

***Haplochromis howesi* spec. nov., a crab and fish eating cichlid from Lake Victoria**

M.J.P. van Oijen

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Key words: Cichlidae; crab eater; piscivore; Lake Victoria; *Haplochromis*; new species; fin squamation.

A new, crab and fish eating *Haplochromis* species, with a piscivorous facies, occurring in rocky habitats in Lake Victoria is described. Special attention is given to the squamation of the dorsal and anal fin membranes. Food preferences of juveniles and adults are discussed, and the decline of this species, in a habitat in which piscivorous Nile perches do not occur, is analysed.

M.J.P. van Oijen, Nationaal Natuurhistorisch Museum (Rijksmuseum van Natuurlijke Historie), Postbus 9517, 2300 RA Leiden, The Netherlands.

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Introduction

The diversity of the haplochromine community of rocky habitats in Lake Victoria has been discovered only recently. In Greenwood's revision papers only one species, viz. *H. nigricans* Boulenger, 1906, is associated with rocky habitats (Greenwood, 1956). Van Oijen et al. (1981) and Witte-Maas & Witte (1985) mentioned 16 species collected near the rocks. Witte et al. (1992b: 28) listed 32 species, which are divided in species restricted to rocks (11), species for which rocks are one of the main habitats (8), and occasional intruders (13). Of these 32 species only 13 have been described and named. Only two of the eleven rock-restricted species have been described, namely the algal scraping *Haplochromis nigricans* (Boulenger, 1906), and the zooplanktivore *Haplochromis nyererei* Witte-Maas & Witte, 1985. In this paper the first predatory rock-restricted haplochromine species is described. This species (sometimes under the cheironym *Haplochromis* "smoke") was referred to as a crab eater by van Oijen et al. (1981), Witte (1984), Barel (1985), Witte & van Oijen (1991) and Witte et al. (1992b), and was placed in a trophic group of its own. However, after examination of the intestines of almost all specimens of this species in the RMNH collection, it now seems that for adults, fish may be as important as crabs, and that for juveniles

fish is the major food. As the classification of trophic groups was based on the dominant food category of adults (Witte, 1981: 178; van Oijen, 1982: 338), the trophic group to which *H. howesi* belongs is more appropriately named 'fish and crab eater'.

Recently the haplochromine cichlid population of Lake Victoria was decimated as a result of the upsurge of the introduced Nile perch. About 200 of the 300 identified species vanished (Witte et al., 1992b). Because the spaces between the rock boulders are inaccessible to Nile perches of a size at which they are able to eat adult haplochromine cichlids (SL c. 200 mm; Gee, 1969; Ligtvoet & Mkumbo, 1990; Ogutu-Ohwayo, 1990), rocky areas are among the few habitats in which cichlids have suffered relatively little from the Nile perch boom (Witte et al., 1992b).

Nevertheless, recent collecting at rocks in the Mwanza area made clear that *H. howesi* declined dramatically. Witte et al. (1992: 13, 28) even reported that this species was no longer present in the catches in 1990. However, in 1992 some individuals were collected again at the Rocky Islands (Bouton and Fermon, pers. comm.).

Methods and techniques

Specimens were collected by angling (hooks baited with worms) and with locally made fish-traps (not baited, or baited with maize meal porridge). Only one, juvenile, individual of *H. howesi* was caught in a gill-net set closely to the rocks.

After capture the specimens were put on ice or in ice water to die. Thereafter, a cut was made in the ventral midline from the anus to below the pelvic fin insertion, and the specimens were fixed and preserved in formalin (5%). Only after transportation to The Netherlands could the formalin be stepwise replaced by ethanol 70%.

For examination of the stomach and gut contents a binocular microscope with normal and transmitted light (magnifications up to 50 ×) was used. Drawings of skeletal elements were made with a drawing mirror.

Terminology and measurements follow Barel et al. (1976, 1977), Hoogerhoud & Witte (1981), Witte & Witte-Maas (1981) and van Oijen (1991).

Abbreviations

HEST = Haplochromis Ecology Survey Team. RMNH = Rijksmuseum van Natuurlijke Historie (now Nationaal Natuurhistorisch Museum). In the section 'Material' the letters A, T, GN behind the catch date indicate specimens caught by angling, fish-trap, or gill-net respectively.

Species description

***Haplochromis howesi* spec. nov.**
(figs 1-24, 27-28, tabs 1-4)

Haplochromis "smoke" Barel, 1985: 423; Witte & van Oijen, 1990: 31, 32; Witte et al., 1992: 13, 17, 28.

Material.— Holotype, ♀, 163.0 mm, RMNH 31718, Mushroom Island, Mwanza Gulf, Tanzania, Lake Victoria, 2-7.iii.1984, A, HEST; Paratypes: all paratypes collected by HEST in the Mwanza Gulf, Tanzania, Lake Victoria; *Anchor Island*: 1 ♂, 74.2 mm, 30432, 24.viii.78, A; 1 ♂, 110.2 mm, RMNH 30390,

25.x.79, T; 1 ♂, 65.5 mm, RMNH 30433, 29.iv.80GN; *Hippo Island*: 1 ♂, 73.4 mm, RMNH 30431, 24.ix.79, A; 1 ♀, 87 mm RMNH 31719, 30.ix.1986, A; *Nyegezi Bay, Northern shore*: 2 ♂♂, 77, 91.9 mm, RMNH 30437-38, 1 ♂, 153.2 mm, RMNH 30448, 1 ♀, 152 mm, RMNH 30447, 5.v.79, T; *Mushroom Island*: 1 ♀, 62.5 mm, RMNH 30440, 24.i.78, A; 3 ♂♂, 58.7-84.2 mm, RMNH 30428-30, 21.vii.78, A; 2 ♀♀, 58.8, 69.9 mm, RMNH 30409-10, 25.vii.78, A; 2 ♂♂, 82.3, 86.2 mm, RMNH 30412-13, 25.vii.78, A; 1 ♂, 72.9 mm + 2 ♀♀, 58.5, 116.7 mm, RMNH 30425-27, 25.vii.78, A; 1 ♂, 91.0 mm, RMNH 30387 (on slide), 1 ♂, 80.9, RMNH 31720 (on slide), 1 ex., 93.0 mm, RMNH 31721 (on slide), 25.vii.78, A; 1 ♀, 105.0 mm, RMNH 30439, 26.vii.78, A; 1 ♀, 93.0 mm, RMNH 30386, 29.vii.78, A; 2 ♀♀, 72.1, 91.4 mm, RMNH 30420-21, 1 ♂, 105.0 mm, RMNH 30458, 29.x.78, A; 3 ♂♂, 59.8-67.1 mm, 30422-24, 18.xi.78, A; 2 ♂♂, 59.3, 61.2 mm, RMNH 30414-15, 17.xii.78, A; 3 ♂♂, 58.9-101.2 mm + 2 ♀♀ 66.6, 79.0 mm, RMNH 30442-46, 24.xii.78, A; 1 ♂, 94.3 mm, 2 ♀♀, 97.0, 107.5 mm, RMNH 30434-36; 4.vi.79, T; 1 ♀, 75.0 mm, RMNH 30389, 24.x.79, T; 1 ♀, 101.2 mm, RMNH 30391, 25.x.79, T; 1 ♀, 114.0 mm, RMNH 30419, 2 ♀♀, 73.0, 92.9 mm, RMNH 30453, 30455, no data; 3 ♂♂ 60.4-87.2 mm + 4 ♀♀ 72.1-163.3 mm, RMNH 31711-17, 2-7.iii.84, A; *Mwanza Gulf Rocks*: 2 ♀♀, 61.9, 79.5 mm, RMNH 30399-400, 1 ♂, 137.0 mm, RMNH 30449, 27.iii.78, A; 1 ♂, 85.0 mm, RMNH 30401 + 1 ♂, 98.8 mm, RMNH 30402, 29.vii.78, A; 1 ♂, 137.6 mm, RMNH 30450, 10.xii.78, A; *Nyegezi Bay*: 1 ex., 96.1 mm, RMNH 30456, 16.v.78, A; *Nyegezi rocks*: 1 ♀, 57.6 mm, RMNH 30392, 1 ♂, 71.3 mm, RMNH 30393, 14.vii.78, A; 1 ♀, 71.1 mm, RMNH 30385, 15.vii.78, A; 2 ♀♀, 50.4, 56.4 mm + 1 ♂, 60.9 mm RMNH 30396-98, 17.vii.78, A; 1 ♀, 65.1 mm, RMNH 30416, 22.vii.78, A 1 ♀, 105.5 mm, RMNH 30441, 13.v.78, A; 4 ♀♀, 58.0-83.3 mm, 2 ex. 59.5, 82.2 mm, RMNH 30403-08; 14.vi.78, A; 1 ♂, 94.5 mm, RMNH 30418, no data.

Etymology.— This species is named in honour of Gordon Howes, ichthyologist of the Natural History Museum, London, as a token of appreciation for his many excellent contributions to fish taxonomy.

Description based on 77 specimens 50.4-163.3 mm SL, measurements were taken from 68 specimens 50.4-163.3 mm SL.

Habitus.— Body moderately slender, moderately laterally compressed. Dorsal head profile almost straight to slightly convex, with a slight incurvation above the eye. Premaxillary pedicel prominence indistinct or absent. Snout tapering somewhat bluntly, mouth moderately oblique. Premaxilla not expanded. Maxilla slightly bul-late in some specimens, the posterior tip not or just reaching a vertical through the anterior eye margin. Lips slightly broadened. Lower jaw prognathous, moderately

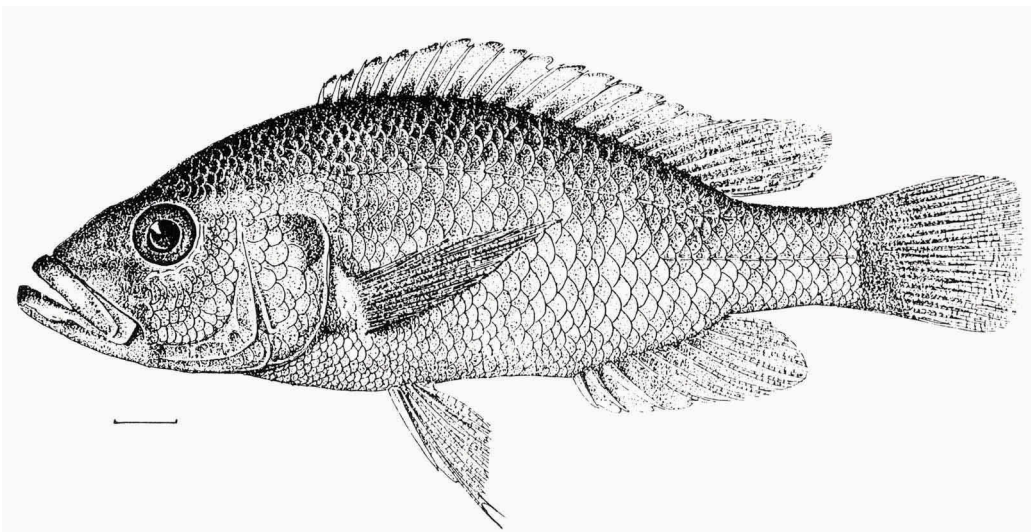


Fig. 1. *Haplochromis howesi* spec. nov. Paratype RMNH 30447. Scale equals 10 mm.

protruding. Rostral lower jaw outline convex, the symphysis sloping rather obliquely caudad. No mental prominence. Lower jaw ventral outline slightly convex, making a distinct angle with ventral head outline. Lateral sides of lower jaw slightly oblique. Dorsal margin of horizontal arm of preoperculum horizontal in most specimens but sloping ventrad or dorsad in others. Rostral margin of vertical arm of preoperculum always slightly caudad inclined.

Cephalic lateral line openings slightly enlarged, lateral line canals on lachrymal faintly visible. Eye moderately small, circular to slightly oblong, distance from dorsal eye rim to dorsal head profile relatively large. Pupil slightly elliptical, a small aphakic space rostro ventrally.

Fins.— Pectoral and pelvic fins not reaching origin of anal. Anal and dorsal fins just or just not reaching caudal fin base. Caudal fin outline rounded to subtruncate, straight.

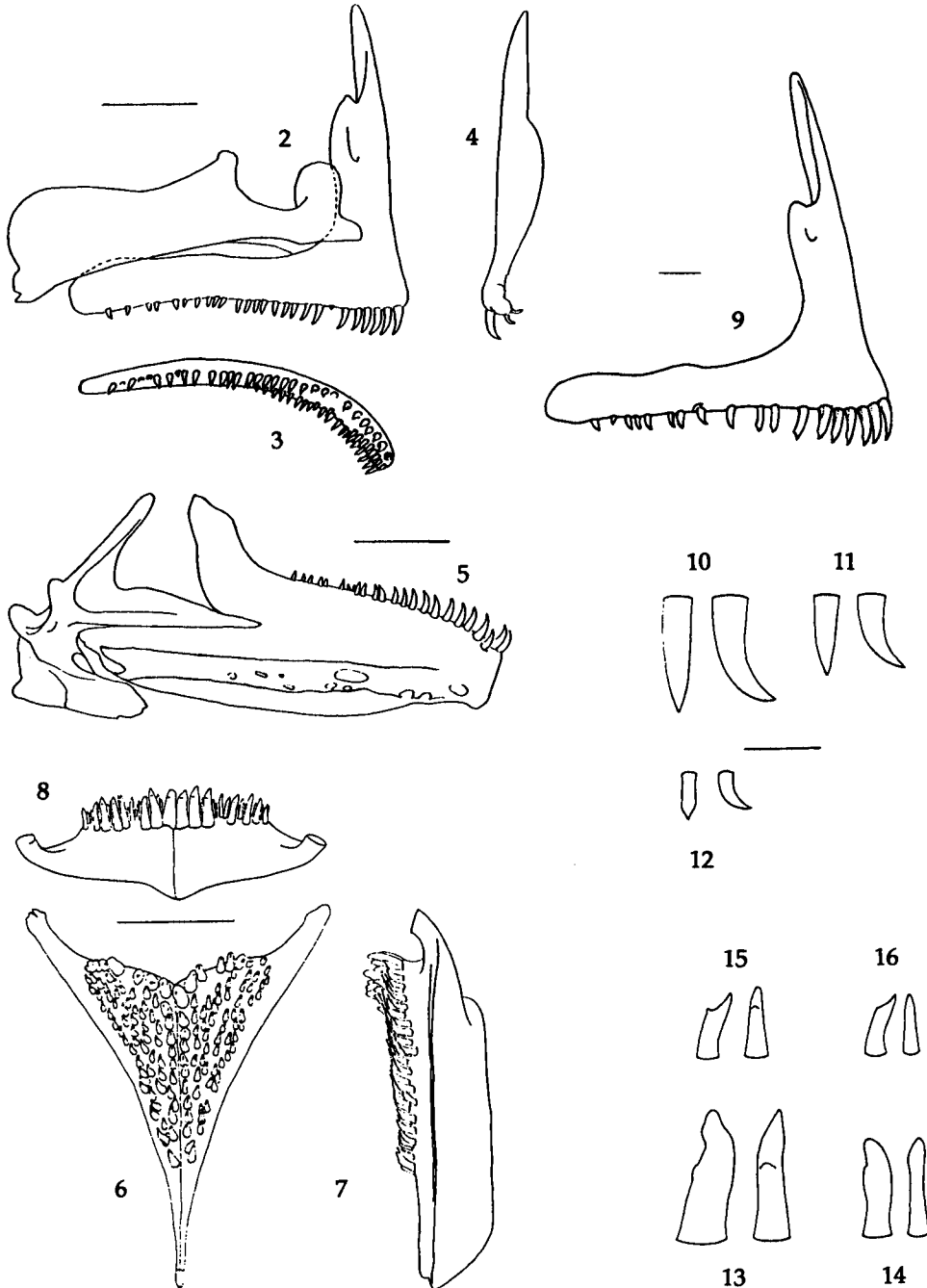
Scales.— Scales on cheek, gill cover, nape, neck and chest cycloid. Scales on remaining parts of body ctenoid. Chest scales moderately small, transition between chest scales and scales on flank and belly gradual. Proximal two-thirds of caudal fin with small, elongate ctenoid scales between the rays. Remarkably, in all specimens is the presence of small, elongate, cycloid scales proximally between some spines and rays of the dorsal and anal fin. These scales may be present in rows or isolated. The number of scales shows high individual variation. Some specimens have only a few isolated scales on the fin membranes, whereas in others many small rows of up to 8 imbricated scales are present. The scales are most numerous in the transition area of the spinous and soft rayed part of the fin. In all but one case there is only one row between two rays. The rows are always connected to the fin basis. The distal scales of the rows and the isolated scales often are rather deeply embedded. Some specimens have an incomplete series of small elongate cycloid scales along the base of the anal fin (fig. 24).

Gill apparatus.— Eight or nine gill rakers on the lower part of the first gill arch; the lowermost three to five conical, the following two slightly flattened with rectangular ends, and the upper ones distally flattened and expanded with complicated shapes. 123-132 filaments on the first hemibranch (n=4).

Viscera.— Intestine length varies from 1.0-1.3 times SL (n=60). Following the definitions of Zihler (1982) the arrangement of the digestive tracks of adult *H. howesi* is of type D (with backflap).

Oral teeth (based on data from all specimens).— Shape. Outer teeth in both jaws relatively slender, slightly curved, acutely pointed unicuspid, nearly circular in cross section. The tips are slightly compressed. In some specimens the tips of many outer teeth are broken. Tooth size decreases gradually laterad. Inner teeth are smaller and more flattened replicas of the outer teeth. Juveniles up till 80 mm SL have unequally bicuspid teeth in the outer rows of both jaws. In a juvenile of 55 mm SL only two medial teeth in the lower jaw and four medial teeth in the upper jaw are unicuspid. In juveniles five or six caudalmost teeth in the upper jaw and two or three caudalmost teeth in the lower jaw are also unicuspid, but these teeth are small and have compressed isoscelene tips.

— Dental arcade and toothband. Dental arcade rounded. Most specimens have two inner rows in both upper and lower jaw. Specimens with three rows in upper or lower jaw were also found; one specimen has only one inner row in the upper jaw. Distance between inner and outer rows about 1.5 times that between inner rows.



Figs 2-16. *Haplochromis howesi* spec. nov. Figs 2-8, 10-16 RMNH 31710 142 mm SL. Fig. 9 RMNH 30389 75 mm SL. Fig. 2. Premaxilla and maxilla, lateral view. Fig. 3. Premaxilla, view perpendicular to dentiferous area. Fig. 4. Premaxilla, medial view of ascending arm. Fig. 5. Lower jaw lateral view. Fig. 6. Lower pharyngeal element, dorsal view. Fig. 7. Lower pharyngeal element, lateral view. Fig. 8. Lower pharyngeal element, caudal view. Figs 9-12. Premaxillary teeth, labial and lateral view. Fig. 9. Premaxilla lateral view. Fig. 10. First tooth of outer row. Fig. 11. twelfth tooth of outer row. Fig. 12. Second tooth of first inner row. Figs 13-16. Lower pharyngeal teeth, lateral and rostral view. Fig. 13. Second tooth of caudalmost row. Fig. 14. Seventh tooth of caudalmost row. Figs 15 & 16. Smaller bevelled teeth from the inner rows. Scale of figs 2-8 equals 5 mm, scale of figs 9-16 equals 1 mm.

— Counts and setting. Adult specimens have 54-58 teeth in the outer row of the upper jaw and 38-50 teeth in the outer row of the lower jaw. In juveniles in the length class of 50-60 mm SL, these numbers are 34-48 and 22-44, respectively. The number of teeth increases with the length of the individuals. Outer teeth in both jaws closely set rostrally and laterally where tooth bases almost touch each other. Caudally the distance between the teeth increases to once the tooth diameter in the lower jaw and twice the tooth diameter in the upper jaw.

— Implantation. Rostral outer teeth erect in the upper jaw, slightly procumbent in lower jaw. Lateral outer teeth in both jaws erect to slightly recumbent, caudal outer teeth in upper jaw moderately recumbent, in lower jaw slightly to moderately recumbent. Inner teeth strongly recumbent.

Pharyngeal teeth.— Counts. There are 16-19 teeth in the caudalmost transverse row and 12 teeth in the two median rows.

Shape.— Most pharyngeal teeth are of the bevelled type, relatively fine and acutely pointed. Some medial teeth of the caudalmost row and some caudal teeth of the medial rows relatively stout and hooked, with a blunt rostro-dorsad directed major cusp. Tooth size increasing from rostral to caudal and from lateral to medial.

Osteology.— The osteological descriptions are based on skeletal elements of four-dissected specimens, SL 75-142 mm.

— Oral jaws. Premaxilla; dentigerous arm slightly longer than ascending arm. Angle between the arms 78-80°. Ventral outline of dentigerous arm slightly convex and sinuous. Lower jaw moderately slender. Length/depth ratio 2.1-2.2. Length of tooth bearing part of dentary is c. 0.4 times the lower jaw length.

— Lower pharyngeal element. Lower pharyngeal element caudally relatively deep, slightly longer than broad (length/width = 1.1-1.2). Dentigerous area slightly longer than broad (length/width 1.0-1.25). The position of the horns relative to the dentigerous area differs from that in other piscivorous species in that the horn facet lies ventrally to the plane of the dentigerous area. In caudal view one gets the impression that the dentigerous area is relatively raised.

— Vertebrae. There are 30 vertebrae, comprising 14 abdominal and 16 caudal elements (n= 2).

Coloration.— Live coloration of sexually active males is not known. A sexually inactive male had the snout, the dorsal part of the head and the body dark brown with a dark orange to red flush on the rostral part of the flank. Cheek brown. Lower jaw dark grey. Dorsal fin brownish grey with a dark brown base, black lappets and inconspicuous red streaks between the rays. Caudal sooty-grey with a dark brown base and inconspicuous red streaks between the rays. Anal brownish black with a dark red area on the rostral half and with two orange yellow egg dummies dorso-caudally. Pectorals dark brown. Pelvics reddish medially, black laterally. In specimens with a lighter ground colour of the head, a lachrymal stripe and a preopercular band were visible.

— Live coloration of ripe and brooding females are not known. Quiescent females have the snout, dorsal head surface, dorsum and dorsal part of flank dark brown grey. Lips brown-black. Cheek and ventral part of head brownish grey. A faint lachrymal stripe and an opercular blotch are visible. Chest and belly whitish with a faint pinkish flush. Ventral part of the flank with a greenish sheen. Five to seven faint vertical bands on the body. All medial fins greenish yellow proximally, hyaline dis-

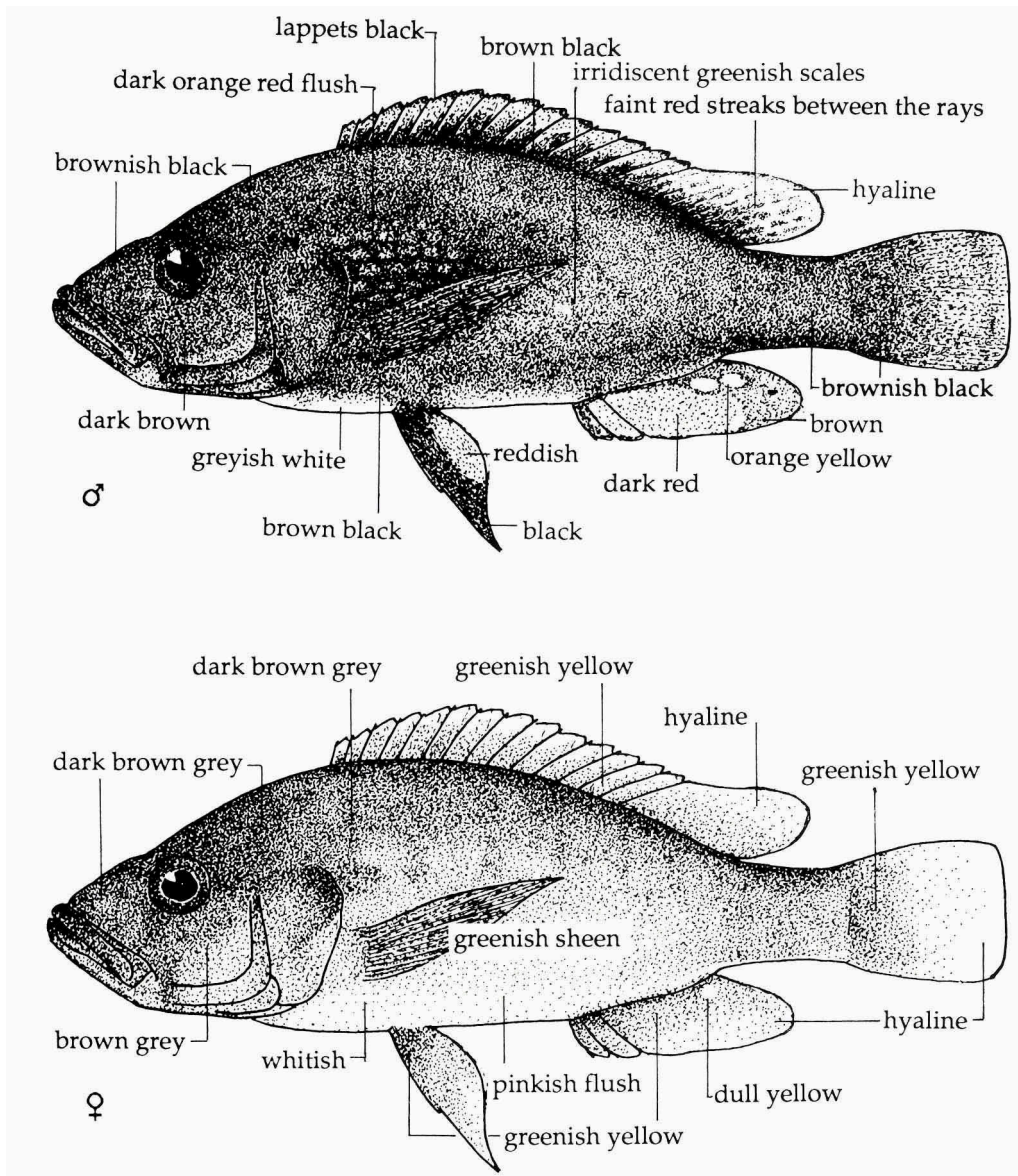


Fig. 17. *Haplochromis howesi* spec. nov. Live colours of a quiescent male and female.

tally. Anal fin with one or two dull yellow spots dorso-caudally. Pectoral fins with black or very dark green rays and a sooty fin membrane. Pelvics greenish yellow. Juveniles generally coloured as females. However, in the smaller individuals the whitish area on the ventral part of the body is almost restricted to the ventral side. Vertical bands more distinct, and faint traces of a midlateral band may be present.

Preserved males have head and body dark chocolate brown, belly somewhat lighter. Except for the opercular blotch, no markings are visible on body or head. Dorsal fin dark

to almost black between spines and rays, the spines and rays lighter. Only tips of lappets noticeably darker than finmembrane. Caudal dark brown, darkest basally and between the rays. Anal dark brownish basally, beige distally. Pectorals almost black, the fin membrane slightly lighter than the rays. Pelvics black laterally, lighter medially.

Preserved females have head and body brownish, darkest dorsally on snout, head and dorsum. Rostral part of lower jaw also dark brown. Chest light brown. Opercular blotch and an indistinct lachrymal stripe present. Five to seven relatively broad vertical bands and traces of a mid lateral band can be discerned on the body. Dorsal fin with a greyish-brown membrane, darker patches proximally between the spines. Dark streaks between the rays. Caudal dark grey proximally, distally lighter grey with small light spots between the rays. Anal grey-brown between the spines and proximally on the soft part, greyish hyaline distally. Pectorals dark grey. Pelvics dark grey laterally, lighter medially.

Preserved juveniles have body and head darkish brown, snout, dorsal head surface and dorsal part of body very dark. Tip of upper lip and rostral half lower lip black. An opercular blotch present in all, a lachrymal stripe in most specimens. All fins sooty, but pelvic fins lighter medially. The black margins of the pectoral fin rays make the fin darkly contrasting against the brownish flanks. Lappets of dorsal fin black. Most specimens have no markings on the body, but a few have six or seven very faint vertical bands which are most distinct at the position of the mid lateral band.

Distribution.— *Haplochromis howesi* is only known from Lake Victoria. All specimens were collected from rocky shores and rocky islands in the Mwanza Gulf (Tanzania). At the end of the 1970s the species was present in 32% of the catches made in rocky areas (E.L.M. Witte-Maas and F. Witte, pers. comm.) Notwithstanding an intensive sampling programme of rocky islands in the Mwanza and Speke Gulf this species has only been caught 4 times since February 1990 (Bouton, pers. comm.)

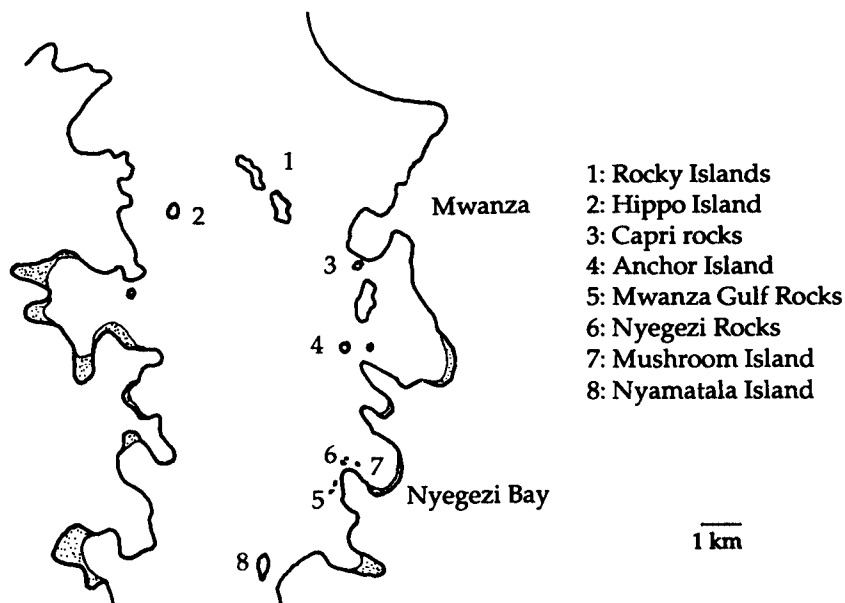


Fig. 18. Catch localities of *Haplochromis howesi* spec. nov. in the northern part of the Mwanza Gulf, Lake Victoria.

Ecology.—Habitat. This species appears to be restricted to the spaces between boulders of rocky shores and rocky islands. Depth of capture varied between 0.5 and 2.5 m.

The fishing method (angling) used to capture most individuals of *H. howesi* obviously poses limitations to the size of the captured fishes. The fact that no individuals smaller than 50.4 mm SL were captured probably is result of the size of the hooks used. If larger specimens occur deeper between the rocks in places which cannot be reached with a hook on a line, the fishing technique may also explain the small number of adults caught.

Food.—The stomachs and guts of eight adult and 58 juvenile specimens were examined. Seven adults had food remains in the guts. Remains of the crab *Potamonautus niloticus* (H. Milne-Edwards, 1837) were found in five; two of these specimens also had fish remains in the gut. Guts of two other adult specimens contained only fish remains. Juveniles had preyed on fish (67 %), shrimps (39 %), insects (27 %) and crabs (15 %).

Breeding and growth.—Only 8 out of the 80 specimens caught are adult. The smallest mature specimen was 113 mm, the largest immature specimen 116 mm. The largest specimen, a quiescent female, has a SL of 163.3 mm. No sexually active males or ripe or brooding females have been caught, so no information is available on the type of breeding.

Diagnosis.—*Haplochromis howesi* is the only species of its genus with a piscivorous facies found between rocks. Its dark brown to brownish black colours distinguish the species from all other predatory haplochromines occurring near rocky areas. Preserved specimens of *H. howesi* can be distinguished from other piscivorous species of Lake Victoria by the following combination of characters: scales on the membranes of dorsal and anal fins, dark brown preserved coloration mostly without body markings, black pectoral fins contrasting with brown flank, tip of upper lip and rostral part of lower lip black. Juveniles of *H. howesi* in their preserved dark coloration resemble adults of *H. harpakteridion* van Oijen, 1991. From this species, which is only known from the northern part of Lake Victoria, *H. howesi* is easily separable

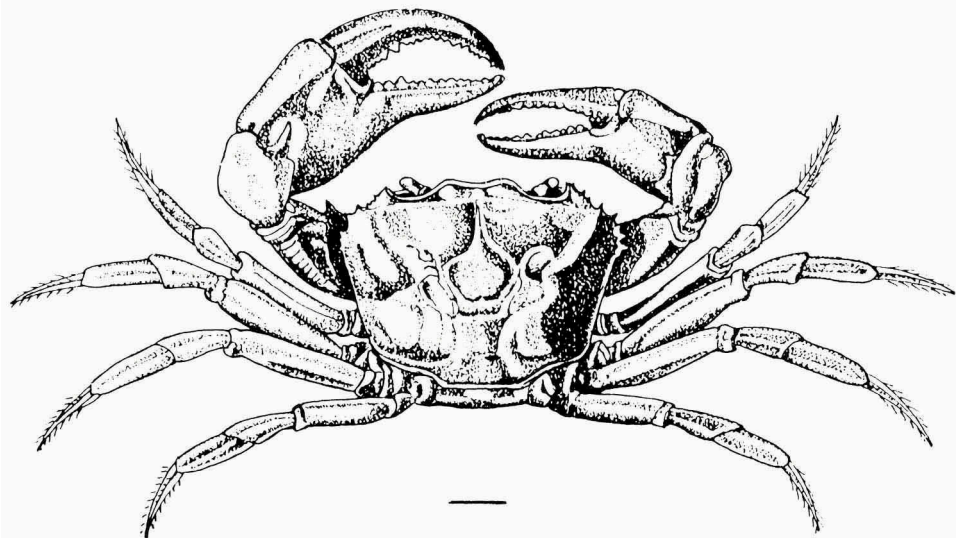
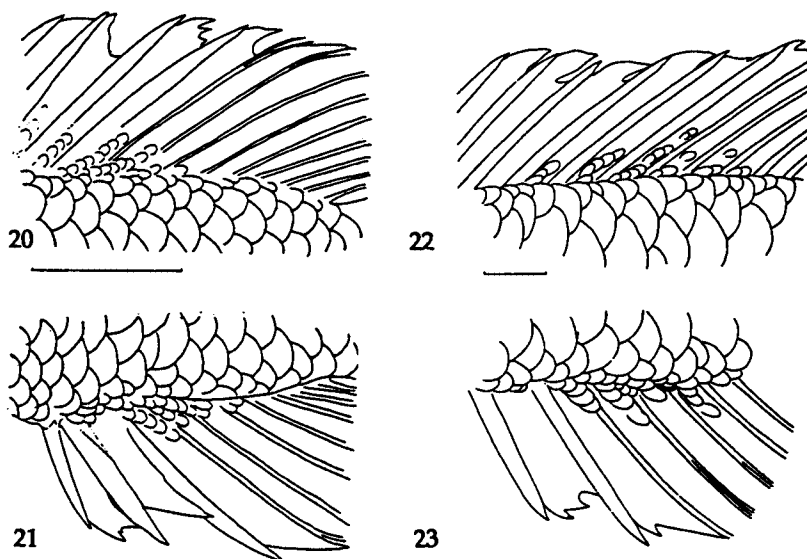


Fig. 19. *Potamonatus niloticus* (H. Milne-Edwards, 1837). Adapted from M. Milne-Edwards, 1854. Scale equals 10 mm.

by its different head shape, which, in morphometric measurements, is most apparent in the larger Eye Length, smaller Cheek Depth, smaller Lower Jaw Length and smaller Premaxillary Ascending Arm Length.

Notes on the fin squamation of *Haplochromis howesi* (figs 20-26)

Although squamation of the dorsal and anal fin membranes is known from species of at least three South American cichlid genera, i.e. *Cichlasoma*, *Laetacara* and *Kribia* (Kullander, 1983; 1975; Kullander & Nijssen, 1989), it is rare in African cichlids. Anal sheath scales in African cichlids were first described by Greenwood (1984) for *Thoracochromis buysi* (Penrith, 1970). According to Greenwood (op. cit.: 189) "It seems that anal sheath scales occur in a number of haplochromine lineages. A sheath, or at least some characteristically almond-shaped scales, has been found in species from Lakes Victoria, Tanganyika and Malawi, as well in some fluviatile taxa." The presence of these scales was not noted previously and therefore not mentioned in species descriptions. The only haplochromine cichlid for which scales on the membranes of dorsal and anal fin are described is *H. squamipinnis* Regan, 1922, a species from lakes Edward and George (Greenwood, 1973). According to Greenwood the minute fin scales in *H. squamipinnis* are aligned in single, short rows and extend from the body onto the fin. Although he described individual variation in the number of spines and rays associated with scale rows and in the distribution of the rows, Greenwood (op. cit.) did not find specimens in which the scale rows are missing. The fin scales in *H. howesi* are closely attached to (sometimes partly embedded in) the fin membrane and only become distinct after the fin membranes have been dried with a tissue. In small specimens with the fins folded against the body, the scales are even more difficult to



Figs 20-23. *Haplochromis howesi* spec. nov. Scales on the membranes of erected medial fins. Transition area of spinous and rayed part of dorsal fin (figs. 20, 22) and anal fin (figs. 21, 23). Figs. 20-21 RMNH 30392, SL 57 mm. Figs. 22-23 RMNH 30447, SL 151 mm. Scales equal 5 mm.

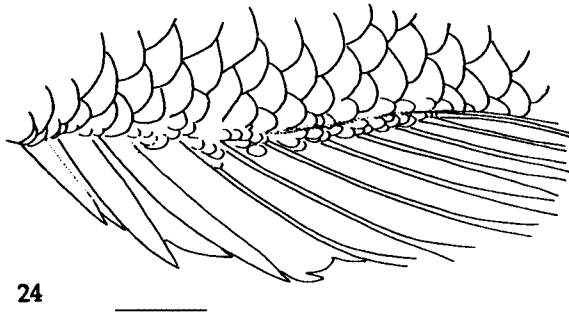


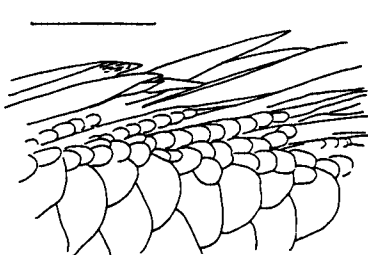
Fig. 24. *Haplochromis howesi* spec. nov. Holotype, RMNH 30436 SL 107.5 mm. Scale sheath at the anal fin basis. Scale equals 5 mm.

detect. There are differences in the fin squamation of *H. squamipinnis* and *H. howesi*. In the former the length of the rows is more or less constant, and the size of the scales gradually decreases distad (see fig. 31 in Greenwood, 1973). In the latter the rows are smaller and more variable in length, and scale size is irregular; moreover, comparatively large, isolated scales are sometimes found at a distance from the fin base.

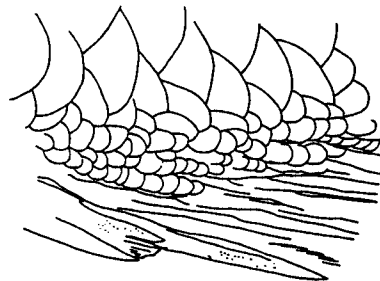
Scale rows along the base of the anal fin are not present in *H. squamipinnis*. When seen on erected fins (figs 20, 23; Greenwood, 1973: inset fig. 32) it is difficult to imagine the function of the fin scales. However, when the scales are observed on (artificially!) folded fins (figs 25, 26) the position of the scales strongly suggest a streamline function, as the resemblance with scale sheaths is striking. The scales are most numerous near the bases of the spines and rays, and in the transition area of the spinous and the soft rayed part of the fins. The rows of scales when lying next to each other in the folded fin might facilitate the water flow along the fins, making it possible for the fish to swim faster or energetically more efficient.

Another function of the scales might be protection of the fin membrane. For *H. howesi*, which lives between rocks, protection of the fin membranes might be necessary, but in the case of *H. squamipinnis* which occurs in open water only, this function of the scales would seem unlikely. Moreover, a shield function would not explain the unequal distribution of the scales over the fin membranes.

On the basis of its distribution among haplochromine cichlids fin squamation *per sé* must be regarded as a derived character. However, as the nature of the fin squamation in *H. squamipinnis* and *H. howesi* is different, and the two species are not



25



26

Figs 25-26. *Haplochromis squamipinnis* Regan, 1922, RMNH 31728, SL 128 mm. Scales on the membranes of folded medial fins. Fig. 25. Dorsal fin. Fig. 26. Anal fin. Scale equals 5 mm.

known to share other derived characters, the fin squamation in these species can only be regarded as a parallel development.

Notes on the food of *Haplochromis howesi* (table 4, fig. 27)

Only three of 66 fishes examined had no food in the guts. Many fishes had full stomachs, and, judging from the condition of the food, had eaten recently. It is remarkable that these apparently well fed fishes are caught on a hook, as this means they engage in active feeding even with a full stomachs. This observation seems to indicate that *H. howesi* is a voracious feeder.

Fish remains were found in 39 (67%) of the 58 examined juveniles. In one fish these remains could not be identified. Two contained ctenoid scales only, and in 34 cases the fish remains could be identified as haplochromines. Two fishes had remains of the cyprinid *Rastrineobola argentea* (Pellegrin, 1904). These fishes were caught in 1984 and 1985, when the effect of the Nile perch upsurge became apparent in the Mwanza Gulf area. Concomitant with the increase in the Nile perch population there was an increase in *Rastrineobola* and a decrease in haplochromines (Wanink, 1991; Witte et al., 1992a).

It was not possible to identify any of the haplochromines to species, but the oral teeth of some of the larger preys clearly indicated that they belonged to algal scraping *Haplochromis* species. In eight of the 34 fishes with haplochromine remains the guts contained remains of two fishes, in one stomach four prey fishes were found. The smallest juvenile in which fish remains were found was 51 mm SL. It was possible to estimate the length of the prey in 24 juvenile and two adult specimens. Often this was possible because the prey was only slightly damaged by capture and digestion (recently caught prey). In the other cases the prey length could be calculated on the basis of skeletal material. For the *Rastrineobola* prey the tables of Wilhelm (unpublished) were used. The relation between predator length and prey length is plotted in fig. 27. It is remarkable that the post larval haplochromine preys rarely are smaller than 12 mm. Post larval cichlids found in stomachs of juveniles of *Haplochromis* species occurring in open water are generally much smaller, i.e. 8-9 mm SL (van Oijen, 1989). Probably the juveniles of haplochromine species occurring in rocky areas are released at a larger size. Previous investigations on a number of species indicated that the eggs of rock frequenting haplochromines are relatively large and the fecundity relatively low as compared to the species living on mud bottoms in the Mwanza Gulf (Goldschmidt & Goudswaard, 1989; Goldschmidt, 1991). Shrimps (*Caridina nilotica* Roux, 1833) formed the second important food items, found in 39% of the guts of juveniles. Insects and insect larvae were encountered in 27.5% of the guts. Odonata larvae formed a third part of these. Remains of crabs (*Potamonautus niloticus*) were found in 15% of the guts. The smallest specimen with crab remains was 72 mm SL. Many specimens had items of different food categories. All combinations of the four food categories were found but fish and shrimps was the most common (n=8). The combinations crab, shrimp and insect (n=2), fish, shrimp and insect (n=4) and fish, crab, shrimp and insect (n=1) were also found, which indicate rather opportunistic feeding behaviour of the juveniles. Changes in food preference of the juveniles in the size range (51-112 mm SL) studied could not be detected.

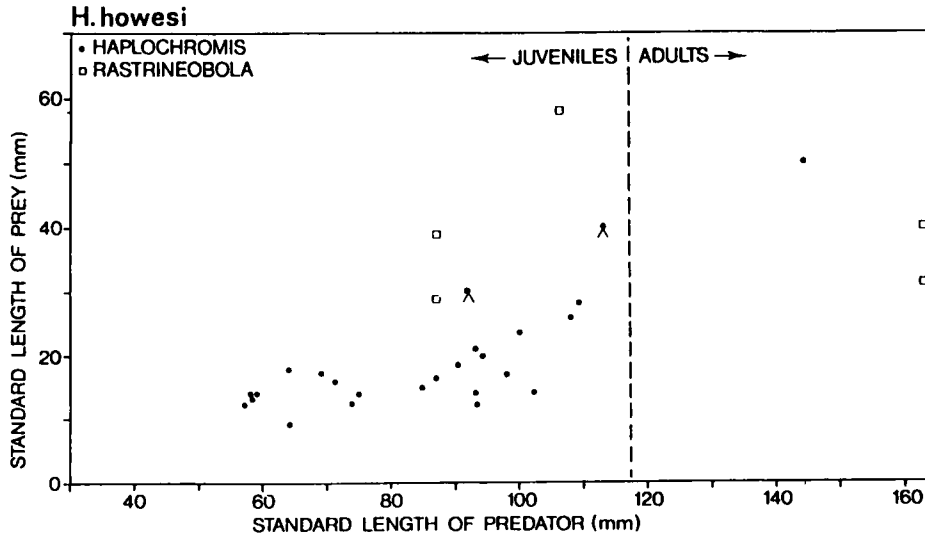


Fig. 27. *Haplochromis howesi* spec. nov. Relation between predator length and length of fish prey. ^ means minimal length. *Rastrineobola argentea* remains were only found in specimens caught in 1984 and 1985.

In the eight adults examined the only food remains found were of crabs and fish. Remains of *Potamonautus niloticus* were found in 5, fish remains in 4 specimens. The fish remains were from *Rastrineobola argentea* in one specimen and from *Haplochromis* in the others. The nature of the crab remains differed between specimens but included a nearly complete cheliped, walking legs, eyes, an abdomen and pieces of carapace. It is very difficult to conclude from the kind and the condition of the crab remains whether they were obtained by active predation or by scavenging activities. The presence of remains of relatively large fishes (of a size far above capturing possibilities of the oral jaws) in the guts of two specimens of *H. howesi* indicates that this species occasionally acts as a scavenger. On the other hand, the presence of hard and orange coloured claws in stomachs of *H. howesi* suggest active predation. Maybe *H. howesi* is both a scavenger on dead crabs and an active predator. As the width of the prey is the limiting factor for prey processing (van Oijen, 1989), and the oral jaw apparatus of *H. howesi* does not seem to be adapted for crushing carapaces, it is likely that this species preys on extremities rather than on whole crabs. Crustaceans can cast off a limb and grow a new one in its place. This provision serves a means of escape from its enemies (Schmitt, 1965). If *H. howesi* would only prey actively on limbs of crabs, it would benefit from the regeneration capacities of its prey in a way comparable to scale eating cichlids.

Only once was a specimen of *H. howesi* observed in an aquarium in the presence of a crab. This specimen of *H. howesi* was the only fish (about eight representatives of three other *Haplochromis* species were present) that took an interest in the crab. Indeed it approached the crab which defended itself with its claws and then withdrew under a rock (pers. obs.). (see below for similar observations on a cichlid species from Lake Malawi). No information on the Lake Victoria habitat of *Potamonautus niloticus* was found in the literature. We only caught crabs in fish-traps set between rocks.

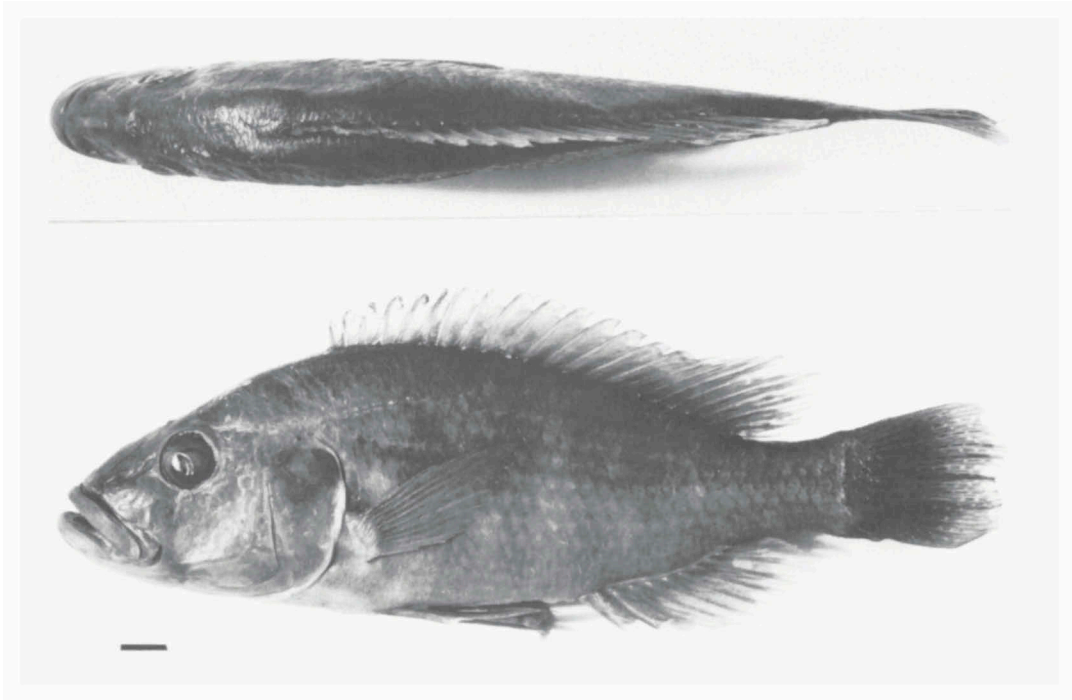


Fig. 28. *Haplochromis howesi* spec. nov. Holotype, RMNH 31718, SL 163.1 mm, dorsal and lateral view. Scale equals 10 mm.

Relations between cichlids and crabs in other African lakes.

Crab remains in stomachs of cichlids have been reported by Poll (1956) in two species from Lake Tanganyika. In the redescription of *Boulengerochromis microlepis* (Boulenger, 1899) Poll mentions that stomachs of many specimens contained remains of crabs and fishes. In one of the two investigated specimens of *Lamprologus cunningtoni* Boulenger, 1906, Poll found legs of crabs; the other specimens contained fish remains. Both cichlid species were collected over soft as well as hard substrate and are not restricted to rocky habitats. No information on crab eating habits of cichlid species from Lake Malawi based on investigations of guts contents is available. However, while diving in that lake, Konings (1989: 47) watched specimens of *Maravichromis epichoralis* (Trewavas, 1935) attacking *Potamonautus orbispinus* (Cunnington, 1907); he suggests that these crabs may form an important part of their diet.

Crabs not only are important as a source of food; for certain cichlid species the food gathering activities of crabs may be instrumental to obtain their own food. In Lake Barombi Mbo (Cameroon, West Afrika) an unusual kleptoparasitic association of cichlids and crabs was first reported by Trewavas et al., (1972) and later studied in detail by Dominey & Snyder (1988). The latter found that six of the eleven endemic cichlid species are occasionally associated with a foraging crab, trying to steal the food the crab exposed by its activities.

Remarks on the decline of *Haplochromis howesi*

Witte et al. (1992b) report the disappearance of 18-19 species associated with rocky habitats: all species classified as occasional intruders (12), four or five of the species for which the rocky areas were one of the main habitats, and two rock restricted species (among which *H. howesi*). The disappearance of the species of the first two groups can be explained by active predation of the Nile perch because its habitat overlapped with that of these species (Witte et al., op. cit.). The disappearance (for *H. howesi* at least not total, see above) of the rock-restricted species concomitant with the Nile perch upsurge is remarkable as piscivorous Nile perches do not enter the rocky habitat. Larger Nile perches may come close to rocks bordering relatively deep, open water but they never penetrate in the crevices between the boulders (Bouton, pers comm.). It is in these spaces between the rocks that all individuals of *H. howesi* were caught. Only if individuals of *H. howesi* during any period of their lives left the cover of the rocks, could they be potential prey for Nile perches. Although sexually active adult individuals have not been caught, there is still a reason to believe that *H. howesi* breeds in the rocky habitat. Relatively small anal spots, as found in *H. howesi*, are found only in surface dwelling species and rock-frequenting species which breed in relatively light areas (Goldschmidt, 1991). If for breeding purposes, individuals of *H. howesi* migrated to the surface layers of the water around the rocks, they certainly would have been caught in gill nets set in these places. However, all adult individuals were caught between the rocks. Another possibility for the occurrence of *H. howesi* outside the rocky habitat could be that the nursery areas of *H. howesi* are situated away from the rocks.

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Table 1. Ranges of linear measurements of *Haplochromis howesi* spec. nov.

Standard length range in mm	50.4-59.5	60.9-68.8	71.3-79.0	82.2-87.2	91.9-98.8	101.2-107.5	110.2-116.7	137-163.3
Number of specimens	10	9	9	9	10	8	3	7
Body Depth	%SL							
Pectoral Fin Length	%SL							
Caudal Peduncle Length	%SL							
Caudal Peduncle Depth	%SL							
Caudal Fin Length	%SL							
Head Length	%SL							
Snout Length	%HL							
Snout Width	%HL							
Head Width	%HL							
Interorbital Width	%HL							
Preorbital Width	%HL							
Lachrymal Width	%HL							
Preorbital Depth	%HL							
Eye Length	%HL							
Cheek Depth	%HL							
Lower Jaw Length	%HL							
Lower Jaw Width	%HL							
Upper Jaw Length	%HL							
Premax. Pedicel Length	%HL							

Table 2. Means and standard deviations of linear measurements of *Haplochromis howesi* spec. nov.

Standard length range in mm		50.4-59.5	60.9-68.8	71.3-79.0	82.2-87.2	91.9-98.8	101.2-107.5	110.2-116.7	137.0-163.3
Number of specimens		10	9	9	9	10	8	3	7
Body Depth	% SL	31.8±0.8	31.0±0.6	32.0±1.1	32.9±1.2	33.3±0.6	32.9±1.5	33.9±0.7	35.2±0.5
Pectoral Fin Length	% SL	23.7±0.9	24.4±0.9	23.3±1.6	23.7±1.4	24.3±1.4	23.4±1.5	25.1±0.4	23.2±1.7
Caudal Peduncle Length	% SL	16.4±0.8	16.1±0.6	16.3±0.5	16.1±0.7	15.4±0.5	15.7±0.7	15.1±0.1	16.1±0.6
Caudal Peduncle Depth	% SL	11.8±0.6	11.7±0.4	11.4±0.3	11.7±0.5	11.6±0.4	11.5±0.4	11.6±0.3	11.7±0.1
Caudal Fin Length	% SL	25.5±0.6	24.9±1.1	24.4±0.5	23.5±0.5	23.4±0.8	22.2±1.9	21.2±2.4	21.5±1.0
Head Length	% SL	37.5±0.9	37.5±0.8	37.6±0.7	37.2±0.6	37.3±0.7	37.0±0.7	37.7±0.4	35.9±0.4
Snout Length	% HL	29.4±1.5	30.0±1.0	31.0±1.4	31.2±0.7	32.4±0.8	32.2±1.6	33.4±0.7	35.0±0.7
Snout Width	% HL	29.6±1.3	30.0±2.2	30.2±1.2	30.9±1.6	29.6±1.1	31.2±1.4	32.6±1.7	33.2±1.4
Head Width	% HL	41.7±1.4	41.4±1.8	40.8±1.0	40.8±1.3	40.8±1.7	41.3±1.2	41.9±1.5	42.3±1.1
Interorbital Width	% HL	18.4±0.9	18.1±0.7	18.1±0.5	19.1±0.9	18.8±1.3	19.8±2.0	18.8±1.0	22.2±0.4
Preorbital Width	% HL	25.8±0.9	25.8±1.0	25.7±0.9	25.8±0.6	25.1±1.1	25.4±1.8	24.2±0.8	27.0±0.9
Lachrymal Width	% HL	25.3±1.9	26.6±1.2	26.4±1.4	26.7±1.6	26.2±0.9	27.2±0.4	26.1±0.2	29.2±1.5
Preorbital Depth	% HL	15.7±0.9	17.1±0.7	16.9±0.4	18.2±0.7	18.2±0.6	18.3±0.6	18.8±0.4	20.2±0.9
Eye Length	% HL	29.2±1.4	29.1±0.7	26.6±0.6	25.9±0.9	24.3±1.2	24.6±0.8	23.6±0.7	22.0±1.0
Cheek Depth	% HL	16.8±1.3	16.9±1.7	18.5±0.5	19.5±1.2	20.0±0.9	20.4±0.8	22.3±0.7	24.5±0.6
Lower Jaw Length	% HL	43.7±1.1	45.2±1.4	44.7±1.6	47.4±1.4	46.8±0.4	47.1±1.1	48.1±1.3	50.4±1.0
Lower Jaw Width	% HL	16.5±1.3	17.9±1.3	18.3±2.2	17.9±1.6	18.5±1.6	18.0±1.2	17.5±2.6	22.5±2.4
Upper Jaw Length	% HL	33.8±1.2	36.2±1.2	35.7±1.1	37.9±1.2	37.5±0.7	37.9±1.1	37.3±0.5	39.8±0.6
Premax. Pedicel Length	% HL	28.6±1.8	29.2±0.7	29.6±0.9	30.0±1.1	29.7±1.6	30.2±1.8	29.3±1.1	30.2±0.7

Table 3. Angular and qualitative measurements, and counts of *Haplochromis howesi* spec. nov.

	ranges	means \pm st.dev.			
Dorsal Head Profile Inclination	29°-38°	31.5° \pm 2.7°			
Premaxillary Pedicel Inclination	33°-44°	37.6° \pm 3°			
Snout Acuteness	63°-77°	69.8° \pm 3.2°			
Gape Inclination	28°-42°	36.3° \pm 3°			
Dorsal Head Profile (curvature)	0; 0(+)				
Premaxillary Pedicel Prominence	0(+)(16);	+(24);	+(+)(1)		
Lower Jaw Anterior Extension	+				
Lateral Snout Outline	0(34);	+(4)			
Mental Prominence	0(46);	0(+)(1)			
Lip Thickening	0				
Premaxilla Beaked	0				
Premaxilla Expanded	0				
Maxillary Posterior Extension	-(8);	0(19);	+(13)		
Cephalic Lateral Line Pores: Width	0				
Lateral Line Scales	31(8);	32(21);	33(14);	34(2)	
Lateral Line - Dorsal Fin (Sc.rows)	6(27);	7(19)			
Pectoral - Pelvic Fin Bases (Sc.rows)	6(17);	7(28);	8(1)		
Cheek (Vertical Sc.rows)	3(2);	4(26);	5(17)		
Dorsal Fin (Spines/Rays)	XV 9 (7);	XV 10 (12);	XVI 8 (2);	XVI 9 (21);	XVI 10 (3)
Anal Fin (Spines/Rays)	III 8 (6);	III 9 (35);	III 10 (5)		

Table 4. *Haplochromis howesi* spec. nov. food remains in guts

	Juveniles		Adults		Total	
	No	%	No	%	No	%
Checked	58		8		66	
Empty stomach	14	24.1	2	25	16	24.2
Empty gut	3	5.1	2	25	5	7.5
Empty stomach + gut	2	3.4	1	12.5	3	4.5
Identifiable foodremains	50	93.1	7	87.5	57	86.3
Unidentifiable fish remains	1	1.7	1	12.5	2	3.0
ctenoid scales	2	3.4			2	3.0
Haplochromines.	34	58.6	3	37.5	37	56.0
<i>Rastrineobola argentea</i>	2	3.4	1	12.5	3	4.5
Total fish remains	39	67.2	4	50.0	43	65.1
<i>Caridina nilotica</i>	23	39.6			23	34.8
<i>Potamonautus niloticus</i>	9	15.5	5	62.5	14	21.2
Copepoda	1	1.7			1	1.5
Unidentifiable insect larvae	11	18.9			11	16.6
<i>Chaoborus</i> larvae	2	3.4			2	3.0
<i>Chironomus</i> larvae	2	3.4			2	3.0
Odonata larvae	5	8.6			5	7.5
Ants	2	3.4			2	3.0
Total insects	16	27.5			16	24.2
Mollusca	1	1.7			1	1.5
Plant material	1	1.7			1	1.5