Geographical variation. The population at Lion's Cove appears to have similar colours and markings to that of Nkhata Bay, but at Ruarwe and Chitande the ground colour of males is dull bluish-brown and that of females is grey-brown. These northern populations are drably coloured relative to those of Nkhata Bay and Lion's Cove.

Habitat. This species inhabits areas of small and medium-sized rocks and may also be found on patches of sand among rocks. It is most numerous between 4 and 15 m depth but its total depth range extends from the extreme shallows to at least 25 m.

Territoriality. At Nkhata Bay, where this species was studied for the greatest period of time, it is one of the most active fishes on the shore. Males aggressively defend their territories against many species, and they frequently indulge in boundary fights. Females are not territorial, but are numerous over the areas occupied by territorial males.

Feeding. Loose Aufwuchs is collected by nipping, nibbling and jerking at the algal mat (Fryer 1959a).

19. *Pseudotropheus lucerna* Trewavas, 1935

Synopsis. A fish of the intermediate zone in shallow waters. Males are brown and purple with a prominent dorsal fin-spot and orange pelvics; females are silvery grey.

Distribution. Nkhata Bay (C), Lion's Cove (C). Fryer (1959a) found this species at Ruarwe.

Coloration. Nkhata Bay males: Body yellowish-brown dorsally with golden-brown shoulders; grey-brown flanks, mauve belly and a blue ventral region to the chest; 7 grey bars. Head yellowish-brown with a golden-brown occipital region; a narrow black interorbital bar; purple edges to the opercula; a black opercular spot and blue chin. Dorsal fin light purple with a broken black submarginal band and yellowish-blue lappets; rayed portion of the fin yellow-orange with a large, black fin-spot. Caudal fin yellow with black rays, yellow-orange trailing portion and black upper and lower borders. Anal fin hyaline with a black submarginal band, orange-red leading edge and reddish trailing portion; a single large yellow egg-dummy. Pelvic fins bright orange-red with black leading edges.

Nkhata Bay females: Body silvery-grey with a faint blue sheen and white belly. Head greyish with conspicuous black opercular spot. Dorsal fin pale transparent grey with yellow hue, a narrow, broken, black submarginal band, a prominent large black dorsal fin-spot and small black patches on the rays. Caudal fin grey with black rays and black upper and lower borders. Anal fin hyaline with a black submarginal band and white leading edge. Pelvic fins grey with black submarginal bands and white leading edges.

Habitat. P. lucerna is a fish of the intermediate zones and also occurs among macrophytes. It was not found below 7 m depth.

Territoriality. Males defend their territories aggressively against conspecifics, but are more tolerant of heterospecifics. They dig nests alongside rocks and sometimes among the fronds of *Vallisneria aethiopica*. Females are not territorial and usually occur in small groups of not more than 10 individuals.

Feeding. P. lucerna was seen to feed from the rocks, sand and macrophytes. Stomach contents examined by Fryer (1959a) comprised mainly loose Aufwuchs and some filamentous algae.

20. *Pseudotropheus* 'polit' (Plate 9d)

Synopsis. A small lithophilous species; males are white and black and have the ability to change colour rapidly. Females are grey-brown.

Distribution. Lion's Cove (C).

Coloration. Males: Body white with a bluish hue and very faint blue bars. Head black with two blue-white interorbital bars. Dorsal fin white with blue cast. Caudal fin pale blue with white inter-ray membranes. Anal fin white with a black submarginal band and white leading edge; 2–4 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Body blue-grey with a broad, dark grey mid-lateral and a broad dorso-lateral band. These longitudinal bands are broken to form three parts, the posterior part of the mid-lateral band forming a dark patch on the base of the caudal fin. Head grey-brown. Dorsal fin whitish-blue with a yellow trailing edge. Caudal fin grey-blue with a yellow trailing edge and a dark grey patch which forms the posterior part of the mid-lateral band. Anal fin yellow with a black submarginal band and white leading edge. Pelvic fins whitish-blue with black submarginal bands and white leading edges.

Habitat. P. 'polit' lives among medium-sized rocks and occasionally in intermediate areas between 1 and 25 m depth. Most individuals occur between 5 and 12 m.

Territoriality. Territorial males aggressively chase intruders and display frequently to neighbouring conspecifics. Females are solitary and none was seen holding a territory.

Feeding. It feeds on Aufwuchs and upon particulate detritic material which accumulates between rocks.

Note: Males of this species have the ability to change colour almost instantaneously from the startling blue-white of sexually active individuals to the drab grey-brown of females. They frequently changed colour when approached by divers and always did so immediately when trapped in the net.

Genus Melanochromis Trewavas, 1935

Trewavas (1935) distinguished this genus from *Pseudotropheus* on the basis of differences in pharyngeal teeth; the *Melanochromis* studied had fewer and larger teeth on the pharyngeal bone. While working on the Mbuna of Nkhata Bay Fryer (1956a, 1957, 1959a) found that the distinction between the two genera was unclear in some instances. Since then the problem has been complicated further by the discovery of numerous species of both genera.

In several articles of the aquarist literature (Johnson 1975; Burgess 1976; Staeck 1977; Loiselle 1979) it was suggested that those *Pseudotropheus* species with longitudinal bands (*P. auratus* (Boulenger, 1897); *P. johanni* Eccles, 1973; *P. simulans* Eccles, 1973) have more in common with similarly marked species of *Melanochromis* than they do with vertically barred species of *Pseudotropheus*. Consequently, aquarists now refer to these species as if they were already

members of the genus *Melanochromis* although no sound taxonomic data have been given to support such a change. Nevertheless, we have found behavioural traits in the field which suggest that these species are more closely related to the genus *Melanochromis*, while D.S.C. Lewis, who is preparing a taxonomic review of the Mbuna, has morphological data which indicate that these three species would be better placed in the genus *Melanochromis*. Consequently, Lewis is formally proposing that all longitudinally banded species which show a reversal of pigmentation patterns in males and females (darkly pigmented bands in males are light in females and *vice-versa*; see also reference to *P. auratus* in Fryer (1959a)) should be assigned to the genus *Melanochromis*. We have anticipated the proposal in this report. The genus *Melanochromis* as it is defined at present, encompasses several lineages, but only one species-complex.

Melanochromis melanopterus species-complex

These are slender-bodied fishes with wide terminal mouths and lips that are slightly thickened (Figure 10a). They have longitudinal banding and are, in general, weakly or intermittently territorial. The *M. melanopterus* species-complex appears to represent a single lineage, though Loiselle (1979) suggests that the complex may be divided into the short-snouted forms which he refers to as the '*auratus* group' and the long-snouted species of the '*melanopterus* group'. We found little behavioural justification for such a division and D.S.C. Lewis (in prep.) examined members of both groups and found no morphological justification for the taxonomic subdividion proposed by Loiselle. We, therefore, do not divide this species-complex.

The *M. melanopterus* species-complex contains 15 species, six which have already been described (Table 9).

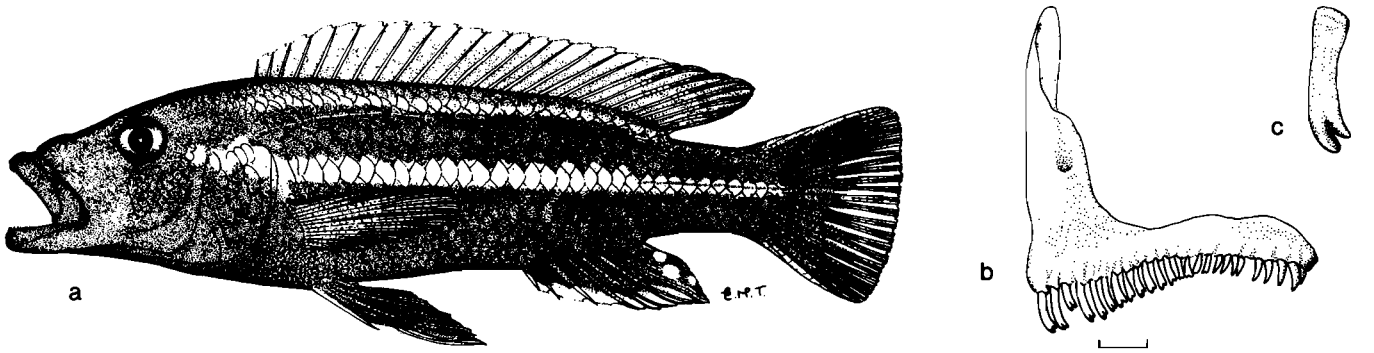

Figure 10 (a) *Melanochromis melanopterus*, Monkey Bay, 126 mm SL. (b) Lateral aspect of left premaxilla of *M. melanopterus* (Scale = 1 mm). (c) Anterior outer row tooth of *M. melanopterus*.

Table 9 The members of the genus *Melanochromis*. The maximum size in mm of each species and the locality at which the largest specimen was caught. The distribution of each species is given according to the 14 major study areas which are depicted in Figure 4. Details of distribution are given for each species in the text. Present (+), absent (−), introduced (i)
A = *Melanochromis melanopterus* species-complex. B = *Melanochromis* 'heterogenous' species-group

	Maximum size		Distribution												
Species	mm (SL)	Locality	I	IIa	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
A																
1. *Melanochromis melanopterus*	114	Likoma I.	+	+	+	+	−	+	+	−	−	+	+	+	−	+
2. *M. auratus*	79	Monkey Bay	+	+	−	+	−	+	+	+	+	+	−	−	−	−
3. *M. vermivorus*	80	Zimbawe I.	+	+	−	−	+	+	+	+	−	+	−	−	−	−
4. *M. simulans*	74	Masinje Rocks	−	−	−	+	−	−	−	−	−	−	−	−	−	−
5. *M. johanni*	67	Masinje Rocks	−	−	−	+	−	−	−	−	−	−	−	−	−	−
6. *M.* 'blotch'	98	Chisumulu I.	−	−	−	+	−	−	−	−	−	−	+	−	−	−
7. *M.* 'lepidophage'	103	Makanjila	−	−	−	+	−	−	−	−	−	−	−	−	−	−
8. *M.* 'chinyamwezi'	76	Chinyamwezi I.	−	−	−	−	+	−	−	−	−	−	−	−	−	−
9. *M.* cf. *chipokae*	121	Thumbi West I.	−	−	−	−	−	+	+	−	−	−	−	−	−	−
10. *M.* 'slab'	92	Mbenji I.	−	−	−	−	−	−	−	+	?	+	−	−	−	−
11. *M. parallelus*	114	Likoma I.	−	−	−	−	−	i	−	−	−	−	+	+	+	+
12. *M.* 'red'	71	Chisumulu I.	−	−	−	−	−	i	−	−	−	−	+	−	−	−
13. *M.* 'black-white johanni'	84	Likoma I.	−	−	−	−	−	i	−	−	−	−	+	−	−	−
14. *M.* 'maingano'	70	Likoma I.	−	−	−	−	−	−	−	−	−	−	+	−	−	−
15. *M.* 'blue'	101	Chitande	−	−	−	−	−	−	−	−	−	−	+	+	+	+
B																
1. *M.* cf. *brevis*	120	Boadzulu I.	+	+	+	−	+	−	−	+	−	−	−	−	−	−
2. *M. crabro*	94	Chinyankwazi I.	−	−	−	+	+	−	−	+	−	+	+	+	−	−
3. *M. labrosus*	101	Likoma I.	−	−	−	−	−	−	−	−	−	+	+	−	−	−
4. *M.* 'brown'	112	Chinyankwazi I.	−	−	−	−	+	−	−	−	−	−	−	−	−	−
5. *M. joanjohnsonae*	74	Likoma I.	−	−	−	−	−	−	−	−	−	−	+	−	−	−

Four additional species were described by Johnson (1975, 1976), but none of these species were found during the survey and consequently they are not included in the species list. *M. mellitus* Johnson, 1976 is purported to come from Mumbo Island, though we did not find a fish like it (other than female *M. vermivorus*) at the island. *M. interruptus* Johnson, 1975 is supposed to come from Likoma Island, but we were unable to match fish of this island to the description. The putative type locality of *M. chipokae* Johnson, 1975 is Chipoka Rocks, an area which we did not visit. *M. loriae* Johnson, 1975 is very similar to *M. chipokae* but exhibits slight differences in coloration. *M. loriae* is also reputedly from Chipoka Rocks.

1. *Melanochromis melanopterus* Trewavas, 1935 (Figures 10a – c)

Synopsis. An elongate, lithophilous species with a large terminal mouth and longitudinal banding. It is most common among medium-sized and large rocks of deepish water.

Distribution. This species was found at all major areas visited except Chinyankwazi I., Chinyamwezi I., the Maleri Is. and Mbenji I. It is uncommon or rare at most diving stations.

Coloration. Monkey Bay males: Body dark brown, almost black with blue mid-lateral and dorso-lateral bands. Head black with a blue interorbital bar and a blue extension of the mid-lateral band which reaches the eye. Dorsal fin yellowish with blue cast; lappets white with orange tips; rays black, trailing edge orange-brown. Caudal fin black, but inter-ray membranes and the upper and lower borders blue; trailing portion of fin orange-brown. Anal fin dark brown, almost black, with blue edges and 1 – 2 yellow egg-dummies. Pelvic fins black with light blue leading edges.

Monkey Bay females: Body brown with dark brown mid-lateral and dorso-lateral bands. Head dark brown. Dorsal fin yellowish-brown, lappets and trailing portion yellow-orange. Caudal fin brown with orange trailing edge. Anal fin black with blue leading edge, orange trailing edge and yellow egg-dummy. Pelvic fins dark brown with blue leading edges and orange-yellow trailing edges.

Geographical variation. At Likoma Island, Chisumulu Island and the north-western coast of Lake Malawi, *M. melanopterus* of both sexes appear to have more yellow and orange on the body and fins than the Monkey Bay population. The populations at Thumbi West Island, Mumbo Island and the rocky shores of the south-eastern arm appear identical with those of Monkey Bay.

Habitat. M. melanopterus occurs over any type of rock and also occasionally in intermediate habitats, but we have seen it most often over medium-sized and large rocks. It is usually in water deeper than 10 m, but has a depth range from surface waters to at least 40 m.

Territoriality. This species appears to be non-territorial. Usually males and females are found hunting for food among the rocks. They usually occur singly or in groups of up to 9 individuals (except at Mumbo Island where as many as 15 – 20 individuals were in the groups). Occasionally males in breeding dress were seen defending an area, but since they vacated these sites almost immediately to approach the divers or join passing groups of conspecifics we were unable to confirm whether they are territorial.

Feeding. M. melanopterus hunts among the rocks for fish fry, feeds from the Aufwuchs mat and catches plankton. Stomach contents of 15 individuals comprised a variety of food items: 2 stomachs were empty, but all the remaining stomachs contained some zooplankton, 4 of which were filled with zooplankton. Nine stomachs contained fish fry, 7 had insect larvae, 6 had benthic crustaceans, 8 contained loose Aufwuchs and 4 contained small amounts of filamentous algae. Fryer (1959a) found insect nymphs and larvae, crustaceans (ostracods and a small crab), fish fry and Aufwuchs in the stomachs of 5 specimens he examined.

2. *Melanochromis auratus* (Boulenger 1899) (Plates 9e & 9f)

Synopsis. A small attractive, lithophilous species with a wide depth range. Males are predominantly blue and black, and females are gold and black.

Distribution. Crocodile Rocks (R), Mpandi I. (U), Nkudzi (U), Mazinzi Reef (C), Chigubi (R), Kanchedza I. (U), Monkey Bay (C), Nankumba Peninsula (U), Domwe I. (U), Thumbi West I. (C), Otter Point (U), Mumbo I. (C), the Maleri Is. (C), Namalenje I. (C), Rifu (R), Mbenji I. (C), Masinje Rocks (U).

Coloration. Monkey Bay males: Body black with a broad, pale blue, mid-lateral band that has a golden band running along its centre; dorso-medial band pale blue with a broad golden-brown band running along its centre, both bands extend onto the head which is black with a yellowish-brown occipital region and a black occipital bar; snout yellowish-brown with 2 black interorbital bars. Dorsal fin golden-yellow. Caudal fin black with light blue edges. Anal fin black with pale blue outer edges; a single yellow egg-dummy. Pelvic fins black with blue-white leading edges.

Monkey Bay females: Body golden with a broad whitish mid-lateral band that has a black band running along its centre; dorso-medial band whitish with a black band that runs along its centre. Both bands extend onto the head which is golden-yellow with black interorbital bars. Dorsal fin golden-yellow with a black submarginal band and orange lappets. Caudal fin yellow with black patches of colour in the dorsal half. Anal fin bluish-yellow with a faint black submarginal band and an ill-defined yellow egg-dummy. Pelvic fins golden-yellow with bluish-white leading edges.

Geographical variation. The basic pattern of markings and colours of *M. auratus* remains the same throughout its distribution, but the intensity of colours varies. At Mumbo Island, Maleri Island and particularly Mbenji Island, males are a deeper black and the blue of the longitudinal bands is a bright royal blue that tends to mask the yellow inner bands. Females of these populations are a richer golden colour.

The Masinje Rocks population differs from those elsewhere in that the female has an off-white, rather than a yellow, belly. The longitudinal bands on the body are closer together than those of other populations and have irregular edges. Similarly, the submarginal band of the dorsal fin has poorly defined edges. The *M. auratus* of the western shores has the black markings of the caudal fin restricted to the dorsal sector, but in the Masinje Rock form these black

markings extend into the lower half of the fin and only the central margin is yellow. The anal and pelvic fins of the Masinje form lack black edges. The Masinje form is illustrated by Plate 9f and may be compared with colour illustrations of *M. auratus* of the western shores (Plate 9e).

Habitat. This species is most numerous among medium-sized rocks though it ventures onto all types of rocky habitat and into intermediate zones. It occurs from the surface to a depth of at least 40 m, but is slightly more numerous in the upper 10 m.

Territoriality. M. auratus males are weakly territorial and seldom stay to defend a particular site for more than a few hours. On occasion they will defend an area aggressively against all intruders, then for no apparent reason move elsewhere and defend another site, sometimes returning to the original site or to take up a different station near to it. Alternatively the male may become non-territorial. Females, non-territorial adult males and juveniles occur singly or in small groups of 8 – 10 individuals.

Feeding. M. auratus feeds from the Aufwuchs mat and frequently does so just within the territorial boundaries of highly aggressive species, apparently harvesting their algal gardens. Stomach contents varied considerably according to where and when specimens were caught. In general, however, stomach contents are dominated either by C2 or by loose Aufwuchs but this species also feeds upon plankton, benthic Invertebrata, C1, C3 and fish fry.

3. *Melanochromis vermivorus* Trewavas, 1935

Synopsis. A relatively short, deep-bodied member of the *M. melanopterus* species-complex which lives among rocks. Males are dark blue with light blue banding; females are grey with black bands.

Distribution. Monkey Bay (C), Nankumba Peninsula (C), Domwe I. (C), Zimbawe I. (N), Thumbi West I. (C – N), Mumbo I, (C), the Maleri Is. (C), Mbenji I. (C), Chinyankwazi I. (N – A), Eccles Reef (C), West Reef (C).

Coloration. Monkey Bay males: Body and head dark blue with contrasting light blue mid-lateral and dorso-lateral bands which continue on to the head; interorbital bar light blue. Dorsal fin pale blue with whitish lappets and black rays. Caudal fin dark blue at the base, but light blue distally; rays black. Anal fin black with a broad light blue periphery; 3 – 7 yellow egg-dummies. Pelvic fins black with withish-blue leading edges.

Monkey Bay females: Body and head grey-white with black mid-lateral and dorso-lateral bands which continue onto the head; interorbital bar silvery-blue and bordered by black bars. Dorsal fin grey-white with blue cast, white lappets and black rays. Caudal fin dark grey with white upper and lower edges. Anal fin blue-grey with a black periphery; 2 – 5 yellow egg-dummies. Pelvic fins black with white leading edges.

Geographical variation. The population at Zimbawe differs from that of Monkey Bay in that all males and most females have orange-red trailing edges to the dorsal and caudal fins. The males at Mumbo Island are a brilliant royal blue with longitudinal bands that are almost white. The populations at the Maleri Islands are relatively dull, males are grey-black with grey longitudinal bands while females are grey-brown with black bands. The Mbenji Island population is the least colourful: males are a drab brownish-black ground colour with grey-blue bands while females are grey-brown with dull black banding. All other populations resemble closely the Monkey Bay populations.

Habitat. M. vermivorus is most numerous among medium-sized rocks, on exposed sediment-free shores, in 3 – 12 m depth. However, it does venture onto both larger and smaller rocks, but is rare in intermediate habitats. Its depth range is from 0 to 30 m.

Territoriality. The territoriality of males of this species varies: at Monkey Bay, the Nankumba Peninsula, Domwe Island, the Maleri Islands and Mbenji Island it is not very aggressively territorial, but does not tolerate conspecific intruders. At Thumbi West Island it is more aggressive and at Zimbawe and Chinyankwazi it is highly aggressive. At those sites where the level of aggression is low the population density of *M. vermivorus* is low and intraspecific encounters are infrequent. However, at Thumbi West Island the population density is greater and at Zimbawe and Chinyankwazi it is greater still with a commensurate increase in intraspecific encounters and aggressive activity. At Monkey Bay territorial males are 2 – 3 m apart in suitable habitats, but at Chinyankwazi they are about 70 cm apart. Not only are the territorial males more densely packed at Chinyankwazi, but there is also a greater number of non-territorial adults which intrude. Females are not territorial. At sites where this species occurs at low population densities females are found singly or in small groups, but at sites where their population density is high (Mitande Rocks, Zimbawe I., and Chinyankwazi I.) they occur in large schools.

Feeding. M. vermivorus feeds deep within gaps among the rocks and also in the water column. The stomachs of 23 individuals caught in 6 – 8 m of water at Monkey Bay contained on average 55% loose Aufwuchs, 30% C2, 8% C1, and 7% plankton.

Stomachs of 16 specimens caught at Thumbi West Island contained 70% benthic Invertebrata, 20% loose Aufwuchs, 5% C2 and the remainder was C1 and plankton. Twenty-two specimens were caught at Mitande Rocks (Thumbi West Island), when plankton was abundant; all had their stomachs filled with phytoplankton (80%) and zooplankton (20%). Fourteen non-territorial individuals caught during a plankton bloom at Chinyankwazi contained exclusively phytoplankton (75%) and zooplankton (25%), but stomachs of 4 territorial males contained, in addition to plankton (65% phytoplankton; 20% zooplankton), 10% C2 and 5% loose Aufwuchs. Apparently this species feeds on plankton when it is available, but on components of the Aufwuchs at other times.

4. *Melanochromis simulans* Eccles, 1973

Synopsis. This species resembles *M. auratus* closely in coloration, but has a more pointed head.

Distribution. Masinje Rocks (U). Eccles (1973) records its presence near Cape Ngombo, just south of Makanjila Point.

Coloration. This species resembles *M. auratus* in coloration. The principal difference between males is that *M. simulans* has a purple-blue ground colour (not black) and a darker blue dorsal fin, sometimes with a faint black submarginal band. Females are yellowish-white (not deep gold) and black markings cover the entire

caudal fin, not just the upper half as in *M. auratus* (see Axelrod & Burgess 1977: 50 for colour illustrations of females of both species).

Habitat. M. simulans was found in 0 – 6 m over rocky and rock-sand zones in a wave-washed area of Masinje Rocks.

Territoriality. This species appears to be non-territorial and its members are usually solitary, although small groups of 3 – 8 individuals of both sexes were found among the rocks.

Feeding. M. simulans was seen to feed from the rocks and to pick up particulate matter disturbed by the waves.

5. *Melanochromis johanni* Eccles, 1973

Synopsis. A small, elongate fish of the intermediate zones in shallow water. Males are predominantly black; females are yellow-orange.

Distribution. Masinje Rocks (C). Eccles (1973) records its presence near Cape Ngombo, just south of Makanjila Point.

Coloration. Males: Body intense black with a royal blue band running from the base of the pectoral fin to the end of the caudal peduncle; a second band runs dorso-laterally from the upper cheek onto the upper, basal part of the caudal fin. Head black. Dorsal fin black with a row of pale blue streaks basally in the membranes; lappets whitish-blue. Anal fin black with whitish-blue leading and trailing edges; 2 – 3 yellow egg-dummies. Pelvic fins black with light blue leading edges.
Females: Head, body and fins yellow-orange with faint banding.

Habitat. This species was found syntopically with *M. simulans* in 0 – 6 m of water among rocks and in the rock-sand intermediate zones.

Territoriality. It is not known whether members of this species hold territories. Non-territorial adult males and females were found singly and in small groups.

Feeding. Individuals were seen to feed from both rocky and sandy substrata and on suspended matter in the water column.

6. *Melanochromis* 'blotch' (Plate 9g)

Synopsis. A rare, dark brown and yellow blotched fish of shallow intermediate zones.

Distribution. Masinje Rocks (R), Chisumulu I. (R).

Coloration. Males and females: Body light yellow-brown with a broad, dark brown mid-lateral band running from the orbit onto the basal region of the caudal fin; a dark brown dorso-lateral band runs from the occipital region to the base of the rayed region of dorsal fin; 8 – 9 dark brown bars cross the bands to give a light and dark patched appearance; belly grey-brown; entire body with a slight bluish sheen. Head grey-brown with a blue inter-orbital bar and a blue iridescence. Dorsal fin yellow with blue rays and orange inter-ray membranes. Caudal fin dark brown at base, yellow distally with light blue inter-ray membranes. Anal fin bluish-yellow with a black leading edge and 2 – 4 yellow egg-dummies. Pelvic fins yellowish-blue with black submarginal bands and white leading edges.

Habitat. This species was found in the intermediate zones between 3 and 10 m depth.

Territoriality. There is no evidence of territoriality. Only solitary individuals were found.

Feeding. This species swims close to the substratum and has been seen to feed upon matter stirred up from the bottom, to nip at Aufwuchs and to attack fishes caught in the net.

Note: It is not known whether males develop different coloration during periods of sexual activity.

7. *Melanochromis* 'lepidophage' (Plate 9h)

Synopsis. A schooling, aquamarine-blue species which feeds upon scales of cichlid fishes. It inhabits intermediate zones in shallow water.

Distribution. At rocky reefs off Makanjila Point (C).

Coloration. Males: Body light aquamarine-blue with a silvery sheen; belly darker blue; a black mid-lateral band runs from the orbit to the base of the caudal fin; a black dorso-lateral band runs from the occipital region to the posterior basal edge of the dorsal fin. Head blue-grey with a conspicuous turquoise opercular spot. Dorsal fin blue-grey; lappets white with orange tips. Caudal fin dark grey at base, pale blue distally; upper and lower borders black with white edges; trailing edge white. Anal fin dusky blue with a dark grey submarginal band and white leading edge; 3 – 4 yellow egg-dummies. Pelvic fins dusky blue with dark grey submarginal bands and white leading edges.
Females: Similar to males, but a relatively dull grey-blue.

Habitat. This species inhabits the sand-rock interface of submerged rocky reefs at less than 8 m depth.

Territoriality. It occurs in schools numbering as many as 60 individuals. There is no evidence of territoriality.

Feeding. Eleven specimens were caught for analysis of stomach contents. One stomach was empty and all others contained cichlid scales only. Four stomachs were crammed to capacity with scales.

8. *Melanochromis* 'chinyamwezi'

Synopsis. A brown, banded lithophilous species endemic to Chinyamwezi Island.

Distribution. Chinyamwezi I. (A).

Coloration. Males: Body light yellowish-brown with blue flecks and a dark brown mid-lateral line running from the orbit onto the caudal fin; a dorso-lateral line runs from the occipital region to the dorsal ridge of the caudal peduncle. Head yellowish-brown with blue flecks and a blue iridescence on the opercula; 2 dark brown inter-orbital bars. Dorsal fin pale yellowish-brown with a dark brown, almost black, submarginal band; lappets whitish with yellow-orange tips; trailing edge orange. Anal fin beige at base but remainder black; 2 – 4 bright yellow egg-dummies. Pelvic fins pale brown posteriorly and black anteriorly.
Females: Body beige with brown bands outlined by blue dots. Head beige with dark brown interorbital bars. Dorsal fin pale beige with brown submarginal band, yellow lappets and an orange trailing edge. Caudal fin brown. Anal fin yellow. Pelvic fins yellow with black leading edges.

Habitat. It was found everywhere at Chinyamwezi from the surface down to at least 43 m.

Territoriality. No territorial individuals were found. Large schools of this fish, comprising more than 100 individuals are common in the shallows. These schools follow divers and nip their exposed skin.

Feeding. Observations revealed that members of this species nipped Aufwuchs from the rocks, ate plankton and also tore pieces off small fishes which were caught in nets.

9. *Melanochromis* cf. *chipokae* (Plate 9i)

Synopsis. This species resembles *Melanochromis chipokae* Johnson, 1975 and is the largest of the *Melanochromis melanopterus* species-complex at the islands of Thumbi West and Mumbo. It lives in the intermediate zones.

Distribution. Thumbi West I. (C), Mumbo I. (R).

Coloration. Males: Body dark blue, almost black with a light blue mid-lateral band which runs from the orbit onto the caudal fin; a light blue dorso-lateral band runs from the occipital region to the anterior part of the rayed portion of the dorsal fin. Head dark blue, virtually black, with a light blue occipital bar and two light blue inter-orbital bars. Dorsal fin pale blue, almost white. Caudal fin black at the base, but light blue distally and along the upper and lower edges. Anal fin black with light blue leading and trailing edges; 2 – 4 yellow egg-dummies. Pelvic fins black with white leading edges. *Females:* Brown with black mid-lateral and dorso-lateral bands occupying the position of the blue bands of males. Head dark brown. Fins pale brown and unpaired fins with orange trailing portions; anal and pelvic fins with black submarginal bands.

Habitat. It occupies all types of rocky shore, but territorial males were found most frequently over sand among rocks. This species is most numerous between 10 and 20 m, but it penetrates to at least 33 m and also occurs rarely in the extreme shallows.

Territoriality. Males defend territories against conspecifics, but they are not strongly territorial and occasionally leave territories to feed elsewhere. Territories held over sandy substrata usually contain an excavated nest and some individuals burrow beneath rocks.

Feeding. The stomach contents of 7 individuals examined showed that 5 had eaten cichlid fry and all contained C1, C2 and benthic Invertebrata. Three stomachs contained zooplankton.

Note: We have not been able to visit Chipoka Rocks to determine whether the Thumbi West population is conspecific with *M. chipokae* which it resembles closely.

10. *Melanochromis* 'slab'

Synopsis. A large, elongate, predatory Mbuna of rocky and intermediate habitats. The preferred sites for male territories appear to be over slabs and upper surfaces of large rocks.

Distribution. Nakantenga I. (C), Maleri I. (C), Nankoma I. (U), Mbenji I. (U).

Coloration. Maleri Island males: Body black with a light grey-blue mid-lateral band running from the eye to the base of the caudal fin; dorso-medial ridge pale blue-grey. Head with blue-grey occipital region and snout with black interorbital bar; cheeks, chin and gular region brownish-grey. Dorsal fin grey with yellow flecks and broad orange trailing edge; lappets yellow-orange. Caudal fin black with an orange-yellow distal region. Anal fin black with a blue-grey leading edge and an orange trailing region; 2 – 4 yellow egg-dummies. Pelvic fins grey with pale blue leading edges. Pectoral fins orange.

Maleri Island females: Body brown with a black mid-lateral band and a black dorso-medial section (positioned as for blue-grey of males). Head brown with a dark brown interorbital bar and light yellow-brown cheeks, chin and gular region. Dorsal fin brown with orange-yellow lappets; distal section of the rayed region orange-yellow. Caudal fin brown at base; orange-yellow distally. Anal fin dark brown along its base; orange-yellow distal region; a white leading edge and 1 – 3 yellow egg-dummies. Pelvic fins yellowish-blue with white leading edges.

Habitat. This species was found mainly over slabs and large rocks, but sometimes over small and medium-sized rocks and in the intermediate zones. It occurs from 3 to 25 m depth.

Territoriality. Territorial males patrol about 1 m above the rocks. They intercept females from passing schools, court and lead them to spawning-sites. Territories are usually over rocks, but sometimes they are in intermediate zones where saucer-shaped nests may be dug. Conspecific males are not tolerated in the vicinity of a territory and are vigorously chased 3 – 6 m by the resident males. Non-territorial females, adult males and juveniles form schools numbering as many as 40 individuals at Nakantenga where this species is most numerous. Although males are aggressive in territorial defence relative to most other members of this genus, they have also been seen to vacate their territories to join schools of non-territorial individuals. This suggests that their ties to the territories are more tenuous than indicated by their aggression.

Feeding. This species was not seen feeding except when it attacked fishes caught in the nets. The stomachs of 11 specimens caught at Nakantenga Island were examined. Four were empty and the other 7 contained cichlid fry, C2, plankton and insects.

11. *Melanochromis parallelus* Burgess & Axelrod, 1976

Synopsis. A lithophilous species found along the north-western shores and at Likoma and Chisumulu Islands. Males are dark blue with light blue bands; females are whitish-yellow with black bands.

Distribution. Likoma I. (C), Chisumulu I. (C), Nkhata Bay (C), Lion's Cove (U), Mara Rocks (U), Ruarwe (U), Mpanga Rocks (R). An introduced population has become established at the island of Thumbi West where it is common at Mitande Rocks.

Coloration. Likoma Island males: Body dark blue, almost black, with a light blue mid-lateral band running from the orbit into the caudal fin; a light blue dorso-medial band running from the occipital region to the base of the posterior edge of the dorsal fin. Head very dark blue with 2 light blue interorbital bars. Dorsal fin black with

white lappets. Caudal fin dark blue with white upper and lower edges, and a white trailing portion. Anal fin black, but light blue posterio-ventrally; 2 – 4 yellow egg-dummies. Pelvic fins black with white leading edges. *Likoma Island females:* Body and head whitish-yellow with black mid-lateral and dorso-medial bands, and also 2 black interorbital bars. Dorsal fin almost white with a prominent black submarginal band. Caudal fin whitish with black upper and lower borders and black streaks distally. Anal fin white posteriorly with black submarginal band and white leading edge. Pelvic fins white with narrow black submarginal bands.

Habitat. M. parallelus is found over a variety of rocky shores and infrequently in the intermediate zones. It occurs from the surface waters down to a depth of at least 40 m, but is most common between 5 and 20 m among large and medium-sized rocks.

Territoriality. Males defend territories against conspecifics only, but they frequently leave their territories to feed elsewhere and they will also do so to follow divers. This species is considered to be weakly territorial. Non-territorial males, females and juveniles usually occur singly or in small groups, but at Ndumbi Rocks, Likoma Island, schools of 30 – 100 individuals sometimes followed divers to feed upon the particulate matter disturbed by their fins.

Feeding. M. parallelus feeds from the Aufwuchs mat, from the water column, and attacks small fishes. The stomachs of 6 specimens caught at Makulawe Point, Likoma Island, were examined: all contained some loose Aufwuchs and benthic Invertebrata, 5 contained zooplankton, 4 contained cichlid fry, one contained mainly C2 and the contents of one were dominated by eggs of the catfish, *Bagrus meridionalis.*

Note: At Mitande Rocks, Thumbi West Island, an introduced population of *M. parallelus* has established territorial sites between 6 and 15 m among medium-sized and large rocks. This suggests that it has sought out its preferred habitat. Furthermore, the behaviour of the introduced individuals appears no different from that of conspecifics in their native regions.

12. *Melanochromis* 'red'

Synopsis. A small species which is endemic to Chisumulu Island where it frequents the upper surfaces of slabs, boulders and large rocks, usually in 4 – 12 m of water. Males are dark blue with lines of blue spots running along the flanks. Females are reddish-gold.

Distribution. This species is endemic to the rocky shores of south-western Chisumulu Island (C), but an introduced population occurs in the vicinity of the holding tanks of the exporters of aquarium fishes at Madimba Bay (U) at Likoma Island. Another introduced population is established at the island of Thumbi West (U).

Coloration. Males: Body dark blue, almost black, with a line of 9 – 10 light blue spots running mid-laterally along the body; a dorso-lateral line of blue spots is present in most individuals. Head dark blue with 2 light blue interorbital bars. Dorsal fin dark blue, almost black, with a narrow purple-blue band lying immediately below the black submarginal band; lappets whitish-blue; trailing edge whitish-blue with orange-red flecks. Caudal fin dark blue, almost black, with pale blue inter-ray membranes and a pale blue trailing edge. Anal fin black with a yellowish-white leading edge and 2 – 4 yellow egg-dummies. Pelvic fins black with white leading edges. *Females:* Uniformly reddish-gold.

Habitat. This species occurs to a depth of at least 23 m, but is most numerous between 4 and 12 m. Although it may be found among rocks of virtually any description, most individuals congregate over slabs or over the upper surfaces of boulders and large rocks.

Territoriality. Males are weakly territorial and direct their aggression towards conspecifics only. Territories are held for short periods (1 – 2 hours) over the upper surfaces of rocks. Non-territorial individuals occur in groups of up to 60 individuals mainly over slabs and boulders.

Feeding. M. 'red' feeds by nipping and jerking at the filamentous algae.

13. *Melanochromis* 'black-white johanni' (Plate 9j)

Synopsis. A small species which inhabits the intermediate zones of the southern regions of Likoma Island. Males are predominantly black and females predominantly white.

Distribution. Endemic to the southern regions of Likoma Island (C), but it has been introduced to Thumbi West I. (R) and Otter Point (R).

Coloration. Likoma Island (Mbuzi) males: Body navy-blue with either 2 longitudinal light blue bands on the flanks or 2 rows of spots in the position of the longitudinal bands. Head black with 2 light blue interorbital bars. Dorsal fin black with white lappets. Caudal fin pale blue with black upper and lower borders and white edges; rays black distally. Anal fin black with a white leading edge and 1 – 4 yellow egg-dummies. Pelvic fins black with white leading edges.
Females: Body whitish-yellow with grey-black longitudinal bands. Head white-yellow with 2 black interorbital bars. Dorsal fin black with white lappets. Caudal fin beige with black upper and lower borders. Anal and pelvic fins black with white leading edges. Juveniles similar to females, but with an orange-yellow ground colour.

Geographical variation. The coloration of the populations at Mazimbwe Islet, Ndomo Point, White Rock and Madimba Bay is essentially similar to that of the Mbuzi form, but males of the Khuyu population have a pale blue wedge that extends forwards from the caudal fin.

Habitat. M. 'black-white johanni' is most common in intermediate zones, particularly at the rock-sand interface, but is also found in purely rocky habitats such as at Mazimbwe Islet. Its depth range is from the surface to at least 30 m, but most individuals occur in less than 10 m.

Territoriality. Males are weakly territorial. Non-territorial individuals of both sexes form groups of up to 60 individuals.

Feeding. This species feeds from both rock and sand substrata and upon plankton.

Notes: (i) This species is sold in the aquarium trade as 'black-white johanni'. (ii) This species occupies a similar rock-sand

habitat at Thumbi West and Otter Point to that at Likoma Island.

14. *Melanochromis* 'maingano' (Plate 10a)

Synopsis. Both sexes of this small lithophilous species are the same colour. Its distribution is limited to Maingano and its adjacent rocky shores.

Distribution. Likoma I. at Membe Point (U), Maingano (C), Mbako Point (U).

Coloration. Males and females: Body dark navy-blue with contrasting light blue dorso-lateral band running from the interorbital bar to the base of the caudal fin; another light blue band running from the pectoral region to the caudal fin; a dorso-medial band usually absent but sometimes represented by a series of blue spots. Head dark navy-blue with a light blue interorbital bar across the snout and another across the forehead. Dorsal fin pale blue along its base with a broad, pitch-black submarginal band; lappets pale blue-white. Caudal fin pale blue-grey with black upper and lower borders and white edges. Anal fin black with a white leading edge and 2 – 5 yellow egg-dummies in a hyaline trailing portion. Pelvic fins black with white leading edges.

Habitat. This species is most numerous over small and medium-sized rocks, but it occasionally ventures into other habitats. It occurs from the surface down to at least 30 m, but is most common between 5 and 12 m.

Territoriality. Some individuals, presumed to be males, were weakly territorial, but they quite frequently vacated their defended areas to feed elsewhere, to court or to follow divers. Most individuals are solitary and show no sign of territoriality.

Feeding. This species was seen to feed from the upper surfaces of rocks and upon plankton. Stomach contents of 6 individuals caught at about 5 m depth at Maingano contained zooplankton (68%), benthic Invertebrata (25%), loose Aufwuchs (5%) and very small amounts of C1 and C2.

15. *Melanochromis* 'blue' (Plate 10b)

Synopsis. A pale blue, large elongate species, with a terminal mouth and slightly hypertrophied lips.

Distribution. Likoma I. at Membe Point (R), Mbako (R), White Rocks (R). Along the north-western shores at Nkhata Bay (R), Ruarwe (R), Mpanga (R), Chitande (R).

Coloration. Nkhata Bay males: Body blue-grey. Head blue-grey with black opercular patch. Dorsal fin blue-grey along the base, but with pale blue-white lappets and a prominent black fin-spot. Caudal fin blue with black upper and lower distal borders and white edges. Anal fin blue-grey at base, black submarginally with a white leading edge and hyaline trailing portion; 2 – 3 yellow egg-dummies. Pelvic fins blue-grey with black submarginal bands and white leading edges.
Females: Unknown.

Geographical variation. Too few specimens have been found for a comparison of live colours. Our records suggest, however, that the Likoma population and those of the north-western lake are probably identical.

Habitat. Most sightings of this fish were in water deeper than 20 m, but its total distribution is from 6 m to at least 40 m. It has been seen at the rock-sand interface, over sand and also in purely rocky habitats.

Territoriality. Only solitary individuals were found and none of these showed any signs of territoriality.

Feeding. On two occasions this species attacked fishes caught in our nets, but there are no other records of feeding behaviour.

Melanochromis heterogeneous species-group

The members of this mixed species-group (Table 9) differ from the *M. melanopterus* species-complex in that they lack clear longitudinal banding and most species are deeper bodied. None of the five species appears to have close phyletic affinities with others in the group. The placement of at least three of the species in the genus may prove to be temporary.

1. *Melanochromis* cf. *brevis* (Figures 11a – c)

Synopsis. A large, deep-bodied species which lives among medium-sized and large rocks in the upper 3 m of water.

Distribution. Boadzulu Island (U), Nkudzi (R), Monkey Bay (R), Chinyankwazi (U), Chinyamwezi (U), Mumbo Island (U).

Coloration. Monkey Bay males: Body dark bue with 2 pale

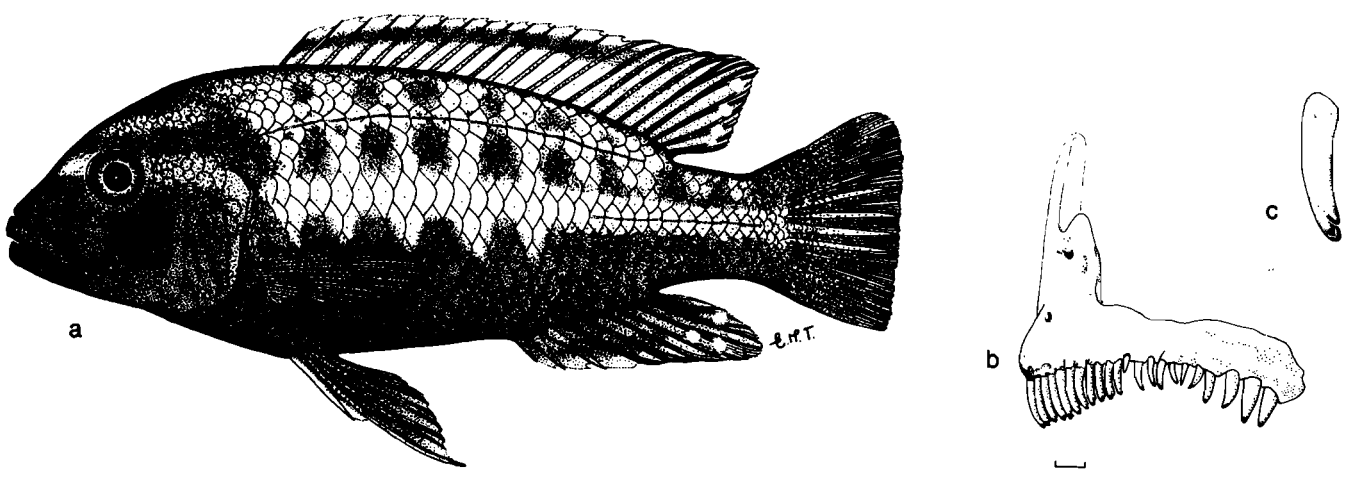

Figure 11 (a) *Melanochromis* cf. *brevis*, Chinyankwazi Island, 118 mm SL. (b) Lateral aspect of left premaxilla of *M.* cf. *brevis* (Scale = 1 mm). (c) Anterior outer row tooth of *M.* cf. *brevis*.

blue longitudinal bands and 7 – 9 pale blue bars. Head black ventrally and dark blue dorsally with a pale blue interorbital bar. Dorsal fin light blue with a black submarginal band and orange lappets; 1 – 5 yellow ocelli on trailing edge. Caudal fin pale blue with black rays. Anal fin pale blue with a black submarginal band and a white leading edge; 2 – 7 yellow-orange egg-dummies. Pelvic fins pale blue with black submarginal bands and white leading edges.

Monkey Bay females: Markings the same as those of males but the bars and bands dark brown set against a khaki ground colour. Head brown with a turquoise interorbital bar. Fins pale brown. Anal and pelvic fins with black submarginal bands and all unpaired fins with orange trailing edges.

Geographical variation. With the exception of the Chinyankwazi and Chinyamwezi populations, which have yellow-orange chests, cheek, chin and gular regions, no geographical variation in colour was found. However, as this fish is uncommon or rare and difficult to catch we never had live individuals from different places at the same time for comparison.

Habitat. This species lives among medium-sized and large rocks in sediment-free zones which are exposed to wave action. It has never been found in water deeper than 4 m and most individuals are in water less than 2 m deep.

Territoriality. Males hold territories in gaps or crevices between rocks. Only conspecific males are excluded from these territories and as these are uncommon, aggression of *M.* cf. *brevis* is not often witnessed. One to four females are usually found in the vicinity of territorial males though the nature of the association is not clear. During calm weather, territorial males retreat into gaps or caves among the rocks, but during turbulent conditions they move to the entrances of their refuge sites.

Feeding. M. cf. *brevis* feeds upon plankton, loose Aufwuchs and small amounts of C1 and C2. Ants and flies have been found in the stomachs of these fishes which suggests that they also feed on insects which are washed or blown into the water from the shore.

Note: M. cf. *brevis* has elements of vertical barring and is deep bodied and in these respects it is unlike any of the members of the *M. melanopterus* species-complex. It is similar to the latter in that it has longitudinal banding (albeit interrupted banding) and it is weakly territorial. Loiselle (1979) suggests that *M. brevis* should be placed in the genus *Pseudotropheus*, but the illustration he gave is not of *M. brevis*. So for the time being *M.* cf. *brevis* should remain in the genus *Melanochromis*.

2. *Melanochromis crabro* Ribbink & Lewis, 1982

Synopsis. An uncommon to rare species with 5 broad bars. Males bluish-brown with buff-coloured bars. Females golden-yellow with dark brown bars.

Distribution. Eccles Reef (R), West Reef (R), Chinyankwazi I. (R – U), Chinyamwezi I. (R), Maleri I. (U), Mbenji I. (U), Likoma I. (R – U), Chisumulu I. (R – U), Nkhata Bay (R).

Coloration. Maleri Island males: Body greyish-brown with pronounced blue or turquoise iridescence; 5 short, broad buff-coloured bars extend only part-way down flank. Head grey-brown with bluish iridescence and with a buff occipital bar and 2 buff interorbital bars. Dorsal fin dark brown except where buff bars enter its base; light blue lappets; tips of lappets yellow. Caudal fin dark brown at base; yellowish-brown distally with 1 – 2 ochre-yellow egg-dummies. Pelvic fins dark brown.

Maleri Island females: Body golden-yellow with 5 broad, dark brown bars; dark brown mid-lateral band present in some individuals. Head golden-yellow dorsally with dark brown occipital bar and 2 dark brown interorbital bars; snout pale brown; cheeks yellow; gular region and branchiostegal membranes yellowish-brown. Dorsal fin very dark brown to black with yellow patches at base continuous with body markings; lappets yellow with darker yellow tips; rayed portion yellow. Caudal fin brown at base, yellow distally. Anal fin yellow with greyish submarginal band and orange trailing edge. Pelvic fins yellow with grey submarginal bands and blue-white leading edges.

Habitat. Most *M. crabro* were found among large rocks but they have also been seen in other rocky habitats and in the intermediate zones. Its depth range extends from 3 to at least 40 m though it is most numerous between 10 and 25 m.

Territoriality. This species is apparently not territorial, but occurs singly, or occasionally in small groups of up to 4 individuals.

Feeding. M. crabro appears to be adapted to feed on *Argulus africanus*, a branchiuran parasite commonly found on the catfish, *Bagrus meridionalis*. It also robs *B. meridionalis* of its eggs which are laid on the substratum (Ribbink & Lewis 1982). In addition to these specialized food resources, *M. crabro* feeds upon zooplankton, phytoplankton, Aufwuchs and benthic Invertebrata (Ribbink & Lewis 1982).

Note: Ribbink & Lewis (1982) placed *M. crabro* in the genus *Melanochromis* because its pharyngeal dentition conforms to the diagnosis of the genus given by Trewavas (1935). Although *M. crabro* is similar to members of the *M. melanopterus* species-complex in that it is elongate, predatory and weakly territorial, it does not have longitudinal banding and so it is placed in the *M.* 'heterogeneous' species-group.

3. *Melanochromis labrosus* Trewavas, 1935

Synopsis. A bilaterally compressed fish with hypertrophied lips.

Distribution. Mbenji I. (R), Likoma I. (U), Chisumulu I. (R).

Coloration. Males and females: Brown, being lighter ventrally than dorsally. Sexually active males develop a purple-blue cast and have 3 – 6 yellow egg-dummies.

Habitat. This species was found among small and medium-sized rocks in water less than 8 m deep. It usually remains hidden among the rocks and appears to be rare. However, a rotenone sample at Maingano revealed that there are more *M. labrosus* among the rocks than indicated by transects and by observation.

Territoriality. M. labrosus appears to be a solitary fish and no territorial individuals were found.

Feeding. It moves from rock to rock placing its narrow mouth and large lips in cracks and grooves, which it seals, and then sucks the benthic Invertebrata and loose Aufwuchs from the sealed area.

Note: Although the aquarist literature suggests that *M. labrosus* would be better placed in the genus *Cyrtocara*, Loiselle (1979) believes this species to be an Mbuna. D.S.C. Lewis (in prep.) agrees with this diagnosis since *M. labrosus* has a small number of discrete egg-dummies which he considers to be an important characteristic of Mbuna. Loiselle (1978) argues that *M. labrosus* has closest affinities with the genus *Labidochromis*, but Lewis (in prep.) has found that it is so unlike any of the existing Mbuna genera that he is placing it in a separate, new genus.

4. *Melanochromis* 'brown'

Synopsis. An elongate, reddish-brown species. Both sexes appear identical in coloration.

Distribution. Chinyankwazi I. (U), Chinyamwezi I. (U).

Coloration. Males and females: Body and head uniform reddish-brown. Fins orange-brown with 1 – 4 yellow egg-dummies on the anal fin of males.

Habitat. This species occurs among rocks of all sizes. Its full depth range extends from 5 to 40 m, but most individuals were seen between 12 and 30 m.

Territoriality. Only solitary non-territorial individuals were found.

Feeding. No data available.

5. *Melanochromis joanjohnsonae* (Johnson, 1974)

Synopsis. A small species which is endemic to Likoma Island where it lives among small rocks usually in water less than 4 m deep. Males are blue with a prominent black submarginal band. Females are greenish-blue with scalloped orange bands.

Distribution. Likoma I. (C), but an introduced population is established at the island of Thumbi West (C).

Coloration. Males: Body iridescent-blue with very faint traces of 7 – 9 dark blue bars. Head bluish-green with 2 brownish interorbital bars; opercular spot greenish-black. Dorsal fin whitish with black submarginal band; lappets white with orange-brown tips; rayed portion has brown spots and orange-yellow ocelli on the trailing edge of some individuals. Caudal fin bluish-white with faint orange-brown flecks and an orange-brown trailing edge. Anal fin whitish-blue with a black submarginal band, a white leading edge and 1 – 5 yellow egg-dummies. Pelvic fins hyaline with black submarginal bands and white leading edges.

Females: Body greenish-blue with 5 – 6 irregular orange bands. Head iridescent blue-green with a criss-crossing network of orange-brown lines. Dorsal fin whitish-green with numerous orange-brown spots sometimes merging to form a dark orange-brown submarginal band. Caudal fin yellowish-blue with orange spots on the basal region, and with longitudinal orange dashes on the distal portion. Anal fin hyaline at base, remainder orange with 1 – 4 bright orange egg-dummies. Pelvic fins orange with white leading edges.

Geographical variation. The populations on the eastern and northern parts of Likoma Island are a deeper, brighter blue than those of the south-western region which have a greenish cast in both sexes.

Habitat. M. joanjohnsonae is most numerous among small rocks in water less than 2,5 m deep. However, it does occur over larger rocks and to a depth of 7 m, but it is very rare beyond 4,5 m depth. Normally it does not leave the rocks, but on hot, windless days in December 1979 we observed some specimens moving onto sand in 3 – 4 m of water in Madimba Bay, near to White Rock. They remained motionless over the sand in groups of up to 25 individuals. It is not known whether this behaviour was a response to the high surface temperature (31 °C) within the sheltered bay or was a response to some other factor. Such behaviour was not recorded elsewhere.

Territoriality. Males vigorously defend territories against conspecifics and sometimes protracted intraspecific bouts of fighting, particularly rapid circling of rivals, were seen. Females are usually solitary and occur most often over the upper surface of prominent rocks which they occasionally defend against conspecifics. However, this appears to be a temporary defence of a feeding area.

Feeding. This species nips at the Aufwuchs, frequently selecting its feeding site with apparent care. Stomach contents of 11 individuals caught at Membe Point, contained mainly insect nymphs and larvae, benthic crustaceans and small portions of C1 and loose Aufwuchs.

Notes: (i) At Thumbi West the introduced population of this species is found in less than 4 m of water, mainly among small rocks. Thus the preferred habitat at the introduced site corresponds with that occupied at Likoma Island. (ii) The taxonomic history of *M. joanjohnsonae* has been bedevilled by amateurish attempts to describe it. This led to unnecessary confusion which was partially resolved by Stock (1976) and finally resolved by Lewis (1980). At various times *M. joanjohnsonae* and other species confused with it, were described as *Labidochromis joanjohnsonae* by Johnson (1974), *Melanochromis exasperatus* by Burgess (1976) and *Labidochromis textilus* by Oliver (1975). In his redescription Lewis (1980) points out that *M. joanjohnsonae* lacks a number of the overt characteristics of the genus and so it is placed in the genus as a temporary measure until such time as the genus is redefined.

Genus *Petrotilapia* Trewavas, 1935 (Figure 12a – c)

Members of this genus are the largest of the Mbuna (Fryer 1959a). The mouth is terminal with a dense brush of long, slender tricuspid teeth on each jaw (Figure 12a – c). In adults the mouth is permanently in a partially open position with many of the teeth exposed to view. As the mouth is terminal, *Petrotilapia* species feed at right angles to the rock surface with their jaws pressed against the rocks. In feeding the teeth are combed through the filamentous Aufwuchs in a characteristic manner (Fryer 1959a; Marsh 1981) to collect loose Aufwuchs and its associated invertebrate fauna. Members of this genus also feed on plankton when it is plentiful (Marsh 1981). Originally this genus was considered to be monospecific (Trewavas 1935; Fryer 1959a), but it is now known to comprise 17 species (Table 10) of which three have already been described (Trewavas 1935; Marsh 1983) and descriptions of the remaining species are due shortly (A.C.

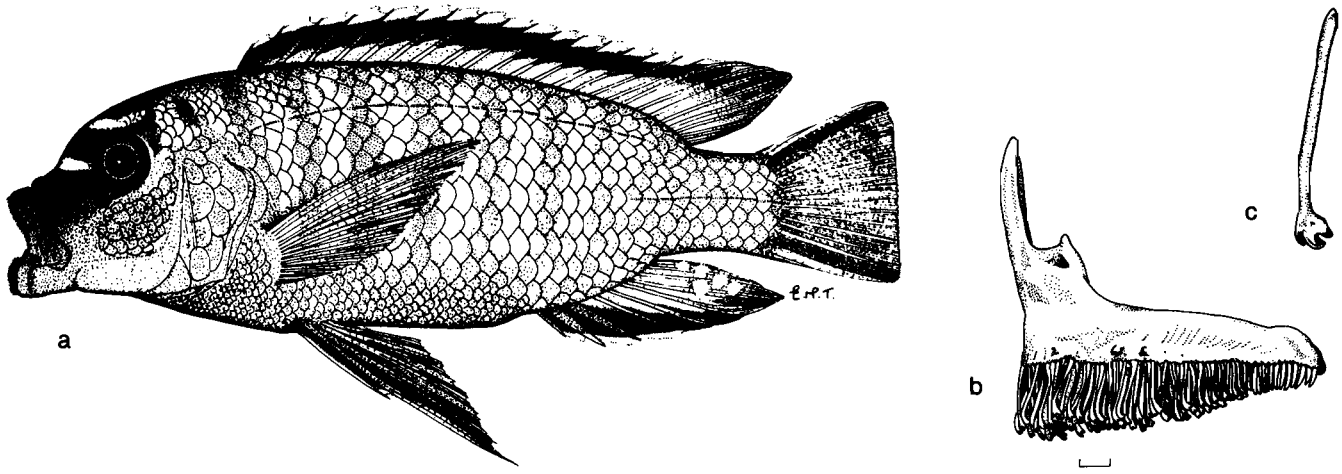

Figure 12 (a) *Petrotilapia* 'mumbo blue', Mumbo Island, 128 mm SL. (b) Lateral aspect of left premaxilla of *Petrotilapia tridentiger* (Scale = 1 mm). (c) Anterior outer row tooth of *P. tridentiger*.

Table 10 The members of the genus *Petrotilapia*. The maximum size in mm of each species and the locality at which the largest specimen was caught. The distribution of each species is given according to the 14 major study areas which are depicted in Figure 4. Details of distribution are given for each species in the text. Present (+), absent (–)

	Maximum size		Distribution												
Species	mm (SL)	Locality	I	IIa	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. *Petrotilapia tridentiger*	137	Monkey Bay	+	+	+	–	–	+	–	–	–	–	–	+	+	+
2. *P. genalutea*	126	Monkey Bay	+	+	+	+	–	+	+	+	+	+	–	+	+	+
3. *P. nigra*	122	Monkey Bay	+	–	–	–	–	+	–	–	–	–	–	–	–	–
4. *P.* 'gold'	130	Chinyankwazi I.	–	–	–	–	+	–	–	–	–	–	–	–	–	–
5. *P.* 'mumbo blue'	135	Mumbo I.	–	–	–	–	–	+	+	–	–	+	–	–	–	–
6. *P.* 'mumbo yellow'	128	Mumbo I.	–	–	–	–	–	–	+	–	–	–	–	–	–	–
7. *P.* 'yellow chin'	135	Makanjila	–	–	–	+	–	–	–	+	+	+	–	–	–	–
8. *P.* 'fuscous'	118	Maleri I.	–	–	–	–	–	–	–	–	+	+	–	–	–	–
9. *P.* 'likoma variable'	145	Likoma I.	–	–	–	–	–	–	–	–	–	–	+	–	–	–
10. *P.* 'likoma barred'	165	Likoma I.	–	–	–	–	–	–	–	–	–	–	+	–	–	–
11. *P.* 'orange pelvic'	132	Chisumulu I.	–	–	–	–	–	–	–	–	–	–	+	–	–	–
12. *P.* 'retrognathous'	125	Chisumulu I.	–	–	–	–	–	–	–	–	–	–	+	–	–	–
13. *P.* 'yellow ventral'	125	Chisumulu I.	–	–	–	–	–	–	–	–	–	–	+	–	–	–
14. *P.* 'small blue'	115	Nkhata Bay	–	–	–	–	–	–	–	–	–	–	–	+	–	–
15. *P.* 'ruarwe'	no record		–	–	–	–	–	–	–	–	–	–	–	–	+	+
16. *P.* 'black flank'	no record		–	–	–	–	–	–	–	–	–	–	–	–	–	+
17. *P.* 'chitande'	no record		–	–	–	–	–	–	–	–	–	–	–	–	–	+

Marsh in prep.).

1. *Petrotilapia tridentiger* Trewavas, 1935

Synopsis. A widespread species which is common on most rocky shores in Lake Malawi where it occurs in shallow water. Males are predominantly pale blue.

Distribution. Chemwezi (R), Boadzulu I. (C), Mpandi I. (C), Kanchedza I. (C), Nkudzi (C), Monkey Bay (C), Domwe I. (C), Otter Point (U), Nkhata Bay (C), Lion's Cove (C), Cape Manulo (C), Mara Rocks (C), Ruarwe (C), Chilumba at Chitande I. (C), Mpanga Rocks (C).

Coloration. Monkey Bay males: Body pale blue with 7 – 9 darker blue bars on flanks, belly whitish-blue. Head pale blue with whitish-blue gular. Dorsal fin pale blue with dark blue to black posterior inter-ray membranes. Caudal fin with sky-blue inter-ray membranes, dark blue to black rays and pale orange-brown trailing edge. Anal fin pale blue with dark blue to black posterior inter-ray membranes, 1 – 5 bright orange to yellow egg-dummies and whitish-blue leading edge and ventral edge. Pelvic fins pale blue with whitish-blue leading edges.
Monkey Bay females: Head and body grey-brown with 7 – 10 dark brown bars on flanks. Bars may be obscured on darker individuals. All fins semi-transparent and matching body coloration.

Geographical variation. Males at Chilumba have a brownish-orange hue on the anal fin and have no black markings in the dorsal and pelvic fins.

Habitat. Occurs over all sizes of rock but appears to prefer large and medium-sized rocks. Usually confined to water less than 8 m deep but occurs down to 18 m at Boadzulu Island. At Monkey Bay males and females are most abundant at 1 m depth.

Territoriality. Males defend territories against conspecific

males. At Monkey Bay territories have a mean area of 22,16 m^2 (Marsh *et al.* 1981). Females and non-territorial males are usually solitary but occasionally a female was seen with a school of *Petrotilapia genalutea*.

Feeding. Adults and juveniles brush the surfaces of rocks in the manner typical of members of this genus and collect loose Aufwuchs and its associated invertebrate fauna. Plankton is utilized when it is abundant. Details of feeding habits are given in Marsh (1981) and McKaye & Marsh (1983).

2. *Petrotilapia genalutea* Marsh, 1983

Synopsis. A widespread species common in shallow water on most rocky shores south of Ruarwe on the western side of the lake and as far north as Makanjila on the eastern side. Males are predominantly bluish-grey with distinctive orange cheeks.

Distribution. Chemwezi (R), Boadzulu I. (C), Mpandi I. (C), Kanchedza I. (R), Nkudzi (C), Monkey Bay (C), Domwe I. (C), Otter Point (U), Thumbi East I. (C), Mumbo I. (C), the three Maleri Is. (C), Namalenje I. (C), Senga Point (R), Mbenji I. (C), Makanjila (C), Nkhata Bay (C), Lion's Cove (C), Cape Manulo (C), Mara Rocks (C), Ruarwe (C).

Coloration. Monkey Bay males: Body bluish-grey with 4 – 6 dark grey vertical bars on flanks, 4 anterior-most bars invariably distinct but remainder may be faded or absent. Anterior half of belly orange-brown, remainder dark bluish-grey. Head blue-grey with orange-brown cheeks and two dark grey interorbital bars. Dorsal fin hyaline grey with a broad, black submarginal band; all interspine and inter-ray membranes hyaline grey with orange-brown blotches except those of trailing edge which are black; lappets orange-yellow, but pale blue in some individuals. Caudal fin rays black, with pale blue inter-ray membranes and an orange trailing edge. Anal fin grey with a black leading section and 1 – 4 yellow egg-dummies. Pelvic fins orange-brown with black submarginal bands and blue-white leading edges.

Monkey Bay females: Body off-white to pale yellow-brown with white belly and a series of thick dark brown to black mid-lateral and dorso-lateral blotches on flanks. These blotches normally close together and often fused posteriorly to form a continuous band; 9 – 10 pale brown bars on flanks and caudal peduncle. Dorsal fin hyaline with a narrow dark grey or black submarginal band; rays orange-brown posteriorly; lappets orange-brown. Caudal fin hyaline grey. Anal fin hyaline grey with a dark grey submargnal band and small pale yellow egg-dummies. Pelvic fins hyaline grey with dark grey submarginal bands.

Habitat. P. genalutea occurs among rocks of all sizes, but is most numerous among medium-sized and large rocks. It inhabits the shallows and usually does not penetrate beyond 8 m, but at Boadzulu Island it occurs to 20 m. Females are usually most abundant in the extreme shallows and males are most abundant at about 3 m depth.

Territoriality. Males defend territories against conspecific males. At Monkey Bay territories have a mean area of 19,88 m^2 (Marsh *et al.* 1981). Females and non-territorial males may be solitary, hover in the water column in groups of up to 200 individuals, or occur in schools numbering between 30 and 300 individuals. These schools often also contain a few members of *P. nigra* and occasionally some *P. tridentiger* females.

Feeding. Adult individuals feed by brushing rock surfaces to collect loose Aufwuchs and its associated invertebrate fauna; they also take plankton when it is abundant. Juveniles feed primarily on plankton. Details of feeding habits are given in Marsh (1981).

3. *Petrotilapia nigra* Marsh, 1983

Synopsis. A relatively small *Petrotilapia* species that occurs in the southern part of the lake. Males are predominantly black.

Distribution. Monkey Bay (C), Domwe I. (C), Otter Point (C), Thumbi West I. (C).

Coloration. Monkey Bay males: Body dark grey-blue with 7 – 10 broad black vertical bars on flanks; caudal peduncle black. Head black with a dark blue interorbital bar. Dorsal fin dark grey, with orange flecks in some specimens, submarginal band broad and black; lappets orange in most specimens, though some individuals have blue tinges particularly along the tips. Caudal fin rays black; inter-ray membranes sky-blue; trailing edge orange-brown. Anal fin black with pale blue leading edge and 1 – 4 bright yellow egg-dummies. Pelvic fins brown with black submarginal bands and whitish-blue leading edges.

Monkey Bay females: Head and body pale brown with dark brown to black mid-lateral and dorso-lateral blotches and 7 – 10 grey-brown bars on flanks. Dorsal fin hyaline with a narrow dark grey to black submarginal band and pale orange lappets. Caudal fin hyaline. Anal fin hyaline with pale blue distal border, a narrow brown to black submarginal band and a few yellow egg-dummies in some specimens. Pelvic fins hyaline with pale blue distal borders and narrow brown to black submarginal bands.

Habitat. Occurs over all sizes of rock but shows a preference for medium-sized rocks. Occupies a broad depth range from the extreme shallows down to 35 m at Thumbi West Island. Males are most common between 6 and 10 m whereas females are most numerous in the extreme shallows down to 2 m.

Territoriality. Males defend territories against conspecific males only. Territories have a mean area of 6,79 m^2 (Marsh *et al.* 1981). Females, non-territorial males and juveniles are usually solitary but occasionally form mixed feeding schools with *P. genalutea*.

Feeding. Adult individuals brush rock surfaces to collect loose Aufwuchs and Invertebrata. When plankton is plentiful members of this species (particularly females) may concentrate entirely on this resource. Juveniles feed predominantly on plankton. Details of feeding habits are given in Marsh (1981).

4. *Petrotilapia* 'gold'

Synopsis. A common fish at the islands of Chinyankwazi and Chinyamwezi. Males are predominantly black and females are predominantly golden.

Distribution. Chinyankwazi I. (C), Chinyamwezi I. (C).

Coloration. Chinyankwazi males: Body black with 7 narrow sky-blue bars on flanks. Head black. Dorsal fin black with sky-blue inter-ray membranes. Caudal fin black with sky-blue inter-ray membranes and a pale brown trailing edge. Anal fin black with 1 – 5 yellow-orange egg-dummies. Pelvic fins black with pale blue leading edges.
Chinyankwazi females: Usually intense gold but some individuals drab brown. Flanks with 2 parallel, horizontal rows of dark brown-black blotches.

Habitat. Occurs over all rock sizes, from the shallows to 35 m depth with the greatest numbers occurring in the shallows.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles occur singly or in groups of up to 30. Groups are particularly common on the exposed sides of the islands.

Feeding. Non-territorial individuals feed on plankton in the water column and on loose Aufwuchs on the rock surface. Territorial males feed predominantly on loose Aufwuchs.

5. *Petrotilapia* 'mumbo blue'

Synopsis. A large fish of the shallows. Males and females have a distinct black submarginal band in the dorsal fin. Males are predominantly blue whereas females are predominantly brown.

Distribution. Thumbi West I. (C), Mumbo I. (C), Mbenji I. (C).

Coloration. Thumbi West Island males: Body sky-blue with pale blue belly and 8 – 9 dark blue vertical bars on flanks. Head dark blue with broad dark grey interorbital bar. Dorsal fin pale blue with prominent black submarginal band; lappets blue with orange tips; rays black, inter-ray membranes blue with numerous orange ocelli along trailing edge. Caudal fin lilac-blue with black rays on orange trailing edge. Anal fin a semi-transparent blue-grey with a broad black submarginal band and a pale blue leading edge; 1 – 6 yellow egg-dummies. Pelvic fins orange with grey rays, black submarginal bands and blue leading edges.
Thumbi West Island females: Body and head uniform dark brown. Dorsal fin hyaline brown with pale orange lappets, a dark grey submarginal band and orange ocelli on posterior inter-ray membranes. Caudal fin hyaline brown with orange trailing edge. Anal fin dark grey anteriorly, hyaline brown posteriorly. Pelvic fins pale orange with dark grey submarginal bands and pale blue leading edges.

Habitat. Occurs over all rock sizes, but appears most numerous over medium-sized and large rocks, from the surface waters to 6 m depth.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles are usually solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

6. *Petrotilapia* 'mumbo yellow'

Synopsis. A common fish at Mumbo Island particularly at about 10 m depth. Males have a distinctive yellow suffusion superimposed on their slate-grey ground colour.

Distribution. Mumbo I. (C).

Coloration. Males: Body slate-grey ground colour suffused with yellow, but chest, belly and shoulder bright yellow; 4 – 6 indistinct grey-green bars traverse flanks. Head grey along dorsal aspect of snout and occipital regions, remainder yellow with bright yellow cheeks, chin and gular regions; interorbital bar light blue; opercular patch black. Dorsal fin hyaline blue with patches of yellow; submarginal band broad and black; lappets blue with orange tips; rays black. Caudal fin blue with black rays and an orange trailing edge. Anal fin bluish-grey with a black submarginal band and light blue leading edge; 1 – 4 yellow egg-dummies. Pelvic fins yellow, tending to orange in some individuals.
Females: Body grey with 7 – 8 dark grey bars and a series of black blotches running mid-laterally along the flanks, another series of small black blotches running dorso-laterally. Dorsal fin hyaline grey with a narrow dark grey submarginal band and pale orange lappets. Caudal fin pale grey with dark grey rays. Anal fin light grey with dark grey borders. Pelvic fins pale grey.

Habitat. Members of this species occur over most rock types but are most common among medium-sized and large rocks. They occur in 3 – 22 m depth, in both sediment-free and sediment-rich zones, but most individuals were found at about 10 m.

Territoriality. Males defend territories against conspecific males, seldom chasing heterospecifics. Females, non-territorial males and juveniles are usually solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

7. *Petrotilapia* 'yellow chin' (Plate 10c)

Synopsis. A large species in shallow waters. Males are sky-blue with a distinctive suffusion of yellow. Females are uniform brown.

Distribution. Makanjila (C), Maleri I. (C), Nankoma I. (C), Nakantenga I. (C), Namalenje I. (C), Mbenji I. (C).

Coloration. Makanjila males: Body blue with chest and anterior belly golden-yellow; 7 – 9 dark blue bars traversing the flanks. Head blue with golden-yellow snout, cheeks, chin, gular region and branchiostegal membranes. Dorsal fin usually blue with patches of yellow, but in some individuals the fin mainly yellow; lappets yellow; rays black; trailing edge orange frequently with orange ocelli. Caudal fin blue with a yellow hue, blue-white upper and lower edges and an orange trailing edge. Anal fin blue, suffused with yellow and with 3 – 7 bright yellow egg-dummies. Pelvic fins golden-yellow with light blue leading edges.
Makanjila females: Uniformly dull brown.

Geographical variation. Males at Mbenji Island vary slightly from the pattern mentioned above. Some specimens have a faint dusky submarginal band in the dorsal fin. The caudal fin rays are dark grey to black. In some individuals there is a dark grey stripe adjacent to the pelvic fin spines.

Habitat. Occurs over all rock types in the shallows and extreme shallows, but is most numerous among medium-sized and large rocks. It normally occurs down to a depth of 6 m

although at Namalenje Island it is restricted to the upper 3 m.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles are usually solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

8. *Petrotilapia* 'fuscous'

Synopsis. Males are predominantly dark brown with a brown-orange cheek region.

Distribution. Maleri I. (C), Nankoma I. (C), Nakantenga I. (C), Mbenji I. (C).

Coloration. Maleri Island males: Body fuscous brown with orange-brown chest and belly. Head dark brown, almost black dorsally, but with orange-brown cheeks, chin, gular region and branchiostegal membranes, lips yellowish-brown. Dorsal fin blue-grey with a broad, black submarginal band; lappets blue with orange tips. Caudal fin fuscous brown with whitish upper and lower edges and an orange-yellow trailing edge. Anal fin blackish-brown with light brown edges and 1 – 5 bright yellow egg-dummies. Pelvic fins yellowish-brown with black submarginal bands and whitish leading edges.
Maleri Island females: Ground colour pale brown to khaki, some specimens dark brown. Flanks with prominent, narrow, black mid-lateral and dorso-lateral bands, which may be divided into blotches by 7 – 9 vertical black bars. Mid-lateral band projecting anteriorly to orbit and many specimens with a black occipital bar. Black dorso-medial blotches present in most specimens. Dorsal fin hyaline with pale grey lappets tipped with orange-brown; submarginal band narrow and dark grey; inter-ray membranes sometimes spotted, either yellow on hyaline background or hyaline on yellow background. Caudal and anal fins hyaline with numerous small bright yellow spots on posterior angle of anal fin. Pelvic fins hyaline with whitish leading edges and narrow grey submarginal bands.

Habitat. Members of this species occur over all rock types from 2 to 27 m and are particularly abundant between 5 and 10 m depth.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles are solitary.

Feeding. Individuals feed in the manner typical of this genus.

9. *Petrotilapia* 'likoma variable'

Synopsis. Territorial males vary in coloration from sky-blue to navy-blue but always have a metallic sheen. Females are off-white with two longitudinal black bands.

Distribution. This species occurs at all the rocky shores of Likoma Island.

Coloration. Males: Body sky-blue to navy-blue with metallic sheen and ochre chest and belly. Head sky-blue to navy-blue with metallic sheen, normally with ochre cheek, chin, gular region and branchiostegal membranes; interorbital bar dark grey. Dorsal fin sky-blue, but sometimes with ochre hue; lappets pale blue anteriorly, pale blue tending to orange posteriorly; trailing edge orange. Caudal fin sky-blue with black rays and an orange trailing edge. Anal fin dark blue with orange trailing edge and 3 – 4 yellow egg-dummies. Some specimens with anal fin entirely ochre coloured. Pelvic fins ochre with pale blue leading edges.
Females. Head and body off-white with 8 – 9 pale grey bars and narrow black mid-lateral and dorso-lateral bands, the former extending anteriorly to form an opercular blotch. In some specimens the ground colour darker and markings less obvious. Dorsal fin hyaline with columns of yellow spots on posterior inter-ray membranes. Caudal fin with pale grey rays and hyaline inter-ray membranes. Anal fin hyaline with yellow spots on posterior angle in some specimens. Pelvic fins hyaline with white leading edges.

Habitat. This species is most common in the shallows, its full depth range is from the extreme shallows to at least 34 m. Most individuals live among medium-sized and large rocks.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles are solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

10. *Petrotilapia* 'likoma barred' (Plate 10d)

Synopsis. Males are sky-blue to navy-blue and have 7 – 9 distinct dark vertical bars on their flanks.

Distribution. This species occurs at all the rocky shores of Likoma Island.

Coloration. Males: Body sky-blue to navy-blue with 7 – 9 dark blue to black bars on flanks; belly blackish; chest dark brown tending to black. Head dark blue dorsally, but blackish-brown below the level of the orbit. Dorsal fin blue-grey with a broad, black submarginal band; lappets pale blue with orange tips in most individuals though some may have either pure blue or pure orange lappets. Caudal fin lilac-blue with black rays and an orange-brown trailing edge. Anal fin bluish-grey with a broad, black submarginal band and a pale blue leading edge; 1 – 6 bright yellow egg-dummies. Pelvic fins grey-brown with black submarginal bands and pale blue leading edges.
Females: Head and body brown with 7 – 9 dark brown to black bars; between the bars a series of dark brown to black mid-lateral and dorso-lateral blotches along the flanks. The mid-lateral blotches extending anteriorly to form an opercular blotch. Dorsal fin brown with lappets and trailing edge orange-brown; black submarginal band narrow. Caudal fin with orange-brown trailing edge, dark brown rays and brown inter-ray membranes. Anal fin dark brown. Pelvic fins brown-orange with pale blue leading edges and black submarginal bands.

Habitat. Typically occurs over a wide range of rock sizes as well as inhabiting weed beds. Common in water less than 6 m deep and rarely found below 10 m except at Mazimbwe Islet where it penetrates to 15 m.

Territoriality. Males defend territories against conspecific

males. Females and non-territorial males are usually solitary but when plankton is abundant they hover in the water column, usually next to projecting boulders, in schools of more than 100 individuals.

Feeding. Individuals feed in the manner typical of members of this genus.

11. *Petrotilapia* 'orange pelvic'

Synopsis. Males are predominantly sky-blue and have bright orange pelvic fins.

Distribution. Chisumulu I. (C).

Coloration. Males: Body dark blue dorsally, but light blue ventrally; 5 – 7 blue-grey bars traversing the flanks. Head blue-grey dorsally but cheeks, chin, gular region and branchiostegal membranes bluish-brown; lips light blue. Dorsal fin blue with a narrow but conspicuous black submarginal band; lappets bluish-white with orange tips; rays black, inter-ray membranes blue with numerous orange ocelli along the trailing edge. Caudal fin rays dark grey, inter-ray membranes lilac, trailing edge orange, upper and lower edges black. Anal fin bluish with black rays and a black leading edge; 1 or 2 large orange-yellow egg-dummies. Pelvic fins bright orange with narrow, black submarginal bands and bluish-white leading edges. *Females:* Head and body normally dark brown but varying from pale brown to chocolate-brown. Opercular spot black. A series of mid-lateral black wedge-shaped blotches on flanks. Certain specimens also with a series of narrow dorso-lateral blotches. Dorsal fin hyaline brown with orange-brown lappets and a narrow black submarginal band. Caudal fin rays dark brown; inter-ray membranes hyaline brown. Anal fin hyaline brown. Pelvic fins brown with an orange hue and white leading edges.

Habitat. Members of this species were found most commonly among medium-sized and large rocks. They appear to favour sediment-free zones in the shallows and are rare below 3 m depth.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles are solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

12. *Petrotilapia* 'retrognathous'

Synopsis. This species differs from all of its congeners in that it has a ventrally directed gape owing to the fact that the premaxilla extends anteriorly beyond the dentary.

Distribution. Chisumulu I. (C).

Coloration. Males: Body sky-blue with 8 – 9 navy-blue bars; belly with variable amount of ochre-brown; in some specimens the hue covers the entire flank region, but in others it is restricted to the chest. Head navy-blue dorsally with ochre-brown cheeks. Dorsal fin sky-blue with a variable amount of ochre-yellow anteriorly; trailing edge has numerous orange ocelli in most specimens. Caudal fin rays navy-blue, inter-ray membranes sky-blue; trailing edge orange; upper and lower edges whitish. Anal fin sky-blue, but suffused with ochre-yellow anteriorly; 1 – 4 bright yellow egg-dummies. Pelvic fins sky-blue with heavy suffusion of ochre-yellow and with white leading edges. *Females:* Head and body dark brown with faint ochre hue; belly paler brown than flanks. Dorsal fin dark brown with hyaline spots in inter-ray membranes; trailing edge orange-brown. Caudal fin dark brown with ochre trailing edge. Anal fin with dark brown rays, grey inter-ray membranes and 1 – 2 small orange egg-dummies. Pelvic fin rays dark brown, inter-ray membranes ochre-yellow; submarginal bands dark grey; leading edges whitish-blue.

Habitat. Members of this species exhibit no apparent preferences for rocks of a particular size. Furthermore, they may also occur in areas where pockets of sand are interspersed among the rocks. Most individuals occur at about 2 m depth, but this species was found to at least 10 m.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles are solitary.

Feeding. Feeds in the manner typical of members of this genus.

13. *Petrotilapia* 'yellow ventral'

Synopsis. Males are blue with yellow ventral surface. Common in deep water.

Distribution. Chisumulu I. (C).

Coloration. Males: Body pale sky-blue with 5 – 6 darker blue bars on flanks; ventral half of flanks, the chest and belly yellow. Head sky-blue dorsally, but yellow-orange below the level of the orbit. Dorsal fin sky-blue with scattered orange-blue flecks. Caudal fin rays yellow and inter-ray membranes lilac-blue. Anal fin navy-blue with a narrow black submarginal band and whitish leading edge; 13 orange-yellow egg-dummies. Pelvic fins yellow. *Females:* Head and body pale brown with rows of thin black dorso-medial, dorso-lateral and mid-lateral blotches. Mid-lateral blotches extending anteriorly to form an opercular blotch. Flanks also with 8 narrow, brown bars. Dorsal fin hyaline with orange lappets. Caudal fin inter-ray membranes hyaline and rays brown. Anal fin hyaline. Pelvic fins hyaline with white leading edges.

Habitat. It is common in water deeper than 10 m, and occurs from 8 m to at least 30 m depth. Members of this species were found most often among medium-sized and large rocks.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles are solitary.

Feeding. Feeds in the manner typical of members of this genus.

14. *Petrotilapia* 'small blue'

Synopsis. This is the smallest *Petrotilapia* species known (Table 10). Males are predominantly sky-blue with a yellow ventral surface and females are predominantly golden.

Distribution. Nkhata Bay (C), Lion's Cove (C), Cape Manulo (U). It probably occurs along the entire coastline between Nkhata Bay and Cape Manulo.

Coloration. Nkhata Bay males: Body sky-blue with 5 – 9

dark blue vertical bars; chest and belly yellow. Head blue with yellow chin, gular region and branchiostegal membranes. Dorsal fin sky-blue, though anterior basal portion orange; a broad, black submarginal band runs the length of the fin; lappets bright yellow. Caudal fin sky-blue with grey rays and an orange-yellow trailing edge. Anal fin hyaline grey with a broad black leading portion; 1 – 6 yellow egg-dummies. Pelvic fins greyish, sometimes with orange flecks; leading edges pale blue.
Nkhata Bay females: Ground colour brilliant gold in most individuals, but body and head varying from brown to golden; a series of dark brown to black blotches running mid-laterally along body, a similar series of blotches running dorso-laterally along the body. Dorsal fin golden with a narrow dark grey-brown submarginal band. Caudal fin golden with brown rays. Anal fin golden. Pelvic fins golden with dark grey submarginal bands.

Habitat. Members of this species are found over most rock types from 2 to at least 42 m depth with most individuals in the middle depths.

Territoriality. Males defend territories against conspecific males, seldom chasing heterospecifics. Females, non-territorial males and juveniles are usually solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

15. *Petrotilapia* 'ruarwe'

Synopsis. Males are predominantly blue with most fins, the gular region and belly yellow.

Distribution. Ruarwe (C), Chilumba at Chitande I. (C) and Mpanga Rocks (C).

Coloration. Ruarwe males: Body and head light blue with faint darker blue bars visible in some specimens; the chin, gular region, ventral part of the chest and the belly are yellow. Dorsal fin yellow with a faint blue hue in some individuals; lappets bright yellow; inter-ray membranes lilac-blue. Caudal fin lilac-blue with blue-grey rays and 2 – 5 bright yellow egg-dummies. Pelvic fins orange-yellow with light blue leading edges.
Ruarwe females: Head and body yellow-buff with 9 khaki bars and thin black mid-lateral and dorso-lateral bands on flanks. All fins hyaline with yellowish hue.

Geographical variation. The population at Chilumba differs slightly from that at Ruarwe. Chilumba males have orange-brown caudal fin rays. Females have a darker brown ground colour which has the effect of obscuring the vertical flank bars; all the fins are hyaline, with a brownish hue.

Habitat. Occurs over all rock sizes with an apparent preference for larger rocks. It has a broad depth range from 2 to 35 m at Ruarwe with its maximum abundance at 15 m.

Territoriality. Males defend territories against conspecific males. Females appear to be solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

16. *Petrotilapia* 'black flank'

Synopsis. Males are almost entirely black or deep purple. Females have a distinctive pattern of black criss-crossing bands and bars on their flanks.

Distribution. Chilumba at Mpanga Rocks (C).

Coloration. Males: Head and body deep purple or black. Dorsal fin grey with orange lappets and a broad black submarginal band. Caudal fin deep purple or black with an orange trailing edge. Anal fin black with 1 – 5 bright yellow egg-dummies. Pelvic fins purple or black with pale blue leading edges.
Females: Head and body colour varying from pale grey to dull brown with 8 black bars crossed by black mid-lateral and dorso-lateral bands; the vertical bars penetrating the dorsal fin. Dorsal fin hyaline with a narrow black submarginal band and orange-tipped lappets. Caudal, anal and pelvic fins hyaline.

Habitat. Occurs over all rock sizes in the shallows between 2 and 8 m depth, but is essentially a fish of large rocks.

Territoriality. Males defend territories against conspecific males. Females, non-territorial males and juveniles are solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

17. *Petrotilapia* 'chitande'

Synopsis. Only found at Chitande Island, Chilumba. Males are predominantly sky-blue with a distinctive yellow patch on their ventral surface.

Distribution. Chilumba at Chitande I. (C).

Coloration. Males: Body sky-blue with yellow chest and belly; 5 blue-grey bars traversing the anterior half of the flanks. Head sky-blue dorsally, but yellow below the orbit. Dorsal fin sky-blue with orange flecks and a narrow black submarginal band; lappets yellow. Caudal fin blue with orange-brown rays, a yellow-orange trailing edge and blackish-grey upper and lower borders. Anal fin grey with a black leading edge and 2 – 4 yellow egg-dummies. Pelvic fins yellow with grey leading edges.
Females: Head and body yellow-buff with 8 brown bars on the flanks and a series of black mid-lateral and dorso-lateral blotches. All fins are hyaline.

Habitat. Occurs over all rock sizes in the shallows and extreme shallows, but territorial males occur most commonly among medium-sized and large rocks. The maximum depth recorded for this species was 6 m.

Territoriality. Males defend territories against conspecific males. Females appear to be solitary.

Feeding. Individuals feed in the manner typical of members of this genus.

Genus *Labidochromis* Trewavas 1935 (Figure 13a – c)

Members of this genus are distinguished from other genera by their long, pointed, unicuspid, forwardly directed anterior teeth (Trewavas 1935). Lewis (1982) has broadened the diagnosis of the genus to include three previously undescribed species, the members of which possess unevenly bicuspid anterior teeth, and a fourth species in which the teeth in the outer row are both bicuspid and unicuspid.

Lewis (1982) redescribed three species and described 13 new species giving illustrations and colour notes of all. As a consequence of this revision the genus *Labidochromis* is

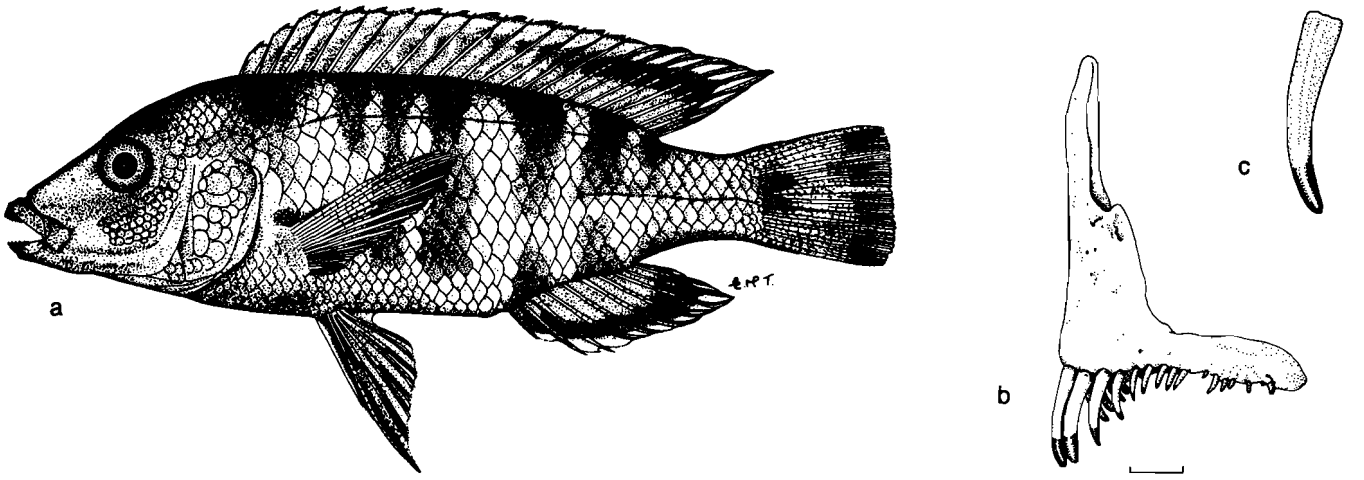

Figure 13 (a) *Labidochromis shiranus*, Nkudzi Point, 66 mm SL. (b) Lateral aspect of left premaxilla of *Labidochromis vellicans* (Scale = 1 mm). (c) Anterior outer row tooth of *L. vellicans*.

Table 11 The members of the genus *Labidochromis*. The maximum size in mm of each species and the locality at which the largest specimen was caught. The distribution of each species is given according to the 14 major study areas which are depicted in Figure 4. Details of distribution are given for each species in the text. Present (+), absent (−), introduced (i)

	Maximum size		Distribution												
Species	mm (SL)	Locality	I	IIa	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. *Labidochromis vellicans*	83	Chinyankwazi I.	+	+	−	+	+	+	+	+	−	−	+	−	−	−
2. *L. shiranus*	78	Nkudzi	−	+	−	−	−	−	−	−	−	−	−	−	−	−
3. *L. heterodon*	73	Boadzulu I.	−	−	+	−	−	−	−	−	−	−	−	−	−	−
4. *L. pallidus*	67	Thumbi West I.	−	−	−	−	−	+	−	+	−	−	−	−	−	−
5. *L.* 'blue bar'	84	Thumbi West I.	−	−	−	−	−	+	−	−	+	−	−	−	−	−
6. *L. mylodon*	69	Mumbo I.	−	−	−	−	−	−	+	−	−	−	−	−	−	−
7. *L. mbenjii*	64	Mbenji I.	−	−	−	−	−	−	−	−	−	+	−	−	−	−
8. *L. ianthinus*	71	Mbenji I.	−	−	−	−	−	−	−	−	−	+	−	−	−	−
9. *L. gigas*	100	Likoma I.	−	−	−	−	−	i	−	−	−	−	+	−	−	−
10. *L. freibergi*	64	Likoma I.	−	−	−	−	−	i	−	−	−	−	+	−	−	−
11. *L. lividus*	71	Likoma I.	−	−	−	−	−	−	−	−	−	−	+	−	−	−
12. *L. zebroides*	68	Likoma I.	−	−	−	−	−	−	−	−	−	−	+	−	−	−
13. *L. strigatus*	69	Chisumulu I.	−	−	−	−	−	i	−	−	−	−	+	−	−	−
14. *L. flavigulus*	68	Chisumulu I.	−	−	−	−	−	i	−	−	−	−	+	−	−	−
15. *L. chisumulae*	66	Chisumulu I.	−	−	−	−	−	−	−	−	−	−	+	−	−	−
16. *L. maculicauda*	64	Ruarwe	−	−	−	−	−	−	−	−	−	−	−	+	+	+
17. *L. caeruleus*	81	Nkhata Bay	−	−	−	−	−	−	−	−	−	−	−	+	−	+

well understood taxonomically and only one of the 17 species listed in Table 11 is undescribed. Lewis (1982) discusses the validity of five other descriptions of species of *Labidochromis* which appeared mainly in the aquarist literature. Of these, only the description of *L. textilus* Oliver, 1975 appears to be valid, despite its inadequacy and the fact that four distinct species were included in the type series (Lewis 1980, 1982). However, as *L. textilus* occurs on the Mozambique coast it was not included in our survey.

As detailed colour descriptions are given by Lewis (1982), only the most notable of the species-specific colours and markings are given below. We also comment on the geographical variation of colour where appropriate.

1. *Labidochromis vellicans* Trewavas, 1935 (Plate 10e)

Synopsis. A small lithophilous species in shallow waters in the southern parts of the lake.

Distribution. Nkudzi (U), Mpandi I. (R), Kanchedza (U), Monkey Bay (C), Nankumba Peninsula (C), Domwe I. (U), Zimbawe I. (C), Thumbi West I. (C), Otter Point (C), Mumbo I. (C), Maleri Is. (C), Namalenje I. (C), Chinyankwazi I. (C), Masinje Rocks (U), Makanjila Point (R). Although Lewis (1982) records the presence of *L. vellicans* at Chinyamwezi Island (p.198), elsewhere in his text (p.197) its distribution is given as Chinyankwazi Island. We found *L. vellicans* at Chinyankwazi Island and not Chinyamwezi Island.

Coloration. Monkey Bay males: Purple-brown with a rusty-brown hue. All fins have orange-brown edges or are predominantly orange-brown.

Monkey Bay females: Greenish-grey with orange-brown edges to all fins. Both sexes with grey vertical bars, but these are faint in males.

Geographical variation. The populations along the western coast from Nkudzi to the northern tip of Domwe Island are very similar in colour to the Monkey Bay forms. However, those at Chinyankwazi Island, Zimbawe Island, Mumbo Island, Masinje Rocks and Makanjila Point are predominantly reddish-brown in colour. The populations at Thumbi West Island and at Otter Point are paler than the Monkey Bay form. The Maleri Island and Namalenje Island forms were not included in the recent revision by Lewis (1982). These populations are pale brown, almost beige, with faint vertical bars.

Habitat. L. vellicans is most common in sediment-free rocky zones, on exposed shores. It favours medium-sized and large rocks. It is usually found in less than 7 m depth but an individual was seen at 15 m at Nakantenga Island (Maleri group) and another at 19 m at Chinyankwazi Island.

Territoriality. This species is not territorial, but occurs singly, in pairs or small groups usually not numbering more than 5 individuals.

Feeding. L. vellicans feeds mainly from the upper surfaces of rocks where it appears to pluck Aufwuchs from cracks and grooves. Stomachs of 12 individuals caught at Monkey Bay contained almost 90% C2, while loose Aufwuchs, C1, benthic Invertebrata and plankton comprised the remainder. Stomachs of 6 individuals caught at Maleri Island, contained 70% C1, 23% C2 and loose Aufwuchs, insects, plankton and benthic crustaceans. Lewis (1982) found that the diet of *L. vellicans* consists predominantly of filamentous algae, inect larvae and benthic crustaceans.

Notes: (i) The *Labidochromis* studied by Fryer (1959a) was not the *L. vellicans* of Lewis (1982) and so the feeding habits attributed to *L. vellicans* by Fryer do not apply to this species. (ii) The small dark brown fishes resembling *L. vellicans* at Likoma Island (Lewis 1982: 198) are now believed to be juvenile *L. gigas* (Lewis pers. comm.).

2. *Labidochromis shiranus* Lewis, 1982

Synopsis. The snout of *L. shiranus* is longer than in any other known species of *Labidochromis* (Lewis 1982). It lives among small rocks in less than 4 m depth. Males are olive-brown with orange markings; females are pale olive with grey bars and bands.

Distribution. Upper Shire River at Mangochi (C), Nkopola (C), Nkudzi (U), Mpandi (U).

Coloration. Males: Olive-brown with bluish cast, with narrow bands on the flanks and 7 – 9 bars. Dorsal fin pale olive with orange-brown spots which run together to form a reticulate pattern on the rayed portion; prominent black dorsal fin-spot.
Females: Pale olive with 7 – 9 grey bars and 2 longitudinal bands. Lower part of caudal fin and distal half of anal fin orange.

Habitat. L. shiranus occurs among small rocks in 0 – 4 m depth.

Territoriality. Members of this species are apparently not territorial and usually occur singly or in pairs, but sometimes slightly larger groups were seen.

Feeding. As the gut contents consist mainly of loose Aufwuchs, Lewis (1982) suggests that the spaced anterior teeth might be used to comb unicellular components from the filamentous Aufwuchs.

3. *Labidochromis heterodon* Lewis, 1982

Synopsis. L. heterodon is the only member of the genus at Boadzulu Island. This little brown species is numerous among the rocks of the shallows.

Distribution. Boadzulu I. (N).

Coloration. Males: Yellowish-brown with a mauve cast and a black submarginal band in the dorsal fin.
Females: Brown with darker brown barring and a less prominent submarginal band in the dorsal fin than found in males.

Habitat. This species is numerous among medium-sized and small rocks in less than 3 m depth, but does penetrate to 10 m.

Territoriality. L. heterodon is a non-territorial species which occurs in large schools, often numbering more than 100 individuals.

Feeding. The Aufwuchs in the shallows at Boadzulu Island is particularly luxuriant, possibly because nutrients washed in from the cormorant colony of the island increase algal productivity. *L. heterodon* feeds mainly from this rich algal growth, nipping and jerking at the filamentous algae. The stomach contents of 10 specimens comprised wads of C1 (85%), loose Aufwuchs, crustaceans and C2.

4. *Labidochromis pallidus* Lewis, 1982

Synopsis. An almost white, lithophilous species of the shallows of the Maleri Islands and Thumbi West Island.

Distribution. At all three Maleri islands: Nakantenga (C), Maleri I. (C), Nankoma I. (C), and Thumbi West I. (U).

Coloration. Males and females: Totally white, but males may have a mauve cast.

Habitat. This species is most numerous in the shallows among medium-sized rocks, but it has been recorded from surface waters to a depth of 25 m, over other rock types and occasionally in intermediate areas.

Territoriality. It is not territorial, occurring singly, in pairs or in small groups usually numbering less than 6 individuals.

Feeding. L. pallidus feeds by nipping at the rock surface. Lewis (1982) found arthropod remains, filamentous algae and loose Aufwuchs in the stomachs of specimens of this species. Loose Aufwuchs was the dominant food item of some stomachs, which is unusual for members of this genus.

Note: Lewis (1982) suggests that the *L. pallidus* at Thumbi West Island may have been introduced there by an exporter of aquarium fishes. It does, however, occur all around the island and its increased density in the vicinity where exporters deposited fishes from other parts of the lake may be the result of some other factor. Unfortunately we shall never know whether *L. pallidus* occurs naturally at Thumbi West Island.

5. *Labidochromis* 'blue bar' (Plate 10f)

Synopsis. A rare blue fish with 10 to 12 dark vertical bars. It occurs among medium-sized and large rocks in sediment-free, shallow areas.

Distribution. Thumbi West I: at Mitande Rocks (R), Namalenje I. (U) and perhaps on the Nankumba Peninsula (unconfirmed observation).

Coloration. Males: Body metallic blue with 10 – 12 dark grey bars; chest and belly whitish; dorso-medial ridge blue-grey. Head blue-grey; chin, lower cheeks, gular region and branchiostegal membranes white; interorbital bar light blue. Dorsal fin blue with narrow, black submarginal band and whitish-blue lappets. Caudal fin blue-grey with orange trailing edge. Anal fin light blue at base, black submarginal band, white leading edge and hyaline trailing edge; 1 – 2 yellow egg-dummies. Pelvic fins pale blue with black submarginal bands and white leading edges.
Females: Pale blue-grey with the same markings as males.

Habitat. This species occurs among medium-sized and large rocks in less than 10 m depth in sediment-free areas.

Territoriality. Members of this species appear to be non-territorial and are usually solitary, but occasionally occur in pairs.

Feeding. It has been seen to nip at the Aufwuchs on the upper surface of rocks.

6. *Labidochromis mylodon* Lewis, 1982

Synopsis. A white species endemic to Mumbo Island.

Distribution. Mumbo I. (U).

Coloration. Male and female: Creamy white.

Habitat. It lives in a variety of habitats, being found on the open faces of boulders and slabs, among medium-sized and small rocks, in the intermediate zones and in beds of *Vallisneria aethiopica*. It occurs from the surface to at least 15 m depth, but is most numerous between 1 and 8 m.

Territoriality. Neither sex of *L. mylodon* is territorial. The species occurs singly, in pairs or occasionally in groups of 3 – 6 individuals.

Feeding. The members of this species feed from crevices and cracks in the rock surface, apparently selecting their food items with care (Lewis 1982). They also feed from the sand and among *V. aethiopica* where they thrust their heads among the leaves and roots of these plants. Lewis (1982) identified several different species of insect larvae, ostracods of the genus *Cypridopsis* and the gastropod *Gabiella stanleyi* in the stomachs of *L. mylodon*. He considers the hypertrophy of the pharyngeal bones and teeth to be adaptations to cope with the molluscan components of the diet of these fishes.

7. *Labidochromis mbenjii* Lewis, 1982

Synopsis. A brown barred lithophilous species of Mbenji Island.

Distribution. Mbenji I. (C).

Coloration. Males: Brown with numerous grey-brown bars and 2 longitudinal bands. Dorsal and caudal fins yellowish with black rays; anal and pelvic fins yellowish with black submarginal bands.
Females: Similar to males, but paler, and the rays in dorsal and caudal fins not as dark.

Habitat. It inhabits all the rocky shores of Mbenji Island, being most numerous in water less than 7 m deep but occurring to at least 18 m.

Territoriality. Members of this species are not territorial, but occur singly, in pairs or in small groups.

Feeding. Members of this species were seen to nip at the Aufwuchs. Lewis (1982) found filamentous algae and loose Aufwuchs in the stomachs.

8. *Labidochromis ianthinus* Lewis, 1982

Synopsis. Pale brown species with a mauve cast. It is endemic to the rocky and intermediate habitats of Mbenji Island.

Distribution. Mbenji I. (C).

Coloration. Males: Pale olive or fawn with a mauve cast and 6 – 7 grey-brown bars. Prominent mauve iridescence on cheeks.
Females: Paler than males with less intense mauve iridescence.

Habitat. L. ianthinus lives in a variety of rocky habitats and in the intermediate zones, usually in less than 10 m depth. At Fuawe Islet, which is part of the western reef around Mbenji Island (Figure 52), it was found to 18 m.

Territoriality. The members of this species are not territorial and occur most often in small groups of up to 8 individuals.

Feeding. It feeds from both rock and sand substrata. Lewis (1982) found that some specimens had fed almost exclusively on chironomid larvae whereas in others the gut contents consisted entirely of detritus and sand grains. He also found a number of other insect larvae and nymphs were included in the diet of this species.

9. *Labidochromis gigas* Lewis, 1982

Synopsis. A large relatively deep-bodied, lithophilous species. Males are cobalt-blue; females are brown.

Distribution. Likoma I. (C), Chisumulu I. (C). An introduced population occurs at Thumbi West I. (U) and another at Otter Point (U).

Coloration. Males: Cobalt-blue, sometimes with faint black barring and a black interorbital bar.
Females: Uniformly brown.

Habitat. L. gigas is present on virtually every type of rocky shore, but appears to favour medium-sized rocks. It is most numerous between 6 and 12 m depth and usually absent from the extreme shallows (except at Ndomo Point and Machili Islet). It occurs to at least 30 m depth.

Territoriality. Males defend territories against conspecifics, but females are not territorial and are usually solitary.

Feeding. It feeds by nipping and jerking at the Aufwuchs. Stomach contents of 14 specimens caught at Maingano contained C2 (90%), C1 (3%), plankton and benthic Invertebrata. Lewis (1982) notes that the diet consists solely of filamentous algae.

Notes: (i) *L. gigas* at Thumbi West Island occupies the same preferred habitat as at Likoma Island and Chisumulu Island. Territorial males may be found between 5 and 14 m depth among medium-sized rocks at Mitande Rocks.

(ii) While generally uncommon or rare at Thumbi West, it is common at Mitande Rocks, the rocky reef just off Thumbi West. It is believed that the introduced population was released at Mitande Rocks.

10. *Labidochromis freibergi* Johnson, 1974

Synopsis. A deep-bodied, lithophilous species of the shallows of the north-eastern regions of Likoma Island. Males are blue with grey barring; females are olive-brown with dark brown barring.

Distribution. Endemic to the north-eastern part of Likoma Island: Mbako Point (U), Maingano (C), Membe Point (C), Madimba Bay (C), White Rock (U) and Mbuzi Point (U). A small population was found at the south-eastern tip of Thumbi West Island where this species is rare (no more than 15 individuals were seen in 1980). This population was almost certainly introduced to Thumbi West Island.

Coloration. Males: Bright blue with 7 grey bars. Head bright blue, except for snout which is grey. Dorsal fin pale blue.
Females: Olive-brown with darker brown vertical bars.

Habitat. L. freibergi inhabits areas of small rocks usually in less than 6 m depth, though occasionally individuals penetrate to about 12 m.

Territoriality. Males are territorial in 2 to 6 m depth and are aggressive towards conspecifics, but they occasionally chase other species also. Females are not territorial and are normally solitary.

Feeding. L. freibergi feeds by nipping at the Aufwuchs mat and on plankton. Stomach contents of 11 individuals comprised 51% C1, 34% C2, 11% plankton and 4% loose Aufwuchs. Lewis (1982) found only filamentous algae in the stomachs of those specimens he examined.

Note: The populations at Thumbi West Island occupied the areas of small rocks in the shallows which is consistent with the habitat preference of this species at Likoma Island.

11. *Labidochromis lividus* Lewis, 1982

Synopsis. A small, cryptic, darkly coloured species found among small and medium-sized rocks, in shallow waters at Likoma Island.

Distribution. It occurs along the northern and western shores of Likoma I. at Mbako Point (U), Makulawe Point (C), Khuyu (C), Ndomo Point (U). Its presence on Masimbwe Islet is unconfirmed.

Coloration. Males: Dark blue, almost black, with 8 narrow blue bars. Head blackish with two bright blue interorbital bars. Dorsal fin black with blue-white lappets. Caudal, anal and pelvic fins mainly dark grey.
Females: Olive-brown with grey barring.

Habitat. L. lividus lives among small and medium-sized rocks, but sometimes occurs among large rocks (at Makulawe Point) and in the intermediate zones (at Khuyu Bay). It is most numerous between 1 and 3 m and rare beyond 6 m.

Territoriality. Males are territorial, defending areas which are centred around holes or gaps among the rocks. They tend to remain hidden and seldom display in the open.

Feeding. It feeds by nipping at the Aufwuchs and appears to favour vertical rock surfaces. Stomach contents of 6 individuals caught at Makulawe Point contained, in varying proportions, C1, C2 and loose Aufwuchs.

12. *Labidochromis zebroides* Lewis, 1982

Synopsis. A deep-bodied, broad-barred, blue lithophilous species endemic to Masimbwe Islet.

Distribution. Likoma I. at Masimbwe Islet (U).

Coloration. Males: Bright blue with 5 – 6 wide black bars running the full depth of flanks and extending onto dorsal fin. Head blue. Fins pale blue with black markings.
Females: Colours unknown.

Habitat. This species lives among medium-sized and large rocks in water less than 6 m deep.

Territoriality. Males defend sites among the rocks, but like *L. lividus* they tend to remain hidden, or to display at the entrances of their refuges.

Feeding. Not recorded.

13. *Labidochromis strigatus* Lewis, 1982

Synopsis. A small, elongate fish of small or pebble-sized rocks in shallow water. Males are blue with vertical bars. Females are greenish-olive with orange bands.

Distribution. Chisumulu I. (C). It also occurs at Likoma Island at Madimba Bay (U) and near to White Rocks (U). As both of these sites are close to where exporters of aquarium fishes maintain holding facilities, it is considered likely that the Likoma Island populations arose from escapees of Chisumulu origin. Similarly, a small introduced population occurs at the south-eastern tip of Thumi West I. (R – U).

Coloration. Males: Royal blue with prominent grey-black bars.
Females: Greenish-olive with vertical barring and numerous thin orange bands.

Habitat. The preferred habitat of *L. strigatus* is among pebble-sized or small rocks in water of 1 – 4 m depth. It does, however, venture into intermediate zones and occurs among larger rocks. Its full depth range is from the surface to at least 10 m.

Territoriality. Males defend territories against conspecifics, occasionally also chasing heterospecific intruders. Territorial males of the intermediate zones construct sand-scrape nests. Females are not territorial and occur singly; sometimes in small groups.

Feeding. Stomachs of 3 individuals were examined and all contained predominantly C1, some C2 and a small proportion of loose Aufwuchs. Two of these individuals also had remains of insects in their stomachs, but these constituted a small fraction of the whole contents.

Note: The introduced populations occupy essentially the same habitat as they do in their native environment.

14. *Labidochromis flavigulus* Lewis, 1982

Synopsis. A small species found among pebbles and small rocks over sandy areas where burrows may be constructed. Members of this species have orange-brown bands and a

yellow gular region.

Distribution. Chisumulu I. (C) and Likoma I. (R). It was probably introduced to Likoma Island where it is found in the vicinity of the holding facilities of exporters of aquarium fishes at Madimba Bay and at Mbuzi Island. However, a small population is established on a submerged reef near White Rock which is between the sites used by exporters for storage of fishes.

Coloration. Males: Olive-grey with scalloped, orange-brown longitudinal bands; gular region and branchiostegal membranes bright golden-yellow. Fins with orange-brown blotches. Anal fin with prominent black submarginal band and 1 – 4 orange-yellow egg-dummies. *Females:* Paler than males with less intense submarginal band in anal fin and fainter yellow gular and branchiostegal region, but more prominent orange-brown longitudinal bands.

Habitat. L. flavigulus lives among small rocks and pebbles which have accumulated on sandy areas. It is most numerous in the extreme shallows, but it does penetrate to 15 m depth though it is rare beyond 8 m.

Territoriality. Territorial males excavate spawning sites wherever the habitat permits burrowing. The excavated sand which is deposited in a small mound at the burrow entrance marks the centre of each territory. Territories are defended against conspecifics most aggressively, but occasionally *L. flavigulus* chases heterospecific intruders. Females are not territorial, occurring singly or in small groups of 10 – 15 individuals.

Feeding. This species nips at the epilithic Aufwuchs when feeding.

15. *Labidochromis chisumulae* Lewis, 1982 (Plate 10g)

Synopsis. A white, lithophilous species endemic to Chisumulu Island.

Distribution. Chisumulu I. (C).

Coloration. Males: White, sometimes with a blue hue; dorso-medial aspect black with incomplete black bars. *Females:* Uniform creamy white, sometimes with faint brownish bars below the dorsal fin.

Habitat. L. chisumulae occurs over a variety of rocky habitats ranging from small rocks in intermediate zones to large rocks in purely rocky environments. Its depth distribution extends from the extreme shallows to at least 25 m.

Territoriality. Members of this species occur singly, in pairs and in small groups usually numbering fewer than 5 individuals. No territorial individuals were found.

Feeding. Individuals remain close to the rocks, feeding from small cracks and crevices in the rock surface. They pluck insect larvae, nymphs, pupae and also ostracods and freshwater mites from these crevices (Lewis 1982).

16. *Labidochromis maculicauda* Lewis, 1982

Synopsis. An elongate lithophilous species of the north-western shores of the lake. Males are darkly coloured; females have orange-brown bands.

Distribution. Chirombo Point (R), Nkhata Bay (C), Lion's Cove (U), Mara Rocks (R), Dankanya Bay (C), Usisya (U), Ruarwe (C), Mpanga R), Chitande (C).

Coloration. Males: Dark brown with darker brown barring. Dorsal fin yellowish with a black or dark brown submarginal band and white lappets with yellow tips. All other fins pale brown, with dark brown blotches. *Females:* Pale olive-grey with 9 – 11 dark brown bars and 7 – 8 narrow, orange-brown bands.

Habitat. It occurs mainly among small and medium-sized rocks, but also among large rocks (Mpanga Rocks, Mara Rocks, Chirombo Point) and in intermediate habitats. It usually occupies the shallows, being most numerous between 2 and 7 m, but it has been found to 12 m depth.

Territoriality. This is a non-territorial species occurring singly and in small groups.

Feeding. It feeds upon invertebrates collected from the Aufwuchs (Fryer 1959a, as *L. vellicans*).

Note: Fryer (1959a) described the biology of this species as that of *L. vellicans.*

17. *Labidochromis caeruleus* Fryer, 1959

Synopsis. A deep-bodied, essentially white species from a variety of habitats of the rocky shores of the north-western regions of Lake Malawi.

Distribution. Chirombo Point (R), Nkhata Bay (R), Lion's Cove (R), Ruarwe (R). Exporters of aquarium fishes report its occurrence at Chilumba, but we cannot confirm this.

Coloration. Nkhata Bay males and females: White with prominent black submarginal bands in dorsal, anal and pelvic fins. Males developing a blue hue when in courtship.

Geographical variation. Specimens south of Nkhata Bay to Chirombo Point and also those at Ruarwe are white without black submarginal bands. Most individuals at Lion's Cove are white with the black fin markings, but a lime-yellow form was also seen there.

Habitat. L. caeruleus occupies a variety of rocky and intermediate habitats, also occurring in *Vallisneria aethiopica* beds. It occurs from the surface down to at least 40 m.

Territoriality. This is a non-territorial species. The fish are usually solitary or form pairs.

Feeding. It feeds by wresting insect larvae and nymphs, ostracods and mites from the rocks (Fryer 1959a). Lewis (1982) found that two individuals had enlarged pharyngeal bones and dentition and that these enlargements correlated with a diet of gastropods, probably *Gabiella stanleyi.* He suggested that these molluscs had been collected in beds of *V. aethiopica.*

Note: Although Fryer (1956a) described the colour of *L. caeruleus* as 'cobalt-blue' no individuals of this colour were seen during our survey.

Genus *Cynotilapia* Regan, 1921 (Figure 14a – c)

Members of this genus possess long, widely spaced, sharp conical outer teeth and have several irregularly spaced, smaller inner teeth. There is, however, considerable interspecific variation in body depth and coloration.

The genus was originally considered to be monotypic, with *C. afra* (Gunther, 1893), the type species. Recently,

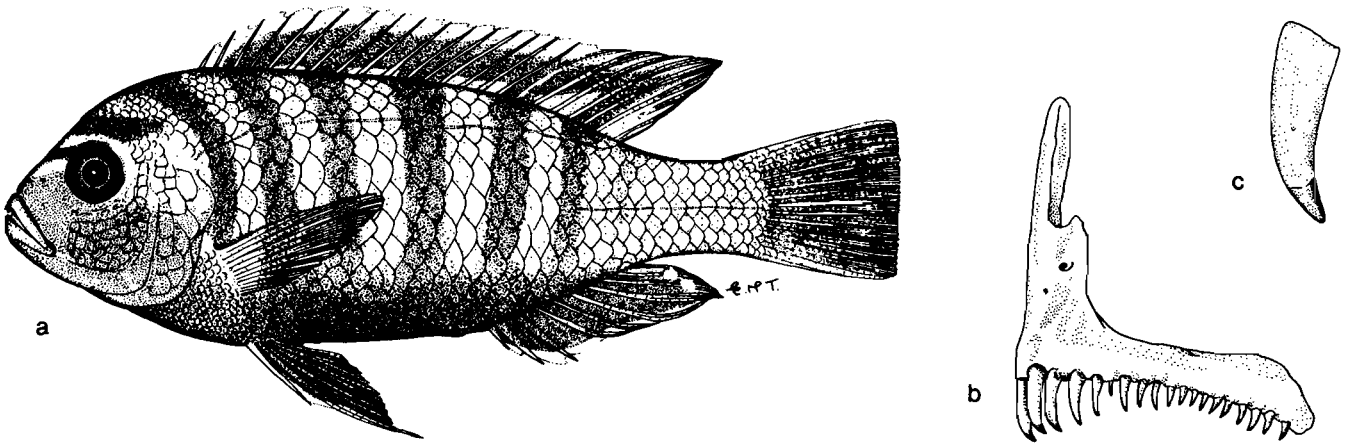

Figure 14 (a) *Cynotilapia afra*, Likoma Island, 93 mm SL. (b) Lateral aspect of left premaxilla of *C. afra* (Scale = 1 mm). (c) Anterior outer row tooth of *C. afra*.

Table 12 The members of the genus *Cynotilapia*. The maximum size in mm of each species and the locality at which the largest specimen was caught. The distribution of each species is given according to the 14 major study areas which are depicted in Figure 4. Details of distribution are given for each species in the text. Present (+), absent (–), introduced (i)

	Maximum size		Distribution												
Species	mm (SL)	Locality	I	IIa	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. *Cynotilapia* 'chinyankwazi'	95	Chinyankwazi I.	–	–	–	–	+	–	–	–	–	–	–	–	–	–
2. *C.* 'maleri'	86	Maleri I.	–	–	–	–	–	–	–	+	–	–	–	–	–	–
3. *C.* 'yellow dorsal'	71	Mbenji I.	–	–	–	–	–	–	–	–	–	+	–	–	–	–
4. *C.* 'black dorsal'	83	Mbenji I.	–	–	–	–	–	–	–	–	–	+	–	–	–	–
5. *C. afra*	101	Likoma I.	–	–	–	–	–	i	–	–	–	–	+	+	+	+
6. *C.* 'mbamba'	105	Likoma I.	–	–	–	–	–	–	–	–	–	–	+	+	+	+
7. *C.* 'ndumbi'	none	caught	–	–	–	–	–	–	–	–	–	–	+	–	–	–
8. *C. axelrodi*	77	Nkhata Bay	–	–	–	–	–	–	–	–	–	–	–	+	–	–
9. *C.* 'lion'	69	Lion's Cove	–	–	–	–	–	–	–	–	–	–	–	+	–	–
10. *C.* 'mpanga'	82	Mpanga Rocks	–	–	–	–	–	–	–	–	–	–	–	–	–	+

a second species, *C. axelrodi* Burgess, 1976 was described and we recognize a further eight species (Table 12).

1. *Cynotilapia* 'chinyankwazi' (Plate 10h)

Synopsis. A large member of the genus which closely resembles *Pseudotropeus zebra* in coloration, markings and general appearance.

Distribution. Chinyankwazi I. (C), Chinyamwezi I. (N).

Coloration. Chinyankwazi males: Body pale blue with 7 – 8 black bars. Head black with pale blue occipital bar and 2 interorbital bars. Dorsal fin pale blue with black bars of the body extending across the fin to merge with the black submarginal band; lappets white with yellow-orange tips. Caudal fin dark blue with white edges. Anal fin black with a white leading edge and 2 – 6 yellow egg-dummies. Pelvic fins black with white leading edges. *Chinyankwazi females:* Similar to males but with grey-blue ground colour.

Habitat. This species is found in greatest numbers among medium-sized rocks, but also occurs among rocks of other sizes. It occurs from 3 m to at least 40 m depth with the greatest number living between 10 and 20 m.

Territoriality. Males hold territories among medium-sized rocks which they defend aggressively against conspecifics and less vigorously against heterospecifics. Females, juveniles, and non-territorial adults form large schools, comprising hundreds of individuals, in the water column 1 – 4 m above the rocks.

Feeding. Non-territorial individuals feed almost exclusively on plankton. Stomachs of 17 individuals caught in Jan./Feb. 1980 contained on average 97% phytoplankton and 3% zooplankton; stomachs of 8 individuals caught in December 1980, contained on average 78% zooplankton and 22% phytoplankton. The differences in stomach contents reflect the differences in availability of zoo- and phytoplankton at the time of our visits. Five territorial males caught in Jan./Feb. 1980 had more variable stomach contents for, in addition to the dominating phytoplankton and zooplankton, small proportions of loose Aufwuchs, filamentous algae and some insect larvae were found.

2. *Cynotilapia* 'maleri'

Synopsis. A deep-bodied, darkly coloured speices living in deep water at Maleri Island.

Distribution. The south-eastern corner of Maleri I. (U).

Coloration. Males: Body dark blue, almost black, with

pitch-black bars. Head black with iridescent blue forehead and occipital region and a blue interorbital bar. In some individuals the forehead has a yellow tinge. Dorsal and caudal fins dark blue. Anal fin black with a white leading edge and 2 – 4 yellow egg-dummies. Pelvic fins black with white leading edges.
Females: Body and head grey with darker grey barring. Fins grey with black submarginal bands on all except caudal fin.

Habitat. It lives among medium-sized and small rocks in the sedimented areas from 17 to 27 m depth.

Territoriality. Males hold territories which they defend against conspecifics. Females, juveniles and non-territorial adult males form schools in the water column 2 – 4 m above the substratum.

Feeding. Observations of feeding behaviour suggest that this species feeds on plankton.

3. *Cynotilapia* 'yellow dorsal'

Synopsis. A blue and black barred lithophilous species with a yellow dorsal fin.

Distribution. Mbenji I. (A).

Coloration. Males: Body light blue with 7 – 8 black bars; belly and chest black ventrally. Head black with a light blue occipital bar and two light blue interorbital bars. Dorsal fin mainly yellow tending to orange posteriorly and blue anteriorly; black body bars penetrate base of fin. Caudal fin light blue with yellow rays and yellow trailing edge. Anal fin hyaline with a black submarginal band and white leading edge; 2 – 9 yellow egg-dummies. Pelvic fins hyaline with black submarginal bands and white leading edges.
Females: Similar in markings to males, but with grey ground colour and yellow fins.

Habitat. This species is abundant among small and medium-sized, sediment-free rocks between 5 and 15 m depth. It is uncommon in sheltered sediment-rich areas and rare in intermediate habitats. Its full depth range is from 2 to 20 m.

Territoriality. Males hold territories which are centred around small caves or holes among the rocks. They are aggressive to most intruders, but particularly hostile towards conspecific intruders. Females, juveniles and non-territorial adult males form large schools in the water column from 2 to about 10 m above the rocks.

Feeding. Members of this species were observed feeding upon plankton. Territorial individuals also feed from the Aufwuchs mat.

4. *Cynotilapia* 'black dorsal' (Plate 10i)

Synopsis. A secretive, blue and black barred, lithophilous species from Mbenji Island with a predominantly black dorsal fin.

Distribution. Mbenji I. (C).

Coloration. Males: Body light blue with 5 pitch-black bars on the flanks and 2 or 3 faint bars on the caudal peduncle. Head black with 2 light blue interorbital bars, a light blue occipital bar and several light blue patches on the occipital region. Dorsal fin pale blue with the black body bars crossing its base to merge with the prominent black submarginal band which runs most of the length of the fin; lappets pale blue sometimes white; trailing edge orange; a variable number of yellow ocelli in rayed portion. Caudal fin slate-blue with light blue rays and orange trailing edge. Anal fin blue-grey with a black submarginal band and a white leading edge; 3 – 5 yellow egg-dummies. Pelvic fins black with white leading edges.
Females: Body and head grey with black markings similar to those of males.

Habitat. This species lives in caves among medium-sized or large rocks and in gaps between rocky pillars. It is most common between 3 and 8 m depth in sediment-free zones.

Territoriality. Males are territorial, but remain close to their sites of refuge, and encounters between conspecific males are uncommon. Non-territorial individuals are usually solitary and remain close to the rocks, but sometimes several may be seen together in the water column.

Feeding. Males feed on plankton, but seldom venture more than a metre of two from their caves to do so. Females also remain close to the rocks while feeding in the water column. This species also feeds on Aufwuchs.

5. *Cynotilapia afra* (Gunther, 1893) (Plates 10j & 11a)

Synopsis. A blue and black barred, lithophilous species which is abundant throughout most of its distribution.

Distribution. Likoma I. (N – A), Chisumulu I. (N – A), Chirombo Point (N), Nkhata Bay (A), Lion's Cove (A), Mara Rocks (A), Dankanya Bay (A), Usisya (A), Mpandi Point (U), Ruarwe (A), Mpanga Rocks (A), Chitande (A).

Coloration. Ndumbi Rocks (Likoma Island) males: Body light blue with 8 – 9 black bars and a black chest and belly. Head black with a blue occipital bar that runs halfway down the operculum and two light blue interorbital bars. Dorsal fin orange-yellow, but penetrated along its base by black body bars and in some individuals two or three of these bars join distally to form a short black submarginal band; 3 – 12 red ocelli on trailing edge. Caudal fin inter-ray membranes pale blue, rays black, upper and lower edges orange and trailing edges orange-yellow. Anal fin black with white leading edge and 5 – 17 yellow-orange egg-dummies. Pelvic fins black with white leading edges.
Ndumbi Rocks (Likoma Island) females: Ground colour grey with similar markings as males.

Geographical variation. At Likoma Island the populations at Makulawe Point, Mbako Point and Maingano have black bars which traverse the flanks and enter the dorsal fin where they merge to form a black submarginal band. In the populations to the south of these sites, however, the black bars penetrate the dorsal fin but remain unconnected. Furthermore, in the northern populations at Likoma Island, the dorsal fin above the submarginal band is either entirely yellow, or entirely white, or yellow anteriorly and white posteriorly. Between 127 and 174 territorial males were examined at each of seven stations to establish what proportion of each population had a yellow dorsal fin, a white dorsal fin or a yellow-and-white dorsal fin. At Ndumbi Rocks and Makulawe Point virtually every male had a yellow fin, but the proportion decreased progressively towards White Rock where males have entirely white fins (Figure 15). It is conceivable that a similar clinal gradation in dorsal fin

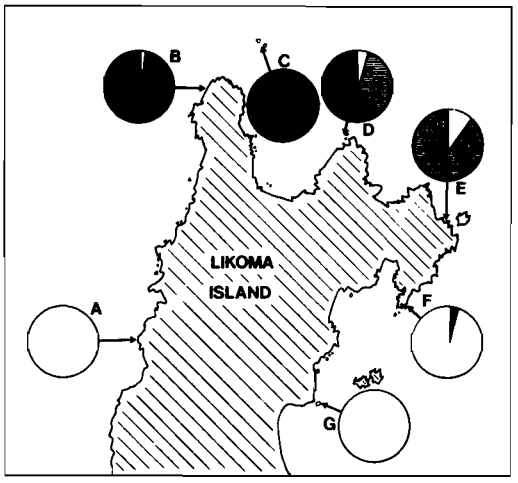

Figure 15 The proportion of the male populations of *Cynotilapia afra* at seven sites (A – G) around the northern sector of Likoma Island which had yellow (= black), yellow-white (= hatched) and white (= white) dorsal fins. A = Khuyu, B = Makulawe, C = Ndumbi, D = Mbako, E = Maingano, F = Membe Point, G = White Rock.

colour occurs between Khuyu Bay (Site A), where *C. afra* has white dorsal fins, and Makulawe Point (Site B), where 96% of the males were found to have yellow dorsal fins.

These differences in fin coloration and markings may reflect inherent differences between proximate populations, indicating that gene flow between these populations is retarded. Until this contention is proven, however, one cannot discount the possibility that the differences in fin colour are phenotypic responses to differing environmental conditions.

Adult *C. afra* at Chisumulu Island are smaller than those of Likoma Island, but are otherwise very similar morphologically. Both yellow and mixed yellow-white finned forms were found at Chisumulu though the proportion of these colour forms at each locality was not assessed.

Similarly, the populations of *C. afra* along the north-western coast of Lake Malawi have both white and yellow dorsal fins with a black submarginal band. Although it was noted that the proportion of each colour form varied between populations, the variation was not quantified.

Habitat. The preferred habitat of *C. afra* is among small and medium-sized rocks, in sediment-free areas which are exposed to currents, but it also lives over large rocks and boulders and in sheltered sediment-rich areas and may even be found in intermediate zones. It is most abundant between 5 and 20 m, but has a total depth range from the surface to at least 40 m.

Territoriality. Male *C. afra* are fiercely territorial though most of their aggression is directed intraspecifically. Territories are usually centred around holes or gaps among the rocks and these fishes tend to remain within their territories and close to the substratum. By contrast, non-territorial individuals are usually found in the water column, 1 – 4 m above the rocks, where they form large mixed schools with other Mbuna species, particularly *Pseudotropeus zebra*.

Feeding. Fryer (1959a) found that the vast majority of *C. afra* stomachs which he examined contained only plankton, but a small proportion (perhaps territorial males) also contained material from the Aufwuchs mat. We found that stomach contents are dominated by zoo- and phytoplankton in non-territorial individuals, but that territorial males also eat loose Aufwuchs, C1, C2, insect larvae and nymphs, and benthic crustaceans.

Note: In his description of the preferred habitat of this species Fryer (1959a) correctly indicates that most individuals live in the water column a short distance away from the rocks. He suggests further, that the species is evolving habits which are emancipating it from the rocks. This gives the impression that *C. afra* is not closely tied to the rocks. Our observations indicate, however, that territorial males are strictly lithophilous and do not venture from their territories even when feeding on plankton, that spawning occurs among the rocks, that refuge is sought among the rocks by most and perhaps all members of the species at night and that fry live among the rocks until large enough to avoid being eaten by other fishes.

6. *Cynotilapia* 'mbamba' (Plates 11b & 11c)

Synopsis. A deep-bodied, large member of the genus which lives in deep water. Males are mainly black with narrow blue bars and a blue or yellow flare on the head. Females are grey.

Distribution. Likoma I. at Mbamba Islet (C), Membe Point (U), Maingano (C), Mbako Point (R), Ndumbi Rocks (R), Makulawe Point (C), Ndomo Point (U), Masimbwe Islet (C), Mbuzi Islets (U). Chisumulu I. at Mkanila Bay (C), Machili Islet (C), Membe Islet (C), Same Bay (U). The north-western shores from Chirombo Point to Nkhata Bay (U – C). Lion's Cove (C), Dankanya Bay (C), Ruarwe (N), Mpanga Rocks (N), Chitande (N).

Coloration. Mbamba Islet males: Body black with 4 – 6 narrow, light blue wedges of colour projecting downwards onto the flanks. Head black with 2 bright blue interorbital bars and a blue flare on the occipital region. Dorsal fin black with whitish-blue lappets. Caudal fin black with whitish-blue upper and lower edges. Anal fin black with whitish-blue edges and 2 – 6 yellow egg-dummies. Pelvic fins black with white leading edges.

Mbamba Islet females: Body and head dark grey; light grey where males are whitish-blue.

Geographical variation. The amount of blue and whitish-blue varies between Likoma Island populations; populations in the south have a greater amount of blue and a more conspicuous flare on the forehead than those in the north. The Chisumulu Island populations have very little blue relative to any Likoma population. From Chirombo Point to Dankanya Bay males have 5 – 8 blue wedges of colour and a bright blue flare on the head which extends onto the dorsal fin. At Ruarwe, Mpanga Rocks and Chitande both the flare and the dorsal fin are yellow (Plate 11c). Females are similarly marked and coloured throughout the distribution of this species.

Habitat. It lives among medium-sized and large rocks in sediment-rich areas, usually in water deeper than 10 m. This species is most numerous between 10 and 25 m, but occurs from 3 m to at least 40 m depth.

Territoriality. Males defend territories aggressively against conspecifics, but they also evict other intruders which penetrate deeply into their territories. The territories centre around holes in, and gaps among, the rocks. Females,

juveniles and non-territorial adults form schools of up to 40 individuals which remain 1 to 5 m above the rocks.

Feeding. Non-territorial individuals were seen to feed almost entirely from the water column, but territorial fishes fed from the water column and from the Aufwuchs within their territories. Stomach contents of 12 individuals (both territorial and non-territorial fishes) caught at 15 m depth at Membe Point (Likoma Island), contained on average 80% zooplankton, 15% phytoplankton, and the remaining 5% comprised filamentous algae and benthic invertebrates.

7. *Cynotilapia* 'ndumbi'

At Ndumbi Rocks a deep-bodied, darkly coloured, cave-dwelling species of *Cynotilapia* was seen between 3 and 15 m. It is uncommon and by virtue of its cryptic behaviour none was caught. We were nevertheless able to view the teeth and assign the specimens with confidence to the genus *Cynotilapia*.

8. *Cynotilapia axelrodi* Burgess, 1976

Synopsis. An elongate, light blue fish of the intermediate habitats.

Distribution. Chirombo Point to Nkhata Bay (C), Lion's Cove (R).

Coloration. Males: Body pale blue, with yellowish-pink belly and chest; 7 – 9 black bars. Head blue tending to grey ventrally with yellowish chin and gular region; one light bue interorbital bar crossing the grey-blue snout. Dorsal fin whitish-blue with white lappets and yellow edges to the rayed part. Caudal fin blue with a blackish base, yellow-orange distal edge and black upper and lower borders with yellowish-white edges. Anal fin hyaline with a broad black submarginal band and a whitish-yellow leading edge; 1 – 4 golden egg-dummies. Pelvic fins hyaline with black submarginal bands and white leading edges.

Females: Body and head blue with very faint black barring; belly, chest and ventral part of caudal peduncle brownish-blue. Fins pale blue with yellowish tinge; black upper and lower borders to caudal fin; black submarginal bands on anal and pelvic fins.

Habitat. This species lives in intermediate zones and may also be found over sand at least 12 m away from rocks. *C. axelrodi* is most numerous in 4 – 10 m depth, but it has been found to 20 m.

Territoriality. Males either dig saucer-shaped spawning sites 8 – 12 cm in diameter and 5 cm deep alongside rocks, or burrow beneath the rocks depositing the excavated sand in a ring around the entrance. These spawning sites usually mark the centre of the territory. Males are aggressive in the defence of their territories chasing conspecific and heterospecific intruders. Non-territorial individuals of both sexes form schools numbering between 20 and 150 members which usually remain in the water column 1 – 2 m above the sand substratum, but sometimes descend onto the sand.

Feeding. C. axelrodi feeds on plankton and also from sandy and rocky substrata onto which the schools periodically descend.

9. *Cynotilapia* 'lion' (Plate 11d)

Synopsis. A small, elongate, yellowish-blue species which lives at the rock-sand interface at Lion's Cove.

Distribution. Lion's Cove (C).

Coloration. Males: Body yellowish-blue dorsally, yellowish-brown ventrally with 6 black bars on the flanks and 2 – 3 faint grey bars on the caudal peduncle. Head bluish-grey over occipital region, snout dark grey; cheeks, chin and gular region ochre-yellow; 2 light blue interorbital bars. Dorsal fin yellowish-blue with 6 black bars of the flanks crossing its base; lappets whitish-blue. Caudal fin blue at base, but black distally with black upper and lower borders and white edges. Anal fin black with a light blue leading edge; 2 – 6 bright golden-yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Markings similar to males, but ground colour sombre greenish-yellow with dark grey barring.

Habitat. This species lives over sand along the rock-sand interface from 2 to at least 30 m depth.

Territoriality. Males are aggressively territorial, usually defending sites alongside or among rocks, but some individuals were found guarding territories over sand as far as 5 m from the rocks. They construct saucer-shaped nests of about 10 cm diameter. Females and non-territorial males occur singly or in small groups over the sand and among the rocks in the intermediate habitats.

Feeding. This species was seen to feed from the water column, the sand and the rocks.

10. *Cynotilapia* 'mpanga'

C. 'mpanga' is a shy, blue and black barred fish that occurs at Mpanga Rocks between 5 and 15 m depth. This species differs from *C. afra* in its cryptic behaviour, its larger adult size and by having an almost entirely black dorsal fin. This species is rare and only one specimen was caught.

Genus *Labeotropheus* Ahl, 1927. (Figures 16a – c)

This genus was originally described by Ahl (1927) who distinguished its members from other cichlids by their possession of large protuberant fleshy snouts. The mouth is inferior-subterminal (Trewavas 1935) which enables the members of this genus to crop algae while swimming almost parallel to the rock surface (Fryer 1956b, 1959a). Only two species are currently recognized (*L. fuelleborni* Ahl, 1927 and *L. trewavasae* Fryer, 1956b) although considerable geographical variation occurs (Ribbink, Marsh, Marsh & Sharp in press, see also below). Both species exhibit polychromatism. *L. trewavasae* has a disjunct distribution, but *L. fuelleborni* occurs in all the major study areas (Table 13).

1. *Labeotropheus fuelleborni* Ahl, 1926 (Plate 11e)

Synopsis. This is the deeper-bodied member of the genus. It inhabits the shallows, favouring medium-large rocks.

Distribution. L. fuelleborni is one of the most widely distributed species of Mbuna and was found at every rocky shore visited, except Chemwezi Rocks and the submerged reef at Mazinzi. It is a common species on virtually all rocky shores.

Coloration. Monkey Bay males: Body blue with 8 – 10 dark blue bars varying in intensity from almost black to hardly discernible; chest and belly whitish-blue. Head blue with 2 blue-black occipital bars and 2 blue-black interor-

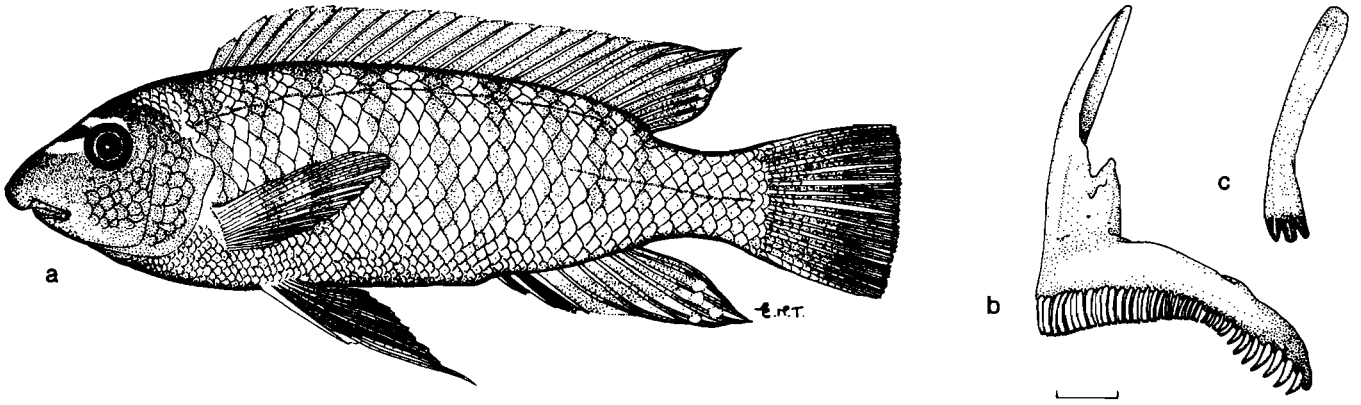

Figure 16 (a) *Labeotropheus trewavasae*, Maleri Island, 90 mm SL. (b) Lateral aspect of left premaxilla of *L. trewavasae* (Scale = 1 mm). (c) Anterior outer row tooth of *L. trewavasae*.

Table 13 The members of the genera *Labeotropheus, Gephyrochromis, Iodotropheus, Genyochromis* and *Cyathochromis*. The maximum size in mm of each species and the locality at which the largest specimen was caught. The distribution of each species is given according to the 14 major study areas which are depicted in Figure 4. Details of distribution are given for each species in the text. Present (+), absent (−)

	Maximum size		Distribution											
Species	mm (SL)	Locality	I	IIa	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. *Labeotropheus fuelleborni*	122	Zimbawe I.	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2. *L. trewavasae*	121	Zimbawe I.	+	−	+	+	−	+	+	+	+	−	−	+	+	+
3. *Gephyrochromis lawsi*	89	Nkhata Bay	−	−	−	−	−	−	−	−	−	−	−	+	−	+
4. *Genyochromis mento*	108	Chinyamwezi I.	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5. *Cyathochromis obliquidens*	112	Nkhata Bay	+	+	−	+	−	+	+	+	−	+	+	+	+	+
6. *Iodotropheus sprengerae*	94	Chinyamwezi I.	−	−	+	−	+	−	−	−	−	−	−	−	−	−

bital bars; lower part of snout, cheeks and opercular regions dark blue; chin, gular region and branchiostegal membranes whitish. Dorsal fin pale blue with black rays and orange-red inter-ray membranes. Caudal fin pale blue with black rays and an orange trailing edge. Anal fin pale blue at base, orange distally with 2 – 5 yellow egg-dummies. Pelvic fins orange with black submarginal bands and whitish-blue leading edges. The blue-blotch (male OB) forms are very rare in Monkey Bay.

Monkey Bay females: Normal females are brown or grey-brown with dark grey barring. Orange-blotch (OB) forms constitute less than 5% of the female population.

Geographical variation. L. fuelleborni exhibits geographical variation, particularly with regard to male fin colours. Unless stated otherwise only male colours are given below as geographical variation in female colours is less obvious. Ground colours of the body and head are given and as barring is present in all populations it is mentioned only where it is particularly intense or virtually absent. For comparisons the reference population is that of Monkey Bay.

Zimbawe Rocks: Pale blue body and head. Dorsal fin blue with orange-red rayed section and yellow ocelli. Caudal fin blue with dusky grey rays and a bright orange trailing edge. Anal fin blue at base, but otherwise grey to hyaline with 3 – 9 yellow egg-dummies. Females almost entirely black and no OB forms were found.

Nkopola: Slate-blue with yellowish fins.

Nkudzi: Body, head and fins very pale blue with an orange trailing edge to dorsal fin.

Mpandi Island: Pale sky-blue with orange anal and pelvic fins. Dorsal fin whitish-blue with orange trailing edge.

Boadzulu Island: Body and head pale blue. Dorsal fin blue with yellowish-orange hue, tending to reddish posteriorly; rayed portion black with yellow-orange trailing edge and orange ocelli. Caudal fin blue with black rays and yellow trailing edge. Anal fin orange with a black patch distally and orange egg-dummies. Pelvic fins orange with black submarginal bands and white leading edges.

Makanjila Point: Body and head blue. Dorsal fin orange-red, caudal fin blue with black rays. Anal fin dark blue-grey with an orange trailing edge and yellow egg-dummies. Pelvic fins orange with blue leading edges.

Masinje Rocks: Body and head blue with yellowish fins.

Eccles Reef and West Reef: Body and head blue. Fins blue with yellow-orange trailing edges.

Chinyankwazi Island: Body and head lavender-blue with prominent black bars dorsally, but fading ventrally. Dorsal fin yellowish-orange cast on blue background, but dominated by a broad black submarginal band. Caudal fin-rays blue with yellow-orange inter-ray membranes. Anal fin blue with yellowish cast and bright golden-yellow egg-dummies. Pelvic fins orange with black submarginal bands and whitish-blue leading edges. About 97% of females are black and 3% OB.

Chinyamwezi Island: Body and head lavender-blue with black bars prominent mid-laterally on the flanks, but fading both dorsally and ventrally; lower half of the head black,

with a light blue chin and gular region. Dorsal fin whitish-blue with black rayed section. Caudal fin rays black with blue inter-ray membranes. Anal fin black with blue-white leading edge and yellow egg-dummies. Pelvic fins black with blue-white leading edges. The number of normal (black) relative to OB and O females was counted along depth contours in the 3 – 10 m depth range by three divers working separately; 53% were normal-coloured and 47% were OB/O ($N = 427$). The OB/O morphs at Chinyamwezi ranged from speckled, through blotched to an almost pure tangerine-orange.

Thumbi West Island: Body and head blue. Dorsal fin blue with orange trailing edge and yellow ocelli, but less black in the rayed portion than Monkey Bay form. Anal fin blue at base, otherwise orange-pink with 3 – 8 yellow egg-dummies. Pelvic fins mainly orange with narrow black submarginal bands and whitish-blue leading edges.

Mumbo Island: Body and head dark blue. Dorsal fin pale blue with orange-red rayed region. Caudal fin rays blue with orange inter-ray membranes and yellow trailing edge. Anal fin orange with yellow egg-dummies. Pelvic fins orange-red with light blue leading edges. Females dark blue-grey and OB, but the OB form is rare.

Maleri Island: Body and head very pale, powder-blue. Dorsal and caudal fins whitish-blue with yellow trailing edges. Anal fin pale yellow-orange. Pelvic fins pale yellow-orange with white leading edges. It is estimated that between 2 and 5% of the males at the south-eastern corner of Maleri Island were the blue-blotched form.

Nakantenga Island: Body and head pale blue, but with a golden-yellow flush on the flanks, extending onto the head in some individuals. This is the only population with yellowish flanks. Dorsal fin blue with a faint golden hue, orange trailing edges and yellow ocelli. Caudal fin blue with an orange trailing edge. Anal fin blue with yellow egg-dummies. Pelvic fins blue with orange trailing portions.

Mbenji Island: Body and head pale blue. Dorsal and caudal fins whitish-blue with bright orange trailing sections. Anal fin blue along posterior basal region, but otherwise bright yellow-orange with yellow egg-dummies. Pelvic fins orange with broad, black submarginal bands and blue-white leading edges. The female OB and O morphs were quite common at Mbenji Island and were heavily exploited for the aquarium trade until 1978, but are now protected.

Likoma Island: Body and head blue. Dorsal fin pale blue with a pinkish-orange hue, bright yellow-orange trailing edge, orange ocelli and purple rays. Caudal fin rays blue with black inter-ray membranes and an orange-yellow trailing edge. Anal fin blue with orange cast and 2 – 5 large yellow egg-dummies. Pelvic fins orange-blue with black submarginal bands and pale blue leading edges. The OB form is uncommon and the O form is rare.

Chisumulu Island: The populations are similar to those of Likoma Island but have less pink in the dorsal fin. The OB female is rare and only one O female was seen.

Chirombo Point to Ruarwe: Body and head sky-blue. Dorsal fin pale blue with black rays and yellow-orange ocelli. Caudal fin rays black with pale blue inter-ray membranes; trailing edge orange. Anal fin pale blue with yellowish-orange egg-dummies. Pelvic fins pale blue with broad black submarginal bands and whitish leading edges.

Chitande: This population is similar to those of the other regions of the north-western shores, but it has a rusty-orange chest, an orange hue to the dorsal fin and the rayed part of the pelvic fins is orange-red.

Habitat. L. fuelleborni shows a preference for medium-large rocks (Ribbink *et al.* in press), but occurs in a wide variety of habitats and in the intermediate zones. It is most common in the shallows, but may penetrate to 18 m.

Territoriality. Males are aggressively territorial towards conspecifics, but pay little attention to heterospecific intruders unless they enter the centre of the territory. Females, juveniles and non-territorial males congregate in the extreme shallows.

Feeding. Non-territorial fish feed from the upper surfaces of rocks, and by virtue of their ventrally directed jaws they are able to feed in water which would be too shallow for fishes of a similar size, but which feed at right angles to the rock surface. Furthermore, since *L. fuelleborni* individuals feed parallel to the rock surface it appears that they are better able to cope with the turbulence which prevails in the extreme shallows than fishes which feed at right angles to the rock face. They favour the upper surfaces of rocks as feeding sites and have a varied diet which comprises mainly loose Aufwuchs, C1, C2, benthic Invertebrata and plankton (Ribbink *et al.* in press).

Note: A small population of the yellow-flanked form from Nakantenga Island was introduced to the island of Thumbi West. It has not been established whether this introduced population is breeding with the native population, but no intermediate forms were recognized.

2. *Labeotropheus trewavasae* Fryer, 1956 (Plate 11f)

Synopsis. L. trewavasae is the slender-bodied member of the genus.

Distribution. Boadzulu I. (C), Thumbi West I. (C – N), Zimbawe I. (C), Mumbo I. (C), Nakantenga I. (C), Maleri I. (C), Nankoma I. (C), Namalenje I. (C), Masinje Rocks (U), Chirombo Point to Nkhata Bay (U – C), Lion's Cove to Chitande (U – C).

Coloration. Boadzulu males: Body and head pale powder-blue. Dorsal fin yellow with pale blue trailing portion and yellow ocelli. Caudal fin pale blue with yellow trailing edge. Anal fin pale blue with 2 – 5 bright yellow egg-dummies. Pelvic fins pale blue with a dark blue submarginal band.

Boadzulu females: Normal females pale brown or light grey-brown; OB females beige with brownish-black blotches.

Geographical variation. Considerable geographic variation in dorsal fin colour was found and the basic coloration of the body and head of the populations along the north-western shores is different from that of the southern populations.

Thumbi West Island: Males are similar to the Boadzulu form, but are a deeper blue, tending to royal blue, with 9 – 10 dark blue bars and a dark blue head. Dorsal fin orange-red; caudal fin blue with a yellow-orange trailing edge. Anal fin blue with a black leading edge and 2 – 7

yellow egg-dummies. Pelvic fins pinkish with white leading edges. Females are normal (brown to grey-brown), OB and O (reddish-orange).

Zimbawe Rocks: This colour form is very similar to the Thumbi West form, but the rays of the dorsal and caudal fins are black; anal fin has a large orange-yellow central portion and the pelvic fins are orange-red.

Mumbo Island: Males are blue with a blue dorsal fin and yellow ocelli. Caudal fin blue with yellow trailing edges. Anal fin blue with a yellow antero-dorsal patch. Pelvic fins yellow with a black submarginal band. Females: brown form or pale OB form are present in approximately equal proportions.

Masinje Rocks: Males are metallic-blue with light blue fins. Females are brown or OB.

Nakantenga Island: Males are blue; fins mainly pale blue. Females are brown to grey-brown forms and OB forms.

Maleri and Nankoma Islands: Males are very similar to the Boadzulu Island form, but deeper blue with yellow-orange dorsal fins. Only pale OB females were found.

Namalenje Island: Males are similar to those of Maleri Island, but the dorsal fin is a deeper orange-red. Both normal and OB females were seen.

Nkhata Bay, Mara Rocks and Mpanga Rocks: Males are blue with blue fins. The only noticeable difference is that the Nkhata Bay form has a purple-blue dorsal fin whereas the other two populations have whitish-blue dorsal fins and the Mara Rocks form is deeper blue with 8 – 10 dark blue bars.

Lion's Cove: Males are purple dorsally on the head and body, with a rusty tint, but blue-grey ventrally and khaki-yellow mid-laterally. The fins are predominantly light blue, but with black submarginal bands on the anal and pelvic fins. Normal and OB females occur.

Ruarwe: The upper half of the body and head of males is khaki-yellow; belly, chest, chin and gular region purple to mauve. A light violet-blue interorbital bar is bordered by two dark brown interorbital bars. Dorsal fin mauve-blue with orange-brown rays, blue inter-ray membranes and orange ocelli. Caudal fin rays orange-brown, inter-ray membranes light blue and trailing edge orange. Anal fin mauve with a black submarginal band, and yellow-orange egg-dummies. Pelvic fins ochre-red with black submarginal bands and white leading edges. At Ruarwe OB females outnumbered normal females 14:1 (Ribbink *et al.* in press).

Chitande; The Chitande form is very similar to the Ruarwe population, but the khaki-yellow extends onto the dorsal fin and further onto the belly in males. Both OB and normal females were seen.

Habitat. L. trewavasae favours large rocks, but also occurs in other habitats and is usually fairly evenly distributed from the surface waters down to about 20 m. It has been found to 34 m depth.

Territoriality. Relative to its congener, *L. trewavasae* is weakly territorial. Males hold large, poorly defended territories among large rocks, normally favouring caves and crevices formed by these rocks. They quite frequently vacate the territories to feed elsewhere. Females, juveniles and non-territorial males usually occur singly or in small groups.

Feeding. At the island of Thumbi West *L. trewavasae* feeds principally from the under-sufaces of rocks (Ribbink *et al.* in press) and it is assumed that other populations also favour these surfaces. This species feeds on loose Aufwuchs, C1, C2, C3, benthic crustacea and plankton in varying porportions (Ribbink *et al.* in press).

Genus *Gephyrochromis* Boulenger, 1901

This genus exhibits numerous resemblances to the genus *Pseudotropheus* with which it may be confused (Fryer 1957). The only real structural difference between *Gephyrochromis* and *Pseudotropheus* is that the teeth in the outer series of both jaws in *Gephyrochromis* may, and often do, become conical and are longer and more slender than in any of the *Pseudotropheus* (Fryer 1957) (Figure 17a – b). There are only two described species in the genus: *G. moorii* Boulenger, 1901 and *G. lawsi* Fryer, 1957. Only *G. lawsi* was found by us (Table 13).

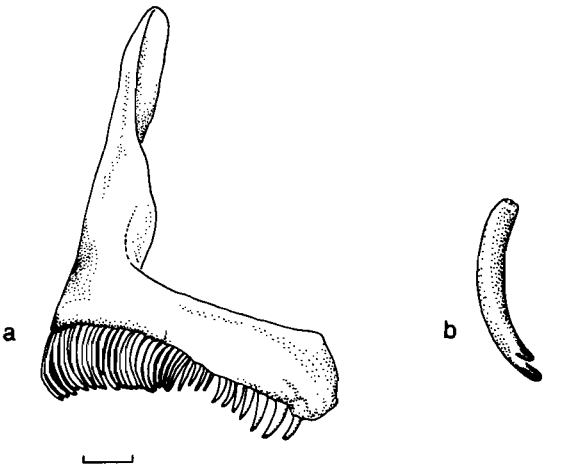

Figure 17 (a) Lateral aspect of left premaxilla of *Gephyrochromis lawsi* (Scale = 1 mm). (b) Anterior outer row tooth of *G. lawsi.*

1. *Gephyrochromis lawsi* Fryer, 1957

Synopsis. A rare fish on the shores we studied, being found in the intermediate zones below 8 m. Both sexes are light in colour and can be identified by the protruding teeth of the lower jaw.

Distribution. Nkhata Bay (R), Lion's Cove (R). Fryer (1957) found this species at Chitimba Bay (previously Florence Bay). *G. lawsi* is rare on the rocky shores we studied, but Fryer (1957) had little difficulty collecting specimens on a beach consisting of coarse shingle and rocks. This suggests that it may be more common in other habitats.

Coloration. Males: Body fawn to bronze dorsally, bluish mid-laterally with a silvery-white chest and belly, but the anterior part of the chest may be black ventrally; 7 faint grey bars traversing the flanks. Head grey-bronze dorsally with a dark grey snout and a light blue interorbital bar; cheeks and opercula silvery-blue; chin and gular region black. Dorsal fin lemon-yellow with whitish-blue flecks on the spines and fin rays. Caudal fin yellowish with blue-white rays and a white lower border. Anal fin whitish-blue with a black submarginal band and 1 – 3

yellow-orange egg-dummies. Pelvic fins grey with black submarginal bands and white leading edges.
Females: Body and head pale grey-brown dorsally, but silvery-white ventrally with 7 – 8 faint grey bars. Dorsal fin whitish-grey with a faint yellow hue. Caudal fin pale grey. Anal fin greyish, darker submarginally, with small orange egg-dummies. Pelvic fins white with grey submarginal bands.

Habitat. At Nkhata Bay and Lion's Cove, *G. lawsi* was found in sediment-rich intermediate zones at depths of 8 – 25 m. Fryer (1957) found this species in 4 – 5 m on the shingle beach at Chitimba Bay, but at Nkhata Bay he found it on the outer fringe of the rocky shore and in water deeper than that frequented by most Mbuna. Fryer (1959a) suggested that this species could not compete successfully with other Mbuna on the truly rocky shores of Nkhata Bay, except in deeper water where the population density is low.

Territoriality. Males are weakly territorial, chasing away some intruders. Females are solitary.

Feeding. G. lawsi feeds mainly upon loose Aufwuchs and has protruding teeth on the lower jaw which are well suited for 'scooping loose material from rock surfaces' (Fryer 1959a).

Genus *Iodotropheus* Oliver & Loiselle, 1972

This genus has only one species, *I. sprengerae* (Figure 18a), which is most easily recognized in the field by its rusty-red coloration, a slightly projecting lower jaw and the possession of a frenum which connects the upper lip to the snout. The outer row teeth are bicuspid and the inner rows tricuspid (Figure 18b – c). *I. sprengerae* occurs in the south-eastern parts of the lake (Table 13).

1. *Iodotropheus sprengerae* Oliver & Loiselle, 1972 (Plate 11g)

Synopsis. A small, reddish-brown non-territorial lithophilous species.

Distribution. Boadzulu I. (C), Chinyamwezi I. (C), Chinyankwazi I. (U).

Coloration. Boadzulu males: Body and head reddish-brown with purple-violet spots in the centre of each scale. Dorsal fin reddish-brown with orange lappets and trailing edges. Caudal fin reddish-brown with narrow blue streaks in the inter-ray membranes and an orange trailing edge. Anal fin brown with a purple cast, orange trailing edge and usually 2, sometimes 3, yellow egg-dummies. Pelvic fins orange-brown with narrow black submarginal bands and white leading edges.
Boadzulu females: Females brown with less red and purple than males.

Geographical variation. The populations at Chinyankwazi Island and Chinyamwezi Island have a little more red, but less purple than the Boadzulu Island form.

Habitat. I. sprengerae lives in a variety of rocky habitats being found over large rocks and slabs, among medium-sized rocks and among small rocks. It also occurs in areas where detritus and organic ooze accumulate in pockets among the rocks and occasionally in the intermediate zones at Boadzulu Island. It is most numerous between 3 and 15 m depth, but occurs from the surface to at least 40 m.

Territoriality. Members of this species are not territorial, occurring singly, in pairs or in small groups which seldom exceed 5 individuals.

Feeding. The members of this species feed by nipping at the Aufwuchs and upon plankton. Stomach contents of 9 specimens caught in 3 – 10 m depth at Chinyamwezi contained principally loose Aufwuchs (73%), insect larvae and nymphs (11%), phytoplankton (10%), zooplankton (4%) and C2 (2%). Stomach contents of 8 specimens caught in 5 – 12 m depth at Boadzulu Island all differed from one another and each contained a variety of food substances: 6 stomachs contained a high proportion of loose Aufwuchs; 3 contained insect larvae, 3 contained C2; 3 contained benthic crustaceans; 3 had pieces of leaves of terrestrial macrophytes; 2 contained phytoplankton, and part of a cormorant feather was found in the stomach of one individual.

Genus *Genyochromis* Trewavas, 1935

This genus is currently considered to be monotypic, but as the species shows so much variability with regard to coloration, it may eventually prove to be polytypic. *G. mento* is a lepidophage and fin-eater (Fryer, Greenwood & Trewavas 1955) and is readily recognized by its prominent lower jaw and broad mouth (Figure 19a – c). *G. mento* enjoys lake-wide distribution (Table 13).

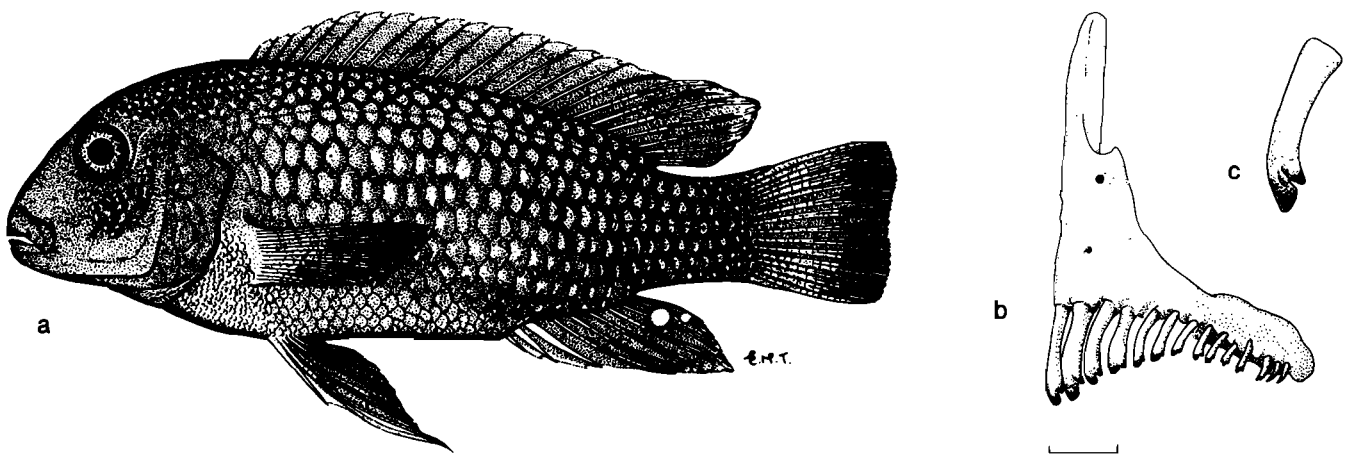

Figure 18 (a) *Iodotropheus sprengerae*, Chinyankwazi Island, 82 mm SL. (b) Lateral aspect of left premaxilla of *I. sprengerae* (Scale = 1 mm). (c) Anterior outer row tooth of *I. sprengerae*.

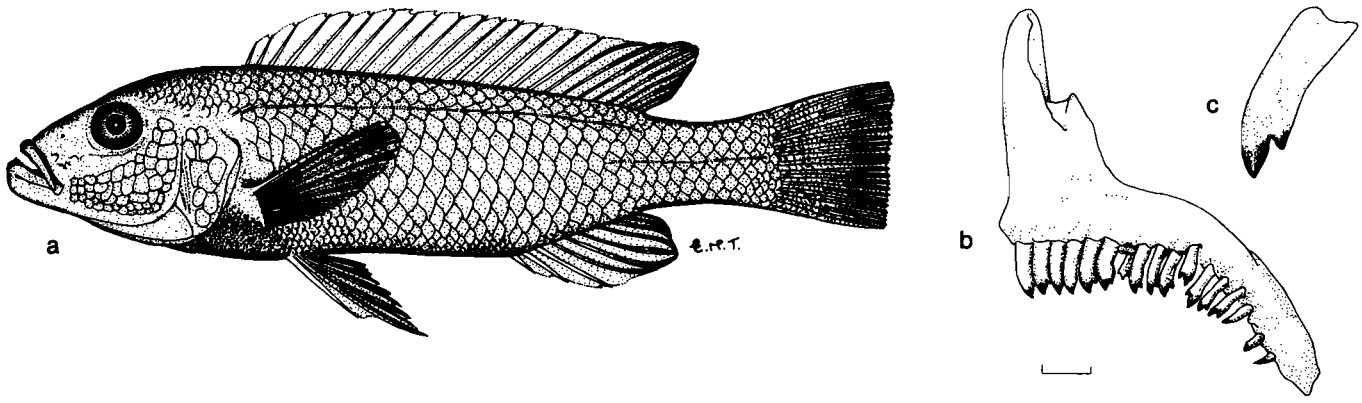

Figure 19 (a) *Genyochromis mento*, Monkey Bay, 85 mm SL. (b) Lateral aspect of left premaxilla of *G. mento* (Scale = 1 mm). (c) Anterior outer row tooth of *G. mento*.

1. *Genyochromis mento* Trewavas, 1935 (Plate 11h)

Synopsis. A lithophilous Mbuna which is specialized to feed upon scales and fins. It exhibits polychromatism.

Distribution. G. mento is present at every rocky shore we visited except Senga Point and Rifu. This fish is easily overlooked because it is usually solitary and has dark coloration, but can be readily located when searched for and is considered to be uncommon verging on common.

Coloration. We were normally unable to distinguish between males and females in the lake and so the notes given could refer to one or both sexes. Several different colour forms are present at each rocky shore:

(i) Pure black specimens at every site where the species occurs.
(ii) A fawn-coloured form with 10 – 11 grey bars, 2 grey bands and whitish fins at all sites.
(iii) A chocolate-brown form with prominent black submarginal bands in the dorsal, anal and pelvic fins, and with orange-tipped white lappets on the dorsal fin at Masinje Rocks, Makanjila Point, Eccles Reef, West Reef, Chinyankwazi I., Chinyamwezi I. and Chemwezi I.
(iv) An olive-green form with black submarginal bands in the dorsal, anal and pelvic fins at Nkopola.
(v) A dark grey form with 3 broken longitudinal bands of black patches at Likoma I. and Chisumulu I.
(vi) A khaki-green form with 2 dark grey longitudinal bands and 8 – 10 dark grey bars. Along the rocky shores of the north-western parts of the lake.
(vii) A plain grey form at Ruarwe, Chitande and Mpanga Rocks.
(viii) The orange-blotch (OB) form is rare — found at Boadzulu I., Nkudzi, Monkey Bay, Thumbi West I., Maleri I., Likoma I., Chisumulu I., Nkhata Bay and Chitande.
(ix) A tangarine-orange form at Chisumulu I. and at Mpanga Rocks.

The relation of the various colour forms to one another is unknown at present.

Habitat. G. mento occurs on all rocky shores and appears to be most numerous over large rocks and boulders. It occurs from the extreme shallows to at least 40 m depth and is most common in 3 – 12 m. It rarely ventures onto sandy substrata.

Territoriality. This species is apparently not territorial. Individuals are normally solitary and frequently when conspecifics are encountered, intraspecific aggression occurs.

Feeding. It feeds by darting towards passing cichlids, particularly the larger species, and biting pieces from their caudal and anal fins. Consequently, many lithophilous fishes have pieces missing from their fins (Plate 10i). Fryer (1959a) records that it feeds principally on the scales of *Labeo cylindricus* Peters, but while this may be correct we have never seen it removing scales from this species. We have, however, seen it rasp scales from the caudal peduncle and flanks of cichlids, though such feeding on scales is infrequent. *G. mento* is attracted to fighting cichlids and snaps up dislodged scales as they drift towards the substratum. Furthermore, while combatants are engaged in battle *G. mento* may approach more closely than normally permitted and tear pieces from the protagonists. *G. mento* has been seen harassing *Petrotilapia* spp. and also *Labeotropheus fuelleborni* combatants to such an extent that the protagonists ceased fighting to chase off the opportunistic lepidophage.

Many fishes respond to *G. mento* by chasing it before it can approach close enough to attack. Consequently, *G. mento* frequently hides in ambush until a prey species approaches closely and then darts out to bite a piece from the victim. *G. mento* was also observed feeding upon Aufwuchs and plankton. Analyses of stomach contents revealed that C1, C2, loose Aufwuchs, insects, plankton and benthic crustaceans are all included in the diet. We have never seen *G. mento* eat scales or fins of conspecifics.

Genus *Cyathochromis* Trewavas, 1935 (Figure 20a – c)

This monotypic genus superficially resembles members of the *Pseudotropheus zebra* species-complex, but it differs from all other Mbuna in its dentition. *Cyathochromis obliquidens* possesses teeth which have slender shafts and compressed spoon-like crowns; those of the outer series sloping obliquely towards the symphysis (Figure 20b & c). *C. obliquidens* is widely distributed in intermediate habitats (Table 13).

1. *Cyathochromis obliquidens* Trewavas, 1935 (Plate 11i)

Synopsis. A large Mbuna of the intermediate habitats in shallow water.

Distribution. Upper Shire River (U), Mangochi (C), Nkopola (C), Nkudzi (C), Mpandi I. (C), Kanchedza I. (C),

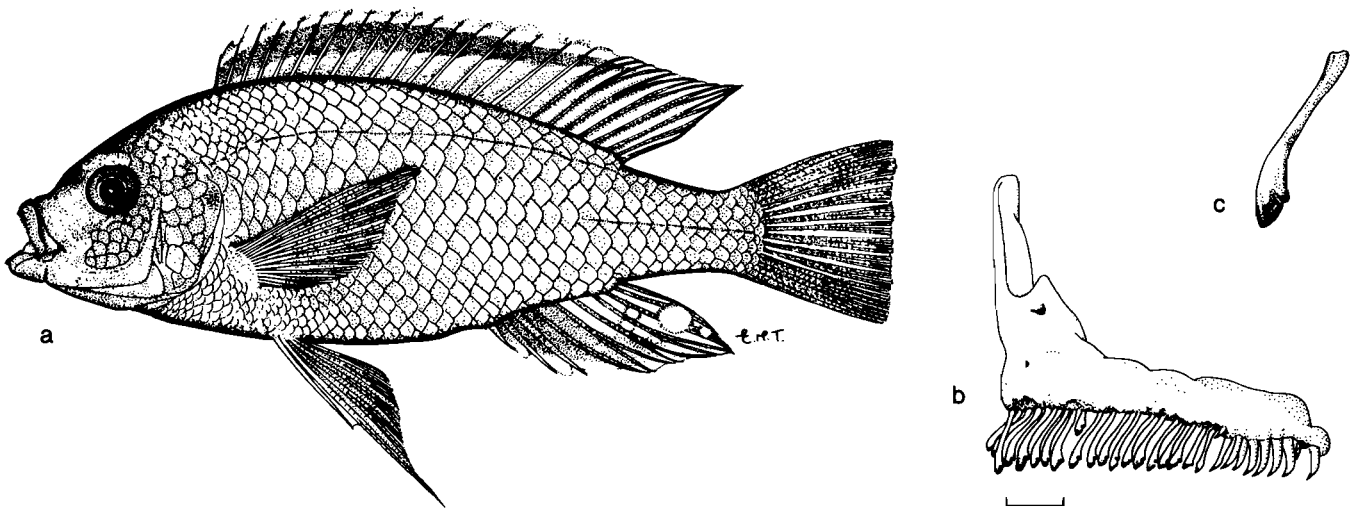

Figure 20 (a) *Cyathochromis obliquidens*, Monkey Bay, 102 mm SL. (b) Lateral aspect of left premaxilla of *C. obliquidens* (Scale = 1 mm). (c) Anterior outer row tooth of *C. obliquidens*.

Chigubi (C), Monkey Bay (C), Mvunguti (C), Domwe I. (U), Chemwezi I. (U), Makanjila Point (U), Masinje (U), Thumbi West I. (U), Otter Point (C), Mumbo I. (C), Maleri I. (U), Nankoma I. (C), Mbenji I. (U), Likoma I. (N), Chisumulu I. (U), Nkhata Bay (C), Lion's Cove (U), Usisya (U), Chitande (U). Exporters of ornamental fishes have told us that *C. obliquidens* also occurs in Lake Malombe. As our survey concentrated upon the rocky zones it is possible that this species is present at sites such as Ruarwe where the shallow-water intermediate zone (its preferred habitat) was not studied.

Coloration. Nkhata Bay males: Body olive-green with brown shoulder and chest. Head olive-green with iridescent purple edges to the opercula. Dorsal fin green with a prominent black submarginal band running through the spinous region; lappets blue along their bases, but otherwise bright yellow; rayed region bluish with yellow trailing region. Caudal fin olive-green at base, greyish distally with blue inter-ray membranes. Anal fin turquoise, but black anteriorly and purple posteriorly; 2 – 3 large yellow egg-dummies. Pelvic fins purple with black submarginal bands and white leading edges.

Nkhata Bay females: Body and head olive-green, almost khaki, with 10 – 11 dark brown bars, a narrow, brown mid-lateral band and a similar dorso-lateral band. Fins pale brown with whitish-brown spots.

Geographical variation. The other populations of *C. obliquidens* found along the north-western coast were similar in coloration and markings to the Nkhata Bay form, but at Likoma I. the ground colour is slate-blue with only a hint of olive-green. At Mbenji I. and Maleri I. it is similar to the Likoma I. form. At Monkey Bay, males are blue-green with olive-green shoulders, yellow-green chests and bellies; 5 grey bars are apparent anteriorly on the flanks. Head olive-green, tending to yellow dorsally, but greyish ventrally with a yellow tinge to the chin and gular region. South of Monkey Bay, towards Mangochi, the chin, gular region, chest and belly become increasingly yellow until they are bright yellow in the southernmost populations. The Chemwezi population is similar to that of Mangochi but not quite as yellow. At Masinje Rocks and Makanjila Point, *C. obliquidens* is not as yellow as the southern populations and the bodies are a deep slate-blue. Females showed virtually no geographical variation.

Habitat. Throughout its distribution *C. obliquidens* occupies intermediate habitats where sand and rock are mixed. It is also common in beds of *Vallisneria aethiopica* which are close to rocks. It is most numerous betwen 1,5 and 4 m, but has been seen to 6 m depth.

Territoriality. Males are aggressively territorial chasing conspecifics and other Mbuna species with which it shares the intermediate habitat, but other cichlids are attacked less often. Spawning sites are excavated either among the *V. aethiopica* or beneath rocks. In dense *V. aethiopica* beds some plants may be uprooted to accommodate the spawning site. Females, juveniles and non-territorial males occur singly or in small groups.

Feeding. Fryer (1959a) described the manner in which *C. obliquidens* brushes loose Aufwuchs from the rocks and from *V. aethiopica* fronds, and he found that stomach contents consisted almost entirely of loose Aufwuchs. We also found that stomach contents are dominated by loose Aufwuchs, and small proportions of C1, C2, plankton, insect larvae and benthic crustaceans were also present.

Genus *Microchromis* Johnson, 1975

A single species of an eleventh genus *Microchromis* was briefly and inadequately described in the aquarist literature and purported to come from Likoma Island. No such fish was found at Likoma Island nor was it recognized anywhere else during our survey. D.S.C. Lewis (pers. comm.) considers the description of this genus to be of doubtful validity.

OTHER CICHLIDS OF ROCKY HABITATS

In addition to the Mbuna, numerous other cichlids are sold as aquarium fishes. Table 14 lists some of the more common or colourful species which occur on the rocky shores. Where available, data on the distribution, coloration and role of these fishes within the rock-frequenting fish community are presented, but as the survey concentrated on the Mbuna many of the descriptions of the non-Mbuna are brief. Notes on piscivores, most members of the Utaka species-flock, and on several fishes which are adapted to