A. guentheri* has not been reported from Ubangui. The dentition of a 58-mm *A. guentheri* with 12 mandibular tooth families is illustrated in Figure 5. Additional mandibular tooth families are apparently formed near the symphysis of the mandible as well as at the outer ends of

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Plate 8

a. *Gymnallabes nops* new species, holotype, 57.0 mm. Zaire River at Tadi (MCZ 50298).
b–d. *Chiloglanis carnosus* new species, holotype, 54.1 mm. Zaire River at Inga (MCZ 50464).
e. *Lamprologus werneri*, 62 mm. Zaire River at Kinganga (MCZ 50390).

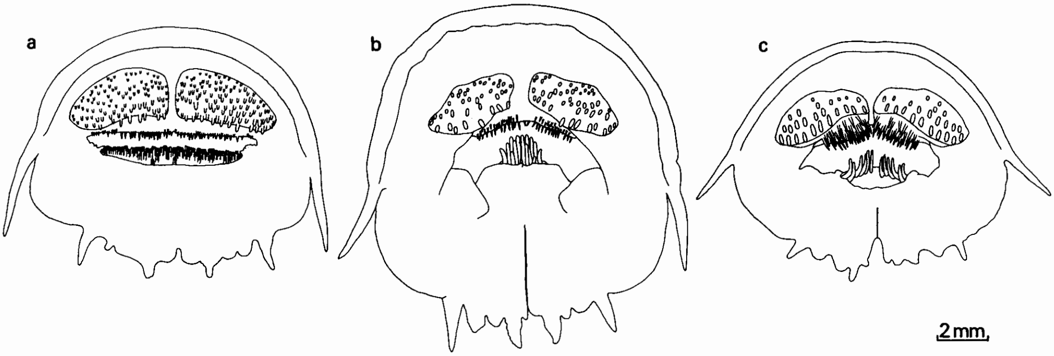

Figure 5. Mochokidae, oral disc and dentition: a. *Atopochilus guentheri*, 58 mm; b. *Chiloglanis congicus*, 60 mm; c. *Chiloglanis carnosus*, 61 mm.

the mandibular tooth row. Our counts exclude partially formed tooth families near the symphysis in which none of the teeth lies as far forward as the anteriormost teeth of previously formed tooth families. The histology of the tooth families and the mode of tooth replacement have not been studied. We suspect that within each tooth family, the anteriormost teeth are the first to be discarded and are successively replaced by the more posterior ones, which continuously "migrate" forward.

TABLE 14. DIFFERENCES BETWEEN TWO SPECIES OF *ATOPOCHILUS* FROM THE LOWER ZAIRE RIVER.

	guentheri	*royauxi*
Standard length mm	57–230	54–201
Head	27.4–30.2	28.7–31.7
Eye	2.0– 3.4	2.7– 4.9
Oral disc length	15.8–20.9	17.6–20.0
Oral disc width	21.0–24.5	24.6–26.4
Mandibular tooth pad length	11.3–13.4	13.4–16.6
External premaxillary tooth pad width	6.7– 8.4	8.5– 9.7
Dorsal spine length	6.3–10.4	8.9–11.5
Body depth	12.9–16.4	14.2–18.2
Spots on abdomen	absent	often present
Number of mandibular tooth families	11–25	18–47

Chiloglanis **Peters 1868**

Type species: *Chiloglanis deckenii* Peters 1868.

A rheophilic genus of small to moderately large mochokids with a sucker mouth, closely related to *Atopochilus*, but distinguished from that genus by having mandibular teeth far fewer and unicuspid throughout life (Figure 5). A description of the dentition is given by Trewavas (1974:358–359). See also our remarks under *Atopochilus*. Our rapids collections include two species of *Chiloglanis*, one undescribed.

Chiloglanis carnosus new species
Plate 8, b–d

Holotype. MCZ 50464, 54.7 mm, R & S 38.

Paratypes. MCZ 50465, 15: 23.8–58.0 mm, R & S 38; MCZ 50541, 27: 19.9–61.0 mm, R & S 41; MCZ 50301, 1: 32.2 mm, R & S 35; MCZ 50382, 7: 31.8–47.3 mm, R & S 28; MCZ 50241, 21: 21.2–57.7 mm, R & S 29.

Diagnosis. Distinguished from all previously described *Chiloglanis* by its short, flat body (width of body divided by depth 1.4–2.1), and furthermore in having a low dorsal fin. Head smooth, without tubercles; diameter of eye 1.6–2.6; fewer than 30 teeth on main tooth-bearing area of each premaxillary; gill opening restricted, terminating well above pectoral spine, its length

TABLE 15. PROPORTIONAL MEASUREMENTS IN *CHILOGLANIS CONGICUS* AND *C. CARNOSUS* (n = 10).

	congicus	*carnosus*
Standard length	48.7–65.1 mm	38.5–60.1 mm
Body width	20.5–22.0	23.2–30.2
Body depth	16.2–18.4	13.2–19.6
Head length	35.3–37.1	28.0–32.4
Head width	24.3–25.1	23.2–29.3
Oral disc length	22.6–24.9	16.9–19.5
Oral disc width	20.1–25.0	19.6–23.9
Maxillary barbel	6.0–7.2	4.1–6.8
Outer mandibulary barbel	4.1–4.7	1.4–2.2
Snout	22.9–24.2	18.1–22.9
Eye	2.6–3.3	1.6–2.5
Interorbital space	7.7–8.7	5.6–9.0
Gill opening	8.2–9.2	3.9–4.6
Predorsal length	40.2–42.7	33.9–38.2
Last dorsal ray to adipose	13.0–16.2	27.4–31.8
Dorsal spine	8.1–10.1	3.7–5.8
Dorsal fin height	13.5–15.9	8.9–12.4
Adipose fin length	21.7–23.7	10.7–14.0
Adipose fin height	3.9–4.7	2.2–2.8
Pectoral spine	10.8–14.1	7.4–9.9
Pectoral fin	19.0–22.1	15.5–19.5
Pelvic fin	13.3–15.7	11.0–14.0
Caudal peduncle length	14.8–17.4	12.9–15.6
Caudal peduncle height	8.4–9.4	8.5–10.5

3.9–4.6; complete vertebral centra behind fused Weberian vertebrae only 24 or 25 (usually 24); back and sides dark blue or bluish grey, with pairs of oval, cream-colored marks anterior and posterior to adipose fin, entire ventral surface of head and body cream-colored or whitish.

Proportional measurements are presented in Table 15.

Dentition (Figure 5). In seven specimens 44–60 mm S. L., the number of teeth on the main tooth-bearing area of the premaxillary varies from 22 to 27, with no relation to length of specimens. There are about 33–35 teeth on the secondary tooth-bearing area of the premaxillary (the small teeth which oppose the dentary teeth), except in one specimen with only 23. The dentaries bear either a single row of teeth, or two rows, in which case the inner row consists of replacement teeth that have just erupted or have yet to erupt from the epidermis overlying them. The number of teeth in the outer tooth row of each dentary varies from five to seven.

Comments. In addition to *C. carnosus*, our rapids collections include specimens which correspond to the description and figures of *C. congicus* Boulenger 1920. The *congicus* differ strikingly from *carnosus* by their higher body (width of body divided by depth 1.1–1.3), higher dorsal fin, larger oral disc, longer barbels, more numerous teeth on main tooth-bearing portion of premaxillary (47–62 teeth on each premaxillary in specimens from 49–87 mm S. L., number of teeth increasing with length of specimens), gill opening extending anteroventrally to in front of pectoral spine insertion, complete vertebral centra behind fused Weberian vertebrae 26–28 (usually 27), and brownish grey back and sides. There are numerous differences in proportional measurements between *carnosus* and *congicus* (Table 15). The dentition of *congicus* is illustrated in Figure 5.

***Lamprologus* Schilthuis 1891**

Type species: *Lamprologus congoensis* Schilthuis, 1891:85–86, pl. 6, fig. 1.

This genus, endemic to the Zaire basin, differs from most other African cichlids in having 4–10 spines in the anal fin, and upper and lower jaws with bands of fine unicuspid teeth and 6–10 enlarged canines anteriorly; scales ctenoid. Pharyngeal apophysis formed by basioccipital bones as well as parasphenoid. Three riverine species are currently recognized: *L. congoensis, L. moquardii* Pellegrin 1903, and *L. werneri* Poll 1959. Our rapids collections include many *werneri* (two color varieties?), a small series perhaps identical with *moquardii*, and two specimens of an un-

TABLE 16. MORPHOMETRIC AND MERISTIC CHARACTERS OF *LAMPROLOGUS LETHOPS*.

	Holotype	Paratype
S. L. mm	27.0	87.9
Head length	30.4	24.9
Head width	20.0	22.5
Body depth	17.8	16.7
Body width	17.0	17.5
Last dorsal spine	9.3	8.0
Last anal spine	10.0	8.3
Pectoral fin	23.0	28.8
Pelvic fin	20.0	16.4
Caud. ped. length	13.7	13.7
Caud. ped. height	10.7	11.4
Dorsal spines	20	20
Dorsal rays	7	7
Anal spines	6	7
Anal rays	6	5
Lateral line scales	45	50
Upper pored scales	30	41
Lower pored scales	12	23
Circumped. scales	24	25
Upper/lower canines	6/8	6/6
Gill rakers	11 + 1 + 4	—
Vertebrae	—	15 or 16 + 17

described species which differs from all other known cichlids in being cryptophthalmic and depigmented.

Lamprologus lethops new species
Plate 9, a–c

Holotype. MCZ 50248, 27.0 mm, R & S 29.
Paratype. MCZ 50249, 87.9 mm, R & S 29.

Diagnosis. A cryptophthalmic, depigmented *Lamprologus* with a relatively flat head and nearly cylindrical body. It is further distinguished from all other riverine *Lamprologus* by its relatively small scales.

Counts and measurements of the two type specimens are given in Table 16. There are two or three suborbitals, the lacrimal with two enlarged lateralis canals extending to its lower rim and one or two small suborbitals (variable). A line of small neuromasts extends posterodorsally on the skin from the last suborbital to the anterior lateralis pore on the pterotic bone, as in most other *Lamprologus*. The basioccipital is incorporated into the pharyngeal apophysis as in other *Lamprologus*. The pharyngeal teeth are moderately molarized (Figure 6).

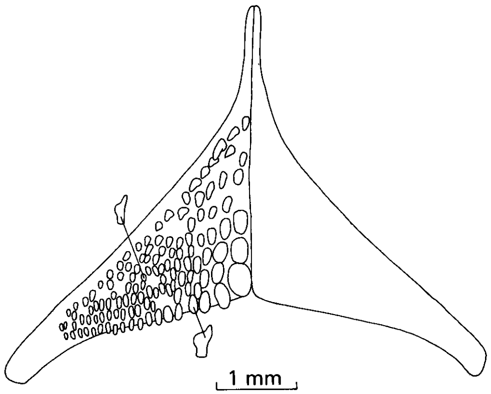

Figure 6. *Lamprologus lethops*, 88 mm, pharyngeal dentition.

Comment. In generic characters, *lethops* agrees fully with the type species of *Lamprologus*.

Nanochromis Pellegrin 1904

Type species: *Pseudoplesiops nudiceps* Boulenger 1899, by original designation.

Nanochromis sensu stricto is distinguished from other African cichlids by having one half or more of the upper row of scales bearing lateral line tubules adjacent to the base of the dorsal fin, rather than separated from it by one or more rows of scales without tubules. The group thus defined includes all of the species dealt with here.

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Plate 9

a. *Lamprologus lethops* new species, holotype, 27.0 mm. Zaire River at Bulu (MCZ 50248).
b–c. *Lamprologus lethops* new species, paratype, 87.9 mm. Zaire River at Bulu (MCZ 50249).
d. *Nanochromis nudiceps*, lectotype, 48.5 mm. Kutu, Zaire (RGMC 1045).
e. *Nanochromis* sp. undet., 45 mm. Small stream near Boende, Cuvette Centrale, Zaire (MCZ 48004).

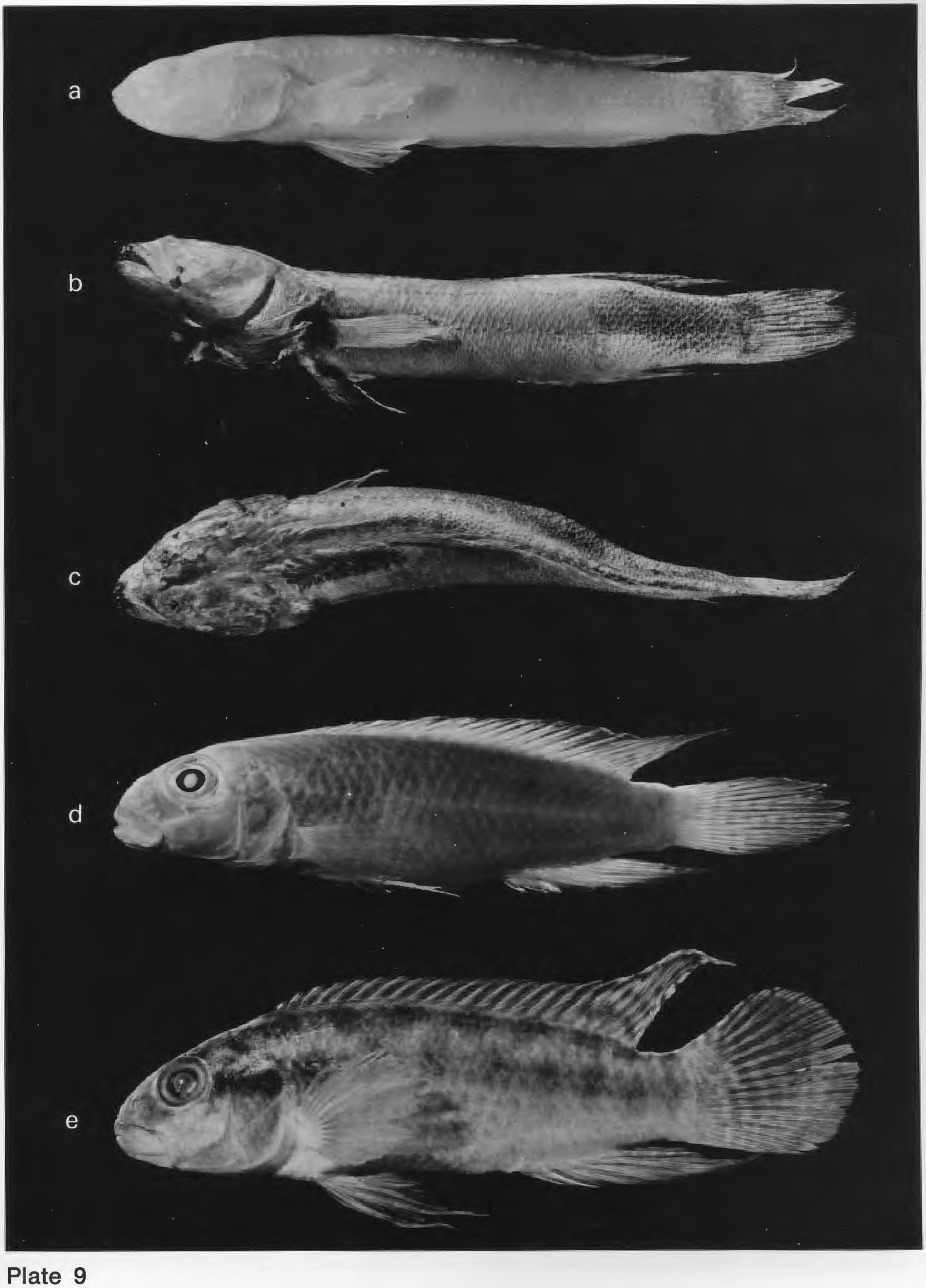

Plate 9

Thys (1968) and Thys and Loiselle (1971) have broadened the generic concept to include several species from Upper Guinea and Lower Guinea, but this does not concern us in the present context.

There are three nominal species of *Nanochromis sensu stricto: N. nudiceps, dimidiatus,* and *squamiceps.* Our rapids collections include four new species which are clearly distinct from *dimidiatus* and *squamiceps.* A problem arises with *nudiceps,* however, because the type series is polytypic. We examined two of the four syntypes and found they belong to different species. It is necessary to designate a lectotype before describing our new species.

Nanochromis nudiceps (Boulenger) 1899
Plate 9, d

Lectotype. RGMC 1045, 48.5 mm, Kutu, Cuvette Centrale. M. P. Delhez, 1899.

Diagnosis. A relatively large *Nanochromis* with level dorsal profile; about last 10 dorsal spines subequal in length; nape scaleless; caudal peduncle as long as high; entire caudal fin with rows of small dark spots forming six to eight narrow vertical bars; soft-rayed portions of dorsal and anal fins with bars similar to those on caudal; dorsal and caudal fins without a dark margin or light submargin.

Counts and measurements are given in Tables 17 and 18.

Comments. Boulenger's description of *nudiceps* is based on all four syntypes, but the one we have selected as lectotype is the largest and best preserved of the four, and the one selected by Boulenger to serve as the figure for his new species. The other three syntypes, all from Stanley Pool (= Malebo Pool), are small and in poor condition; they differ from the lectotype in having a black margin and light submargin on the dorsal fin and upper edge of the caudal fin. Such coloration distinguishes one of our new species, *N. parilus,* with which they may be identical.

TABLE 17. FREQUENCY OF TOTAL DORSAL ELEMENTS IN SPECIES OF *NANOCHROMIS* (TOTAL DORSAL ELEMENTS = NUMBER OF SPINES PLUS RAYS IN DORSAL FIN, LAST RAY COUNTED AS ONE WHEN SPLIT TO BASE).

		22	23	24	25	26	27
nudiceps	Kutu					1	
sp. undet.	Boende			1		1	
	Bandundu			1		2	
consortus	Inga				6		
parilus	Wombe					6	4
	Kinganga					10	
	Inga				2	7	1
minor	Tadi		1				
	Kinganga	1	1	1			
splendens	Tadi			9	1		
	Kinganga		1	8	1		
	Inga		2	6	2		

The four new species about to be described agree with *nudiceps* as well as sp. undet. in having only two infraorbital bones, a lacrimal with two lateralis canals extending to its lower rim, and an elongate second infraorbital. The posterior end of the second infraorbital tends to project straight back, rather than follow the orbital rim. The new species further agree with *nudiceps* but differ from sp. undet. in lacking predorsal bones and in having five lateralis pores on the mandible and seven on the preopercle (including one at the junction with the skull). *N.* sp. undet. has one predorsal bone, four mandibular pores and six preopercular pores. The new species all have scaleless cheeks, and three of them also have scaleless napes, as in *nudiceps.* One new species, *consortus,* has scales on the nape, but they are minute and few in number. *N. dimidiatus* and *squamiceps,* on the other hand, have large scales on the cheeks and on the nape.

Apart from *nudiceps,* the only previously described *Nanochromis sensu stricto* are *N. dimidiatus* (Pellegrin) 1900 (type locality Banghi) and *N. squamiceps* (Boulenger) 1902 (type locality Lindi River, Upper Congo). Matthes (1964:134–137) placed *squamiceps* in the synonymy of *dimidiatus*; Thys (1968:387) indicated they are distinct but did not record his observations. *N. dimidiatus* differs from *nudiceps*, and from all of our new species, in having one or two moderately large scales just below the posterior portion of the eye (at least in some specimens), and a dark longitudinal band extending midlaterally from the posterior edge of the eye to the end of the caudal fin (see Pellegrin, 1904, pl. 4, fig. 2). Two specimens from Bangui in the British Museum (BMNH 1975.2.10: 1–2) agree with the description of *dimidiatus*, and are distinct from our new species; we have not examined the type specimens. The relatively deep-bodied specimens from Boende and Bandundu in the Cuvette Centrale, reported here as *Nanochromis* sp. undet. (Tables 17–18, Plate 9e), may represent a new species; we had originally identified them as *dimidiatus*. *N. squamiceps* differs from *nudiceps* and from all our new species in having large scales on the nape and cheek. *N. dimidiatus* and *squamiceps* further differ from all of our new species in having the caudal fin uniformly marked with rows of small dark spots forming several narrow vertical bars (as in *nudiceps*).

Nanochromis consortus new species
Plate 10, a, b

Holotype. MCZ 50551, 52.2 mm, R & S 41.
Paratypes. MCZ 50552, 5: 26.0–49.0, R & S 41.

Diagnosis. A *Nanochromis* with dorsal fin spines stubby anteriorly, increasing regularly in length from first to last; total dorsal elements modally 25 (Table 17); nape with a few small, embedded scales; mature females with anterior half of anal fin black.

This species differs strikingly from *dimidiatus* and *minor.* It is readily distinguished from *splendens* by coloration and morphometric characters (Table 18). It is similar in meristics to *parilus* and *nudiceps.* From *parilus* it differs in coloration, in the profile of the spinous dorsal fin, and in adults having a smaller eye (eye diameter 27.6–31.8% of head length in *consortus* versus 29.4–33.0% in *parilus*). It differs from *nudiceps* in the coloration of the caudal fin, in the profile of the spinous dorsal fin, and in the ratio of caudal peduncle length to height (Table 18).

Size. Our two largest *consortus*, 49.0- and 52.2-mm males, are about 4–7 mm longer than the largest *splendens* and 5–8 mm longer than the largest *parilus* we obtained. The largest female is 40.7 mm.

Coloration. Life colors unrecorded. Preserved specimens of both sexes, adults as well as young, have body beige with grey edgings on scales, and no trace of vertical bars. Forehead, nape, and lacrimal rusty brown, apparently due to underlying adipose tissue. Sexually mature males and females differ in the coloration of the fins, all of which except the pectoral fin tend to be longer in males. In males posterior portion of soft dorsal and upper two-thirds of caudal with several vertical rows of dark spots; upper third of caudal sometimes with longitudinal streaks between the rays and lower third of caudal dusky, without marks, indicating that in life the upper half of the caudal differs in color from the lower half; anterior two-thirds of anal dusky, posterior third yellowish near base with faint indication of vertical bars. In females, dorsal, caudal, and posterior half of anal fins plain, dusky grey. The only mature female in our collection, which is gravid, has the anterior half of the anal fin black (Plate 10, b), a feature not found in any other *Nanochromis* of either sex.

Nanochromis parilus new species
Plate 10, c, d

Holotype. MCZ 50474, 44.1 mm, R & S 38.
Paratypes. MCZ 50475, 38: 21.6–41.4 mm, R & S 38; MCZ 50202, 11: 11.5–40.8 mm, R & S 19; MCZ 50250, 1: 30.8 mm, R & S 29; MCZ 50309, 3: 31.8–42.1 mm, R & S 35; MCZ 50340, 14: 13.4–44.1 mm, R & S 26; MCZ 50391, 5: 19.3–41.5 mm, R & S 28.

Diagnosis. N. parilus differs from all other *Nanochromis sensu stricto* in having

TABLE 18. MORPHOMETRIC AND MERISTIC CHARACTERS IN *NANOCHROMIS SENSU STRICTO*.

	nudiceps[1]	sp. undet.[2]	*consortus*[3]	*parilus*[4]	*minor*[5]	*splendens*[6]
n: S. L. mm	1: 48.8	5: 29.2–45.0	6: 26.0–52.2	10: 32.4–44.1	4: 21.0–23.8	10: 33.3–43.2
Head	31.6	32.6–34.7	29.6–33.1	30.7–34.3	32.3–34.5	31.0–35.0
Eye (% headlength)	31.2	28.3–30.9	27.6–31.8	29.4–33.0	29.3–30.0	28.7–34.5
Interorbital (% headlength)	16.2	21.6–23.6	16.1–18.2	12.8–16.5	17.9–19.5	12.1–15.6
Preorbital (% headlength)	18.8	9.9–15.7	14.8–19.2	13.6–17.7	11.4–12.2	15.2–19.4
Depth	24.8	28.4–30.9	23.8–25.1	23.3–27.8	23.6–26.1	20.4–24.9
Last dorsal spine	14.6	10.0–14.2	11.8–15.1	12.2–15.9	15.2–16.8	11.2–16.0
Pectoral fin	23.0	23.8–27.3	19.7–23.8	22.7–25.8	19.3–21.9	21.3–22.9
Pelvic fin ♂	30.5	—	28.5–29.8	26.3–33.9	25.6–32.2	35.4–43.0
Length caudal ped./height caudal ped.	0.98	0.90–1.00	1.25–1.42	1.09–1.32	0.97–1.22	1.17–1.38
Dorsal spines	18	17–19	18	18–19	17–18	16–18
Dorsal rays	8	7–8	7	7–8	5–6	6–7
Anal rays	6	5–6	5–6	6–7	5–6	6
Upper pored scales	14	8–11	8–13	11–16	6–10	11–16
Lower pored scales	4	2–4	2–6	3–7	2–5	4–6
Midlateral scales	26	24–25	26–28	25–27	23–24	25–27
Transverse scales[7]	9	7–8	9–10	9	7	8–10
Gill rakers	8+1+3	7–9+1+3–4	7–9+1+3–4	7–9+1+3–6	6+1+2–3	7–9+1+3–6
Vertebrae	27	25–26	28 (n = 3)	27–29	25	27–28

[1] RGMC 1045 (lectotype). [2] MCZ 48004, Boende; MCZ 50588, Bandundu. [3] MCZ 50551 (holotype); MCZ 50552 (paratypes). [4] MCZ 50474 (holotype); MCZ 50475 (paratypes). [5] MCZ 50341 (holotype); MCZ 50342 (paratypes). [6] MCZ 50476 (holotype); MCZ 50477 (paratypes). [7] Number of scales in an oblique row extending dorso-anteriorly from base of third anal spine to base of dorsal fin.

a black margin and light submargin on the dorsal fin and upper edge of the caudal fin, and no vertical markings on the caudal fin in either sex. It differs from sp. undet., *consortus*, and *minor* in having the last ten spines in the dorsal fin subequal in length, and differs from other *Nanochromis* except *nudiceps* in having a mode of 26 total dorsal elements (Table 17). Sexual dichromatism is slight compared to other species from the Lower Zaire rapids.

Counts and measurements are given in Table 18.

Size. Our largest male is 44.1 mm. The largest female is 40.8 mm; a gravid specimen with about 100 eggs up to .5 mm in diameter is 34.4 mm.

Color. In both sexes, dorsal portions of head and body olivaceous; cheek blue; ventral portion of branchiostegal membranes reddish; eye with a rusty-red spot on upper orbital rim and a dark iris; body behind pectoral fin with an iridescent blue-green patch grading into a rosy-violet patch posteriorly which extends onto belly; dorsal fin and upper portion of caudal fin with a black margin and light submargin; light submargin on caudal yellow-orange and bordered by a dark streak ventrally; lower half of caudal and entire anal fin violet, without distinct marks; pelvic fins whitish with grey outer rays. In mature females, violet patch on belly tends to be more intense than in males; and outer rays perhaps less dusky. No other sexual differences in coloration observed.

Comments. Nanochromis from Malebo Pool identified as *nudiceps* by Poll (1939: 44, fig. 25) agree with *parilus* in having a black margin on the dorsal fin and upper edge of the caudal. They differ primarily in having small round spots arranged in seven vertical bars on the lower half of the caudal fin, as in *splendens*. At five localities in the rapids we obtained from one to four specimens resembling Poll's Malebo Pool material, always in the presence of larger numbers of *parilus*, and, except at one locality, larger numbers of *splendens* (Table 3). These undetermined *Nanochromis* may be sexually dichromatic *parilus*, hybrids between *parilus* and *splendens*, or possibly yet another species. We are inclined to feel that the first of these three hypotheses offers the most likely explanation.

Nanochromis minor new species
Plates 10, e; 11, a

Holotype. MCZ 50341, 23.3 mm, R & S 26.
Paratypes. MCZ 50342, 2: 21.0–22.5 mm, R & S 26; MCZ 50310, 1: 23.8 mm, R & S 35.

Diagnosis. N. minor differs from all other known African cichlids in its tiny adult size and in having sharp points on the posterior edge of the opercle and subopercle. It further differs from all other *Nanochromis* in having a black-tipped mandible and sharply defined, lunate brown (or maroon) marks on the scales. The numbers of gill rakers, of vertebrae, of scales, and of total dorsal elements are fewer than in any other *Nanochromis* (Tables 17 and 18). Dorsal spines short anteriorly, increasing regularly in length from first to last, in contrast to all other *Nanochromis* except sp. undet. and *consortus*.

Size. Our three males, 22.5–23.8 mm, all have well-developed sexually dimorphic coloration. The one female, a gravid specimen with roughly 40 eggs .3 mm in diameter, is 21.0 mm.

Color. In both sexes, tip of mandible black and scales with sharply defined, lunate brown or maroon marks; eye with a rusty-red spot on upper orbital rim and a white iris. In males, branchiostegal membranes and adjacent breast reddish; dorsal and anal fins with dark brown vertical marks; upper third of caudal yellowish, lower two-thirds with large roundish brown spots arranged in five or six vertical bars on a clear background; a longitudinal band extends from the head to the base of the caudal fin, where it stops. In females, body behind pectoral fin with a violet patch extending onto the belly; longitudinal band

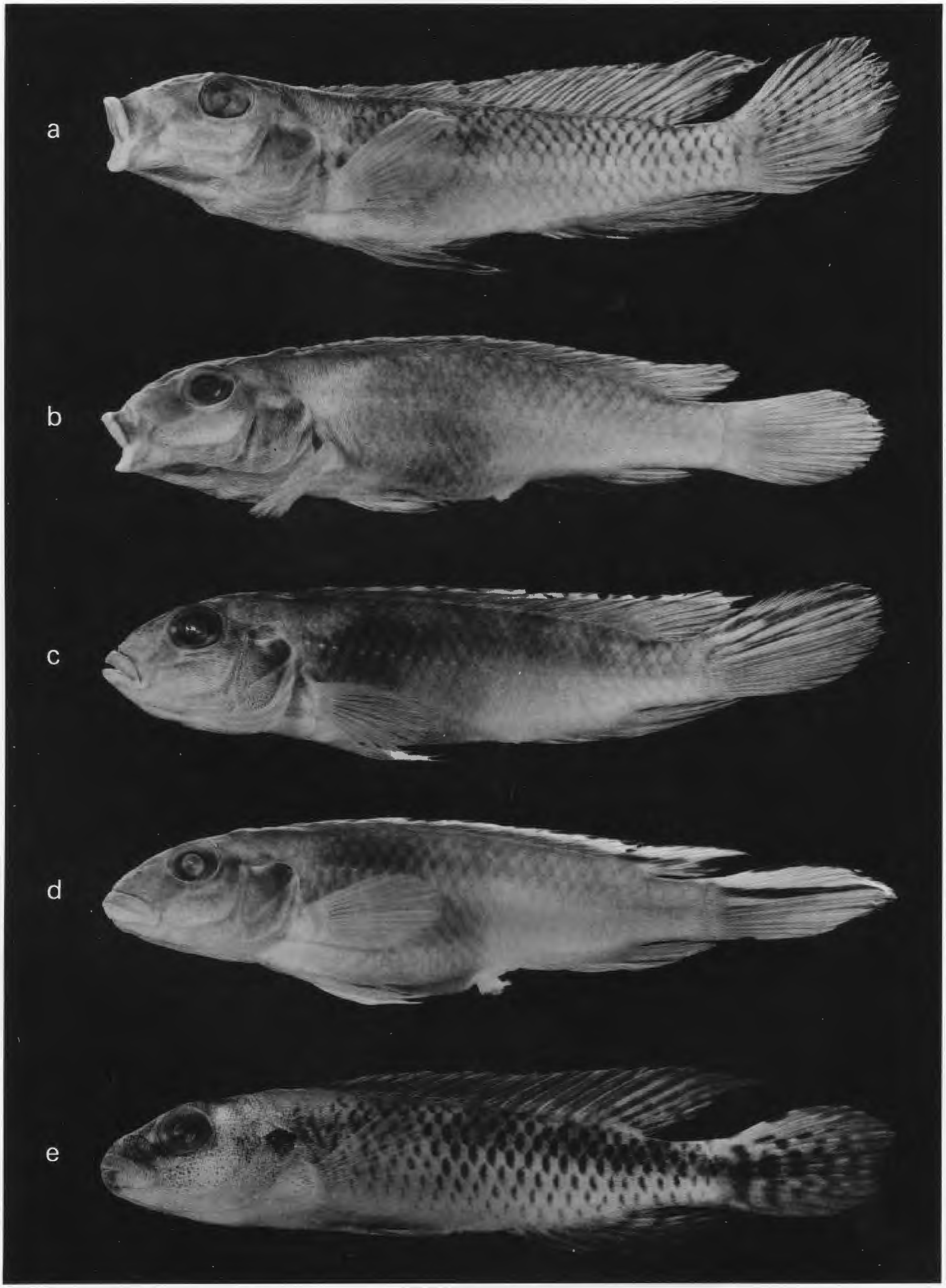

Plate 10

from head to base of caudal fin continued to end of middle caudal fin rays; upper and lower portion of caudal fin each with a maroon band paralleling the longitudinal band on middle of caudal fin, rest of caudal fin clear; dorsal and anal fins dusky brown, without markings.

Comment. N. minor were found only in relatively still backwaters, open to the mainstream, with mixed rock and silty-sand bottom, where the only other fishes were also small and few in number.

Nanochromis splendens new species

Plate 11, b, c

Holotype. MCZ 50476, 43.1 mm, R & S 38.

Paratypes. MCZ 50477, 170: 16.4–45.3 mm, R & S 38; MCZ 50311, 61: 13.2–44.6 mm, R & S 35; MCZ 50343, 5: 9.0–34.0 mm, R & S 26; MCZ 50392, 87: 14.2–42.0 mm, R & S 28; MCZ 50553, 28: 15.4–42.8 mm, R & S 41.

Diagnosis. A slender *Nanochromis* differing from all others in having canary yellow and orangish red pigments on the gill covers of both sexes at maturity; males with long, filamentous black pelvic fins and vertical carmine bars on lower half of caudal fin; body depth of males 20.4–22.0% S. L. (versus 23.3–30.9% in all other species). *N. splendens* differs from sp. undet., *consortus*, and *minor* in having the last 10 dorsal spines subequal in length; it differs from *nudiceps* and from the other species collected in the Lower Zaire rapids in having a mode of 24 total dorsal elements (Table 17).

Counts and measurements are presented in Table 18.

Size. Our largest male is 45.3 mm. The largest female is 36.9 mm; a gravid specimen with about 50 eggs 1.2–1.8 mm in diameter is only 30.0 mm.

Color. In both sexes, dorsal portions of head and body olivaceous; gill covers canary yellow anteriorly and orangish red posteriorly; eye with a red spot on upper orbital rim; iris white, making the eye appear larger than it would otherwise; scales on body with faint grey edges; body with five or six indistinct vertical bars, and an iridescent blue patch behind the gill cover grading to dark bluish violet behind the pectoral fin.

In males, cheek iridescent blue; branchiostegal membranes red; dorsal fin yellowish, with brown streaks paralleling the spines and rays; tips of dorsal spines with yellow lappets; soft portion of dorsal with dark grey margin extending to upper edge of caudal fin; upper half of caudal yellowish orange, with horizontal brown streaks, lower half with seven to eight vertical carmine bars on a clear background; posterior half of anal fin similar to lower half of caudal, anterior half of anal carmine on base and dark grey distally; filamentous outer ray of pelvic fin black, inner rays whitish.

In females, cheek canary yellow; branchiostegal membranes dusky yellowish; belly and vent region violet; spinous portion of dorsal fin red-orange along the base, grading to yellow distally; caudal yellowish at base grading to reddish distally, without distinct marks; anal uniformly bluish; outer pelvic rays white, inner rays clear. In 10–30% of the females, including specimens as small as 9 mm, the soft-rayed portion of the dorsal fin has a large black spot partially surrounded by lightened areas (Plate 11, c). Such a distinctive spot is not found in either sex of any other *Nanochromis*.

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Plate 10

a. *Nanochromis consortus* new species, holotype, ♂, 52.2 mm. Zaire River at Inga (MCZ 50551).
b. *Nanochromis consortus* new species, paratype, ♀, 40.7 mm. Zaire River at Inga (MCZ 50552).
c. *Nanochromis parilus* new species, holotype, ♂, 44.1 mm. Zaire River at Inga (MCZ 50474).
d. *Nanochromis parilus* new species, paratype, ♀, 40.8 mm. Zaire River near Wombe (MCZ 50202).
e. *Nanochromis minor* new species, holotype, ♂, 23.3 mm. Zaire River near Kinganga (MCZ 50341).

In juveniles the vertical bars on the sides of the body are more pronounced than in adults of *splendens* and juveniles of *consortus* and *parilus*.

Sexual dimorphism. In addition to the differences in size and coloration noted above, mature males of *splendens* tend to have the rays of the dorsal, anal, and pelvic fins forming filamentous extensions, and they also have a longer caudal fin than females; similar differences occur between the sexes of other *Nanochromis*, but are far less marked.

Comment. N. splendens is the most colorful and perhaps the most rheophilic *Nanochromis*.

Steatocranus Boulenger 1899

Steatocranus Boulenger, 1899:52 (type species *Steatocranus gibbiceps* Boulenger 1899, by original designation).

Leptotilapia Pellegrin 1928 (type species *Leptotilapia rouxi* Pellegrin 1928, by original designation).

Gobiochromis Poll 1939 (type species *Gobiochromis tinanti* Poll 1939, by original designation).

A rheophilic genus comprising seven closely related species endemic to the Zaire basin and one isolated species in the Volta basin, all having cycloid scales; two rows of scales bearing lateral line pores; 30–34 scales in a lateral series; 19–22 dorsal spines and three anal spines; a frontal gibbosity of variable development; and upper and lower jaws with an outer row of large bicuspid teeth and one to three inner rows of small tricuspid and conical teeth. Gill rakers on first arch 5–12. Pharyngeal apophysis formed exclusively by parasphenoid bone. Longest soft ray in pelvic fin is the third or middle ray. The species in which spawning behavior has been observed are substrate spawners, affixing their eggs to rocks. Sexual dichromatism apparently absent. Juveniles with a "tilapia-mark" on anterior base of soft-rayed dorsal fin. Vertebrae 28–31.

Our collections from the Lower Zaire rapids include four species, one of them new. In addition, we have found new species in the rivière Mbomou in Ubangui and in the rivière Mpozo, a tributary of the Lower Zaire River. Counts and measurements of all of the species of *Steatocranus* are presented in Table 19.

Steatocranus gibbiceps Boulenger 1899
Plate 11, d

Diagnosis. S. gibbiceps differs from all of its congeners in having a relatively narrow snout and upper and lower jaws with two greatly enlarged truncate teeth anteriorly (Figure 7). It differs from *casuarius* and *ubanguiensis* in coloration, and from *mpozoensis, rouxi, tinanti,* and *irvinei* in having only a single inner row of tricuspid teeth in each jaw. It is most similar to *S. glaber*, from which it differs primarily in dentition and in having a much shorter intestine.

Color. Olive brown; scales with a light-colored center and a dark submargin. Branchiostegal membrane uniformly dark brownish or blackish brown; breast cream-colored.

Comments. This is by far the most abundant species in our rapids collections. See comments under *casuarius*.

Steatocranus casuarius Poll 1939
Plate 11, e

Diagnosis. S. casuarius differs strikingly from all other *Steatocranus* except *ubanguiensis*

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Plate 11

a. *Nanochromis minor* new species, paratype, ♀, 21.0 mm. Zaire River near Kinganga (MCZ 50342).
b. *Nanochromis splendens* new species, holotype, ♂, 43.1 mm. Zaire River at Inga (MCZ 50476).
c. *Nanochromis splendens* new species, paratype, ♀, 35.4 mm. Zaire River at Inga (MCZ 50477).
d. *Steatocranus gibbiceps*, 84 mm. Zaire River at Inga (MCZ 50555).
e. *Steatocranus casuarius*, 67 mm. Zaire River at Inga (MCZ 50556).

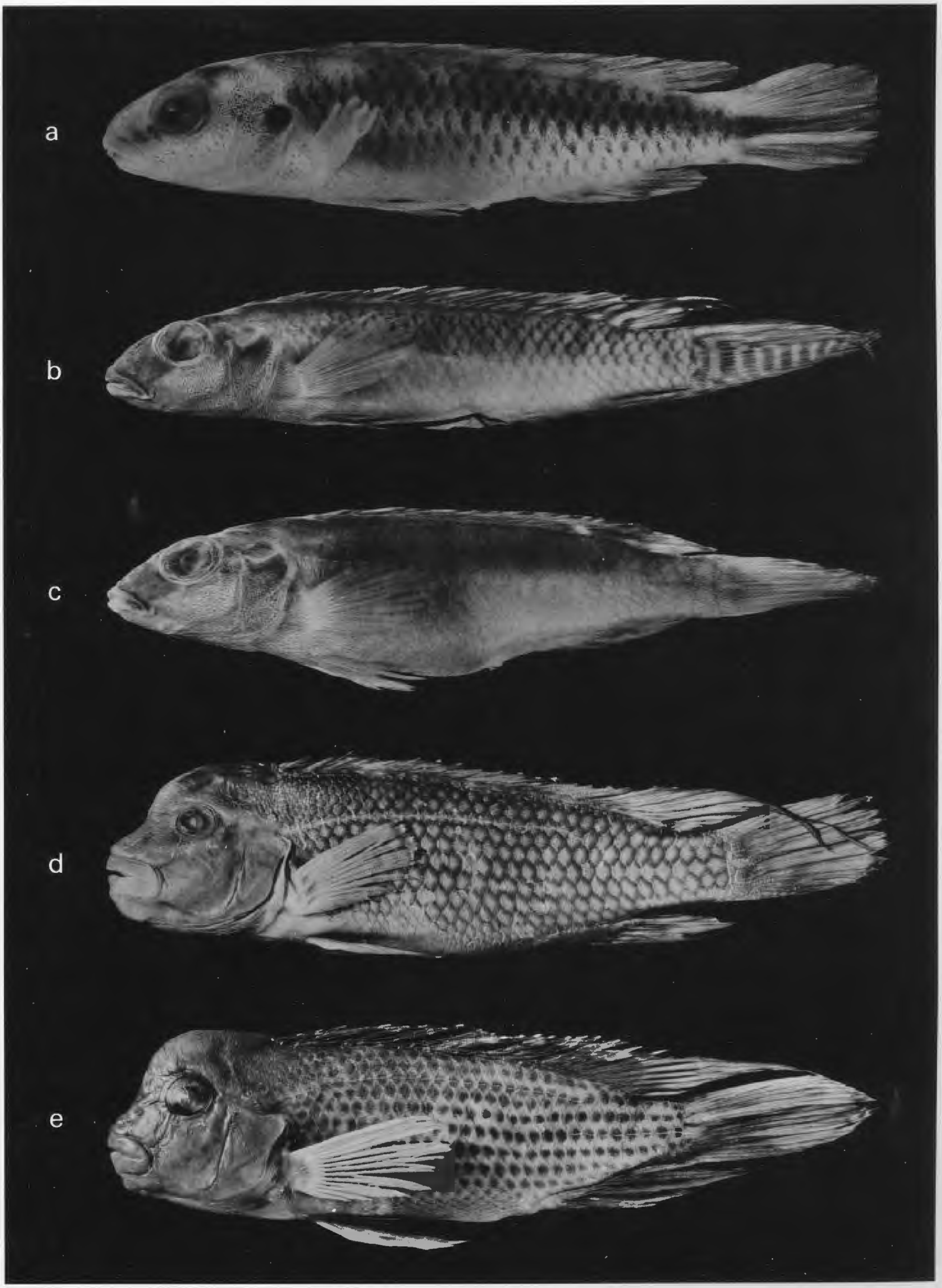

Plate 11

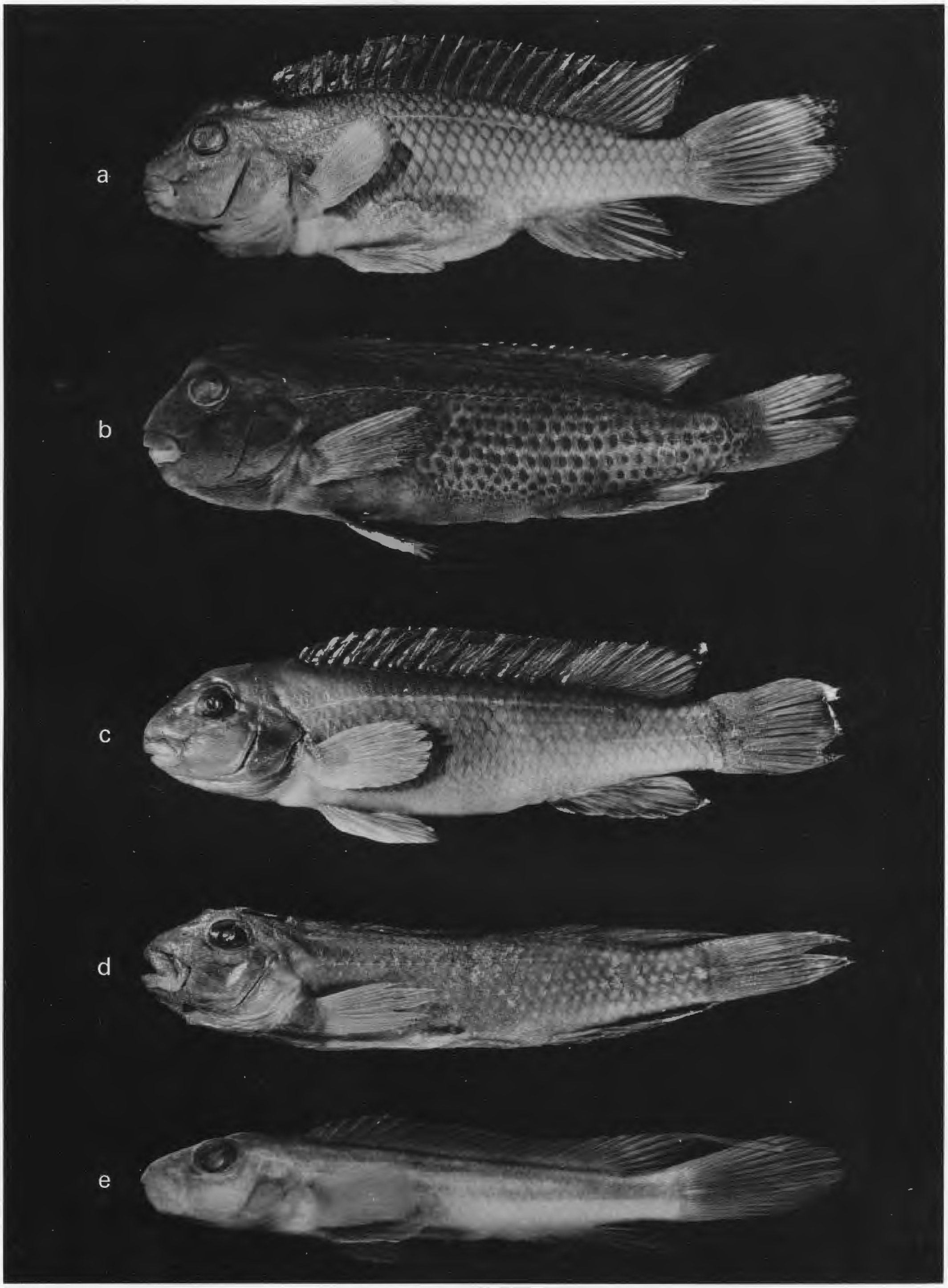

Plate 12

guiensis in coloration: scales with strongly contrasting dark center and light submargin. It differs from *ubanguiensis* in having a much shorter caudal peduncle, noticeably longer fins, longer head, larger eye, one or two more dorsal spines, and one more vertebra (Table 19).

Coloration. See diagnosis. Overall coloration dark brown in life, more than in *gibbiceps.* Branchiostegal membranes dusky cream-colored centrally, darkening towards the edges; breast dusky cream-colored.

Comments. S. *casuarius* and *gibbiceps* were found sympatrically in large numbers, including young, at most of our rapids localities (Table 3). They are immediately distinguishable at all sizes by the difference in coloration. Larger specimens of the two species differ strikingly in dentition and length of intestine. S. *casuarius* has an extremely long, highly coiled intestine (length about 1.5–3 times S. L.) and apparently feeds predominantly on algae. S. *gibbiceps* has a relatively short, uncoiled intestine (length about two-thirds to four-fifths S. L.) and feeds largely on gastropods, including *Septariellina congolensis,* which it swallows whole without crushing. This is the only *Steatocranus* in which we found snails in the stomach contents.

Steatocranus glaber new species

Plate 12, a

Holotype. MCZ 50557, 52.5 mm, R & S 41.
Paratypes. MCZ 50558, 18: 10.7–47.0 mm, R & S 41.

Diagnosis. Adult *glaber* are distinguished from all other *Steatocranus* by having large chisel-shaped teeth, with straight or only slightly notched cutting edges, in the outer tooth row of both jaws (Figure 7). The species differs strikingly from *casuarius* and *ubanguiensis* in coloration, and from *mpozoensis, rouxi, tinanti,* and *irvinei* in having only a single internal row of tricuspid teeth in each jaw. It is most similar to *mpozoensis* and *gibbiceps.* From *mpozoensis* it differs in having a terminal mouth, noticeably longer fins, and fewer gill rakers (Table 19). It differs from *gibbiceps* in dentition, in having the snout broadly rounded instead of narrow and relatively pointed, and in having a long, highly coiled intestine.

Coloration. Preserved specimens light brownish or greenish; scales with light centers and dark submargins as in *gibbiceps* but with less contrast; fins probably tinged with red in life; branchiostegal membranes and breast light brownish or dusky cream-colored.

Comment. In contrast to *casuarius,* the intestinal contents of *glaber* are noticeably opaque in radiographs, consisting largely of diatoms and sand grains cemented together.

Steatocranus ubanguiensis new species

Plate 12, b

Holotype. MCZ 50584, 52.8 mm, rivière Mbomou, a tributary of the Ubangui River, near Gozobangui, Central African Republic; T. R. Roberts, 29–30 May 1971.
Paratypes. MCZ 50585, 2: 45.3–46.3 mm, same locality as holotype.

Diagnosis. S. *ubanguiensis* is distinguished from all of its congeners in having an extremely steep forehead, shorter jaws and fewer teeth, and more reduced scales on the anterior half of the body and entire abdomen. It differs from all except *casuarius* by the coloration of its scales. It is

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Plate 12
a. *Steatocranus glaber* new species, holotype, 52.5 mm. Zaire River near Inga (MCZ 50557).
b. *Steatocranus ubanguiensis* new species, holotype, 52.8 mm. Rivière Mbomou near Gozobangui (MCZ 50584).
c. *Steatocranus mpozoensis* new species, holotype, 48.9 mm. Rivière Mpozo (MCZ 50582).
d. *Steatocranus rouxi*, 49 mm. Luluabourg, Kasai (AMNH 12358, holotype of *Steatocranus elongatus*).
e. *Steatocranus tinanti*, 36 mm. Zaire River near Gombe (MCZ 50160).

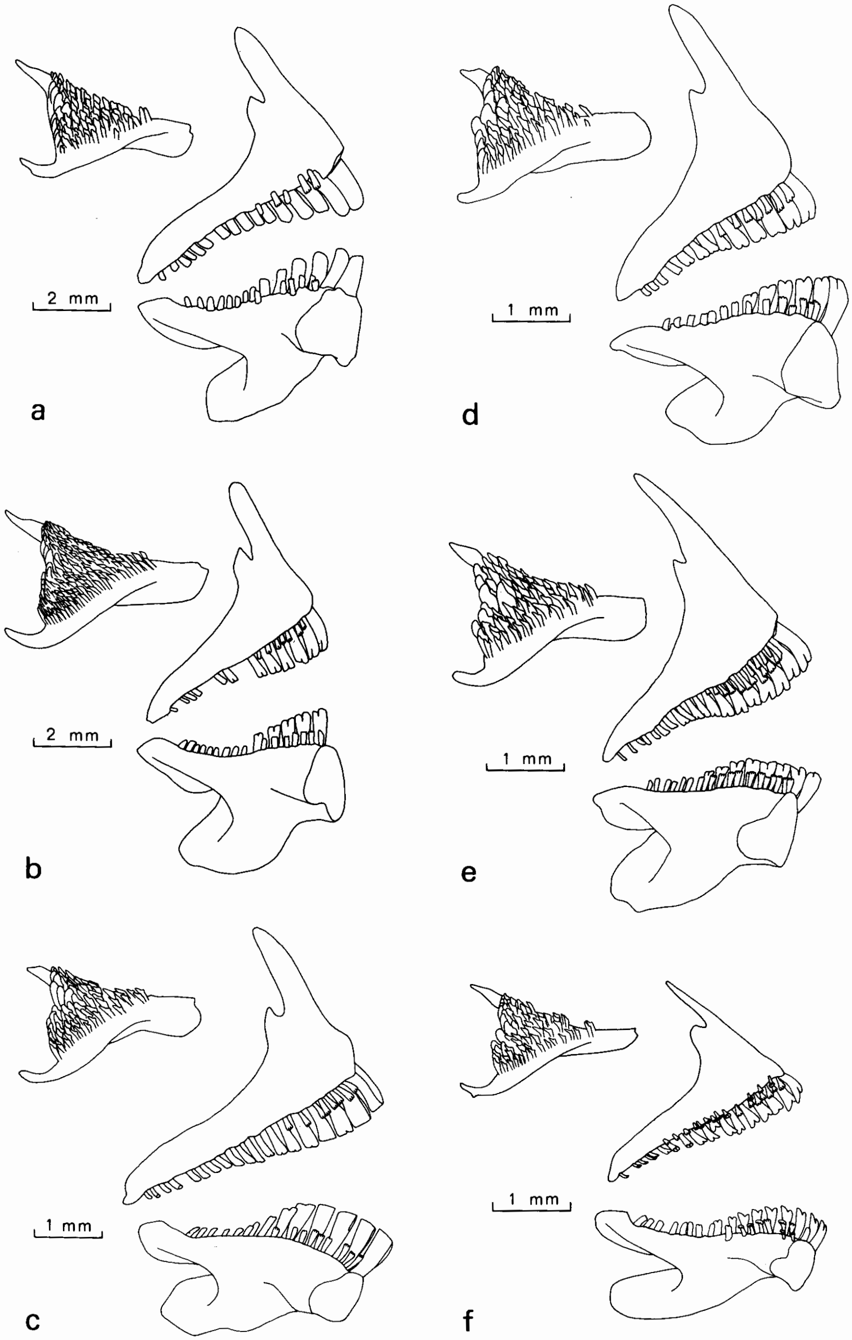

Figure 7. *Steatocranus*, dentition: a. *gibbiceps*, 74 mm; b. *casuarius*, 66 mm; c. *glaber*, 43 mm; d. *ubanguiensis*, 45 mm; e. *mpozoensis*, 50 mm; f. *tinanti*, 36 mm.

further distinguished from *casuarius* in having much shorter fins, a longer caudal peduncle, a shorter head, and a smaller eye (Table 19).

Coloration. Body dark brown, head dark brown or blackish; scales with a dark brown center and a light submargin, as in *casuarius*; branchiostegal membranes brownish centrally, with a sharply defined thin black margin.

Steatocranus mpozoensis new species
Plate 12, c

Holotype. MCZ 50582, 48.9 mm, R & S 74: rapids in rivière Mpozo a few km upstream from the bridge on the road from Kinshasa to Matadi. Lat. 5°51'S, Long. 13°31'E. Water 23.8°C, pH 8.5–9.0, O_2 8 ppm. 1 September 1973.

Paratypes. MCZ 50583, 25: 22.2–54.7 mm, same locality as holotype.

Diagnosis. A *Steatocranus* distinguished from all others in the Zaire basin in having an overhanging snout, the outer teeth in the upper jaw visible from below even when mouth is closed; fins relatively short. It differs from *casuarius* and *ubanguiensis* in coloration, and from *gibbiceps* and *glaber* in having the external row of jaw teeth all bifid and less massive (Figure 7). It differs from *irvinei* in having fewer gill rakers, a larger eye, and a narrower preorbital bone.

Coloration. Body greenish in life; fins tinged with red; center of scales light-colored and submargin darker but less pronouncedly so than in *gibbiceps* and *glaber*. Branchiostegal membranes yellowish green.

Comments. In *mpozoensis,* and also in *tinanti,* the upper lip is in some specimens joined to the skin of the snout by a median frenum and the upper jaws are relatively nonprotrusible. This is unusual in cichlids.

Steatocranus rouxi (Pellegrin) 1928
Plate 12, d

Leptotilapia rouxi Pellegrin, 1928: 112–113 (Luluabourg, Kasai); Pellegrin and Roux, 1928: 300–301, pl. 2, fig. 2 (illustration of holotype).

Steatocranus elongatus Nichols and LaMonte, 1934: 4–5, fig. 4 (Luluabourg).

Diagnosis. S. rouxi differs from all other *Steatocranus* in the Zaire basin in having 15–16 instead of 12 circumpeduncular scales; from *irvinei* it differs in having fewer gill rakers, fewer teeth, and a terminal rather than subterminal mouth. It further differs from *casuarius* and *ubanguiensis* in coloration and in morphometrics (Table 19), from *gibbiceps* and *glaber* in having the outer jaw teeth bifid and less massive, and from *gibbiceps, casuarius, glaber* and *ubanguiensis* in having two internal rows of tricuspid jaw teeth instead of only one.

Comments. This is perhaps the most generalized *Steatocranus.* Morphologically it appears to link the extremely elongate *tinanti* with the other members of the genus.

The type specimens of *S. elongatus* agree closely with the description and figure of *rouxi,* the types of which we have not examined. Our counts and measurements of the *elongatus* types are compared with Pellegrin's counts and measurements and some additional measurements made on the published figure of the holotype of *rouxi* in Table 20. It should be noted that the figure of the holotype of *elongatus* is erroneous with respect to dorsal profile and scale pattern; in these characters the holotype of *elongatus* closely resembles the figure of *rouxi.*

Pellegrin distinguished his genus *Leptotilapia* from *Steatocranus* on the basis of a more elongate body, two internal rows of tricuspid jaw teeth, and lack of a frontal gibbosity. Development of the gibbosity varies among individuals as well as among the species of *Steatocranus*; it is best developed in old males of *casuarius.* Nichols and LaMonte's specimens of *rouxi* have it better developed than Pellegrin's holotype. Although Nichols and LaMonte reported only a single inner row of jaw teeth in *elongatus,* we find that the type specimens actually have two.

TABLE 19. MORPHOMETRIC AND MERISTIC CHARACTERS IN *STEATOCRANUS*.

	gibbiceps[1]	*casuarius*[2]	*glaber*[3]	*ubanguiensis*[4]	*mpozoensis*[5]	*rouxi*[6]	*tinanti*[7]	*irvinei*[8]
n: S. L. mm	6: 51.0–83.5	6: 45.0–66.8	6: 31.0–52.5	3: 45.3–52.8	6: 46.4–54.7	2: 48.9–50.9	6: 38.5–62.6	6: 62.8–84.4
Head	29.2–32.4	32.2–33.9	30.1–31.9	29.0–29.2	28.0–30.3	28.8–30.3	28.9–32.4	31.2–34.5
Eye (% headlength)	21.0–26.1	26.5–31.0	24.5–29.2	24.2–26.7	21.9–26.4	24.0–25.5	23.6–28.3	17.1–21.6
Preorbital (% headlength)	16.8–22.1	17.9–19.0	15.6–20.3	20.5–21.6	15.7–18.6	17.7–19.5	13.6–19.4	25.9–31.9
Depth	25.1–28.7	30.0–32.3	27.7–30.1	29.0–29.8	24.4–26.5	22.3–24.8	15.5–23.4	26.0–28.4
Last dorsal spine	10.4–14.8	14.9–17.8	14.5–17.5	12.1–14.3	10.2–12.7	12.0–12.1	10.0–12.7	12.6–13.5
Longest dorsal ray ♂	29.9–39.9	33.9–44.2	36.1–47.2	16.1–17.7	19.8–32.9	31.5–34.2	22.1–34.5	17.5–27.3
Last anal spine	10.4–12.7	15.7–18.0	12.8–14.3	10.4–11.9	8.7–11.3	11.4–11.7	7.5–11.7	8.1–12.6
Longest anal ray ♂	22.3–36.0	30.8–34.1	24.2–33.5	16.8–18.4	20.2	20.0–24.4	19.6–30.0	15.9–22.4
Pectoral fin	21.4–24.6	24.4–27.2	22.1–24.0	22.5–23.1	19.2–21.3	19.4–21.5	19.4–22.8	19.7–25.1
Pelvic fin	24.1–27.2	28.1–29.2	23.8–27.1	21.4–24.3	21.6–23.4	22.7–24.6	21.0–27.3	18.2–23.8
Caudal fin	25.3–30.6	32.2–36.5	27.7–29.8	23.1–23.9	22.2–24.5	25.2–25.5	25.5–28.0	17.5–26.1
Length caudal peduncle/ height caud. ped.	1.21–1.35	0.89–1.07	1.28–1.48	1.21–1.41	1.20–1.39	1.25–1.50	1.49–1.89	1.27–1.41
Dorsal spines	19–20	20–21	19–21	19	20–21	20	21–22	20–21
Dorsal rays	7–8	6–7	6–7	7	8	7	7–8	8
Lateral line scales	30–32	30–31	30–32	30–31	31–32	31–32	33–34	32–34
Upper pored scales	20–21	21–23	20–21	22–23	21–24	20–22	21–22	24–26
Lower pored scales	8–10	8–9	9–11	7–8	8–10	8–9	9–12	7–9
Circumped. scales	12	12	12	12	15–16	12	12	16
Outer teeth, upper jaw	27–37	32–38	32–41	26–30	32–36	34–36	35–54	48–56
Gill rakers	6–7	6–7	6–7	6	8	5–6	6–8	11–12
Anterior + posterior vertebrae	14–15+14–5	15–16+13–14	15–16+14–15	14+14	14–16+14–15	14–15+15–16	15–16+15–16	16–17+14–15
Total vertebrae	28 (1); 29 (6); 30 (1)	29 (8)	29 (4); 30 (2)	28 (3)	29 (1); 30 (7)	29 (1); 31 (1)	31 (5); 32 (3)	31 (6)

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[1] MCZ 50555 (R & S 41). [2] MCZ 50480 (R & S 38). [3] MCZ 50557–7 (holotype and paratypes). [4] MCZ 50585–6 (holotype and paratypes). [5] MCZ 50583–4 (holotype and paratypes). [6] AMNH 12358 and 12449 (holotype and paratype of *Steatocranus elongatus*). [7] MCZ 48003 (Kinsuka). [8] UMMZ 195059 (Volta River at Akosombo).

TABLE 20. COMPARISON OF THE NOMINAL SPECIES *STEATOCRANUS ELONGATUS* NICHOLS AND LAMONTE 1934 WITH ITS SENIOR SYNONYM *STEATOCRANUS ROUXI* (PELLEGRIN) 1928.

	rouxi[1]	*elongatus*	
	Holotype	Holotype	Paratype
S. L. mm	60	48.9	50.9
Head	27.8	28.8	30.3
Orbit (% headlength)	28.7	25.5	24.0
Interorbital (% headlength)	14.4	15.6	13.6
Snout (% headlength)	43.1	39.7	41.5
Depth	21.3	22.3	24.8
First dorsal spine	4.0*	2.2	1.4
Third dorsal spine	5.7*	5.9	6.1
Last dorsal spine	12.3	12.1	12.0
Longest dorsal ray	41.3	31.5	34.2
Third anal spine	10.3*	11.7	11.4
Longest anal ray	23.9*	20.0	24.4
Pectoral fin	20.8	21.5	19.4
Pelvic fin	24.6*	22.7	24.6
Length caudal peduncle	14.0*	16.0	14.7
Depth caudal peduncle	10.9*	10.6	11.8
Caudal fin	25.0	25.2	25.5
Dorsal fin	XX,8	XX,8	XX,8
Anal fin	III,7	III,7	III,7
Pectoral fin	i,12	ii,13	ii,12
Upper pored scales	22	20	22
Lower pored scales	9	9	8
Midlateral scales	34	32	31
Circumpeduncular scales	16	16	15
Tooth rows	3	3	3
Outer teeth, upper jaw	42	34	36
Gill rakers	5	6	5

[1] Measurements calculated from Pellegrin's original description, or, for those marked*, taken from the figure of the holotype published by Pellegrin and Roux, 1928: plate 2, figure 2.

Steatocranus tinanti (Poll) 1939
Plate 12, e

Gobiochromis tinanti Poll, 1939:48–49, fig. 31 (Léopoldville).
Leptotilapia tinanti Poll, 1957:139.

Diagnosis. A very distinctive *Steatocranus*, differing from all others in its very elongate body, distinctive coloration, longer caudal fin, more numerous lateral line scales, and superolateral eyes.

Coloration. A pair of longitudinal bands, light dusky brown, extend the length of the body, converging posteriorly; the upper band runs between the base of the dorsal fin and the upper row of pore-bearing scales, the lower band being midlateral in position. Rest of body dusky cream-colored, head dark dusky brown, lightening on cheeks. Branchiostegal membranes cream-colored or dusky brown.

Steatocranus irvinei (Trewavas) 1943

Gobiochromis irvinei Trewavas, 1943:186, figs. 1–2 (Volta River at Senchi Ferry).
Leptotilapia irvinei Trewavas and Irvine, 1947: 277, fig. 183 (abstract of original description; color note on live or freshly preserved specimens).

Diagnosis. A *Steatocranus* distinguished from all others in having scales on the opercle; a relatively small, high-set eye, with a wide preorbital bone; and 11–12 gill rakers on the first gill arch, including two or three on its upper limb. The jaw teeth are smaller and more numerous than in any other species, and are arranged in four rows in both jaws rather than only two or three rows. Teeth in internal rows of lower jaw predominantly conical, rather than predominantly tricuspid. Adults commonly grow to 150 mm; the largest Zaire *Steatocranus* are about 90 mm.

In having an overhanging snout and subterminal mouth, *irvinei* agrees with *mpozoensis* but differs from all other Zaire *Steatocranus*.

A detailed description of *irvinei* is given by Trewavas (1943). We have examined six freshly preserved specimens (UMMZ 195059) collected from the Volta River in the tailwaters of the dam at Akosombo by D. J. Stewart in June, 1973. Trewavas and Irvine (1947) recorded the color as dark greyish green; our specimens are dark bluish black, especially on the head, branchiostegal membranes, and dorsal, anal, and pelvic fins, and dark brown or blackish brown on the breast and belly.

Comment. If the *Steatocranus* species from the Zaire basin and *irvinei* from the Volta basin represent a monophyletic group, the geographical distribution of this genus offers an interesting parallel to that of the rheophilic mormyrid *Campylomormyrus tamandua*.

TABLE 21. MORPHOMETRIC AND MERISTIC CHARACTERS IN *TELEOGRAMMA*.

	gracile	*brichardi*	*depressum*[1]	*monogramma*[2]
Largest ♂ S. L. mm	70.6	79.9	95.1	60.8
Largest ♀ S. L. mm	54.8	63.6	70.9	67.6
Interorbital	5.2–5.9	4.6–6.2	6.3–7.5	3.8–4.4
Depth of body	14.9–16.1	15.8–17.4	10.5–12.3	14.2–15.8
Width of body (% bodydepth)	104–115	84–106	136–166	87–106
Sixth dorsal spine	7.1–8.7	8.5–12.6	4.9–7.4	10.4–12.6
Total dorsal elements	29(1) 30(7) 31(2)	29(4) 30(6)	31(10)	29(3) 30(3) 31(1)
Dorsal spines	22(1) 23(5) 24(4)	22(2) 23(8) 24(1)	23(1) 24(9)	20(7)
Dorsal rays	6(2) 7(8)	6(4) 7(5) 8(1)	7(9) 8(1)	9(3) 10(3) 11(1)
Total anal elements	12(4) 13(4) 14(2)	13(5) 14(4) 15(1)	14(4) 15(6)	12(1) 13(4) 14(2)
Anal spines	5(8) 6(2)	4(1) 5(9)	5(7) 6(3)	4(7)
Anal rays	7(6) 8(2) 9(2)	8(4) 9(5) 10(1)	8(1) 9(5) 10(4)	8(1) 9(4) 10(2)
Pored scales	33–35	49–56	46–58	33–35
Scales above lat. line ±	87–95	70–80	90–110	51–59
Circumpeduncular scales	23–25	24–27	23–26	17–19
Gill rakers (2nd arch)	8(3) 9(7)	11(4) 12(8) 13(2)	10(4) 11(2) 12(3)	8(2) 9(4) 10(1)
Precaudal vertebrae	13(2) 14(11) 15(3)	13(10) 14(4)	13(2) 14(20)	13(3) 14(4)
Caudal vertebrae	17(2) 18(11) 19(3)	18(4) 19(10)	18(9) 19(3)	18(1) 19(3) 20(3)
Total vertebrae	31(1) 32(12) 33(3)	31(1) 32(15)	32(10) 33(11)	32(1) 33(6)

[1] Types. [2] AMNH 12384, Luluabourg, Kasai.

Teleogramma **Boulenger 1899**

Type species: *Teleogramma gracile* Boulenger 1899, by original designation.

An endemic Zairean genus of exceptionally elongate, highly rheophilic cichlids, with small cycloid scales and a single continuous row of lateral line scales. Longest soft ray in pelvic fin is the third or middle ray. Jaws with bands of fine unicuspid teeth and a few enlarged anterior canines, as in *Lamprologus*. Pharyngeal teeth unicuspid or weakly bicuspid, nonmolarized. Dorsal fin with 20–24 spines, anal with four to six. The only other African cichlid with a single continuous row of lateral line scales is *Gobiocichla*, a less elongate form with multicuspid jaw-teeth and only 13 dorsal spines endemic to the Niger River.

Teleogramma comprises four species, one known only from Kasai, the other three from the rapids of the Lower Zaire River. Females, usually smaller than males, are characterized by having the thin red margin on the lappets of the spinous dorsal fin and on the soft dorsal continued as a broad swath on the upper lobe of the caudal fin. In males the caudal fin is either uniformly dark in color, or has only a very thin red margin on the upper lobe. This particular dichromatism is not found in any other cichlids. Counts and measurements for all of the species are presented in Table 21.

Teleogramma gracile Boulenger 1899
Plate 13, a–b

Diagnosis. A *Teleogramma* distinguished from each of the other species by slight but consistent differences in morphometrics, and from all of them by having fewer anal-fin rays (7–9, with a mode of 7, versus 8–10, with a mode of 9). It is the only

→

Plate 13

a–b. *Teleogramma gracile*, ♂, 59 mm, and ♀, 46 mm. Zaire River at Bulu (MCZ 50252).
c. *Teleogramma monogramma*, ♂, 63 mm. Luluabourg, Kasai (AMNH 12384).
d–e. *Teleogramma brichardi*, ♂, 73 mm. Zaire River at Kinsuka (MCZ 48008).
f–g. *Teleogramma depressum* new species, holotype, ♂, 90.0 mm. Zaire River at Inga (MCZ 50482).

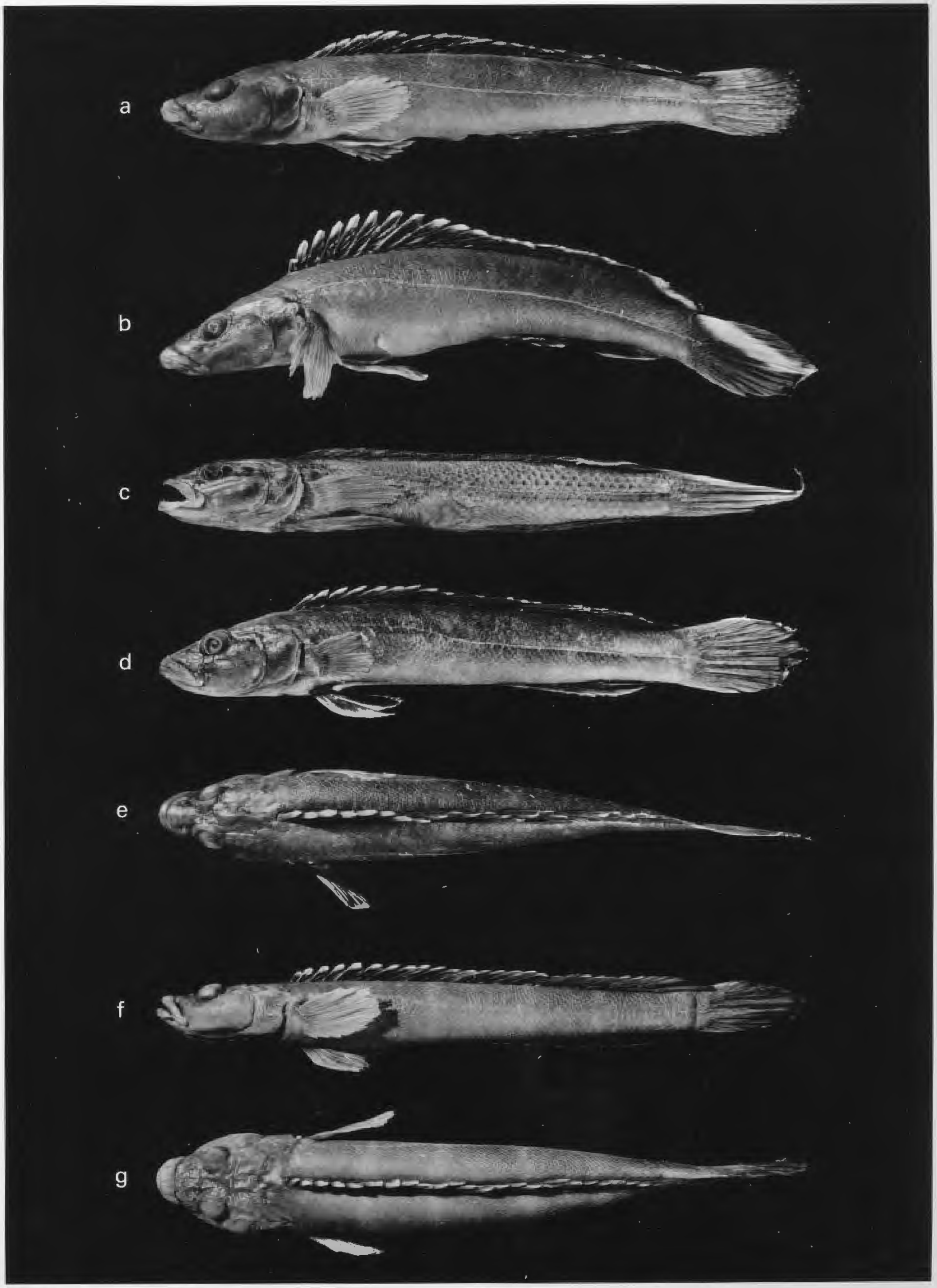

Plate 13

species in which females have a broad black margin above the red area on the upper lobe of the caudal fin (Plate 13, b). It further differs from *brichardi* and *depressum,* its congeners in the rapids of the Lower Zaire River, in having only 33–35 pored lateral line scales (versus 46 or more), and only 8–9 gill rakers on the second gill arch (versus 10 or more). From *monogramma* it differs in having 22–24 dorsal spines instead of only 20, and much smaller scales above and below the lateral line scale row.

Teleogramma monogramma (Nichols and LaMonte) 1934

Plate 13, c

Diagnosis. T. monogramma differs from its congeners in having a dorsal fin with 20 spines and 9–11 rays; relatively large scales above and below the series of pored lateral line scales; and a narrower interorbital space (3.8–4.4, versus 4.6 or more). (Coloration of caudal fin in females unknown).

Teleogramma brichardi Poll 1959

Plate 13, d–e

Diagnosis. A relatively compressed *Teleogramma,* body depth 15.8–17.4; pored lateral line scales 49–56, scales impinging directly on lateral line series from above about 70–80. Females with uppermost portion of caudal fin entirely red.

Comment. This species, fairly abundant in the rapids near Kinsuka, has not been found elsewhere.

Teleogramma depressum new species

Plate 13, f–g

Holotype. MCZ 50482, 90.0 mm, R & S 38.

Paratypes. MCZ 50161, 18:32.1–59.9 mm, R & S 2; MCZ 50396, 17:24.4–76.2 mm, R & S 28; MCZ 50483, 63:17.0–84.8 mm, R & S 38; MCZ 50559, 19:28.8–95.1 mm, R & S 41.

Diagnosis. A very distinctive *Teleogramma,* with a more flattened head and body than any other known cichlid; width of body from one and a third to one and two-thirds greater than depth of body; interorbital space broad, 6.3–7.5 (compare dorsal views of *brichardi* and *depressum* in Plate 13); dorsal fin spines and rays distinctly shorter than in other *Teleogramma;* pored lateral line scales 46–58, with about 90–110 scales impinging on them from above (Table 21). Females with a thin black margin above the red on the upper lobe of caudal fin.

***Mastacembelus* Scopoli 1777**

Type species: *Mastacembelus mastacembelus* (Solander, *in* Russell) 1794 (see Wheeler, 1956).

Mastacembelus are eel-like fishes, without pelvic fins, and with 7–40 detached, depressible spines in the anterior portion of the dorsal fin. There are 15 species in Asia and at least 50 in Africa. Our rapids collections include eight species; three are new, and differ from all previously known *Mastacembelus* in lacking scales.

Our vertebral counts in *Mastacembelus* and their definitions are as follows: total vertebrae = all vertebrae with a complete and separate centrum counting that in urophore as one; predorsal vertebrae = vertebrae anterior to first dorsal pterygiophore; abdominal vertebrae = vertebrae anterior to first anal pterygiophore; and caudal vertebrae = vertebrae posterior to last abdominal vertebra and having a complete and separate centrum.

Mastacembelus marchei Sauvage 1879

Mastacembelus marchei Sauvage, 1879:1 (la chute de Doumé, dans le pays de Adouma, haut Ogôoué); Sauvage, 1880:36–37, pl. 1, fig. 1 (illustration of holotype).

Diagnosis (after Sauvage). A *Mastacembelus* with two preopercular spines; length of head seven times into length of body; dorsal fin with 24 spines and 78 rays, anal with two spines [probably an error] and 80 rays.

The illustration of the holotype apparently shows the color pattern well. The following description of the coloration is translated from Sauvage (1880):

> body brownish, widely marbled with yellow; a series of black spots, large and regular, on the back and at the base of the anal fin; side of the head black; underside of body with a uniformly yellowish tint; anal fin with a black border; tip of caudal fin white, with a wide, black band; posterior portion of soft dorsal fin bearing some black spots, anterior portion small, irregular deep-colored spots, uniting to form three bands; pectoral fins colorless.

Dr. Thys van den Audenaerde kindly supplied the following information about the type locality: "the falls at Doumé are on the Ogowé River some 30–50 km upstream and to the east of Lastoursville, in a forested area about 250–260 m above sea level, between 0°50 and 1°01′S and 12°56 and 13°11′E."

The specimens we questioningly refer to *marchei* agree with Sauvage's brief description in most respects, except in having slightly more dorsal fin spines, three anal spines instead of two, and in coloration. The difference in coloration, however, is so great and so consistent that we suspect our specimens represent an as yet undescribed species, probably endemic to the Zaire basin.

Our specimens have a strong preorbital spine and two strong preopercular spines. Radiographs of several reveal the dorsal fin has 25–27 spines (the last spine hidden) and about 75–92 rays; anal fin with three spines (last hidden) and about 77–78 rays; predorsal vertebrae 5–6; abdominal vertebrae 29–30; caudal vertebrae 47–50; total vertebrae 77–79. The largest specimens tend to have the head and body uniformly light grey or brownish grey on the back and sides, becoming lighter still on the lips, cheek, and undersides of head and abdomen. Median fins dark brownish grey basally, with a light margin. Pectoral fins uniformly light. In the smaller specimens from R & S 41 the general coloration is similar to that described for larger specimens, except that several have a series of light-colored, roundish spots on the dorsal midline and dorsal fin. A large series of half-grown specimens from the rivière Mbomou in Ubangui (MCZ 50590) have similar coloration, except that the entire head and body are of a darker, browner hue, and the light-colored spots on the back and dorsal fin stand out more sharply.

Comment. Two specimens from Malebo Pool, identified as *marchei* by Poll (1959: 111–112) apparently represent the same species as our material.

Mastacembelus paucispinis Boulenger 1899

Mastacembelus paucispinis Boulenger, 1899:55, pl. 28, fig. 3 (Matadi).

Diagnosis. A *Mastacembelus* distinguished from all others by having only 7–10 dorsal spines (the species with the next lowest number of dorsal spines having 19 or more); dorsal rays in excess of 100, up to 125; origin of soft dorsal fin midway between occiput and a vertical line through origin of anal fin; anal fin with three spines and 79–83 rays; a preorbital spine and two preopercular spines; total vertebral count 81–83; predorsal vertebrae 4 or 5 (usually 5); abdominal vertebrae 28–29; caudal vertebrae 51–55.

Coloration. Largest specimens dark violaceous blue on back and sides, underside of head and abdomen lightened; median fins of same color as back and sides, except for white distal margin of anal and caudal; back and dorsal fin in some specimens with small, indistinct whitish marks or mottling; pectoral fin dark, with white spots or mottling. In smaller specimens the body and fins are much more distinctly mottled; specimens over about 150 mm S. L. have a distinctly violaceous blue tint on the back and sides, but specimens smaller than that tend to be brownish on the back and sides, and much lighter on the ventral surfaces. The coloration of juveniles as well as adults is unlike that in any other *Mastacembelus* in the rapids. The coloration of *M. congicus* is more ornate or detailed, on the fins as well as on the body; adults do not assume a dark violaceous blue tinge and their ventral surface is much whiter than in *paucispinis*.

Comments. The holotype of this species was obtained at Matadi, without indication of habitat; Poll (1959:145) reported a specimen from the rapids at Kinsuka. We found it in the midst of extensive rapids, in areas where the bottom is predominantly coarse sand. Other *Mastacembelus* in these areas were *M. congicus* and *M. brachyrhinus.*

Mastacembelus brachyrhinus Boulenger 1899
Plate 14, a

Mastacembelus brachyrhinus Boulenger, 1899:55–56, pl. 28, fig. 4 (Matadi).

Diagnosis. A microphthalmic *Mastacembelus* with no preorbital spine; a strong preopercular spine; eye normally developed; dorsal fin with 30–32 spines and 63–70 rays; anal fin with three spines and 62–67 rays; total vertebral count 77–80; predorsal vertebrae 5; abdominal vertebrae 32–34; caudal vertebrae 44–46; principal caudal rays 5 + 5. (All of these counts, except "principal caudal rays," are based on at least 10 specimens; the dorsal spine counts are based on all 39 of our specimens and the count of the holotype given by Poll, 1959.)

Coloration. Adults variable, either uniformly dark brown, brownish black or black, or else brownish or greyish brown with numerous light-colored, round or oval blotches. Most of the small specimens from R & S 29 are brownish with light-colored round spots relatively larger and better defined than in adults. There is no indication that living specimens undergo rapid color change.

Comments. This species, otherwise known only from the holotype, collected at Matadi without indication of habitat, was found at three of our rapids localities. It is of special interest because of its close relationship, possibly ancestral, to *Mastacembelus brichardi.*

Mastacembelus brichardi (Poll) 1958
Plate 14, b

Caecomastacembelus brichardi Poll, 1958:388; Poll. 1959:112–115 pls. 20 and 26.

Diagnosis. A strongly cryptophthalmic *Mastacembelus*, with eyes deeply embedded in the head, not visible at the surface; body more or less depigmented; no preorbital spine; a single, strong preopercular spine; dorsal fin with 27–30 (usually 28 or 29) spines and 55–60 rays; anal fin with three spines and 59–63 rays; body bilaterally compressed, much deeper than wide, covered with small scales; total vertebral count 71–73; predorsal vertebrae 4; abdominal vertebrae 28–29; caudal vertebrae 42–44; principal caudal rays 5 + 5. (All of these counts, except "principal caudal rays," are based on 30 or more specimens.)

Coloration. Coloration variable. Some specimens entirely milky white or pinkish in life, with no melanophores on the head or body. At the other extreme are specimens with fine melanophores rather uniformly distributed over the back and sides, producing a decidedly dusky appearance. Some specimens have a faint mottling on the dorsal portions of head and body. Juveniles exhibit the same range of coloration as adults, and all populations exhibit considerable variation. They do not seem to be capable of rapid changes of coloration. Poll (1959, pl. 26, fig. 2) published a photograph of a specimen in which the pigmentation is much darker and mottling more pronounced than in any specimens collected by us, possibly produced by keeping the specimen in a well-lit aquarium before it was preserved.

Comment. Although Poll recognized the close relationship between this species and *M. brachyrhinus,* he proposed a new genus for it because of its depigmentation and "lack" of eyes. In doing so, he cited as precedent the case of *Caecorhamdia* Norman 1926, erected for a blind "species" otherwise virtually identical to the widely distributed and highly variable *Rhamdia quelen.* Loss of the eyes, and the depigmentation usually associated with it, is a loss or reduction character likely to occur independently without other notable change, especially in genera such as *Rhamdia* and *Mastacembelus* in which the eyes are normally small and of secondary importance. The objection to recognizing a genus based on a single character of this nature is that there is no way to determine whether the several species that may eventually be referred to the genus evolved independently. It is contrary to the objectives of phyletic classification to follow a procedure that will inevitably result in polyphyletic taxa. For this reason we have not designated a new genus for *Lamprologus lethops,* and would not recognize *Caecobarbus, Typhlobagrus, Anoptichthys,* or other "genera" distinguished solely on the absence of eyes and superficial pigmentation.

Mastacembelus brichardi is the most abundant member of the genus in our collections from the rapids. Large numbers of them were present at five of the nine principal collecting stations. We found it together with *M. brachyrhinus* only at R & S 29, along with a small number of specimens morphologically intermediate between them, which we tentatively interpret as interspecific hybrids.

Mastacembelus brachyrhinus × *M. brichardi*
Plate 14, c

MCZ 50256, 6:26–145 mm, R & S 29.

The eye in these specimens, while lying at the surface and appearing normally developed, is not so large as in *brachyrhinus,* its diameter 0.5–1.0% S. L. in specimens 91–145 mm. Their coloration is uniform dark brownish, without lighter marks even in the smallest specimen, as dark as some less pigmented *brachyrhinus,* and much darker than *brichardi.* They are intermediate between *brachyrhinus* and *brichardi* in all meristic characters. The following counts were obtained from radiographs: dorsal spines 29(4), 30(1); anal rays 58–66; total vertebrae 74(1), 75(2), 76(2); predorsal vertebrae 4(3); abdominal vertebrae 30(1), 31(2), 32(2); and caudal vertebrae 44(5).

Samples of *brichardi* obtained at our other localities did not include any specimens with eyes superficial in position or with comparably intermediate meristic characters. The large sample from R & S 38, however, does include a specimen in which the eye is much closer to the surface than in typical *brichardi.* This 98-mm individual has 30 dorsal spines and is exceptionally darkly pigmented, but in all other respects it agrees with *brichardi.* That a population of *brichardi* can produce individuals with some *brachyrhinus*-like characters suggests that they may be one and the same species.

Mastacembelus crassus new species
Plate 14, d

Holotype. MCZ 50257, 134.0 mm, R & S 29. *Paratypes.* MCZ 50258, 176:34.6–157.8 mm, R & S 29; MCZ 50318, 14:54.0–122.5 mm, R & S 35; MCZ 50400, 1:75.5 mm, R & S 28.

Diagnosis. A *Mastacembelus* in which juveniles as well as adults have a very thick head and body, the body nearly round in cross section and entirely scaleless; no preorbital or preopercular spines; weakly cryptophthalmic; eye minute, .6–1.1, decreasing in relative size with growth; dorsal fin with 20–21 (usually 20) spines and 52–61 rays; anal fin with two spines and 51–61 rays; total vertebral count 63–67; predorsal vertebrae 4 or 5 (usually 5); abdominal vertebrae 22–24; caudal vertebrae 41–44; principal caudal rays 4+4 or 4+3.

Coloration. Coloration highly variable. A very few specimens are entirely depigmented, milk-white, or pinkish in life, cream-colored after preservation. Most individuals are counter-shaded, with depigmented abdomens, and grey marblings or variegations dorsally. In some specimens marbling extends onto the belly. A few are almost uniformly grey except for a clearly defined depigmented area on the belly, mottled lips, and mottled median

Plate 14

fins. In none is the body uniformly grey. The distal portions of the median fins are usually depigmented, although sometimes they are mottled. Coloration of adults and juveniles is similar. They do not appear capable of rapid color change.

The eyes are approximately the same relative size in all specimens, regardless of the degree of pigmentation. In five of the most darkly pigmented specimens, 80–130 mm, eye diameter is .6–.7, and in five exceptionally light-pigmented individuals 94–144 mm, .6–.8.

Comments. This species was found only in the most extreme rapids habitats, in areas with predominantly rock-rubble bottom, and always with large numbers of *M. brichardi.* Radiographs of 20 *crassus* and 20 *brichardi* revealed snails in the stomachs of several *brichardi* but not in *crassus.* The snails are *Bulimus* (*Parabithynia*). We find no evidence of morphological intergradation between the two species.

Mastacembelus latens new species
Plate 14, e

Holotype. MCZ 50529, 65.0 mm, R & S 29.
Paratypes. MCZ 50530, 2:47.6–72.0 mm, R & S 29.

Diagnosis. A weakly cryptophthalmic and incompletely depigmented *Mastacembelus*; body bilaterally compressed, completely scaleless, and more elongate than in *brichardi*; no preorbital or preopercular spines. Dorsal fin with 21–24 spines and 55–58 rays; anal with 2 or 3 spines and about 58–62 rays. Total vertebrae 67–69; predorsal vertebrae 4; abdominal vertebrae 28–29; caudal vertebrae 67–69. Principal caudal rays 3 + 3.

Coloration. The smallest of our three specimens, 47.6 mm, is almost completely depigmented, the only melanophores being a few small, scattered clusters of tiny melanophores mostly on the posterior half of the body. In the two larger specimens, melanophores are more numerous and relatively conspicuous, concentrated on the dorsal surface of the head, along the dorsal midline of the body, and on the dorsal fin (Plate 14, e). Background coloration in all three specimens white or yellowish cream-color.

Comment. Numerous *brichardi* and *crassus* of comparable length were taken simultaneously with the type specimens of *latens*; all individuals were readily assigned to species at the first glance.

Mastacembelus aviceps new species
Plate 14, f

Holotype. MCZ 50564, 124.5 mm, R & S 41.
Paratypes. MCZ 50565, 9:49.7–106.5 mm, R & S 41; MCZ 50487, 17:39.9–112.1 mm, R & S 38.

Diagnosis. A *Mastacembelus* with the body elongate and round in cross section, depth of body 5.9–6.9, and width of body 5.0–7.5; head flattened; no preorbital or preopercular spines; scales absent; dorsal fin with 20–22 spines and 44–52 rays; anal fin with two spines and 49–52 rays; total vertebral count 61–65; predorsal vertebrae 3–5; abdominal vertebrae 22–24; caudal vertebrae 38–42; principal caudal rays 3 + 3.

Coloration. Coloration similar in all specimens: uniformly olivaceous or drab dorsally, grading to dull cream on abdomen and flanks.

Comments. Although *aviceps* agrees with *crassus* in lacking spines on the head, in

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Plate 14

a. *Mastacembelus brachyrhinus*, 143 mm. Zaire River at Bulu (MCZ 50254).
b. *Mastacembelus brichardi*, 124 mm. Zaire River at Bulu (MCZ 50255).
c. *Mastacembelus brachyrhinus* × *Mastacembelus brichardi*, 145 mm. Zaire River at Bulu (MCZ 50256).
d. *Mastacembelus crassus* new species, holotype, 134.0 mm. Zaire River at Bulu (MCZ 50257).
e. *Mastacembelus latens* new species, holotype, 65.0 mm. Zaire River at Bulu (MCZ 50259).
f. *Mastacembelus aviceps* new species, holotype, 124.5 mm. Zaire River at Inga (MCZ 50564).

lacking scales, and in having similar meristic characters (except the lower anal ray count in *aviceps*), they are very different in other respects, and in fact, *aviceps* does not closely resemble any other known species. One of the localities where we found *aviceps* was in an extensive area of rocks and muddy bottom, the mud of about the same color as the body of *aviceps*. This is in marked contrast to the bottoms of rock rubble or rocks and coarse sand where we encountered other *Mastacembelus*. Nevertheless, *aviceps* lives in a rapids habitat as extreme as that of any of the others.

REPRODUCTION

Little is known about reproduction in the fishes of the Lower Zaire rapids. External fertilization apparently is the unbroken rule; we did not find nor do we know of any definite evidence for internal development or even internal fertilization in any of the species encountered in the rapids. Mature males of amphiliid and mochokid catfishes often have elongated genital papillae which terminate in a pore, and could conceivably function as intromittent organs (even more elongate genital papillae of similar appearance occur in mature males of the Andean catfish family Astroblepidae). None of the rapids fishes have been found with internally developing embryos, so that if internal fertilization does occur, it is presumably followed by egg-laying, rather than viviparity. Among the rapids Cichlidae, the only ones known to brood the eggs in their mouth are *Haplochromis*. So far as known, the others are substrate spawners, attaching the eggs to rocks.

As can be seen from Table 3, no fewer than 54 of the 129 species taken by our rapids survey are represented by young of 30.5 mm or less in standard length. The following 28 species are represented by young of 20.5 mm or less, which means they must have been spawned within a matter of days or at most a few weeks only before we collected them:

Microthrissa minuta
Myomyrus macrodon
Myomyrus pharao
Stomatorhinus sp. or spp.
Alestes macrolepidotus
Distichodus antonii
Distichodus sexfasciatus
Distichodus fasciolatus
Barilius lujae
Garra congoensis
Labeo nasus
Labeo sorex
Labeo sp. or spp. other than *sorex* and *nasus*
Chrysichthys cf. *cranchii*
Notoglanidium pallidum
Haplochromis demeusii
Haplochromis polli
Lamprologus cf. *moquardii*
Lamprologus werneri
Nanochromis parilus
Nanochromis splendens
Steatocranus gibbiceps
Steatocranus casuarius
Steatocranus tinanti
Steatocranus glaber
Teleogramma gracile
Teleogramma depressum
Mastacembelus brichardi.

Young as small as 20 or 30 mm have seldom been reported for fishes inhabiting any of the larger African rivers. Most of the species for which we collected young of 30.5 mm or less are otherwise known only from half-grown or adult specimens. This is particularly true for the taxa Mormyridae, Bagridae, Mochokidae, *Distichodus*, and *Labeo*. In most large African rivers, especially those of the so-called "sand-bank" category, it is very difficult to collect the young of many species, because their strongly seasonal reproductive activities are restricted to periods of steadily rising water. By the time the flooding has receded, the rapidly growing young are no longer this small. Due to its relative stability, the mainstream of the Lower Zaire River apparently offers a major exception to this general rule. One would expect, *a priori*, that here reproduction would be less seasonal than in other African rivers, and our data support this hypothesis.

ADAPTATIONS

The 129 fish species in our collections from the Lower Zaire rapids can be grouped into four broad categories based on the degree or nature of their specialization to the rapids environment: 1) poorly adapted; 2) moderately adapted; 3) highly adapted to habitats exposed to strong current (rheophilic); and 4) highly adapted to rapids habitats but avoiding strong current by burrowing or intrusive behavior (hyporheic). We shall consider the first two categories briefly, and the latter two in more detail.

Poorly adapted

In the poorly adapted category are grouped 32 species; while this represents 24% of the species collected, they comprised only about 2% of the actual number of specimens. Almost half of them are represented by single specimens:

Nannothrissa parva
Hippopotamyrus psittacus
Hippopotamyrus macrops
Marcusenius monteiri
Petrocephalus grandoculis
Alestes liebrechtsii
Hydrocynus lineatus
Hydrocynus goliath
Micralestes acutidens
Citharinus congicus
Citharinus gibbosus
Citharinus macrolepis
Barbus pleuropholis
Labeo lineatus
Labeo velifer
Labeo cyclorhynchus
Labeo weeksii
Auchenoglanis occidentalis
Chrysichthys brevibarbus
Chrysichthys longibarbus
Eutropius grenfelli
Schilbe mystus
Heterobranchus longifilis
Malapterurus electricus
Synodontis alberti
Synodontis notatus
Synodontis pleurops
Synodontis nigriventris
Lates niloticus
Hemichromis bimaculatus
Tylochromis lateralis
Tetraodon mbu.

For all or almost all of these species, presence in the rapids is probably atypical or accidental, and the main populations occur in less turbulent habitats in the mainstream or tributaries. In many instances, they apparently enter becalmed rapids habitats, which they then leave when the water level starts to rise and the current increases. Some of the species in this list were obtained on the margins of rapids habitats, or in less extreme conditions than characteristic of the rapids at high water. It seems unlikely that any of these species establish populations in the more extreme rapids habitats.

Moderately adapted

In this category are grouped 38 species exhibiting little or no morphological adaptation to living in rapids habitats. They are moderately rheophilic or adapted to less extreme rapids habitats; in most instances the main populations occur outside the rapids habitats. They constitute 19% of the specimens collected:

Polypterus ornatipinnis
Microthrissa minuta
Odaxothrissa vittata
Poecilothrissa congica
Potamothrissa acutirostris
Potamothrissa obtusirostris
Mormyrops deliciosus
Mormyrops masuianus
Mormyrus proboscirostris
Mormyrus bumbanus
Petrocephalus simus
Pollimyrus plagiostoma
Alestes macrolepidotus

Alestes imberi
Alestes comptus?
Micralestes humilis
Distichodus mossambicus
Distichodus antonii
Distichodus lusosso
Distichodus sexfasciatus
Distichodus atroventralis
Distichodus fasciolatus
Distichodus maculatus
Barilius weeksii
Barilius lujae
Chelaethiops elongatus
Engraulicypris congicus
Labeo macrostoma
Labeo greenii
Leptocypris modestus
Bagrus ubangensis
Chrysichthys cf. *cranchii*
Synodontis greshoffi
Synodontis caudalis
Synodontis decorus
Synodontis nummifer
Haplochromis polli
Mastacembelus congicus.

The clupeids *Odaxothrissa, Poecilothrissa, Potamothrissa* and *Microthrissa,* along with the cyprinids *Chelaethiops, Engraulicypris,* and *Leptocypris,* apart from their streamlined form and deeply forked caudal fins, exhibit little morphological adaptation to rapids as such; they are basically mid-water or open-water forms often or usually associated with current.

Highly adapted, rheophilic

This is the largest of the four categories, with 51 species and 65% of the specimens. These inhabit the most extreme rapids habitats, and their main populations seem to be restricted entirely or almost entirely to rapids. Many of them exhibit morphological adaptations to the rapids:

Campylomormyrus mirus
Campylomormyrus rhynchophorus
Mormyrops mariae
Mormyrops engystoma
Mormyrus cyaneus
Mormyrus iriodes
Myomyrus macrodon
Myomyrus pharao
Stomatorhinus sp. or spp.
Bryconaethiops yseuxi
Nannocharax macropterus
Garra congoensis
Labeo barbatus
Labeo nasus
Labeo sorex
Labeo variegatus
Labeo lividus
Varicorhinus macrolepidotus
Bagrus caeruleus
Chrysichthys delhezi
Chrysichthys helicophagus
Chrysichthys sp. undet.?
Rheoglanis dendrophorus
Amphilius sp.
Doumea alula
Phractura lindica
Clarias longibarbus
Atopochilus guentheri
Atopochilus royauxi
Chiloglanis congicus
Chiloglanis carnosus
Synodontis acanthomias
Synodontis soloni
Synodontis longirostris
Synodontis brichardi
Haplochromis demeusii
Lamprologus cf. *moquardii*
Lamprologus werneri
Nanochromis consortus
Nanochromis parilus
Nanochromis minor
Nanochromis splendens
Steatocranus gibbiceps
Steatocranus casuarius
Steatocranus tinanti
Steatocranus glaber
Teleogramma gracile
Teleogramma depressum
Mastacembelus cf. *marchei*
Mastacembelus paucispinis
Mastacembelus brachyrhinus.

No fewer than 21 of these are known only from the Zaire River between Kinshasa and

Matadi, and the great majority are apparently restricted to the mainstreams of the Zaire River and of its larger tributaries. Many occur elsewhere in the Zaire basin but not beyond, namely the two *Campylomormyrus*, *Mormyrops mariae*, the two *Myomyrus*, *Labeo barbatus*, *L. sorex*, *Varicorhinus macrolepidotus*, *Chrysichthys delhezi*, *Doumea alula*, *Phractura lindica*, *Atopochilus royauxi*, *Chiloglanis congicus*, *Synodontis acanthomias*, *S. longirostris*, and *Lamprologus moquardii*. Several apparently have markedly disjunct distributions, e.g., *L. sorex*, known elsewhere only from the mainstream of the Ubangui River and from the rapids of the Zaire River upstream from Kisangani. A few are relatively rare or only locally abundant in the mainstream rapids but have dense populations in high gradient tributaries such as the Inkisi, especially above waterfalls which act as barriers to the upstream passage of most other fishes. These species are *Garra congoensis*, *Amphilius* sp., *Doumea alula*, *Phractura lindica*, and *Chiloglanis congicus*. Our only large mainstream samples of *Amphilius* sp., *Doumea alula*, and *Phractura lindica* came from R & S 41, at a place about on, or two kilometers upstream from the mouth of a large high gradient tributary, the rivière Lufu. The distribution of *Varicorhinus macrolepidotus* is perhaps also affected by the placement of such tributaries.

The commonest readily observable morphological adaptation in the highly specialized rheophilic fishes is reduction of eye size, followed by varying degrees of depression or dorsoventral flattening of the body form. Other adaptations involve modifications of the mouth, fins, and coloration.

Reduction of eye size. Nearly half of the highly specialized rheophilic species are microphthalmic:

Campylomormyrus rhynchophorus
Mormyrops mariae
Mormyrops engystoma
Mormyrus cyaneus
Mormyrus iriodes
Myomyrus macrodon
Myomyrus pharao
Stomatorhinus sp. or spp.
Labeo sorex
Bagrus caeruleus
Chrysichthys sp.
Rheoglanis dendrophorus
Amphilius sp.
Doumea alula
Phractura lindica
Clarias longibarbus
Atopochilus guentheri
Atopochilus royauxi
Chiloglanis congicus
Chiloglanis carnosus
Synodontis acanthomias
Mastacembelus cf. *marchei*
Mastacembelus paucispinis
Mastacembelus brachyrhinus.

The *Mormyrops*, *Mormyrus*, *Stomatorhinus*, and *Mastacembelus* belong to genera in which all or almost all species, including those not inhabiting rapids, have small or smallish eyes. In this respect, these genera may be regarded as preadapted to the rapids habitat. The Mormyridae have a complex electrogenic-electrosensory system for gathering information from the environment, and this faculty presumably serves them better than their eyes, in the rapids habitats as well as elsewhere. It should be noted that the reduction of the eye size is more extreme in *Campylomormyrus rhynchophorus*, *Mormyrus iriodes* and *Stomatorhinus* spp. than in any other Mormyridae. *Labeo sorex*, *Bagrus caeruleus*, *Chrysichthys* sp., *Chiloglanis carnosus*, and *Synodontis acanthomias* all have eyes smaller than any or almost any other species in their respective genus. The reduction is particularly striking in *Labeo sorex*. Although the eyes of the rheophilic species listed here are very small, they are always superficial in position, never partially or completely covered by skin and other tissues, and never entirely absent.

Modified body form. A number of the

fishes have dorsoventrally depressed heads and bodies:

Garra congoensis
Bagrus caeruleus
Rheoglanis dendrophorus
Clarias longibarbus
Atopochilus guentheri
Atopochilus royauxi
Chiloglanis carnosus
Synodontis brichardi
Teleogramma depressum.

Chiloglanis carnosus and *Synodontis brichardi,* while not so depressed as most other species listed here, are flatter than any other members of their respective genus. The flattening is most striking in *Atopochilus,* and in *Teleogramma depressum,* which has the flattest head and body of any member of the family Cichlidae (Plate 13, f–g).

A number of the rapids cichlids are exceptionally elongate for members of their family, and this is evidently a modification for life in the rapids:

Lamprologus (three species)
Nanochromis, especially *splendens*
Steatocranus tinanti
Teleogramma, especially *depressum.*

Modifications of the mouth. A number of the rheophilic cyprinids and catfishes belong to genera characterized by highly specialized lips which form a sucking disc:

Garra
Labeo
Atopochilus
Chiloglanis
Synodontis.

Superficially at least, the structure of the sucker in the species inhabiting the rapids of the Lower Zaire River appears to be no more specialized than in species found elsewhere in the Zaire basin or other parts of Africa.

A modification which may have evolved in response to rapids habitats in the Zaire basin is the highly specialized, elongated tubular mouth of *Campylomormyrus.*

Modified fins. A few species have paired fins which are flattened and expanded:

Garra congoensis
Labeo nasus
Labeo sorex
Amphilius sp.
Doumea alula
Phractura lindica.

The three Amphiliidae are most specialized in this respect. None of these species is endemic to the mainstream rapids of the Lower Zair River.

In most cichlids the longest soft ray in the pelvic fin is the first or outermost ray, but in *Steatocranus* and *Teleogramma* it is the third or middle ray, and the first ray is relatively short. This trait is also present in at least some *Lamprologus* species in the rapids, in which the second and third soft pelvic rays are about equally long, and the first ray is shorter.

Coloration. Blue or bluish coloration, evidently an adaptation to the rapids environment, characterizes a surprising number of phyletically diverse rheophilic species:

Mormyrops engystoma uniformly greyish blue
Mormyrus cyaneus uniformly light blue, or light blue with a bluish black head
Labeo nasus dark blue on back and sides, dusky ventrally
Labeo sorex uniformly dusky grey or bluish grey
Labeo lividus dull dark blue on back and sides, lighter ventrally
Varicorhinus macrolepidotus brilliant blue with silvery reflections, white ventrally
Bagrus caeruleus uniformly bluish dorsally and laterally, white ventrally
Chrysichthys delhezi uniformly dark blue dorsally and laterally, whitish ventrally
Chrysichthys helicophagus bluish grey dorsally and laterally, lighter ventrally
Rheoglanis dendrophorus blue or grey-blue dorsally and laterally, greyish ventrally
Atopochilus guentheri mottled with indis-

tinct dark spots; ground color bluish-grey dorsally and laterally, grey or whitish ventrally

Atopochilus royauxi similar to *A. guentheri*, but with a tendency to mottling with smaller spots extending ventrally as well as dorsally and laterally.

Chiloglanis carnosus light bluish with violet undertones on back and sides, lightening ventrally; a pair of dorsolateral white spots just in front of adipose fin, and a somewhat smaller pair just in back of adipose fin (Plate 8, b).

Synodontis acanthomias small, roundish dark spots on a whitish, grey, or bluish grey background, lightening ventrally

Mastacembelus paucispinis young mottled; adults uniformly bluish, or bluish with violaceous undertones.

In other riverine habitats in the Zaire basin, relatively few species exhibit blue or bluish coloration, indicating strong selection for such coloration in the rapids. There is some indication that it is involved in concealment. Many of the fishes, as indicated above, are lighter ventrally (countershaded), as in classical cases of blending or concealing coloration exhibited by fishes in a great variety of environments. The mottling of the two species of *Atopochilus* definitely helps to conceal them from human observation, and their bluish coloration appears to complement this effect. *Atopochilus* provides perhaps the best examples of concealing coloration among the rapids fishes.

At least two species of Mormyridae are characterized by darkly pigmented (Black) and depigmented (White) phena or morphs: *Mormyrops mariae* (Plate 5, a-b) and *Stomatorhinus* sp.

Highly adapted, intrusive or hyporheic

This fourth category, our last, comprises only eight species, all highly specialized and apparently endemic to the rapids of the Lower Zaire River. They account for 14% of the specimens taken by our survey:

Notoglanidum pallidum
Gymnallabes tihoni
Gymnallabes nops
Lamprologus lethops
Mastacembelus brichardi
Mastacembelus crassus
Mastacembelus latens
Mastacembelus aviceps.

Of these species, *Mastacembelus brichardi* and *Gymnallabes tihoni* appear to be the most abundant. *M. brichardi* occurred at six of our nine rapids collecting localities, and was very abundant at four of them. *G. tihoni* was present at four localities, and was so abundant at R & S 41 that we had to discard two or three hundred, which are not included in our tallies. *Mastacembelus crassus* was abundant only at one locality, R & S 29, in the same rocky pool that yielded our only specimens of *Lamprologus lethops* and *M. latens*. Of the approximately 750 specimens taken from this pool, 45% belong to our hyporheic category.

Notoglanidium pallidum and *Mastacembelus aviceps* are microphthalmic, and *Gymnallabes nops* apparently anophthalmic (we have not dissected the head of the unique specimen to verify this point). The remaining species are cryptophthalmic. In *Gymnallabes tihoni* and *Mastacembelus crassus* the eyes lie in little pits or crypts, largely hidden from the surface; in *Lamprologus lethops*, *Mastacembelus brichardi*, and *M. latens* they are completely covered over by the skin and tissues of the head. We suspect these species employ the eyes primarily to detect light, from which they flee.

In *Mastacembelus brichardi* and *latens* the head and body are laterally compressed, of a form more or less typical of *Mastacembelus* from non-rapids habitats. In *Notoglanidium pallidum* and *Gymnallabes tihoni* the head and body are strongly depressed, as in some of the highly rheophilic forms. The heads and bodies of *Gymnallabes nops*, *Lamprologus lethops*, *Mastacembelus crassus*, and *M. aviceps*, on the other hand, are more or less of uniform thickness and round in cross-section, a form rarely encountered in riverine fishes, and absent among the rheophilic forms from the Lower Zaire rapids. Perhaps these hyporheic species with round bodies burrow into the mud (*Gymnallabes nops, Mastacembelus aviceps*) or loose rock rubble (*Mastacembelus crassus, Lamprologus lethops*?) that accumulate underneath and between rocks in the rapids.

DISCUSSION

Speciation and adaptation in the extensive tracts of rapids habitats in the mainstream of the Zaire River and its larger tributaries has contributed significantly to the present diversity of the rich and highly endemic Zairean ichthyofauna. The families most strongly affected by this evolution have been Mormyridae, Bagridae, Mochokidae, and Cichlidae, but its effect has been felt to some extent by at least five more of the 25 families inhabiting the Zaire basin: Cyprinidae, Amphiliidae, Clariidae, Characidae, Schilbeidae and Mastacembelidae.

Rapids fishes in the Zaire basin are still far from being well known, especially those of the Ubangui, the Kasai, and the Upper Zaire River or Lualaba. A number of species found to be relatively common by our survey of the Lower Zaire rapids were previously known from only the holotypes or a few specimens, with little or no precise indication of habitat: *Mormyrops engystoma, Bryconaethiops yseuxi, Labeo sorex, Chrysichthys delhezi, Clarias longibarbus, Teleogramma gracile, Mastacembelus paucispinis,* and *M. brachyrhinus.* It is likely that additional distinctive but poorly known species will prove to be fairly common in rapids.

TABLE 22. THE FAMILIES AND THE NUMBERS OF SPECIMENS, GENERA, SPECIES, AND ENDEMIC SPECIES TAKEN AT NINE COLLECTING LOCALITIES IN RAPIDS HABITATS IN THE MAINSTREAM OF THE LOWER ZAIRE RIVER.

	Specimens	Genera	Species	Endemic Species
1. Cichlidae	2694	7	17	13
2. Mormyridae	1042	8	19	3
3. Mastacembelidae	905	1	8	6
4. Cyprinidae	648	8	19	2
5. Mochokidae	552	3	16	3
6. Clupeidae	357	5	6	0
7. Bagridae	240	5	11	4
8. Amphiliidae	214	3	3	0
9. Clariidae	181	3	4	2
10. Distichodontidae	146	2	8	0
11. Characidae	124	4	9	1
12. Citharinidae	14	1	3	0
13. Malapteruridae	14	1	1	0
14. Schilbeidae	10	2	2	0
15. Polypteridae	6	1	1	0
16. Tetraodontidae	1	1	1	0
17. Centropomidae	1	1	1	0
Totals	7149	56	129	34

The familial composition of the rapids fishes obtained by us in the Lower Zaire River is indicated in Table 22. It is a remarkable fact that cichlids are represented by more than twice as many endemic rapids species as any other family, and that these endemic cichlid species together constitute more than one-third of the total number of specimens collected! This contrasts very sharply indeed with rich riverine faunas elsewhere in Africa, particularly the Cuvette Central of Zaire (the richest area), where cichlid species are invariably few and seldom constitute a major portion of the individual fishes present. The one place in the Zaire basin where cichlid predominance surpasses that of the rapids is Lake Tanganyika. This invites a comparison of the rapids fauna with that of the lake. The spectacular success of Cichlidae in the great lakes of East Africa has been the subject of much good evolutionary speculation (Fryer and Iles, 1972; Greenwood, 1974), but far less attention has been given to other fish groups and to the great riverine fish faunas of Africa.

TABLE 23. FISH FAMILIES OF THE ZAIRE BASIN AND THEIR CONTRIBUTION TO THE FAUNA OF LAKE TANGANYIKA AND OF THE LOWER ZAIRE RAPIDS.

	Present		Endemics	
	Lake	Rapids	Lake	Rapids
Lepidosirenidae	+*			
Polypteridae	+	+		
Clupeidae	+	+	+	
Mormyridae	+	+		+
Pantodontidae				
Kneriidae				
Phractolaemidae				
Characidae	+	+	+	+
Distichodontidae	+	+		
Citharinidae	+	+		
Ichthyboridae				
Cyprinidae	+	+	+	+
Bagridae	+	+	+	+
Schilbeidae		+		
Amphiliidae		+		+
Clariidae	+	+	+	+
Mochokidae	+	+	+	+
Malapteruridae	+	+		
Cyprinodontidae	+		+	
Centropomidae	+	+*	+	
Anabantidae	+*			
Eleotridae				
Cichlidae	+	+	+	+
Mastacembelidae	+	+	+	+
Tetraodontidae	+	+*		

* Presence marginal.

Of the three African lakes in which explosive lacustrine evolution has produced large numbers of endemic species, Tanganyika has a far greater number of endemic genera (43) than Malawi and Victoria combined (28). The explanation most often advanced for this difference is the time factor, Tanganyika being several million years older than Malawi and Victoria. As pointed out by Roberts (in press), the explanation should also be sought in the relatively impoverished riverine faunas from which the Malawi and Victoria ichthyofaunas evolved. The greater diversity of the Tanganyika ichthyofauna must be related in part to the rich Zairean stocks which contributed to it. As indicated in Table 23, seven of the ten families which have contributed endemics to the Tanganyikan fauna are also represented by endemics in the rapids of the Lower Zaire River. It seems a reasonable hypothesis that evolution in the rocky habitats in the rapids of the Zaire basin played a major role in preadapting such families as Cichlidae, Mastacembelidae, Mochokidae, Clariidae, Bagridae, and Cyprinidae to the rocky littoral of Tanganyika, with pride of place to the endemic Zairean cichlid genus *Lamprologus.*

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