

RESULTS

Cichlid fishes of rocky habitats

THE MBUNA

Most Mbuna genera were described by Regan (1921) and Trewavas (1935) and are distinguished from one another principally by anatomical differences resulting from the evolution of trophic specializations. The classification is based upon differences in gross morphology, in jaw structure and in differences in the pattern and anatomy of the oral and pharyngeal dentition. The resulting generic diagnoses separated reasonably the 23 Mbuna species known in 1935. Since Trewavas's study, however, many more species have been discovered (we list 196 Mbuna taxa below) and, as a fairly high proportion of these do not conform to the original generic diagnoses, a revision of Mbuna systematics is necessary. Although the present study is not principally concerned with taxonomy the results provide data on coloration, behaviour and the habitat preference characteristic of each species. These data are valuable aids to identification and hence useful taxonomic tools.

In addition to the 10 described genera we recognize several different species-groups within the genera *Pseudotropheus* and *Melanochromis*. Some of these, such as the sibling species-complexes, are closely related and represent natural groups which are undoubtedly monophyletic. These monophyletic assemblages are referred to as species-complexes. Other species are grouped because they share a number of behavioural or morphological features though they are apparently polyphyletic; these are referred to as species-groups. Since these are probably polyphyletic groups there is little doubt that members of each will be assigned eventually to different taxonomic groups. The Mbuna group is a monophyletic species-flock (Trewavas 1935; Fryer 1959a; Fryer & Iles 1972), but a number of different branches from the monophyletic stem have contributed to some of the currently recognized genera and species-groups. The term polyphyletic is used below when referring to those groups which comprise several lineages.

This survey records 196 Mbuna taxa which have been assigned to the genera and species-groups as listed in Table 1. Of these 196 taxa only 49 are previously described, but there are described species which have not been included here either because they do not occur in the area studied or their descriptions are so inadequate that we were unable to match

Table 1 The number of species of Mbuna in each genus, species-complex and species-group

	Number of species
Genus <i>Pseudotropheus</i>	
<i>P. zebra</i> species-complex	27
<i>P. tropheops</i> species-complex	34
<i>P. williamsi</i> species-complex	8
<i>P. elongatus</i> species-group	24
<i>P.</i> 'aggressive' species-group	12
<i>P.</i> 'miscellaneous' species-group	20
Genus <i>Melanochromis</i>	
<i>M. melanopterus</i> species-complex	15
<i>M.</i> 'heterogeneous' species-group	5
Genus <i>Petrotilapia</i>	17
Genus <i>Labidochromis</i>	17
Genus <i>Cynotilapia</i>	10
Genus <i>Gephyrochromis</i>	2
Genus <i>Labeotropheus</i>	2
Genus <i>Iodotropheus</i>	1
Genus <i>Cyathochromis</i>	1
Genus <i>Genyochromis</i>	1
Total	196

them with species which we found. These additional Mbuna are discussed in the appropriate sections below.

Genus *Pseudotropheus* Regan 1921

Fryer (1957: 350) considers that the genus *Pseudotropheus* is 'rather ill-defined' since it is so very similar to the genus *Gephyrochromis*. He also notes (Fryer 1956a: 88) that the distinction between some of its members and fishes of the genus *Melanochromis* is very tenuous. With the increasing number of Mbuna discovered since 1957 the need for a taxonomic revision of the genus has grown. Our division of the genus into three species-groups and three species-complexes may provide taxonomic pointers to at least some of the divisions necessary within the genus.

The *Pseudotropheus zebra* species-complex (Figure 6a)

All species which resemble *Pseudotropheus zebra* anatomically are included in this species-complex. These

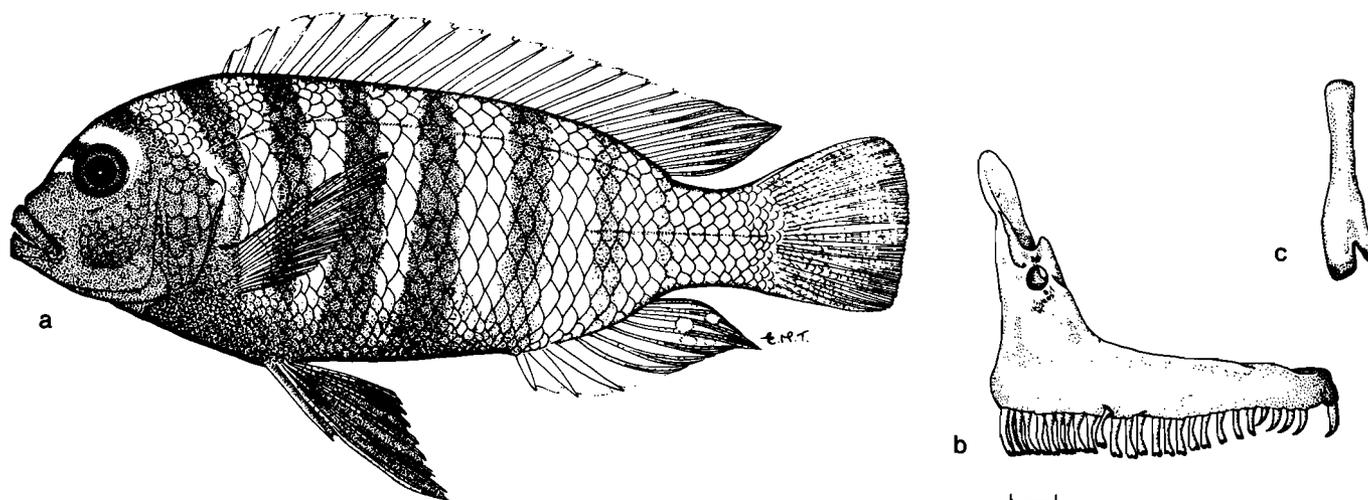


Figure 6 (a) *Pseudotropheus zebra*, Monkey Bay, 95 mm SL. (b) Lateral aspect of left premaxilla of *P. zebra* (Scale = 1 mm). (c) Anterior outer row tooth of *P. zebra*.

fishes have terminal mouths which they press against the rocks during feeding to collect loose Aufwuchs in the manner described by Fryer (1959a) and Holzberg (1978). Although their feeding behaviour is similar to that of *Petrotilapia* spp. and *Cyathochromis obliquidens* Trewavas, 1935, these genera differ anatomically, particularly in dentition. *P. zebra* as defined by Boulenger (1899), Trewavas (1935) and Fryer (1959a), has several rows of teeth of which the outermost are close-set and bicuspid (Figure 6b & 6c). The inner rows, three or four in number, are composed of tricuspid teeth which are long, rather mobile and widely separated. A few of the lateral teeth are conical (Figure 6b). A superficial examination of the dentition of several different members of this species-complex indicates that the teeth are not identical in all species. These differences in dentition are likely to be important anatomical features which may be used in the future to distinguish between at least some species of this complex.

Only 5 of the 27 species listed in Table 2 are described. *Pseudotropheus lanisticola* Burgess 1976 is not included in the list as it is considered to be conspecific with *Pseudotropheus livingstonii* Boulenger 1899.

1. *Pseudotropheus zebra* (Boulenger, 1899) (Plate 1a)

Synopsis. *P. zebra* is a blue and black barred species which is numerous among small and medium-sized rocks at many areas of the lake. It apparently prefers sediment-free zones of the shallow and middle depths. It exhibits

polychromatism.

Distribution. Nkopola (C), Nkudzi (N), Boadzulu I. (N–A), Kanchedza I. (N), Monkey Bay (N–A), Nankumba (N–A), Domwe I. (N), Zimbabwe I. (N), Thumbi West I. (N–A), Otter Point (C), Mumbo I. (N), Namalenje I. (N), West Reef (N), Eccles Reef (N), Makanjila (C), Masinje (C), Likoma I. (N–A), Chisumulu I. (N–A), Nkhata Bay (N–A), Lion's Cove (N–A), Dankanya Bay (N).

Coloration. Monkey Bay BB males: Body powder-blue with 8–10 black bars. Head light blue dorsally with black occipital and interorbital bars; lower half of snout as well as cheeks and opercula black, but chin blue and branchiostegal membranes light blue, almost white. Dorsal fin pale blue with yellow-orange spots on trailing edge. Caudal fin blue with yellow trailing edge. Anal fin dark blue anteriorly, pale blue posteriorly with variable number of yellow egg-dummies, but usually 3–7. Pelvic fins blue with black submarginal bands and white leading edges.

Monkey Bay BB females: Body and head pale blue almost white with darker blue blotches. Fins pale blue, 2–9 yellow-orange egg-dummies.

Monkey Bay OB females: Body and head yellow-orange though whitish-yellow in some individuals, with a variable number of black blotches and orange spots. A few orange individuals were found which did not have any black markings.

Table 2 The members of the *Pseudotropheus zebra* species-complex. 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)

Species	Maximum size		Distribution													
	mm (SL)	Locality	I	Ila	Iib	Iic	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. <i>Pseudotropheus zebra</i>	113	Likoma I.	+	+	+	+	–	+	+	–	+	–	+	+	–	–
2. <i>P. livingstonii</i>	121	SE Arm Trawl	+	+	+	+	–	+	+	–	+	–	–	–	–	–
3. <i>P. zebra</i> 'mazinzi'	94	Mazinzi	–	+	–	–	–	–	–	–	–	–	–	–	–	–
4. <i>P. elegans</i>	132	SE Arm Trawl	+	+	+	+	–	–	–	–	–	–	–	–	–	–
5. <i>P. zebra</i> 'fusco'	82	Maleri I.	–	+	–	–	–	i	–	+	–	+	–	–	–	–
6. <i>P. zebra</i> 'masinje'	77	Masinje	–	–	–	+	–	–	–	–	–	–	–	–	–	–
7. <i>P. heteropictus</i>	86	Thumbi West I.	–	–	–	–	–	+	–	–	–	–	–	–	–	–
8. <i>P. zebra</i> 'mumbo'	84	Mumbo I.	–	–	–	–	–	–	+	–	–	–	–	–	–	–
9. <i>P. zebra</i> 'blue'	82	Maleri I.	–	–	–	–	–	–	–	+	–	–	–	–	–	–
10. <i>P. zebra</i> 'red dorsal'	78	Nakantenga I.	–	–	–	–	–	–	–	+	–	–	–	–	–	–
11. <i>P. zebra</i> 'yellow throat'	102	Maleri I.	–	–	–	–	–	–	–	+	–	–	–	–	–	–
12. <i>P. zebra</i> 'black dorsal'	94	Maleri I.	–	–	–	–	–	–	–	+	–	–	–	–	–	–
13. <i>P. zebra</i> 'patricki'	74	Mbenji I.	–	–	–	–	–	–	–	+	–	+	–	–	–	–
14. <i>P. zebra</i> 'mbenji'	100	Mbenji I.	–	–	–	–	–	–	–	–	–	+	–	–	–	–
15. <i>P. lombardoi</i>	84	Mbenji I.	–	–	–	–	–	–	–	–	i	+	–	–	–	–
16. <i>P. livingstonii</i> 'likoma'	96	Likoma I.	–	–	–	–	–	i	–	–	–	–	+	–	–	–
17. <i>P. zebra</i> 'bevous'	88	Likoma I.	–	–	–	–	–	–	–	–	–	–	+	–	–	–
18. <i>P. aurora</i>	87	Likoma I.	–	–	–	–	–	i	–	–	–	–	+	–	–	–
19. <i>P. zebra</i> 'greberi'	94	Chisumulu I.	–	–	–	–	–	–	–	–	–	–	+	–	–	–
20. <i>P. zebra</i> 'cobalt'	85	Nkhata Bay	–	–	–	–	–	i	–	–	i	–	i	+	–	–
21. <i>P. zebra</i> 'gold'	94	Lion's Cove	–	–	–	–	–	–	–	–	–	–	–	+	–	+
22. <i>P. zebra</i> 'ruarwe'	79	Ruarwe	–	–	–	–	–	–	–	–	–	–	–	–	–	+
23. <i>P. zebra</i> 'chilumba'	115	Mpanga Rocks	–	–	–	–	–	–	–	–	–	–	–	–	+	+
24. <i>P. zebra</i> 'mpanga'	102	Mpanga Rocks	–	–	–	–	–	–	–	–	–	–	–	–	–	+
25. <i>P. zebra</i> 'chitande'	82	Chitande	–	–	–	–	–	–	–	–	–	–	–	–	–	+
26. <i>P. zebra</i> 'pearly'	89	Mpanga Rocks	–	–	–	–	–	–	–	–	–	–	–	–	–	+
27. <i>P. zebra</i> 'ianth'	82	Mpanga Rocks	–	–	–	–	–	–	–	–	–	–	–	–	–	+

Geographical variation. *P. zebra* is widespread and shows considerable geographical variation on coloration and markings. Some populations discussed here may be better categorized as subspecies or even as species if the specific mate recognition hypothesis of Paterson (1978) could be strictly and sensitively applied to these populations. For the time being, however, the populations grouped here are considered to be conspecific since they have in common a number of morphological, ecological and behavioural characteristics.

The differences in coloration of members of various populations from those of the Monkey Bay individuals are given for sexually active males, and where appropriate, for adult females.

The Zimbabwe Island form is darker than any other *P. zebra* population. The black vertical bars are broad and run into the dorsal fin where they merge to produce an almost entirely black fin (Plate 1b). The caudal anal and pelvic fins as well as the head are predominantly black. Females are almost entirely black with indistinct barring.

At Nkopola, Nkudzi, Mpandi Island and Kanchedza Island the dorsal fin is lime-yellow and the caudal and anal fins have a yellow cast (Plate 1c).

At Boadzulu Island the rayed portion of the dorsal fin is yellow. At Masinje Rocks the rayed portion of the dorsal fin has yellow spots.

At West Reef the black bars of the flanks run into the dorsal fin which has an orange rayed portion (Plate 1d).

Along the Nankumba Peninsula and at the islands of Domwe and Thumbi West the *P. zebra* populations appear identical to those of Monkey Bay, except at Mitande Rocks, off Thumbi West Island, where 40% to 60% of females are pinkish-yellow and unbarred.

At Otter Point the populations along the mainland rocky zones appear identical to those of Monkey Bay, but at Otter Island the head of males has a light blue lower half.

At Mumbo Island the dorsal fin has a yellowish tinge and a yellow-orange trailing portion. The vertical bars on the flanks penetrate a short distance into the dorsal fin.

Both sexes of the Namalenje Island population appear identical in coloration to the Monkey Bay forms.

At Likoma Island males are paler blue and at Ndumbi Rocks they are almost white.

Around the southern regions of Chisumulu Island (Same Bay, Membe Islet, Liwelo Bay) *P. zebra* males are so faintly barred that they appear almost uniformly pale blue, but the anal and pelvic fins have conspicuous black markings. Around the northern sector, at Machili Islet and Mkanila Bay, *P. zebra* males are distinctly barred. The upper half of the head is light blue and sharply divided from the lower black half. The diving stations at Chisumulu Island were too far apart to ascertain whether a colour gradation occurs or whether the differently coloured populations are abruptly divided at some intervening point.

From Chirombo Point to Dankanya Bay, the populations appear indistinguishable from those of Monkey Bay.

Habitat. This species lives in a variety of rocky habitats and is occasionally found over sand and among macrophytes, but it is most numerous among small-medium and medium-sized rocks where the sediment layer is thin. It is most common in 5–20 m, but its full depth range extends from the extreme shallows to at least 40 m. In many areas, however, its entire depth range is not used. For example at the point

of the Nkhata Bay peninsula *P. zebra* penetrates to 35 m, but within Nkhata Bay it is seldom seen below 20 m (p.920). One possible reason for this difference is that within Nkhata Bay the sediment layer covering the rocks below 20 m is thicker than at the point of the peninsula.

Territoriality. Males defend areas of about 100–200 cm diameter at Nkhata Bay (Holzberg 1978). These territories are usually centred around a hole among the rocks in which the resident spawns or takes refuge. Females, juveniles and non-territorial adult males occur in large schools, frequently numbering hundreds of individuals as well as singly or in small groups.

Feeding. The way in which *P. zebra* brushes loose Aufwuchs from the rocks was described by Fryer (1959a) and Holzberg (1978). Fryer (1959a) found that at Nkhata Bay *P. zebra* subsists entirely upon loose Aufwuchs. The stomachs of 36 territorial individuals caught in Monkey Bay contained on average 81% loose Aufwuchs, 16% benthic Invertebrata, 3% phytoplankton and tiny amounts of filamentous algae. Non-territorial fishes feed in the water column and their stomach contents were dominated by plankton. At times when plankton is abundant in Monkey Bay, territorial males also feed in the water column, taking large amounts of plankton. Indeed, at most areas we visited *P. zebra* fed upon plankton when it was available.

2. *Pseudotropheus livingstonii* (Boulenger 1899)

Synopsis. *P. livingstonii* lives mainly over sand where it finds refuge in the empty shells of the gastropod, *Lanistes nyassanus* (Plate 1e).

Distribution. Trawl samples of the Malawi Fisheries Department show that the species is common over much of the south-eastern and south-western arms of the lake. We found it at Makanjila (U), West Reef (U), Chemwezi (R), Crocodile Rocks (C), Boadzulu I. (R), Nkudzi (R), Mphandi I. (U), Kanchedza I. (U), Monkey Bay (Zambo) (C), Mvunguti (U), Otter Point (U), Thumbi West I. (R), and the Maleri Is. (R). We did not find *P. livingstonii* at Nkhata Bay and believe that Fryer (1959a) misidentified a fish we have called *P. zebra* 'gold' (its colours are given in Fryer & Iles 1972: 540).

Coloration. Monkey Bay males: Body violet-blue with 5 to 6 faint brownish-blue bars running across the flanks, but not onto the belly or chest; belly pale blue posteriorly, yellowish-blue anteriorly; chest golden-yellow. Head grey-blue dorsally, light blue ventrally with yellow chin and light blue interorbital bar. Dorsal fin violet-blue along its base, yellowish-orange distally with bright orange tips to the lappets. Caudal fin orange-yellow with light blue longitudinal streaks and light blue upper and lower edges. Anal fin grey-blue antero-dorsally, yellowish postero-ventrally with 1–3 yellow egg-dummies. Pelvic fins grey with black submarginal bands and white leading edges.

Monkey Bay females: Body pale brown basic colour with an overall blue tinge; the dorso-medial ridge, upper aspect of caudal peduncle and particularly the region above the shoulder dark brown frequently with magenta tinge; belly pale brown almost white in some individuals; 6–7 dark brown bars running about half-way across flanks from dorsum. Head grey-brown dorsally, light brown ventrally with iridescent purple-blue around the

mouth and along the edges of the opercula; chin and gular regions whitish-brown. Dorsal fin orange-yellow with blue tinge and orange lappets; rayed portion pale blue with pattern of orange and white streaks. Caudal fin pale blue with longitudinal orange and white streaks. Anal fin bright orange-yellow anteriorly, blue posterodorsally with a yellow egg-dummy. Pelvic fins hyaline posteriorly, black submarginally with white leading edges.

Geographical variation. The species probably forms a continuous series of local populations throughout its distribution along the sandy regions of the south-eastern and south-western arms of the lake. Nevertheless those populations in the south-eastern arm south of Nkudzi appear larger, deeper bodied and a darker blue than the other populations (unquantified observations).

Habitat. Lives principally over sand, but also in intermediate habitats and rarely over rock. *P. livingstonii* has been seen from 2,5–40 m depth and it has been caught in trawl samples to depths of 50 m.

Territoriality. The foci of *P. livingstonii* territories are the empty shells of the gastropod *Lanistes nyassanus* (Dr K. McKaye, pers. comm.). The shells are occupied by adults of both sexes, but we also found juveniles, some of which were very small, in these shells which indicates that shells are used as refuge sites from early in the lives of these fishes. When they are found away from shells, *P. livingstonii* are usually solitary or in small groups comprising fewer than five individuals.

Feeding. *P. livingstonii* feeds from sand, presumably taking epipelagic algae.

3. *Pseudotropheus zebra* 'mazinzi'

Synopsis. Pale blue males and brown females which inhabit a submerged rocky reef.

Distribution. Mazinzi Reef (N).

Coloration. Males: Body, head, dorsal and caudal fins pale blue. Anal and pelvic fins black with 1–3 yellow egg-dummies on anal fin.

Females: Body and head uniformly brown. Dorsal and caudal fins pale brown, but anal and pelvic fins dark brown to black.

Habitat. Over both rock and sand at the reef.

Territoriality. Males exclude all intruders from their territories, but appear a little more tolerant of heterospecifics than they are of conspecifics. Females, juveniles and non-territorial adult males form large schools above the reef.

Feeding. At the time of our visit to Mazinzi (November) virtually the entire population was feeding on plankton; a few individuals were seen to feed on epilithic Aufwuchs and from the sand.

4. *Pseudotropheus elegans* Trewavas, 1935

Synopsis. A large sand-dwelling species common in trawl samples.

Distribution. It has been caught in trawl samples in the south-east and south-west arms of the lake, at Nkhotakhota and at Bandawe. Jackson (1961a) reports that the type specimen was caught by Christy at Chilumba. We found

P. elegans at West Reef (R), Chemwezi (C), Crocodile Rocks (C), Boadzulu I. (R), Nkudzi (R) and Mazinzi (U).

Coloration. Mazinzi males: Body bluish with a brown tinge, but grey along dorsal ridge; chest and belly whitish with yellow tinge in some individuals; 5–6 broad grey-brown bars; caudal peduncle yellowish-brown. Head grey-blue dorsally, grey-brown below the level of the orbit; chin whitish; branchiostegal membranes yellow; interorbital bar light blue; opercular patch black. Dorsal fin whitish-grey with yellow spines and rays, lappets white with orange tips; inter-ray membranes white basally and yellow-orange distally; in some individuals the entire rayed portion yellow-orange. Caudal fin orange-yellow with pale blue inter-ray membranes. Anal fin grey-yellow with black submarginal band and white leading edge; 1–6 yellow egg-dummies. Pelvic fins orange-yellow with black submarginal bands and white leading edges. Pectoral fins bright yellow.

Females. Not known.

Habitat. Trawl samples and diving observations indicate that *P. elegans* is a sand-dweller. It also occurs at the sand-rock interface. At Chemwezi it was one of the more common Mbuna on the rocks. We found it at 6 m depth and it has been recorded to 76 m in trawl samples.

Feeding. Stomach contents of 58 specimens taken from a trawl sample off Nkudzi at 30 m depth contained on average, 78% benthic Invertebrata, 12% phytoplankton, 6% zooplankton and 4% loose Aufwuchs, mainly diatoms.

Note: Colour notes were made from a sample of more than 250 freshly caught males. Strangely, not one of the specimens taken in the trawl sample was a female.

5. *Pseudotropheus zebra* 'fusco' (Plate 1f)

Synopsis. Bright yellow males are conspicuous fishes of the intermediate zones, females are brown.

Distribution. All three Maleri Is. (C–N), Mbenji I. (C), Thumbi West I. (R), Nkudzi (U) and Mazinzi Reef (U).

Coloration. Maleri Island males: Body and head golden-yellow. Dorsal fin pale blue with yellowish tinge. Caudal fin yellow with blue cast. Anal fin pale blue with a single bright yellow egg-dummy (occasionally two egg-dummies). Pelvic fins yellow, but black submarginally with white leading edges.

Maleri Island females: Body and head brown, fins pale brown.

Geographical variation. *P. zebra* 'fusco' at Thumbi West Island (only one individual found), Mazinzi Reef and Nkudzi are superficially indistinguishable from the Maleri Island populations. Males at Mbenji Island are a brighter yellow and the dorsal and anal fins are lighter in colour with white dorsal fin lappets. Females in all populations appear identical.

Habitat. This species inhabits intermediate zones and lives over sediment-covered slabs. Depth distribution is dependent on the presence of intermediate zones which it follows from 3–27 m.

Territoriality. Males are aggressively territorial and ritualized intraspecific fights were common in the population at the north-western shore of Maleri Island. Sand-scrape nests

were found in many territories. Females are not territorial and are evenly dispersed over the intermediate habitats tenanted by territorial males.

Feeding. Members of this species feed in a manner typical of the *P. zebra* group. Surprisingly therefore, stomachs of 15 individuals caught at 6 m depth at Maleri Island contained on average, 44% insect larvae, 27% zooplankton, 14% phytoplankton and only 13% loose Aufwuchs with small proportions of filamentous algae. At the time we visited Mbenji Island (March 1980) zooplankton were common and the species spent a considerable amount of time feeding in the water column.

6. *Pseudotropheus zebra* 'masinje'

Synopsis. A small member of the *P. zebra* species-complex which inhabits the intermediate zone. Males are blue and yellow, females are brown.

Distribution. Masinje Rocks (U).

Coloration. Males: Body and head pale blue with faintly yellow belly, chest, gular region, chin and branchiostegal membranes. Fins pale blue with a yellow egg-dummy on the anal fin.

Females: Body and head uniformly brown with pale brown fins.

Habitat. Intermediate zones in 2–7 m depth.

Territoriality. Males hold territories over rocks and less frequently over sand where nests are usually excavated. Females form schools with juveniles and non-territorial adult males.

Feeding. This species was seen to feed from the rocks and to take plankton from the water column.

Note: This species is superficially similar to *P. zebra*, but it is smaller and not as vividly coloured.

7. *Pseudotropheus heteropictus* Staeck, 1980 (Plate 1g)

Synopsis. A fish of the rock-sand interface at the island of Thumbi West. It resembles *P. zebra*, but is not as deep-bodied.

Distribution. Thumbi West I. (C–N).

Coloration. Males: Body pale blue with 6–8 black bars traversing the flanks anterior to the vent and 4–6 faint bars crossing the body posterior to the vent; ventral part of chest and the belly dark grey. Head pale blue occipital region, but interorbital region black with two light blue bars; mouth, cheeks, opercula and gular region dark grey-blue. Dorsal fin pale blue with a broad black submarginal band; lappets white. Caudal fin blue at base with black upper and lower borders and white edges; trailing edge black. Anal fin black with white leading edge and 3–9 bright yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Body beige with 8–9 grey-blue vertical bars, belly whitish with faint bars. Head grey-brown with blue tinge and 2 prominent light blue interorbital bars; opercular spot black; chin and branchiostegal membranes whitish-yellow, though bright yellow in some individuals. Dorsal fin grey-brown with a black submarginal band; lappets and trailing edge yellow-orange; numerous orange ocelli. Caudal fin grey-brown with dark grey up-

per and lower borders and yellow-orange trailing edge. Anal fin orange, but hyaline along its base. Pelvic fins orange with black submarginal bands and white leading edges.

Habitat. *P. heteropictus* lives at the sand-rock interface, over slabs, over pockets of sand among the rocks and occasionally over broken rock. It is most numerous at 15 to 25 m, but occurs from 4 m to at least 40 m depth.

Territoriality. Males usually hold territories over sand and dig sand-scrape nests alongside or beneath rocks. They also defend territories over slabs and occasionally over purely rocky substrata. Territories are defended mainly against conspecifics, but heterospecific intruders are not tolerated in the vicinity of the nest. Females, juveniles and non-territorial adult males occur singly, in pairs, or in small groups of 3–8 individuals.

Feeding. Feeding behaviour is similar to that of *P. zebra*, but takes place in sediment-rich areas.

8. *Pseudotropheus zebra* 'mumbo' (Plate 1h)

Synopsis. A brown and beige species of the intermediate zones of Mumbo Island.

Distribution. Mumbo I. (C).

Coloration. Males and females: Body beige with 6–7 brown, wedge-shaped bars that taper towards the belly. Head beige with brown occipital and interorbital bars. Dorsal fin beige, but brown bars from the body extend across its base. Caudal fin grey-brown with a darker grey along the upper and lower borders. Anal and pelvic fins light brown with dark brown submarginal bands and white leading edges; 1–3 yellow egg-dummies on anal fin of males.

Habitat. This species inhabits the intermediate zone where its distribution follows the rock-sand interface in 3–25 m depth.

Territoriality. Males hold territories which they defend against conspecifics. Females and juveniles are usually solitary, though they occasionally occur in groups of 2–5 individuals.

Feeding. Members of this species were seen to feed from the Aufwuchs mat and from sandy substrata.

9. *Pseudotropheus zebra* 'blue' (Plate 1i)

Synopsis. A small lithophilous species. Males are pale blue. Females are light brown.

Distribution. Maleri I. (N) and Nankoma I. (C).

Coloration. Maleri Island males: Body and head pale powder-blue usually without a trace of barring. Dorsal, caudal and anal fin pale blue, almost white; 1–5 yellow egg-dummies. Pelvic fins pale blue with black submarginal bands.

Maleri I. females: Body and head light brown, fins yellow. 2–5% females of the OB colour morph.

Habitat. Common among small-medium rocks between 5 and 15 m, but the depth distribution extends from 0 to 25 m.

Territoriality. Males are territorial and while they frequently share space with other members of the *P. zebra* species-complex, their aggression is directed almost exclusively at

conspecifics. Females, juveniles and non-territorial adults form large schools.

Feeding. Stomach contents of 17 territorial males contained on average 76% loose Aufwuchs, 17% phytoplankton, 5% zooplankton and 2% benthic Invertebrata. Four non-territorial fishes had their stomach contents dominated by plankton (about 60% phytoplankton and 30% zooplankton) and the remaining 10% was loose Aufwuchs.

10. *Pseudotropheus zebra* 'red dorsal' (Plate 1j)

Synopsis. A distinctly barred, lithophilous species with a red dorsal fin.

Distribution. Endemic to Nakantenga I. (N) but a small population has been introduced to Maleri I. (R) by an exporter of aquarium fishes.

Coloration. Males: Body pale blue with 5 pitch-black bars anterior to the vent and 3–4 faint bars posterior to the vent; chest and belly black. Head black with two pale blue interorbital bars and a pale blue occipital bar. Dorsal fin orange-red and penetrated along its base by black vertical bars from the body. Caudal fin yellow-orange with blue inter-ray membranes. Anal fin light blue with 1–4 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Body blue-grey with black barring. Head black with blue-grey interorbital and occipital bars. Dorsal and caudal fins brownish-red. Anal and pelvic fins black.

Habitat. Occurs from 2 to 27 m over small to medium-sized rocks. It occupies essentially the same habitat as that used by *P. zebra* 'maleri-blue' at Maleri and Nankoma Islands.

Territoriality. Males defend territories against conspecific males only. Females, juveniles and non-territorial adult males occur in schools in the water column, but were also found singly among the rocks.

Feeding. Stomach contents of 12 individuals caught at 4–8 m depth indicated that this species had been feeding on loose Aufwuchs (43%), plankton (40%), benthic Invertebrata (12%) and filamentous algae (5%).

11. *Pseudotropheus zebra* 'yellow throat' (Plate 2a)

Synopsis. A large, lithophilous blue species of shallow waters with a yellow gular region.

Distribution. All three Maleri Is. (C–N).

Coloration. Males: Body sky-blue with 7–9 broad, blue bars; chest yellow ventrally. Head sky-blue with a darker blue occipital and interorbital bar; chin, gular region and branchiostegal membranes yellow. Dorsal and caudal fins pale blue with yellow tinge. Anal fin pale blue with black leading edge and 1–5 yellow egg-dummies. Pelvic fins yellow posteriorly, black anteriorly.

Females: Body dark brown sometimes almost black, with darker bars and yellowish chest. Head dark brown with yellow chin, gular region and branchiostegal membranes. Fins pale brown, but pelvics with black submarginal bands and an orange-yellow tinge.

Habitat. The preferred habitat is among small to medium-sized rocks in sediment-free zones. Members of this species are most numerous between 2 and 8 m, but rare beyond 12 m depth.

Territoriality. Only males hold territories, but they do not appear to be as aggressive in territorial defence as other lithophilous members of the *P. zebra* species-complex at the Maleri Islands. Females, juveniles and non-territorial males usually occur singly or in small groups.

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

12. *Pseudotropheus zebra* 'black dorsal' (Plate 2b)

Synopsis. A lithophilous fish of deep, sediment-rich habitats. Males are heavily barred with a prominent black band in the dorsal fin; females are light yellow.

Distribution. All three Maleri Is. (C).

Coloration. Maleri Island males: Body light blue with 7 conspicuous black bars anterior to the vent and 3 faint bars posterior to the vent; belly dark brown or black. Head pale blue except for a black patch on the forehead which is divided by a bright blue interorbital bar; cheek and chin rusty-red. Dorsal fin blue, but black bars of the body enter the fin to merge with the prominent black submarginal band; lappets white. Caudal fin pale blue with black margins. Anal fin black anteriorly, dusky-blue posteriorly, with 1–4 yellow egg-dummies. Pelvic fins black with white leading edges.

Maleri Island females: Body and head pale yellow, sometimes beige. Fins bright yellow.

Geographical variation. Males at Nakantenga are identical to those of Maleri Island except cheek and chin pale blue, not rusty-red. No variation of female coloration was noted.

Habitat. This species lives in deeper water than the other lithophilous members of the *P. zebra* species-complex at the Maleri Islands, occurring from 5 m down to the limit of the rocky zone (27 m), sometimes extending a few metres onto sand. The greatest numbers of this species are found between 15 and 20 m among broken medium-sized rocks. It also occurs over featureless slabs and occasionally over sand patches among rocks.

Territoriality. Males are aggressively territorial chasing both conspecifics and heterospecifics from their territories. Saucer-shaped nests are dug by those males which hold territories over sand. Females and other non-territorial members of this species are usually solitary.

Feeding. By virtue of the depth at which it lives, the rocks from which members of this species feed are normally covered by a layer of sediment. The stomach contents of eight individuals caught in 10 to 12 m depth at Nakantenga Island contained on average 35% loose Aufwuchs, 27% benthic crustaceans, 26% plankton, 6% insects and the remainder C₁ and C₂.

13. *Pseudotropheus zebra* 'patricki' (Plate 2c)

Synopsis. A shallow-water fish which lives over sand in close proximity to rocks.

Distribution. Maleri I. (U), Nankoma I. (U), Namalenje I. (U) and Mbenji I. (C).

Coloration. Mbenji males: Body pale brownish-yellow with a mustard-yellow patch on the shoulder; 5–6 brown bars traverse the flanks. Head pale brown with mustard-yellow occipital region and grey snout; two bright silvery-

blue inter-orbital bars are conspicuous features of this species. Dorsal fin yellowish-blue with yellow lappets. Caudal fin yellow-brown with longitudinal pale blue streaks and narrow, black upper and lower borders. Anal fin black anteriorly, lilac-blue posteriorly with 1–2 large, yellow egg-dummies. Pelvic fins dusky-yellow, black submarginally with white leading edges.

Mbenji females: The same colours as males but relatively drab.

Geographical variation. The populations at Namalenje Island and at the two northern Maleri Islands are a sandy-brown with faint yellow shoulders and occipital regions; they are not as intensely marked as the Mbenji Island population.

Habitat. Inhabits sandy areas among rocks or near to rocks in sediment-rich areas. Although it is seldom found over purely rocky habitats, it is not found more than 5 to 7 m from the rocks. *P. zebra* 'patricki' is most numerous at 3–7 m depth, but its depth distribution extends from 1–12 m.

Territoriality. Males are territorial and normally excavate sand-scrape nests, most frequently alongside or beneath rocks, but also in sand several metres from the nearest rocks. They are vigorous in the defence of their territories, usually directing aggression conspecifically. Females, juveniles and non-territorial adult males are normally solitary.

Feeding. This species feeds from sand and rock substrata and on plankton in the water column.

14. *Pseudotropheus zebra* 'mbenji' (Plates 2d & 2e)

Synopsis. A large deep-bodied lithophilous species of Mbenji Island which exhibits polychromatism.

Distribution. Mbenji I. (C).

Coloration. Males: Body pale powder-blue with very faint traces of vertical barring. Head powder-blue with a dark blue interorbital bar. Dorsal fin yellow-orange. Caudal fin blue, usually with orange borders. Anal and pelvic fins pale blue. OB forms marbled blue on white.

Females: Body and head dark brown with orange-brown unpaired fins. Pelvic fins orange with thin black submarginal bands and white leading edges. OB forms whitish-yellow with black blotches.

Habitat. It is more common on exposed, wave-washed shores than in sheltered sediment-rich regions which suggests that it prefers sediment-free zones. Inhabits predominantly medium-sized rocks from 1 to 19 m depth, and is most numerous between 5–15 m.

Territoriality. Territorial aggression of males is confined almost entirely to conspecific male intruders. Females and other non-territorial individuals form schools of 10–50 fishes, often in mixed groups with *Cynotilapia* spp. and *P. lombardoi*.

Feeding. Territorial males do feed principally from the Aufwuchs mat within their territories, but at the time of the survey (May 1980) zooplankton was abundant and many individuals joined feeding females and juveniles in the water column.

15. *Pseudotropheus lombardoi* Burgess, 1976.

Synopsis. Yellow males and blue females of sediment-rich areas.

Distribution. Endemic to Mbenji I. (C) but introduced to Namalenje I. (R) by an exporter of aquarium fishes.

Coloration. Males: Body bright golden-yellow with black barring which may disappear completely in highly motivated fishes. Head golden-yellow. Dorsal fin yellowish-blue, darker yellow in rayed portion; lappets whitish. Caudal fin yellow with pale blue longitudinal streaks. Anal and pelvic fins yellow. Egg-dummy bright yellow.

Females: The entire fish pale blue with 5 black vertical bars that extend from immediately below the dorsal fin lappets across the flanks and taper off before reaching the belly. Black occipital and interorbital bars present and black markings in the rayed part of the dorsal fin and on the caudal fin.

Habitat. *P. lombardoi* is usually found in areas rich in sediment and is most numerous at the sand-rock interface and over large flat rocks. However, it also occurs among medium-sized rocks. It lives from 2 to 25 m depth and is most numerous in water deeper than 10 m.

Territoriality. Males are strongly aggressive intraspecifically, but weakly aggressive towards heterospecific intruders. Those individuals which hold territories over sand in the intermediate zone excavate nests, usually digging beneath rocks. Females, juveniles and non-territorial adults occur singly or in small groups.

Feeding. *P. lombardoi* feeds on plankton and from both rocky and sandy substrata.

Note: Males of most haplochromines of Lake Malawi are blue when sexually active, but *P. lombardoi* is unusual in that females are blue with black barring while males are golden-yellow with black barring.

16. *Pseudotropheus livingstonii* 'likoma' (Plate 2f)

Synopsis. Superficially resembles *P. livingstonii* and also inhabits sandy zones and intermediate areas. Juveniles take refuge in snail shells.

Distribution. Endemic to the southern half of Likoma I. (N), but an introduced population occurs at Thumbi West I. (R).

Coloration. Likoma males: Body light brown with mauve-blue flecks of colour on the scales; 6–7 mauve-brown bars of equal intensity traversing flanks, but not extending onto belly. Head light brown with iridescent mauve cheeks, lips and edges to the opercula; interorbital bar bright blue-mauve. Dorsal fin pale brown with a poorly defined narrow blue submarginal band and orange lappets; rayed portion yellowish-brown. Caudal fin light brown with pale blue rays, and an overall blue tinge. Anal fin black, with white leading edge, a hyaline area postero-dorsally and 2–3 yellow egg-dummies. Pelvic fins black with white leading edges.

Likoma females: Body beige with 6–7 grey-brown bars traversing flanks, but not extending onto belly. Head dark grey-brown dorsally and light brown ventrally with a blue tinge on the lips, around the mouth, on the opercular spot and on the posterior edge of the operculum. Dorsal fin hyaline with a hint of blue; lappets whitish; rayed portion pale brown. Caudal fin pale brown with light blue rays. Anal fin black with white leading edge

and 2–3 yellow egg-dummies. Pelvic fins black with white leading edges.

Habitat. Common in intermediate habitats and over sand, but uncommon in purely rocky environments. Usually found in water less than 15 m deep, but juveniles have been seen inhabiting the shells of *Lanistes nyassanus* down to a depth of 23 m.

Territoriality. Throughout most of its distribution range this species appeared to be non-territorial, normally being found in mixed schools comprising adults and subadults of both sexes. These schools usually numbered between 15 and 60 individuals, but occasionally schools of about 200 members were seen. A large group of territorial fish was found in 4–12 m depth at Ponyemba, where parallel ridges of rock run out towards Masimbwe Islet. The territorial fishes were about 2 m apart, were highly aggressive intraspecifically and their defended areas were usually at the base of the rocks and centred around sand-scrape nests. Approximately 25% of the territorial fishes defended areas which were entirely on the rocky ridges. Associated with these males were numerous females and non-territorial males which remained 2–3 m above the males in the water column, apparently feeding on plankton.

Feeding. *P. livingstonii* 'likoma' feeds from rock and sand substrata. The stomach contents of 13 individuals caught at Khuyu Bay contained on average, 68% benthic invertebrates, 20% loose Aufwuchs, 8% plankton and 4% C1. However, they have been seen to orientate themselves to plankton-bearing currents where they fed exclusively upon plankton. Also, during the construction of an artificial reef at Khuyu Bay this species was seen to tear wads of filamentous algae from rocks which had been collected in the extreme shallows and placed on the reef.

17. *Pseudotropheus zebra* 'bevous' (Plate 2g)

Synopsis. An elongate member of the species-complex which inhabits the rock-sand interface.

Distribution. Likoma I. (U) and Chisumulu I. (U).

Coloration. *Likoma males:* Body blue with 8–9 narrow black bars, but belly uniformly grey-blue. Head greyish-blue with a dark grey opercular patch. Dorsal fin pale blue with a narrow black submarginal band and white lappets that are yellow-tipped. Caudal fin blue with black upper and lower borders and white edges. Anal fin blue-grey with a black submarginal band and a white leading edge, 1–4 yellow egg-dummies. Pelvic fins grey-blue with black submarginal bands and white leading edges. *Likoma females:* Body light grey with darker grey barring. Head dark grey. All fins light grey, but black submarginal bands on anal and pelvic fins.

Geographical variation. The males at Chisumulu Island differ from those at Likoma Island by having a yellowish chest, inconspicuous barring, a bright blue opercular patch and blue lips. The rayed portion of the dorsal fin yellow-orange. Caudal fin yellowish-blue with orange trailing edge. In some individuals the rayed portion of the dorsal fin may be darkened by a dorsal fin-spot. Pelvic fins have yellowish-white leading edges. Females resemble those of Likoma Island.

Habitat. Inhabits the rock-sand interface zone from 6 to

36 m, but is most numerous between 10 and 25 m.

Territoriality. Males defend territories over sand, among rocks, and occasionally in purely rocky environments in proximity to sandy areas. Sand-scrape nests are dug. Most aggression is directed towards conspecifics. Females are not territorial, usually occurring singly or in small groups (2–8 individuals) with other non-territorial conspecifics.

Feeding. Members of this species were seen to brush the Aufwuchs in a *P. zebra*-like manner. Occasionally individuals gripped the algae and jerked it from the rocks. *P. zebra* 'bevous' was also observed feeding upon zooplankton.

18. *Pseudotropheus aurora* Burgess, 1976

Synopsis. An inhabitant of the intermediate zones of shallow water. Males blue and yellow, females brown.

Distribution. Endemic to the southern half of Likoma I. (C) occurring from Madimba Bay to Ulisa (Figure 55). It has also been introduced to Otter Point (U) and Thumbi West I. (U) by exporters of aquarium fishes.

Coloration. *Likoma Island males:* Body violet-blue dorsally, powder-blue lower flanks and belly; chest and anterior part of belly golden-yellow; 6–7 blue-grey bars present, but usually very faint in sexually active individuals. Head violet-blue dorsally with the occipital region tending to grey in some individuals; cheeks, chin, gular region and branchiostegal membranes golden-yellow; interorbital bar indistinct pale blue. Dorsal fin yellow with light blue rayed portion and an indistinct narrow, blue submarginal band. Caudal fin yellow with blue cast. Anal fin pale blue, tending to yellow posteriorly with a bright yellow egg-dummy. Pelvic fins yellow with white leading edges.

Likoma Island females: Body and head brown; fins beige.

Habitat. *P. aurora* inhabits the intermediate zones being particularly common along the rock-sand interface. Occasionally it occurs in purely rocky habitats which are close to sand. It has never been found below 8 m depth and is most numerous between 2 and 5 m.

Territoriality. Territories are held by males, usually over the upper surfaces of medium-sized and large rocks, but a small proportion of males occupy less prominent sites and some defend areas at the base of rocks where they dig sand-scrape nests. Females, juveniles and non-territorial adult males occur singly or in groups of up to 30 individuals.

Feeding. Frequently *P. aurora* were seen in schools with *Utaka*, *Cynotilapia afra* and *P. zebra* in the water column above the rocks where they fed on plankton. Normally, however, they fed from the rock and sand substrata.

19. *Pseudotropheus zebra* 'greberi' (Plate 2h)

Synopsis. A deep-bodied fish of sediment-rich zones in deeper water.

Distribution. Chisumulu I. (C).

Coloration. *Males:* Body pale blue with 8–9 golden-brown bars; chest golden. Head golden with blue tinge dorsally; occipital bar golden-brown and interorbital bars light blue. Dorsal fin pale blue with white lappets and a lime-

yellow trailing edge. Caudal fin pale blue suffused with yellow. Anal fin blue with 2–7 yellow egg-dummies. Pelvic fins yellowish with narrow black submarginal bands and white leading edges.

Females: Body grey-blue with darker grey barring and pale grey fins.

Habitat. It is most numerous in sediment-rich areas between 10 and 35 m depth where it lives among small and medium-sized rocks, occasionally venturing onto slabs and large rocks.

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

Feeding. Feeds on plankton and Aufwuchs.

20. *Pseudotropheus zebra* 'cobalt'

Synopsis. Anatomically identical to *P. zebra*, but differs in that individuals are either uniformly cobalt-blue or pure white.

Distribution. Endemic to the Nkhata Bay area (N) where it inhabits the rocky zone from Chirombo Point to the southern shores of Dankanya Bay. Mara Rocks (U). It has also been introduced to the islands of Likoma (R), Namalenje (R) and Thumbi West (C–N) by exporters of aquarium fishes.

Coloration. Most males uniformly cobalt-blue and some individuals with 6–8 faint, incomplete bars. Rarely, white individuals defend territories and, although white is the female coloration, Holzberg (1978) believes that these territorial individuals are white males. Most females pure white, but blue females also occur though they are never the brilliant blue of males (Holzberg 1978).

Habitat. *P. zebra* 'cobalt' inhabits areas of small and medium-sized rocks within a depth range of 0–25 m. It is most common from 3 to 10 m and appears to avoid sediment-rich areas.

Territoriality. Males are territorial (Holzberg 1978). Females, juveniles and non-territorial adult males usually form schools, but also occur singly among the rocks.

Feeding. It is assumed that, since these fishes feed in the same manner as *P. zebra* and since Fryer (1959a) considered them to be conspecific with *P. zebra* in his analysis of stomach contents, *P. zebra* 'cobalt' feeds principally upon loose Aufwuchs.

Note: In his study of the Mbuna at Nkhata Bay, Fryer (1959a) considered *P. zebra* to show a higher degree of polychromatism than it actually has for he believed *P. zebra* 'cobalt' to be conspecific with *P. zebra*. Holzberg (1978) showed that the BB, OB and O forms of *P. zebra* did not spawn with the white (W) and blue (B) forms of *P. zebra* 'cobalt'. He also found behavioural and ecological differences between the two species.

21. *Pseudotropheus zebra* 'gold' (Plate 2i)

Synopsis. A golden member of the species-complex. It occurs in sediment-rich areas of deeper water.

Distribution. Chirombo Point to Ruarwe (C) along north-western shores, but absent from Mara Rocks, Mpanga

Rocks and Chitande.

Coloration. Nkhata Bay males: Body gold with 8–9 brownish-blue bars. Head gold with a grey-brown snout and occipital region; two light blue interorbital bars. Dorsal and caudal fins yellow. Anal fin golden with pale blue edges and a bright yellow egg-dummy. Pelvic fins golden-yellow with black submarginal bands and light blue, almost white, leading edges.

Nkhata Bay females: Similar to males but dull brownish-yellow.

Geographical variation. Males at Lion's Cove are brighter yellow with fainter barring. At Ruarwe the bars are dark brown and the belly, chest, pelvic fins and head are black. The anal fin of the Ruarwe form is predominantly black, but retains its light blue edging.

Habitat. Occurs over rocks of a variety of sizes and in intermediate zones, but is most common among medium-sized and medium-large rocks of sediment-rich areas. Its full depth range is from 5 to at least 40 m and it is most numerous between 12 and 25 m.

Territoriality. Territorial males direct their aggression principally at conspecifics. Where territories are in the intermediate zones, sand-scrape nests are excavated. Non-territorial fishes are usually solitary but also form small groups of up to 15 individuals.

Feeding. This species was seen to feed from the rock surface and on plankton in the water column. Fryer (1959a) reports that its stomach contents contained loose Aufwuchs (Fryer 1959a identified this fish as *P. livingstonii*).

22. *Pseudotropheus zebra* 'ruarwe'

Synopsis. An elongate member of the *P. zebra* species-complex which inhabits the intermediate zone.

Distribution. Ruarwe (C).

Coloration. Males: Body sky-blue with 4 dark blue bars on the anterior half of the flanks and 3–4 lighter bars posteriorly. Head dark grey along the occipital region and snout; two light blue interorbital bars and a light blue occipital bar. Dorsal fin pale blue with a prominent black submarginal band which is narrow anteriorly, but broadens posteriorly; lappets light blue to almost white. Caudal fin pale blue with black upper and lower borders and white edge; rays black. Anal fin hyaline posteriorly, black submarginally with a white leading edge; 3–6 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Colours not recorded.

Habitat. Lives in the intermediate zone particularly along the rock-sand interface, but also in other regions where sand occurs between the rocks. It was found from 5 to 35 m depth, but was most common at about 20 m depth.

Territoriality. Males hold territories over sand where nests are dug alongside or beneath rocks. Females and other non-territorial individuals form schools of 5–30 members.

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

23. *Pseudotropheus zebra* 'chilumba' (Plate 2j)

Synopsis. A large, deep-bodied member of the *P. zebra*

species-complex which lives among rocks in sediment-free zones. A characteristic of the species is the black submarginal band in the dorsal fin.

Distribution. Chilumba at Mpanga Rocks (C), Chitande (C – N) and at the base of the harbour wall (U); Ruarwe (C), Mpandi Point (U), Usisya (C) and Mara Rocks (C).

Coloration. *Chitande males:* Body pale blue with 4 pitch-black bars on the anterior half of the body and 4 – 5 faint bars on the posterior half; belly unbarred. Head pale blue with two black interorbital bars, a black occipital bar and a black line above the upper lip; gular region and branchiostegal membranes yellow. Dorsal fin pale blue with pitch-black, prominent submarginal band and light blue, almost white, lappets; trailing portion pale blue with yellow ocelli. Caudal fin pale blue. Anal fin pale blue with 1 – 5 yellow egg-dummies. Pelvic fins black with light blue almost white leading edges.

Chitande females: Body and head grey with black barring similar to that of males; gular region and branchiostegal membranes off-white, tinged with yellow. Unpaired fins light grey with a black submarginal band in the dorsal fin. Pelvic fins black with white leading edges.

Geographical variation. This species shows considerable geographical variation. The form at the harbour wall at Chilumba appears the same as that found at Chitande, but that at Mpanga Rocks has pale yellow, almost white chest, gular region and chin (not bright yellow); its submarginal band in the dorsal fin is narrower and does not run the entire length of the fin. At Ruarwe the species is similar to the Chitande form. At Usisya and Mpandi Point it resembles the Chitande form, but the posterior half of the dorsal fin is red. At Mara Rocks the barring is very faint, as is the submarginal band in the dorsal fin. Females are similar to the Chitande form at all sites, except Mara Rocks where the barring is inconspicuous.

Habitat. It is a lithophilous fish favouring medium-sized rocks in sediment-free zones; it does occur over large rocks (Mara Rocks and Mpanga Rocks) and also over small rocks (Usisya and Mpandi Point) close to sandy areas. Common between 2 and 15 m but found from the extreme shallows to at least 21 m.

Territoriality. Males are territorial, exhibiting mainly intraspecific aggression. Females and other non-territorial individuals usually occur in small schools, but some individuals are solitary.

Feeding. Seen to feed on Aufwuchs and from plankton.

24. *Pseudotropheus zebra* 'mpanga' (Plate 3a)

Synopsis. A member of the *P. zebra* species-complex which has an orange dorsal fin and is found at Mpanga Rocks.

Distribution. Mpanga Rocks (C).

Coloration. *Males:* Body pale blue with 7 – 8 black bars, becoming fainter posteriorly; belly and chest black. Head black with pale blue interorbital and occipital bars. Dorsal fin orange with white lappets. Caudal fin blue basally, yellowish-blue distally with white upper and lower edges. Anal fin black, but with hyaline trailing edge and 3 – 8 yellow egg-dummies and a white leading edge. Pelvic fins black with white leading edges.

Females: Same as males, but relatively drab.

Habitat. It lives among medium-sized and large rocks as well as over boulders in sediment-free zones. This species is common between 2 and 25 m, but may be found in the extreme shallows and to a depth of at least 31 m.

Territoriality. Males are territorial, defending their territories principally against conspecifics. Females are not territorial and usually occur in schools, but may also be solitary.

Feeding. They were seen to feed upon Aufwuchs and plankton.

Note: *P. zebra* 'mpanga' is very similar to *P. zebra* and could be conspecific with it. However, it co-exists with a sibling species (*P. zebra* 'chilumba') which might have equally valid claims to conspecificity with *P. zebra*, and it inhabits a region in which the rocks are larger than those normally frequented by *P. zebra* (except for the *P. zebra* population on Zimbabwe which lives over large rocks and boulders). For the time being, therefore, the Mpanga Rocks population is categorized separately.

25. *Pseudotropheus zebra* 'chitande'

Synopsis. A small lithophilous member of the *P. zebra* species-complex which exhibits polychromatism.

Distribution. Chitande (C).

Coloration. *Males:* Body and head sky-blue, with faint grey-blue barring on the flanks. Dorsal, caudal and anal fins pale blue with 2 – 5 yellow egg-dummies on the anal fin. Pelvic fins black. No OB males seen.

Females: Body and head grey, fins pale grey with black blotches.

Habitat. The preferred habitat appears to be among small and medium-sized rocks in 5 – 15 m depth. The total depth range of this species is from the extreme shallows where rocks are sediment-free down to at least 30 m where a heavy sediment mantle covers the rocks.

Territoriality. Males defend territories principally against conspecifics. Females are not territorial.

Feeding. It feeds from the rocks and on plankton.

26. *Pseudotropheus zebra* 'pearly' (Plate 3b)

Synopsis. A small lithophilous member of the *P. zebra* species-complex; both sexes white.

Distribution. Mpanga Rocks (U) and Ruarwe (U – C).

Coloration. *Males:* Pearly white with bluish-white fins.
Females: Creamy white.

Habitat. It is most common among small and medium-sized rocks, where territories are held. However, the members of this species appear to range widely to feed and are found in other rocky habitats. It occurs from the surface waters down to at least 35 m depth, but is most numerous in 4 – 18 m.

Territoriality. *P. zebra* 'pearly' is probably the least aggressive member of the *P. zebra* species-complex. Although males defend territories against conspecifics, they may leave their territories to feed. Females and other non-territorial individuals are usually solitary, but were occasionally seen

in small groups numbering less than five.

Feeding. Members of this species feed on Aufwuchs and plankton. *P. zebra* 'pearly' appears to be more closely tied to the rocks than other members of the *P. zebra* species-complex and does not rise more than about 0,5 m above the bottom to catch plankton.

27. *Pseudotropheus zebra* 'ianth' (Plate 3c)

Synopsis. A small lithophilous violet-grey member of the *P. zebra* species-complex.

Distribution. Mpanga Rocks (U).

Coloration. Males: Body off-white with violet tinge, 7–8 purple-brown bars. Head pale brown with violet-tinged cheeks, a grey-brown snout and occipital region and a pale bluish-white interorbital bar. Dorsal fin yellowish-brown, but rayed portion grey-brown with blue-tinged inter-ray membranes; lappets white. Caudal fin grey-brown with dark grey, almost black upper and lower borders. Anal fin black with light blue leading edge and a single large, yellow egg-dummy. Pelvic fins hyaline posteriorly, black submarginally with white leading edges.

Females: Similar to males, but without the violet and purple sheen.

Habitat. This species was found in regions where small rocks had collected among the large rocks and boulders that characterize Mpanga Rocks and were seldom seen away from these areas. It occurs from 4 to 16 m depth.

Territoriality. Males are aggressively territorial chasing mainly conspecifics, but also heterospecifics, some of which were much larger than themselves.

Feeding. Seen to feed from the Aufwuchs mat and from the water column.

Pseudotropheus tropheops species-complex

Pseudotropheus tropheops Regan, 1921 was one of the first Mbuna to be described. A similar species was described by Ahl (1927) as *P. macrophthalmus*, and Trewavas (1935) described a closely related species, *P. microstoma*, as well as a subspecies, *P. tropheops gracilior*, leaving Regan's

species as the nominal subspecies.

Fryer (1959a) did not recognize the species and subspecies previously described and assigned them all to *P. tropheops*, arguing that the morphological differences which had been used to distinguish them were merely expressions of an unusually large degree of intraspecific variability. It is now apparent that many members of the *P. tropheops* species-complex exist (Table 3). Members of this group are recognized by the profile of the snout which descends steeply (Figure 7a). The angle at which the snout descends varies slightly from one species to the next but is nonetheless a clear distinguishing feature of the group. The mouth in most species is slightly subterminal and feeding is usually effected at an angle of about 45° to the rock surface. Algae are nipped from the rocks with a sideways and upward jerk of the head.

A superficial examination of the dentition of members of this species-complex indicates that all species are similar, each having an outer series of bicuspid teeth, several inner rows of tricuspid teeth and a series of large conical teeth on the lateral edges of the upper jaws (Figures 7b & c).

P. tropheops romandi Colombe, 1979 is reputedly from Likoma Island, though no such fishes were found there during this survey. We believe that the female is *P. tropheops* 'intermediate' from Thumbi West Island, but we are unable to identify the male (the holotype) from Colombe's description. As it is likely that two different species are included in the type series of *P. tropheops romandi* we do not use the name here. We have included in the *P. tropheops* species-complex a species which resembles *Pseudotropheus novemfasciatus* Regan, 1921 as it has a sloping head profile. This fish is referred to as *P. cf. novemfasciatus* as it has not been established positively that Regan's species and that which we recognize are the same.

1. *Pseudotropheus cf. gracilior* (Plate 3d)

Synopsis. This is an elongate broad-mouthed species of deeper waters favouring sediment-coated rocks in the south-western regions of the lake.

Distribution. Nkudzi (C), Kanchedza I. (U), Monkey Bay (C), Mvunguti (C), Domwe I. (C), Thumbi West I. (C) and Otter Point (C).

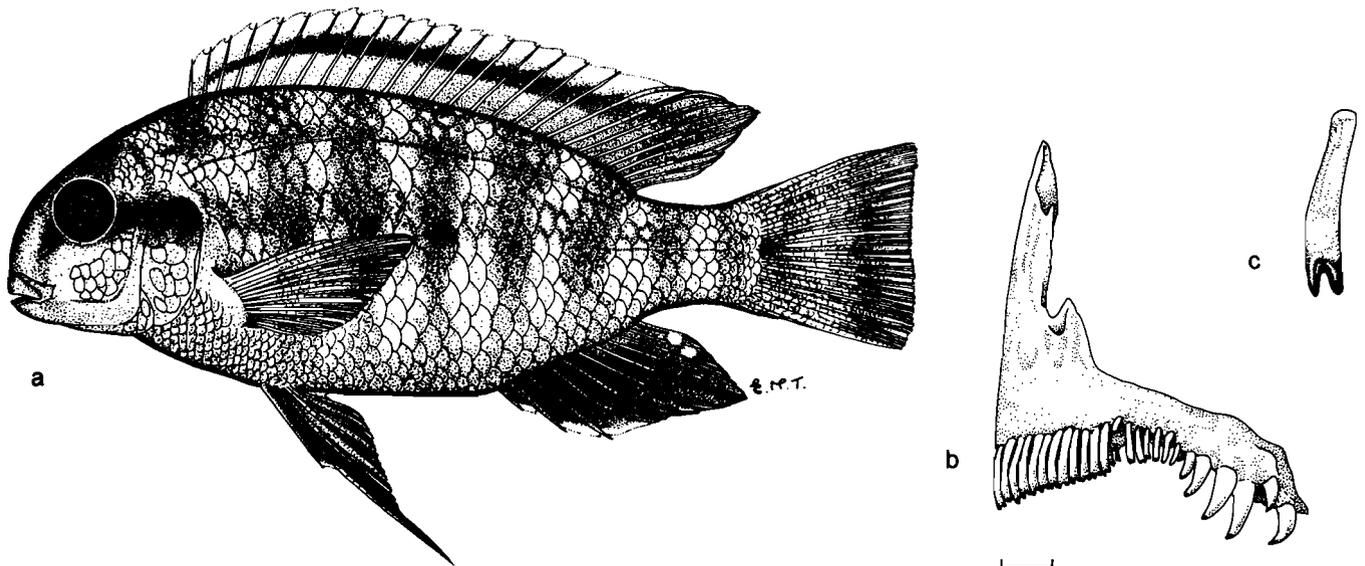


Figure 7 (a) *Pseudotropheus tropheops* 'orange chest', Monkey Bay, 88 mm SL. (b) Lateral aspect of left premaxilla of *P. tropheops* 'orange chest' (Scale = 1 mm). (c) Anterior outer row tooth of *P. tropheops* 'orange chest'.

Table 3 The members of the *Pseudotropheus tropheops* species-complex. 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)

Species	Maximum size		Distribution													
	mm (SL)	Locality	I	IIa	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. <i>Pseudotropheus</i> cf. <i>gracilior</i>	91	Monkey Bay	+	+	-	-	-	+	-	-	-	-	-	-	-	-
2. <i>P. tropheops</i> 'orange chest'	118	Zimbabwe I.	+	+	+	-	-	+	-	+	-	-	-	-	-	-
3. <i>P. tropheops</i> 'broad mouth'	100	Chemwezi Rocks	+	+	-	+	-	+	-	+	+	-	-	-	-	?
4. <i>P.</i> cf. <i>microstoma</i>	98	Monkey Bay	+	-	-	-	-	+	-	-	-	-	-	-	-	-
5. <i>P. tropheops</i> 'red cheek'	101	Masimbwe Islet	+	-	-	-	-	i	-	-	-	-	+	-	-	-
6. <i>P.</i> cf. <i>novemfasciatus</i>	90	Monkey Bay	+	+	-	-	-	-	-	-	-	-	-	-	-	-
7. <i>P. tropheops</i> 'boadzulu'	102	Boadzulu I.	-	-	+	-	-	-	-	-	-	-	-	-	-	-
8. <i>P. tropheops</i> 'black dorsal'	98	West Reef	-	-	-	+	-	-	-	-	-	-	-	-	-	-
9. <i>P. tropheops</i> 'yellow gular'	103	Eccles Reef	-	-	-	+	-	-	-	-	-	-	-	-	-	-
10. <i>P. tropheops</i> 'chinyankwazi'	93	Chinyankwazi I.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
11. <i>P. tropheops</i> 'chinyamwezi'	105	Chinyamwezi I.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
12. <i>P. tropheops</i> 'lilac'	104	Thumbi West I.	-	-	-	-	-	+	-	-	-	-	-	-	-	-
13. <i>P. tropheops</i> 'lilac mumbo'	106	Mumbo I.	-	-	-	-	-	-	+	-	-	-	-	-	-	-
14. <i>P. tropheops</i> 'lilac maleri'	88	Maleri I.	-	-	-	-	-	-	-	+	+	-	-	-	-	-
15. <i>P. tropheops</i> 'intermediate'	89	Thumbi West I.	-	-	-	-	-	+	-	-	-	-	-	-	-	-
16. <i>P. tropheops</i> 'gold otter'	79	Otter Point	-	-	-	-	-	+	-	-	-	-	-	-	-	-
17. <i>P. tropheops</i> 'maleri blue'	91	Maleri I.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
18. <i>P. tropheops</i> 'maleri yellow'	101	Maleri I.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
19. <i>P. tropheops</i> 'mbenji blue'	92	Mbenji I.	-	-	-	-	-	-	-	-	-	+	-	-	-	-
20. <i>P. tropheops</i> 'mbenji yellow'	98	Mbenji I.	-	-	-	-	-	-	-	-	-	+	-	-	-	-
21. <i>P. tropheops</i> 'yellow chin'	115	Makulawe Point	-	-	-	-	-	-	-	-	-	-	+	-	-	-
22. <i>P. tropheops</i> 'membe'	88	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
23. <i>P. tropheops</i> 'dark'	112	Ndumbi Rocks	-	-	-	-	-	-	-	-	-	-	+	-	-	-
24. <i>P. tropheops</i> 'gold'	89	Mkanila Bay	-	-	-	-	-	-	-	-	-	-	+	-	-	-
25. <i>P. tropheops</i> 'mauve'	79	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	+	+
26. <i>P. tropheops</i> 'olive'	92	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	+	+
27. <i>P. tropheops</i> 'black'	103	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	+	+
28. <i>P. tropheops</i> 'rust'	87	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
29. <i>P. tropheops</i> 'deep'	85	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
30. <i>P. tropheops</i> 'band'	102	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
31. <i>P. tropheops</i> 'no band'	94	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
32. <i>P. tropheops</i> 'red fin'	89	Ruarwe	-	-	-	-	-	-	-	-	-	-	-	-	?	+
33. <i>P. tropheops</i> 'weed'	83	Chitande	-	-	-	-	-	-	-	-	-	-	-	+	+	+
34. <i>P. tropheops</i> 'chitande yellow'	99	Chitande	-	-	-	-	-	-	-	-	-	-	-	-	-	+

Coloration. Monkey Bay males: Body bronze-yellow at shoulder, along dorsum and on chest; flanks and caudal peduncle royal blue; barring usually not prominent though 4 anterior bars occasionally distinct, but 3 in the region of caudal peduncle normally inconspicuous. Head bronze-yellow with metallic-blue edges to operculum and chin. Snout and forehead dark blue, interorbital bars light blue. Dorsal fin yellowish-blue in spinous portion, grey-blue in rayed portion; submarginal band black, lappets yellow with white tips. Caudal fin dark blue at base, lighter blue distally, upper and lower edges white. Anal fin blue, with black submarginal band and a white leading edge; 1-3 yellow egg-dummies. Pelvic fins black with white leading edges.

Monkey Bay females: Two colour forms: body and head either yellow or grey-white. Black submarginal band running length of dorsal fin. Rayed part of dorsal fin and entire caudal fin covered by faint white dots.

Geographical variation. Little geographical variation was found. Thumbi West Island males have darker, almost

ochre-brown coloration on shoulder, dorsum and chest. The areas of blue are smaller and tend to lilac. Females at Nkudzi are brighter yellow; almost orange.

Habitat. This species prefers sediment-rich rocky areas and is accordingly most numerous in sheltered zones, such as Monkey Bay and Nkudzi Bay. When on exposed shores it is usually at depths beyond which the cleansing effects of wave action and surface currents are felt. It favours slabs, boulders and large rocks, but also occurs at the rock-sand interface. Its depth distribution is from the surface down to at least 40 m, but it is most numerous between 6 and 25 m.

Territoriality. Males defend territories among rocks. Frequently these territories are at the edge of slabs at sites where other rocks provide refuges for spawning. Some territories were also found over sand in the intermediate zones. Most of these territories centred around sand-scrape nests which had been excavated alongside or beneath rocks. Females and juveniles are not territorial, but occur singly or in small

groups. Occasionally groups of 30 individuals were seen feeding together over slabs.

Feeding. Stomachs of 42 specimens caught in Monkey Bay contained on average 53% loose Aufwuchs, 38% benthic Invertebrata, 7% plankton and small proportions of C1, C2, and C3. Considerable individual variation was found in the stomach contents, some fishes had eaten loose Aufwuchs exclusively while stomachs of others caught at the same time and in the same area were crammed to capacity with benthic Invertebrata, particularly copepods and insect larvae.

2. *Pseudotropheus tropheops* 'orange chest' (Plate 3e)

Synopsis. A common lithophilous species of the south-western areas of the lake.

Distribution. Monkey Bay (C–N), Nankumba (C), Domwe I. (C), Zimbabwe I. (C), Kanchedza I. (C), Chigubi (U), Nkudzi (C), Mpandi I. (C), Crocodile Rocks (C), Boadzulu I. (C), Chemwezi I. (C), Thumbi West I. (C), Otter Point (C), Maleri Is. (C).

Coloration. Monkey Bay males: Body purple-grey, sometimes with brownish cast, ground colour with 7–8 grey bars faintly visible; chest and anterior part of belly orange-yellow. Head purple-grey dorsally, with orange-yellow opercula and chin; in some individuals the orange-yellow coloration extending onto the snout. Dorsal fin yellow with a blue cast; prominent black submarginal band; lappets yellow; rayed portion yellow-grey. Caudal fin bluish-grey with yellow cast, yellow upper and lower edges and yellow trailing edge. Anal fin blue with black submarginal band and white leading edge; 1–3 yellow-orange egg-dummies. Pelvic fins yellow-blue with black submarginal bands and white leading edges.

Monkey Bay females: Body grey-brown with 7–8 grey bars. Head grey-brown. Dorsal fin pale grey-brown with a prominent submarginal band and yellow lappets. Caudal, anal and pelvic fins grey-brown with narrow black submarginal bands on the anal and pelvic fins. This species also has an orange-blotch form which is uncommon in Monkey Bay.

Geographical variation. The populations of male *P. tropheops* 'orange chest' at Nankumba, Domwe I., Kanchedza I. and Chigubi are very similar in coloration and markings to that of Monkey Bay. At Mpandi I., Nkudzi and Crocodile Rocks the yellow in the fins of males is brighter and the orange-yellow of the cheeks, chin and chest is more intense than in the Monkey Bay form. The Boadzulu I. form is dark purple-brown with an ochre-red chest, chin and shoulder. The Zimbabwe form is a very dark purple-brown. The populations at Thumbi West I., Otter Point and the Maleri Islands are generally lighter in colour than that at Monkey Bay, and they have more yellow in the fins.

In addition to the chest markings and coloration, a characteristic feature of these fishes is the conspicuous yellow or orange of the dorsal fin lappets and usually at least part of the fin's basal region. Females of all populations are similar, except those of Boadzulu I. and Zimbabwe I. which are almost black.

Habitat. *P. tropheops* 'orange chest' is particularly numerous among medium and medium-large rocks, in areas

which are relatively free of sediment. Its depth distribution extends from the extreme shallows to at least 33 m. The maximum numerical abundance of adults is between 5 and 18 m, but juveniles are abundant in the extreme shallows and rare beyond 8 m.

Territoriality. Adults of both sexes, but particularly males, hold territories on the upper surfaces of rocks, preferring sites where crevices, holes or cracks provide some refuge. Territories are so aggressively defended that algal gardens (defined on p.184) develop. Juveniles are not territorial, but form large groups which feed in the shallows.

Feeding. The stomach contents of 210 adults caught in Monkey Bay, contained on average 71% C2, 11% C1, 8% loose Aufwuchs. Small quantities of benthic Invertebrata and plankton comprised the remaining 10%. However, when plankton is plentiful, stomachs of members of this species may be filled with it.

3. *P. tropheops* 'broad mouth' (Plate 3f)

Synopsis. A deep-bodied species with a steeply descending snout and a wide mouth. It frequents shallow, sediment-rich rocky zones and intermediate habitats of southern Lake Malawi.

Distribution. Nkopola (C), Nkudzi (C), Mpandi I. (C), Chigubi (C), Kanchedza I. (C), Monkey Bay (C), Nankumba (C), Domwe I. (C), Chemwezi I. (C), Makanjila (U), Masinje (U), Thumbi West I. (U), Otter Point (U), Maleri I. (U), Nankoma I. (C), Senga Point (R), Rifu (R).

Coloration. Monkey Bay males: Body bluish with golden-yellow cast; shoulder and chest tarnished gold; 5 prominent black bars running from the base of the dorsal fin to the belly, but usually not onto the belly, 2–4 faint bars posterior to the vent. Head tarnished-yellow on cheek, upper operculum and the sub-occipital region; opercular spot black with iridescent green-blue anterior edge; edges of opercula lilac-blue; gular region and branchiostegal membranes yellow; snout and occipital region dark blue-grey with two conspicuous light blue interorbital bars and a faint bar traversing the snout; eye bar black (lachrymal stripe, Barel *et al.* 1977). Dorsal fin blue-grey with a black submarginal band running its full length; lappets white with orange tips; trailing portion orange tinged. Caudal fin dark blue-grey at base, lighter distally with orange tinge to trailing edge. Anal fin black anteriorly, grey distally with 2–4 yellow egg-dummies. Pelvic fins grey to hyaline with black submarginal bands and white leading edges.

Monkey Bay females: Body yellow-orange at chest and shoulder, otherwise grey-white with yellowish hue; a mid-lateral row of 9–12 black patches running from behind the eye onto the base of the caudal fin; a dorso-lateral row of 8–9 black patches running from the occipital region to the caudal peduncle. Head yellowish-white ventrally, greyish dorsally; branchiostegal membranes and gular region yellow; 2 blue interorbital bars. Dorsal fin hyaline with blue cast; a black submarginal band and white lappets with yellow tips; trailing edge faintly yellow with numerous small white dots. Caudal fin grey with hyaline inter-ray membranes and faintly yellow trailing edge. Anal fin dusky with a black submarginal band and a single yellow egg-dummy. Pelvic

fins faintly yellow with white leading edges and black submarginal bands.

Geographical variation. Males at Masinje, Makanjila and Chemwezi have a greenish hue on the body and the vertical bars are dark green, tending to black. Other than this, geographical variation is minimal. Females appear unchanged throughout their range.

Habitat. *P. tropheops* 'broad-mouth' occurs in water less than 8 m deep in sediment-rich areas. It is predominantly lithophilous, but also lives over sand and among plants close to rocky zones.

Territoriality. Males are aggressively territorial excluding all intruders, particularly conspecifics. Territories are usually at 2 to 5 m depth, on horizontal upper surfaces of large rocks and slabs, normally where a narrow groove or depression in the rock may serve as a refuge and spawning site. Occasionally, territories were found among smaller rocks and also over sand. At Nkudzi territories over sand in the intermediate zone are common. Most females are not territorial, but a small proportion do defend territories.

Feeding. Stomachs of 22 specimens caught in Monkey Bay contained on average 72% C1 and 18% loose Aufwuchs. Small proportions of C2, benthic Invertebrata and plankton comprised the remaining 10%.

4. *Pseudotropheus cf. microstoma* (Plate 3g)

Synopsis. A large, deep-bodied species with a sharply curved head profile. It inhabits the rock-sand interface.

Distribution. Monkey Bay (C), Mvunguti (C), Domwe I. (C), Otter Point (C). Despite its presence at the nearby Domwe Island, along the rocky areas from the Ilala Gap to Chembe, at Otter Point and even over Chembe Beach, it was not found at Thumbi West Island.

Coloration. *Monkey Bay males:* Body royal blue traversed by 5 prominent, black bars which extend across flanks from dorsum to belly; 2 additional, but inconspicuous bars situated immediately anterior to the caudal peduncle; chest and belly black. Head black except for a blue patch on the upper operculum that extends onto the dorsal part of the head; 2 light blue interorbital bars. Dorsal fin blue with a broad black submarginal band that runs the full length of the fin and merges at the base of the fin with the vertical body bars; lappets light blue with yellow flecks; rayed portion yellowish with orange trailing edge. Caudal fin black at base, trailing edge yellow-orange. Anal fin black with grey to hyaline trailing portion and 2 large orange-yellow egg-dummies. Pelvic fins dark grey.

Monkey Bay females: Body grey-brown with barring similar to that of males. Head brown. Fins brown with yellowish tinges.

Habitat. Greatest numbers of *P. cf. microstoma* occur at the rock-sand interface and in areas where patches of sand are interspersed among rocks. It also occurs over boulders and slabs, and is rare in purely rocky habitats. It does cross sand and was one of the Mbuna species to colonize an artificial reef built at Zambo at 3–5 m depth, 150 m from rocky shores (unpublished data). It inhabits a wide depth range, often following the rock-sand interface as it descends from the extreme shallows to at least 40 m.

Territoriality. Males are particularly active in the defence of territories in the mornings, but in afternoons several may be found feeding alongside one another. Defended areas are over rocks or alongside rocks over sand where small cup-shaped spawning sites (nests) are dug. Females are not territorial, occurring singly or in small groups which remain close to the substratum.

Feeding. *P. cf. microstoma* plucks Aufwuchs from the rocks. Stomach contents of 11 adults caught in Monkey Bay contained more C3 (47%) than any other species. The fish also ate on average 26% C1 and 17% loose Aufwuchs, and the remainder of the contents comprised benthic Invertebrata and plankton.

5. *Pseudotropheus tropheops* 'red cheek' (Plate 3h)

Synopsis. A small-mouthed species of shallow, sediment-free rocky zones. Males are characterized by rusty-red patches on head, shoulder and chest. Females are apricot-yellow.

Distribution. Likoma I. (C), Chisumulu I. (C), Nankumba Peninsula between Tsano Rock and Zambo Point (U). An introduced population from Likoma I. has become established at Thumbi West I. (U).

Coloration. *Likoma males:* Body deep blue with 6–7 dark purple bars and rusty-red splashes of colour on the shoulder and pectoral region of chest. Head bluish-yellow with a grey-blue occipital region and snout; 2 light blue interorbital bars; a rusty-red splash on cheek and another on the subopercular region; branchiostegal membranes and gular region yellowish. The four rusty-red patches on the head and body sometimes merging but usually separated by intervening areas of bluish-yellow. Dorsal fin blue, but suffused with yellow; a prominent black submarginal band running the length of the spinous portion of the fin; lappets light blue, almost white with yellow tips; rayed portion of fin grey-blue, sometimes with faint yellow spots. Caudal fin blue-grey with darker upper and lower borders and yellowish trailing edge. Anal fin black anteriorly, grey distally with 2–4 yellow egg-dummies. Pelvic fins have white leading edges, black submarginal bands and yellowish-grey trailing portions.

Likoma females: Body apricot-yellow with two longitudinal rows of dark brown patches, one running dorso-laterally and the other mid-laterally. Head golden-yellow. All fins yellow.

Geographical variation. Chisumulu Island males have lighter blue bodies than those of Likoma Island. The Nankumba form has head patches which are more orange than those of the Likoma form. Females at all sites are similar.

Habitat. Medium-sized, rounded rocks in sediment-free areas are preferred by this species. *P. tropheops* 'red cheek' is most numerous from the surface to about 6 m, though an individual has been recorded at 19 m.

Territoriality. Males hold territories over the upper surfaces of rocks from which they chase all Mbuna intruders, but they treat conspecifics most aggressively. Females are not territorial, normally occurring singly.

Feeding. Males feed principally from within their territories plucking at the filamentous algae. Females feed from within

the same habitat, but are usually not permitted to feed from occupied territories. Stomachs of 20 individuals caught at Likoma Island contained on average 93% C2, 6% loose Aufwuchs and 1% of C1.

Note: The population found between Tsano Rock and Zamboni Point is small, probably numbering less than 500 individuals. It resembles the other populations in markings, habitat preference and behaviour, but its relationship to the Likoma and Chisumulu Island populations is unknown. As the populations appear superficially similar they are regarded as conspecific for the time being.

6. *Pseudotropheus cf. novemfasciatus*

Synopsis. An inhabitant of the vegetated areas in shallow, sediment-rich areas. Males are blue-grey and olive-yellow. Females are grey and olive-yellow.

Distribution. Monkey Bay (C), Kanchedza I. (C), Chigubi (U), Nkudzi (C), Mpandi I. (C), Nkopola (U).

Coloration. Monkey Bay males: Body blue-grey with an extensive olive-yellow overlay across the shoulder and back; a further olive-yellow patch covering the pectoral region of the chest; ventral region of chest and anterior belly black; 5 incomplete dark grey bars traversing mid-lateral part of flanks. Head blue-grey with olive-yellow occipital region; chin black; interorbital bar bright iridescent blue; opercular spot iridescent blue. Dorsal fin olive-yellow with a narrow submarginal band; lappets white with yellow tips. Caudal fin dark grey with light blue inter-ray membranes, white upper and lower edges and a yellow trailing edge. Anal fin black with a white leading edge and yellow egg-dummies. Pelvic fins black with contrastingly white leading edges.

Monkey Bay females: Body olive-yellow, tending to light grey ventrally; 5–6 dark grey bars conspicuous. Head olive-yellow, grey ventrally with blue interorbital bar. Dorsal fin yellowish-grey with narrow black submarginal band. Caudal, anal and pelvic fins grey.

Habitat. *P. cf. novemfasciatus* does not occur below 6 m. It is most abundant in intermediate habitats which comprise small and medium-sized rocks in vegetated areas. Usually the areas in which it lives are rich in sediment.

Territoriality. Territorial males defend areas which are usually less than 1 m in diameter. Saucer-shaped sand-scrape nests occur in most territories. Females and juveniles usually occur in groups of 3–15 individuals.

Feeding. This species appears to collect epiphytic growths from the surface of macrophytes. It also feeds from the Aufwuchs mat growing on rocks.

7. *Pseudotropheus tropheops* 'boadzulu' (Plate 3i)

Synopsis. This species is endemic to Boadzulu Island where it inhabits water deeper than 10 m.

Distribution. Boadzulu I. (C).

Coloration. Males: Body light blue with a yellowish tinge and 7–8 darker blue bars which become progressively paler ventrally so that the belly is unbarred. Head blue-grey dorsally, cheeks and chin pale blue and opercular patch black. Dorsal fin blue with prominent black submarginal band; lappets white with yellow tips. Caudal

fin blue with yellowish inter-ray membranes, yellow trailing edges and dark grey upper and lower borders. Anal fin dark blue tending to black anteriorly; leading edge white; 2–5 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Body silvery-grey with darker grey bars similar to those of males. Head grey. Fins greyish with darker grey markings corresponding to black markings of males.

Habitat. This species inhabits rocky and intermediate, sediment-rich zones of deeper water. It is most numerous between 20 and 25 m, is seldom found in less than 10 m and may go as deep as 40 m.

Territoriality. Males are weakly territorial, defending areas of about 1.5 m diameter. Non-territorial males and females remain in groups of 10–15 individuals.

Feeding. It was observed feeding from rock surfaces and from the water column where it presumably caught plankton.

8. *Pseudotropheus tropheops* 'black dorsal' (Plate 3j)

Synopsis. This species lives on rocky reefs in south-eastern Lake Malawi. The males are blue and the females yellow.

Distribution. Eccles Reef (C), West Reef (C).

Coloration. West Reef males: Body deep blue with 6–7 grey-blue vertical bars, which may be faint in some individuals. Head blue-grey dorsally tending to brownish-grey ventrally. Dorsal fin blue with prominent black submarginal band; lappets white. Caudal fin black with white edges and a few longitudinal blue streaks. Anal fin black anteriorly becoming hyaline posteriorly with 1–3 yellow egg-dummies. Pelvic fins black with white leading edges.

West Reef females: Body yellow with faint grey bars. Head greyish-yellow. Dorsal fin yellow with a black submarginal band. Caudal fin grey with a yellow cast. Anal and pelvic fins dark grey, almost black.

Geographical variation. The individuals at Eccles Reef are very similar in coloration, markings and size to those of West Reef, but males are paler blue and females are beige.

Habitat. This species occupies submerged reefs which comprise mainly large rocks as well as medium-sized rocks, boulders and slabs. While occurring over all these rock types it is most numerous among medium-large rocks at 8–12 m depth. The full depth range extends from 3 m to the rock-sand interface which occurs at a maximum depth of about 18 m.

Territoriality. Males hold territories over rocks of all sizes, including slabs. Females are not territorial.

Feeding. This species was observed feeding on Aufwuchs and from the water column.

Note: This species lives syntopically with *P. tropheops* 'yellow gular', the males of which are also blue. They may be distinguished, however, by the presence of the prominent black submarginal bar and the lack of a yellow gular region in *P. tropheops* 'black dorsal'. Females of the latter species are yellow, not grey-brown like those of *P. tropheops* 'yellow gular'.

9. *Pseudotropheus tropheops* 'yellow gular'

Synopsis. A small-mouthed species from reefs and shallow rocky areas of the south-eastern coast of Lake Malawi. Males are blue with a yellow gular region; females are grey-brown.

Distribution. Masinje (C), Makanjila (U), Eccles Reef (C), West Reef (C).

Coloration. *West Reef males:* Body blue with faint grey barring and a yellow chest. Head greyish-blue dorsally, lighter blue ventrally with a yellow chin and gular region; branchiostegal membranes whitish-yellow. Dorsal fin bluish-yellow. Caudal fin blue-grey. Anal fin blue-grey with a black submarginal band and a white leading edge; 2–4 yellow egg-dummies. Pelvic fins yellow-gold with black submarginal bands and white leading edges.

West Reef females: Body grey-brown, head dark grey dorsally, yellowish-grey ventrally. Fins pale grey with dark grey submarginal bands on anal and pelvics.

Geographical variation. Males of the populations at Makanjila and Masinje are a paler blue than those of West Reef and Eccles Reef and have a larger patch of yellow on the chest and belly. Females are darker grey at Makanjila and Masinje.

Habitat. At Eccles Reef and West Reef this species is found only in purely rocky habitats since it lives in water less than 7 m deep which is much shallower than the rock-sand interface. However, at Masinje and Makanjila it occupies rocky and intermediate zones of shallow water.

Territoriality. Males are territorial showing considerable aggression towards conspecifics. Females, non-territorial adult males and juveniles form schools of 20–50 individuals.

Feeding. It feeds from the rock surfaces, the water column and, where it lives in the intermediate zones, it has been seen to feed from sand substrata.

10. *Pseudotropheus tropheops* 'chinyankwazi'

Synopsis. The only member of the *P. tropheops* species-complex at Chinyankwazi Island.

Distribution. Chinyankwazi I. (C).

Coloration. *Males:* Body blue with silvery sheen, 6–7 black vertical bars of which the anterior 3–4 are broad and dark, but posterior bars faint; chest bronzed yellow. Head dark blue-grey with a light blue interorbital bar that is flanked by black bars; lower cheek, chin, gular region and branchiostegal membranes coppery-yellow. Dorsal fin mustard-yellow with a narrow black submarginal band running about half its length; rays black, inter-ray membranes light blue; lappets bright yellow; trailing edge orange. Caudal fin dark grey at base with light blue inter-ray membranes and black rays distally; upper and lower borders black with white edges; trailing edge orange. Anal fin black anteriorly, pale blue posteriorly with single large yellow egg-dummy. Pelvic fins black with white leading edges.

Females: Body grey-blue, almost black in some individuals with black barring. Head dark grey. Dorsal fin grey with yellowish tinge, a thin submarginal band and a white trailing edge. Caudal fin grey. Anal and pelvic fins dark grey with a trace of yellow on the pelvics.

Habitat. Occurs over rocks of all sizes, but is most numerous among small and medium-sized rocks in 3–10 m. It is rare beyond 14 m (deepest record is 16 m) and in the extreme shallows.

Territoriality. Territorial males favour broken rock but may be found over slabs where cracks or crevices provide refuge. Territories are so aggressively defended that algal gardens were discernible in some. Females are not territorial and occur in small groups or singly.

Feeding. This species has a narrow mouth and feeds by nipping and plucking at the Aufwuchs. It was also seen to feed upon plankton. Stomach contents of 8 specimens contained on average 60% C1, 25% phytoplankton (which was abundant in the water in Jan./Feb. 1980), 10% zooplankton and the remainder loose Aufwuchs and C2. A chironomid larva occurred in one stomach.

11. *Pseudotropheus tropheops* 'chinyamwezi' (Plate 4a)

Synopsis. The only member of the *P. tropheops* species-complex at Chinyamwezi Island.

Distribution. Chinyamwezi I. (C–N).

Coloration. *Males:* Body ochre-yellow tending to grey-brown dorsally and light yellow ventrally, particularly yellow at the chest region; 6–7 blue-brown vertical bars. Head dark grey dorsally; lower cheek, chin, gular region and branchiostegal membranes ochre-yellow. Dorsal fin black with a yellow base. Caudal fin black with pale blue longitudinal streaks. Anal fin black with white leading edges and a yellow egg-dummy. Pelvic fins black with white leading edges.

Females: This species exhibits polychromatism having both normal (N) and orange-blotch (OB) females. The N females are almost totally black with a brown-yellow patch on the chest.

Habitat. It lives all around Chinyamwezi Island which comprises broken rocks of varying sizes, but most individuals occur among medium-sized rocks. Its depth range is from surface waters to at least 30 m, but most individuals live between 5 and 20 m.

Territoriality. Males are highly aggressive in the defence of their territories. Algal gardens were found in about 25% of territories. Some females were also found defending territories, but most are not territorial.

Feeding. Stomach contents of 5 individuals were dominated by phytoplankton which was abundant in Jan./Feb. 1980 when the specimens were caught. Small quantities of C1, C2 and loose Aufwuchs were also present.

* * *

The three species discussed next occur at the islands of Thumbi West, Mumbo and Maleri. All three populations have a similar basic coloration (lilac-blue in males) and all are essentially similar anatomically, but they do differ in details of coloration and preferred habitat (including depth distribution) and so they are considered as different species for the time being.

* * *

12. *Pseudotropheus tropheops* 'lilac' (Plate 4b)

Synopsis. A shallow-dwelling species of sediment-free zones where it inhabits medium-sized rocks.

Distribution. Thumbi West I. (C).

Coloration. Males: Body lilac-blue with a metallic sheen and yellowish chest and shoulder; 5 broad dark blue bars traversing the flanks but not extending on to the belly and 2–3 faint bars crossing the caudal peduncle. Barring of variable intensity extremely faint in some sexually active individuals, but conspicuous in others. Head lilac-blue with a silvery sheen on forehead and 2 grey inter-orbital bars; chin, gular region and branchiostegal membranes yellow, opercular region golden-yellow. Dorsal fin lilac-blue with pale yellow blotches below a narrow, black submarginal band; lappets light blue, almost white with yellow tips; trailing edge orange. Caudal fin pale blue with dark grey rays; upper and lower borders black with white edges; trailing edge orange. Anal and pelvic fins pale blue with black submarginal bands and white leading edges; 2–3 yellow egg-dummies on anal fin. *Females:* Body pale brown, almost beige with a row of 7–8 black blotches running dorso-laterally and another row mid-laterally. Head brown with two faint grey inter-orbital bars. Dorsal fin yellowish with a narrow black submarginal band. Caudal fin pale blue with grey rays and brown trailing edge. Anal fin dark brown, almost black anteriorly, light brown posteriorly. Pelvic fins brown.

Habitat. *P. tropheops* 'lilac' seldom occurs beyond 5 m depth and is most numerous in 1 to 3 m among rounded, medium-sized rocks in sediment-free zones. It has not been seen in intermediate habitats.

Territoriality. Only males defend territories, usually over the upper surfaces of rocks. The territories have a diameter which is frequently dictated by the size of the rock, but is usually not more than about 1,75 m. Conspecific male intruders are treated aggressively, sometimes being chased for distances of about 3 m. Heterospecifics are not tolerated within the territories, but are not normally pursued beyond the territorial boundary. Females occur singly.

Feeding. Filamentous algae are plucked from the rocks, predominantly from the upper surfaces.

13. *Pseudotropheus tropheops* 'lilac mumbo' (Plate 4c)

Synopsis. The only member of the *P. tropheops* species-complex found at Mumbo Island.

Distribution. Mumbo I. (C).

Coloration. Males: Body lilac-blue with an opalescent sheen, 6–7 grey bars traversing the flanks but not extending onto the belly; chest and belly orange-yellow, though extent of this colour variable, being either confined to the chest or extending back to beyond the anal fin; a separate rusty-yellow patch covering the shoulder. Head blue with silvery sheen on occipital region and dorsal aspect of snout; mouth, lower part of cheek, chin, gular region and branchiostegal membranes yellow, tending to deep gold in some individuals. Dorsal fin light blue, suffused with yellow; black submarginal band narrow anteriorly, broadening posteriorly; lappets white with yellow tips. Caudal fin dark grey. Anal fin predominantly black with blue trailing edge and a yellow patch postero-dorsally; 1–2 yellow egg-dummies. Pelvic fins yellow-orange with black leading edges. *Females:* Body light brown with a single row of 6–8

large dark brown blotches running mid-laterally. Head light brown. Dorsal and caudal fin predominantly pale brown. Anal fin black, pelvic fins black anteriorly, but orange-brown posteriorly.

Habitat. This species lives principally over medium-sized and large rocks, though it is also found over slabs and boulders. It is rare among small rocks and in intermediate habitats. *P. tropheops* 'lilac mumbo' occurs from the surface to at least 25 m depth, being most common between 3 and 15 m.

Territoriality. Males are strongly territorial. Territories are usually held among medium-sized rocks where a refuge may be found and occasionally on open rock faces. Those individuals which tenant exposed areas have been seen to spawn in the open (once alongside a vertical rock face), but most individuals spawn while hidden from view. Females are not territorial.

Feeding. Feeds from the upper surfaces of rocks, where it appears to crop filamentous algae. It also feeds on plankton.

14. *Pseudotropheus tropheops* 'lilac maleri'

Synopsis. A wide-mouthed species which occurs in shallow rocky areas.

Distribution. All three Maleri Islands (C).

Coloration. Males: Body lilac-blue with silvery sheen which may become violet in sexually active individuals; barring faint; chest and anterior region of belly burnished yellow, tending to orange in some individuals. Head lilac, tending to violet with opalescent sheen; mouth, chin and lower opercular region burnished yellow. Dorsal fin light blue suffused with yellow, and with white and violet flecks; submarginal band lacking but the rayed portion of the dorsal fin black; lappets white, tipped with yellow. Caudal fin blue with black rays, black upper and lower borders and white edges. Anal and pelvic fins yellowish with black submarginal bands and white leading edges; 2–5 yellow-orange egg-dummies.

Females: Body buff-grey with broken vertical barring giving a blotched appearance. Head buff-grey. Dorsal fin buff with a conspicuous black blotch in rayed portion. Caudal fin light brown with darker brown rays and borders. Anal and pelvic fins yellowish-brown with black submarginal bands and white leading edges.

Habitat. The preferred habitat of this species is among small and medium-sized rocks, though it does occur on large rocks and rarely in intermediate habitats. It is most numerous in water shallower than 4 m and is rare beyond 10 m.

Territoriality. Males are territorial but do not usually display over prominent rocks, preferring to remain among smaller rocks which are sometimes set among large rocks. Aggression is directed strongly towards conspecifics, but heterospecifics are chased only when they penetrate deeply into the territory. Females are not territorial.

Feeding. Aufwuchs is collected by nipping and plucking which suggests that filamentous algae are ingested. This species has also been seen to feed on plankton.

15. *Pseudotropheus tropheops* 'intermediate' (Plates 4d & 4e)

Synopsis. Dark blue males and bright golden-yellow females

which breed in the intermediate zones.

Distribution. Thumbi West I. (C).

Coloration. Males: Body dark blue with 7–8 black bars on the flanks. Head black. Dorsal fin dark blue with a prominent, broad, pitch-black submarginal band; lappets whitish-blue with yellow tips; trailing edge orange. Caudal fin dark blue with white upper and lower edges and usually a light blue trailing edge, but in some individuals trailing edge yellow-orange. Anal fin black with a light blue trailing edge, a white leading edge and 1–3 yellow egg-dummies. Pelvic fins black with white leading edges, dusky brown posteriorly tending to orange in a few individuals.

Females: Uniformly golden-yellow with a conspicuous black submarginal band running the length of the dorsal fin. Thin black submarginal bands on the anal and pelvic fins.

Habitat. Males occur most commonly over patches of sand among rocks and are also found over sediment-covered slabs. They are rare in other habitats. Females and juveniles, however, range more widely and are usually found in purely rocky environs, in intermediate zones and in *Vallisneria aethiopica* beds. This fish occurs to at least 25 m depth. Males are rare in water shallower than 5 m, but females and juveniles occur in the extreme shallows.

Territoriality. Males establish territories over patches of sand occurring among rocks and over slabs. Nests are excavated beneath or alongside rocks and are 3–5 cm deep and 14–26 cm in diameter ($N=34$). Territorial aggression is directed principally toward conspecifics. Females and juveniles are not territorial.

Feeding. Males feed from rock and sand substrata within their territories and on plankton in the water column. Non-territorial individuals feed in rocky areas, intermediate zones, from *V. aethiopica* fronds and on plankton. Stomach contents of 5 territorial males contained on average 70% loose Aufwuchs, 20% C1, 8% C2 and 2% benthic Invertebrata.

16. *Pseudotropheus tropheops* 'gold otter'

Synopsis. A golden-yellow species which lives over the upper surfaces of rocks in shallow water.

Distribution. Otter Point (C).

Coloration. Males and females: Body and head golden-yellow with a dusky brown patch extending from the occipital region, along the back to the caudal peduncle. Fins yellow with narrow black submarginal bands in the anals and pelvics.

Habitat. It lives over the upper surfaces of large rocks in 1–5 m depth.

Territoriality. Males are territorial, defending areas over the upper surfaces of rocks. Females and juveniles are not territorial and are normally solitary.

Feeding. This species was seen to feed from the Aufwuchs mat.

Note: Although this species is superficially similar to *P. tropheops* 'gold' of Chisumulu Islands, it is considered to be a different species since it has a different preferred habitat.

17. *Pseudotropheus tropheops* 'maleri blue'

Synopsis. An uncommon species found at the Maleri Islands in shallow water over large rocks.

Distribution. Maleri I. (U), Nankoma I. (R), Nakantenga I. (R).

Coloration. Maleri Island males: Body blue with 4–6 broad, grey bars. Head slate-grey with a bright blue interorbital bar. Dorsal fin blue-grey with a narrow black submarginal band and white lappets. Caudal fin grey-blue at base, lighter blue distally with black streaks. Anal fin black anteriorly, grey to hyaline posteriorly; 1–3 yellow egg-dummies. Pelvic fins dusky grey posteriorly, black submarginally with white leading edges.

Females: Not known.

Habitat. This species was found over the upper surface of large, flat rocks usually in less than 5 m depth.

Territoriality. Males defend territories on the upper surfaces of rocks.

Feeding. Feeds from the Aufwuchs mat.

18. *Pseudotropheus tropheops* 'maleri yellow' (Plate 4f)

Synopsis. A shallow-water lithophilous species of the Maleri Islands. Males are predominantly yellow; females are brownish.

Distribution. Maleri I. (U–C), Nankoma I. (U–C), Nakantenga I. (U–C) and Namalenje I. (U–C).

Coloration. Maleri males: Body mainly yellow with bright yellow chest, shoulder, pectoral region and belly, but having a grey-blue cast over the yellow elsewhere. Head bright yellow on cheek, operculum, chin and branchiostegal membranes, but snout and occipital regions dark grey. Dorsal fin yellowish-blue with faint black markings in position of submarginal band; rayed portion grey dorsally, pale blue ventrally; lappets white. Caudal fin inter-ray membranes yellow and rays blue. Anal fin pale blue with a narrow black submarginal band and white leading edge; 1–3 yellow egg-dummies. Pelvic fins golden-yellow.

Maleri females: Body brownish with faint black markings in position of longitudinal bands. Head grey-brown. Fins pale brown with black submarginal bands on anal and pelvic fins.

Geographical variation. Sexually active males at Nankoma Island, at the north-western part of Maleri Island and at Namalenje Island are more yellow than those along the southern part of Maleri Island. Those at Nakantenga have a deeper blue coloration and less yellow. Females at all sites have the same coloration.

Habitat. It inhabits rocky zones of both sheltered and exposed regions, favouring large rocks in shallow water. It rarely occurs below 5 m depth.

Territoriality. Only the males are territorial and they display over the upper surfaces of prominent rocks.

Feeding. This species feeds mainly from the upper surfaces of large rocks.

Note: This species occurs syntopically with *P. tropheops* 'lilac maleri', but may be distinguished from it by dif-

ferences in coloration. Behaviourally too, the two species differ: territorial *P. tropheops* 'maleri yellow' frequents the upper surfaces of large prominent rocks, which rise above surrounding smaller rocks, whereas *P. tropheops* 'lilac maleri' defends areas among the smaller rocks (Table 4).

Table 4 The number of territorial *P. tropheops* 'lilac maleri' and *P. tropheops* 'maleri-yellow' found over large prominent rocks and over small and medium-sized rocks over a distance of approximately 100 m at Maleri Island (Site C; Figure 47) at 2–5 m depth

	<i>P. tropheops</i> 'lilac maleri'	<i>P. tropheops</i> 'maleri yellow'
Over large rocks	3	33
Over medium-small rocks	25	4

19. *Pseudotropheus tropheops* 'mbenji blue' (Plate 4g)

Synopsis. A species found among medium-large rocks in exposed areas of the Mbenji Islands. Males are predominantly blue, females are brown.

Distribution. Mbenji I. (C).

Coloration. Males: Body silvery-blue with 7–8 grey-blue bars, decreasing in intensity posteriorly; chest tarnished yellow. Head grey-blue dorsally, but tarnished yellow on cheek, chin and gular region. Dorsal fin pale blue with yellow cast; submarginal band black, narrow and faint; lappets white; trailing portion blue with black inter-ray membranes. Caudal fin grey-blue with a yellow tinge distally. Anal fin pale blue postero-dorsally, black submarginally with 1–4 yellow egg-dummies. Pelvic fins ochre-yellow posteriorly, black submarginally with white leading edges.

Females: Uniformly brown body and head; fins pale brown.

Habitat. This species frequents upper and vertical surfaces of medium-sized and large rocks in sediment-free areas. It seldom occurs over slabs, among smaller rocks or in intermediate zones. It is most common between 3 and 12 m at exposed sites, but may penetrate to at least 25 m depth.

Feeding. The species feeds from the Aufwuchs of upper and vertical rock surfaces and on plankton.

20. *Pseudotropheus tropheops* 'mbenji yellow' (Plate 4h)

Synopsis. A fish of the Mbenji Islands which favours sheltered sediment-rich areas. Males are mainly yellow, but females are grey.

Distribution. Mbenji I. (C).

Coloration. Males: Body predominantly yellow tending to blue-grey dorsally; 5–6 narrow grey-brown vertical bars of which only the anterior 3 are darkly pigmented. Head yellow except for blue-grey occipital region and snout. Dorsal fin yellow with prominent black submarginal band running its full length and broadening in the rayed part of the fin; lappets yellow. Caudal fin dark grey-blue with light blue inter-ray membranes. Anal fin pale blue posteriorly, black submarginally with a white leading edge and 2–3 yellow-orange egg-dummies.

Pelvic fins yellow posteriorly, black submarginally with white leading edges.

Females: Body greyish-brown with two longitudinal rows of black blotches on the flanks. Head grey. Dorsal fin grey with distinct black submarginal band. Caudal, anal and pelvic fins grey.

Habitat. This species occurs mainly among small rocks of sheltered sediment-rich areas, but also occurs in the intermediate zones of sheltered areas. It was found from the surface waters down to a depth of 25 m, but is most numerous between 2 and 15 m.

Feeding. Members of this species feed from sediment-covered surfaces of rocky and sandy substrata.

21. *Pseudotropheus tropheops* 'yellow chin' (Plate 4i)

Synopsis. A wide-mouthed species endemic to Likoma and Chisumulu Islands where it occupies the intermediate habitats in shallow water. Males are distinguished from other species at these islands by their lime-yellow chest, chin, gular and shoulder regions.

Distribution. Likoma I. (C), Chisumulu I. (C).

Coloration. Likoma Island (Maingano) males: Body lilac-blue with yellow chest, belly and shoulder. Head yellow except for blue-grey occipital region and snout. Dorsal fin pale blue with a thin black submarginal band, yellow lappets and a predominantly black trailing portion. Caudal fin light blue with black inter-ray membranes and black upper and lower borders. Anal fin black anteriorly, pale blue posteriorly with 1–4 yellow egg-dummies. Pelvic fins mainly yellow with narrow black submarginal bands and white leading edges.

Likoma Island (Maingano) females: Body grey with a dorso-lateral and a mid-lateral row of black blotches. Head light grey, but darker on snout and occipital region. Fins grey.

Geographical variation. At Khuyu, White Rock and Yofu Bay of Likoma Island (Figure 55) sexually active males may be almost entirely yellow. This yellow extends onto the fins and very little black is evident. At Chisumulu Island, females are more purple than lilac and the yellow is darker, tending to gold. The fins are lime-yellow with virtually no trace of black. Females of all populations are similar, though those of Chisumulu Island are not as grey, being more brown.

Habitat. This species is common in intermediate zones and along the rock-sand interface of shallow water. It occupies both sheltered and wave-washed areas. At Likoma Island it is most numerous from 1 to 5 m and was not found below 11 m depth. At Chisumulu, however, it is most common in the shallows, but has been recorded to 23 m.

Territoriality. Males normally hold territories at the base of rocks where they dig spawning-sites (nests), 2–4 cm deep and about 1–10 cm diameter, in the sand close to the rocks. Some individuals live in purely rocky habitats where they cannot excavate nests. They are particularly aggressive towards conspecific males and intolerant of most other intruders. Females are not territorial and occur singly or in small groups.

Feeding. *P. tropheops* 'yellow chin' feeds from rocks, sand and plants and quite often on plankton in the water column.

Stomachs of 35 individuals caught at Likoma Island contained mostly loose Aufwuchs (64%), C1 and C2 (both 14%) and the remaining 8% comprised benthic Invertebrata. Sand grains are common in the stomachs of these fishes.

22. *Pseudotropheus tropheops* 'membe' (Plate 4j)

Synopsis. A heavily barred, elongate species of sediment-covered, medium-sized rocks in the middle depths.

Distribution. Likoma I. (C).

Coloration. Males: Body dark blue with 8–10 dark brown bars; dorso-medial band golden-brown; belly black; chest bronzed gold. Head blue dorsally, golden-brown ventrally; single light blue interorbital bar; a broad, dark brown occipital bar. Dorsal fin golden-brown with black submarginal band, white lappets and yellow trailing edge. Caudal fin brown. Anal and pelvic fins dark brown; 1–4 yellow egg-dummies.

Females: Body beige-yellow with grey barring. Head yellowish. Dorsal fin off-white with yellow tinge posteriorly. Caudal fin grey with yellow-orange borders and trailing edge. Anal fin bright orange. Pelvic fins yellow with a dark submarginal band and white leading edges.

Habitat. Occurs principally among medium-sized rocks, but is also common among small rocks and at the rock-sand interface. Since it lives in deeper water, being most common between 10 to 30 m, the area it occupies is usually rich in sediment. Its total depth range is from 3 to at least 40 m.

Territoriality. Males are aggressively territorial, but most of their aggression is directed at conspecifics. Females are not territorial and occur in small groups of 5 to 10 individuals or singly.

Feeding. *P. tropheops* 'membe' feeds principally from sediment-covered rock surfaces. Stomachs of 5 specimens caught at Membe Point contained on average about 80% loose Aufwuchs, 15% C2 and 5% benthic Invertebrata.

23. *Pseudotropheus tropheops* 'dark' (Plate 5a)

Synopsis. A deep-bodied, dark brown species of rocky habitats. Pelvic fins are long, extending half-way along the anal fin when folded against the body.

Distribution. Likoma I. (C).

Coloration. Males: Upper half of head and body, and entire caudal peduncle and caudal fin dark brown. Ventral half of head as well as chest and belly ochre-yellow. Dorsal fin light brown with a dark brown, almost black, submarginal band running three quarters of the fin's length; lappets dull yellow. Anal fin black with 1–3 yellow egg-dummies. Pelvic fins golden-brown with black leading edges.

Females: Uniformly dull brown with black submarginal bands.

Habitat. This species is most common among medium-sized and medium-large rocks, but also ventures into intermediate zones and among small rocks. Its full depth range extends from the surface waters to at least 33 m but it is most numerous between 7 and 20 m.

Territoriality. Males are vigorous in the defence of their ter-

ritories, chasing away most intruders. Females are not territorial.

Feeding. Observations suggest that it feeds mainly from vertical surfaces of rocks from which it appears to pluck filamentous Aufwuchs.

24. *Pseudotropheus tropheops* 'gold' (Plate 5b)

Synopsis. A golden-yellow fish endemic to Chisumulu Island.

Distribution. Found only along the north and north-eastern shores of Chisumulu I. (C).

Coloration. Males: Uniform golden-yellow with a blue tinge on the trailing edge of dorsal and anal fins. Caudal fin yellow with pale blue inter-ray membranes.

Females: Uniformly brown.

Habitat. It is most numerous over medium-sized and small rocks in purely rocky environs, but it also occupies the intermediate zones of the rock-sand interface. It is common between 10 and 20 m, but occurs from 3 to 25 m depth.

Territoriality. Males are territorial, maintaining positions over the upper surfaces of prominent rocks. Most of their aggression appears directed at conspecifics. Females are not territorial.

Feeding. Observations of this species in the field indicate that it feeds upon Aufwuchs and plankton.

25. *Pseudotropheus tropheops* 'mauve' (Plate 5c)

Synopsis. A small lithophilous species in shallow water: males are predominantly mauve-blue, females are apricot-yellow.

Distribution. It is common at all rocky shores of the north-western coast from Chirombo Point to Chitande.

Coloration. Nkhata Bay males: Body pale mauve-blue with 7–8 faint purple bars that cross the flanks, but do not extend onto the belly; purple dorso-lateral and mid-lateral bands faintly visible in most specimens; chest pale blue with faint yellow tinge; belly pale blue, almost white ventrally. Head blue with a dark blue occipital bar, 2 dark blue interorbital bars and a pale iridescent blue band between the interorbital bars; chin blue with hint of yellow. Dorsal fin pale violet with a faint, thin, black submarginal band and yellow lappets. Inter-ray membranes of trailing edge black. Caudal fin blue with dark blue, almost black, inter-ray membranes. In some individuals the caudal fin has a yellow trailing edge and yellowish rays. Anal fin pale blue posteriorly, grey-black anteriorly with a very pale blue, almost white, leading edge; 1–3 yellow egg-dummies. Pelvic fins light brownish-yellow posteriorly, black submarginally with white leading edges.

Nkhata Bay females: Body apricot-yellow with two bands of brown blotches running longitudinally. Head apricot-yellow with mauve interorbital bars. Dorsal, caudal, anal and pelvic fins yellow with faint black markings on the anal and pelvic fins.

Geographical variation. At Lion's Cove and Chilumba sexually active males are similar in coloration to the Nkhata Bay form, but at Usisya and Mara Rocks all have a well-defined yellow-gold patch which covers the chin, gular

region and chest and may extend onto the belly. Females appear similar in colour throughout their distribution.

Habitat. *P. tropheops* 'mauve' lives among medium-sized rocks and is most common in purely rocky habitats of sediment-free zones, occasionally seen over sand patches among rocks. It is most numerous in water less than 5 m deep, but is found to at least 10 m depth.

Territoriality. Males hold territories over the upper surfaces of medium-sized rocks, frequently choosing prominent rocks from which to display. Females are not territorial, are solitary and tend to be aggressive towards one another.

Feeding. Members of this species appear to nip filamentous algae from the rocks, apparently favouring the upper surfaces. Males feed from within their defended areas while females feed from untenanted rocks in the preferred habitat.

26. *Pseudotropheus tropheops* 'olive' (Plates 5d & 5e)

Synopsis. A lithophilous species in shallow water: males are predominantly olive-yellow; females are silvery-grey with black barring and banding.

Distribution. Common on all rocky shores of the north-western coast from Chirombo Point to Chitande.

Coloration. *Nkhata Bay males:* Body olive-yellow with 9–10 purple-blue vertical bars which are intense in some individuals but indiscernible in others. Head olive-yellow with a black patch behind the orbit, a black opercular spot, a dark purple-blue interorbital bar and an eye bar; a violet band running from the mouth, ventrally along the pre-operculum. Dorsal fin yellowish-green with lilac-blue spots. Caudal fin grey with olive-yellow inter-ray membranes. Anal fin orange-yellow posteriorly, black anteriorly, usually only one large yellow egg-dummy. Pelvic fins gold posteriorly, black anteriorly.

Nkhata Bay females: Body silvery-grey, sometimes with golden cast; 9–10 grey-brown vertical bars, which may have lilac or violet iridescence. Mid-lateral and dorso-lateral bands broken into a series of black blotches, being pitch-black where they cross the vertical bars; chest pale blue. Lower half of head violet-blue, upper half silvery-grey with a black patch posterior to orbit and a black bar running from the occipital, across the suboccipital and midway down the posterior margin of the operculum. Dorsal fin silvery-grey with a series of black blotches along its base and numerous small yellow, white or lilac spots which dot the fin. Caudal fin grey with purple rays. Anal fin hyaline with a blue patch anterodorsally and a single yellow egg-dummy. Pelvic fins hyaline, with a yellow cast posteriorly and a black submarginal band.

Geographical variation. At Chilumba and Ruarwe males are more yellow than those of Nkhata Bay, some tending to bright gold. All the fins are predominantly yellow, though the inter-ray membranes of the dorsal fin are lilac in some specimens at Mpanga Rocks. It was noted that the population within the bay at Chilumba and also the population at Mpanga Rocks, are a deeper golden-yellow than that at Chitande. Females at Chilumba and Ruarwe have the same markings as the Nkhata Bay form, but the ground colour is olive-yellow and not silvery-grey.

Habitat. The preferred habitat of *P. tropheops* 'olive' ap-

pears to be among medium-sized and medium-large rocks of sediment-free shores, but it may also occur over boulders and slabs (e.g. at Mpanga Rocks where other rock types are rare). It is rare in intermediate areas. Most individuals occur in less than 2 m and very few occur below 5 m depth.

Territoriality. Males are aggressive in the defence of their territories which occasionally contain algal gardens. Females are not territorial and usually occur in groups of 3–6 individuals.

Feeding. Both sexes feed from upper and vertical rock surfaces, apparently cropping filamentous algae. They have also been seen taking plankton.

27. *Pseudotropheus tropheops* 'black' (Plate 5f)

Synopsis. A large, common species of the rocky zones of the north-western part of the lake. Males are purple-blue with a golden chest and gular region and virtually no trace of barring. Females and juveniles are black.

Distribution. Found at every diving station along the north-western coast (Figure 68).

Coloration. *Nkhata Bay males:* Body purple-blue, tending to black dorsally and light blue ventrally, usually unbarred, though 6–8 dark purple bars apparent in some individuals; chest and belly golden, sometimes ochre. Head dark purple, tending to black dorsally, but blue below the level of the eye with a violet base to the pre-operculum; chin, gular region and branchiostegal membranes golden tending to ochre; 2 light blue interorbital bars; opercular spot black with lilac iridescence. Dorsal fin golden-yellow, though portion below the prominent black submarginal band with a blue cast; lappets yellow with bright yellow tips; submarginal band broadening posteriorly to fill much of rayed portion of fin. Caudal fin dark purple-blue with faint yellowish trailing edge. Anal fin dark purple with light blue leading edge, an ochre tinge at its base and a single large orange-yellow egg-dummy, but occasionally 1–2 smaller egg-dummies present. Pelvic fins yellow with white leading edges and narrow faint black submarginal bands.

Nkhata Bay females: Usually entirely black, or dark grey with a prominent pitch-black submarginal band in the dorsal fin. *P. tropheops* 'black' may exhibit polychromatism, but until a successful mating with an OB female is observed this remains unconfirmed.

Geographical variation. Throughout its wide geographical distribution the basic colours and markings of this species remain virtually unchanged. At Ruarwe and Chilumba, however, the black submarginal band of males is reduced to a thin line except in the rayed portion of the fin where it expands to form a large fin-spot. Females of these northern populations are dark brown rather than black.

Habitat. *P. tropheops* 'black' is most numerous among medium-sized and large rocks. It also occurs over boulders and slabs, particularly at Mpanga Rocks and Mara Rocks where these rock types predominate. Members of this species occur from surface waters to at least 24 m depth, but are most numerous between 3 and 15 m.

Territoriality. Males are aggressively territorial holding territories of 2–3 m diameter. Females have been seen to chase conspecifics, but it is not certain whether they practise

territoriality.

Feeding. Both sexes feed from the upper and vertical surfaces of rocks, apparently taking filamentous algae.

28. *Pseudotropheus tropheops* 'rust'

Synopsis. Males are heavily barred with a prominent rusty-yellow patch on the head, shoulder and chest. Females are grey-brown with two rows of black blotches.

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

Coloration. *Nkhata Bay males:* Body purple-blue with 10–12 dark purple bars, and, in some individuals, faint purple-grey mid-lateral and dorso-lateral longitudinal bands; chest and shoulder rusty-yellow; belly light blue. Head rusty-yellow with a black patch on the operculum, one on the snout and another in the position of an eye-band; single black interorbital bar; a large black patch situated mid-dorsally on the head a prominent feature. Dorsal fin pale blue, suffused with yellow; submarginal band comprising a few unconnected, narrow, black streaks. Caudal fin dark purple with lighter purple inter-ray membranes and a yellow trailing edge. Anal fin black anteriorly, hyaline posteriorly with 1–3 yellow egg-dummies. Pelvic fins yellow with thin black submarginal bands and white leading edges.

Nkhata Bay females: Body light grey-brown with a dorso-lateral and a mid-lateral row of black patches running the length of the body. Head grey with darker grey markings similar to those of males. Fins grey, suffused with yellow.

Habitat. *P. tropheops* 'rust' frequents small-medium and medium-sized rocks, occasionally occurring in the intermediate habitats and over large rocks and boulders. It appears most common in sediment-rich areas between 6 and 15 m, but also inhabits the extreme shallows and penetrates to depths of at least 23 m.

Territoriality. Only males are territorial. They appear relatively tolerant of heterospecific intruders, but highly aggressive towards conspecific males. Females are non-territorial, occurring singly or in small groups of up to 8 individuals.

Feeding. *P. tropheops* 'rust' feeds from the Aufwuchs mat and will also take plankton.

29. *Pseudotropheus tropheops* 'deep'

Synopsis. A small species which frequents deep water at Nkhata Bay.

Distribution. Nkhata Bay (C).

Coloration. *Males:* Body purple dorsally, lilac ventrally with a bright golden-orange patch covering the shoulder, pectoral region, chest and anterior belly; 5–6 faint grey bars. Head dark purple, almost black dorsally, lighter purple around the eye; cheek, chin, gular region and branchiostegal membranes golden-orange; opercular spot black; a single light blue interorbital bar. Dorsal fin golden-yellow with a narrow dark blue submarginal band and yellow lappets with white tips; trailing edge golden. Caudal fin black, suffused with yellow; trailing edge orange-yellow. Anal fin hyaline posteriorly, black submarginally and white anteriorly; a single orange egg-

dummy. Pelvic fins orange posteriorly, black submarginally and white anteriorly.

Females: Body reddish-brown tending to khaki-brown dorsally and yellow ventrally; 5–6 faint, grey bars. Head khaki-brown dorsally tending to lilac ventrally. Dorsal fin dull orange with numerous small white flecks and a narrow black submarginal band; lappets yellowish-white. Caudal fin khaki with blue cast and yellow trailing edge. Anal and pelvic fins orange-yellow, with black submarginal bands and white leading edges.

Habitat. *P. tropheops* 'deep' frequents small and medium-sized rocks in the sediment-rich deeper areas. It is most numerous between 15 and 20 m, but rare in water shallower than 10 m. Depth distribution extends to at least 30 m.

Territoriality. Males are aggressively territorial; females are not territorial.

Feeding. Members of this species feed from sediment-covered surfaces, but it is not known which components of the Aufwuchs it collects.

30. *Pseudotropheus tropheops* 'band'

Synopsis. A shallow-water species of the intermediate habitat where males nest on sand among or near rocks. Males are predominantly yellow with a conspicuous black submarginal band running half-way along the dorsal fin. Females are grey.

Distribution. Nkhata Bay (C).

Coloration. *Males:* Body yellow with bluish cast on flanks and caudal peduncle; belly and shoulder bright golden-yellow; 6–7 grey bars usually very faint, sometimes absent. Head golden-yellow with grey-blue patch running from between the eyes over the occipital region to the dorsal fin; snout light grey with 2 violet-blue interorbital bars; opercular spot greenish-black; chin, gular region and branchiostegal membranes gold. Dorsal fin yellow with violet tinge, a prominent solid black submarginal bar runs about half-way along the fin, but comprises broken black dashes posteriorly; lappets violet with gold edges. Caudal fin yellow with golden trailing edge and violet rays. Anal fin bluish with a yellow cast, black submarginally with a white leading edge and usually a single golden egg-dummy. Pelvic fins orange with black submarginal bands and white leading edges.

Females: Body grey with dark grey blotches. Head grey with bluish interorbital bars. Dorsal fin grey with a yellowish tinge in some individuals and a faint black submarginal band. Caudal fin grey. Anal and pelvic fins yellowish-grey with black submarginal bands.

Habitat. *P. tropheops* 'band' lives mainly over sand either among rocks or near to rocks. It is fairly common in both wave-washed and sheltered zones along the Nkhata Bay peninsula. It is most numerous in 1–3 m depth and is absent below 6 m.

Territoriality. Males are territorial and defend areas of about 2 m diameter. They dig saucer-shaped nests in sand alongside rocks or underneath rocky overhangs. Females are not territorial.

Feeding. Males feed mainly from rocks within their territorial boundaries, though they do occasionally venture further afield and may feed from sand also. Females feed from

both rock and sand.

31. *Pseudotropheus tropheops* 'no band'

Synopsis. A shallow-water species of the intermediate habitat where males nest on sand among or near rocks. Very similar in coloration to *P. tropheops* 'band', but males are more brightly coloured and do not have a submarginal band.

Distribution. Nkhata Bay (U).

Coloration. Males: Body bright golden-yellow, tending to lilac-blue posteriorly. Head golden with prominent grey patch on the occipital region of the head, 2 lilac-blue interorbital bars. Dorsal fin golden-yellow with faint lilac-blue hue posteriorly. The black submarginal band absent. Caudal fin golden-yellow with violet rays. Anal fin bluish-yellow with a black submarginal band and white leading edge, 1–2 orange egg-dummies. Pelvic fins orange with black submarginal bands and white leading edges.

Females: Very similar to those of *P. tropheops* 'band'.

Habitat. The habitat preferences are currently indistinguishable from those of *P. tropheops* 'band'.

Feeding. Feeding behaviour is also indistinguishable from that of *P. tropheops* 'band'.

Note: *P. tropheops* 'band' and *P. tropheops* 'no band' are very similar anatomically, in basic coloration, in behaviour and apparently in habitat preference. It is possible that they are conspecifics, but we regard them as distinct species because colour differences do exist, particularly the presence or absence of the submarginal band of the dorsal fin. In addition, the 10 largest territorial males of *P. tropheops* 'band' are larger (95–102 mm SL) than the 10 largest *P. tropheops* 'no band' (87–94 mm SL). As the differences between these fishes were not recognized until after the transect were completed, both populations are treated together as *P. tropheops* 'band' (Figures 69 & 70).

32. *Pseudotropheus tropheops* 'red fin' (Plate 5g)

Synopsis. This species occupies a variety of rocky and intermediate habitats. Males are dark blue with red markings in the dorsal fin. Females are yellowish with a prominent black submarginal band in the dorsal fin.

Distribution. Ruarwe (C), Chitande (C), Mpanga Rocks (U). Possibly Mara Rocks (unconfirmed observation).

Coloration. Ruarwe males: Body dark blue with silver-blue sheen and 4–7 black bars. Head dark blue with a light blue interorbital bar and a violet sheen along lower region of pre-operculum; opercular patch black with greenish cast. Dorsal fin bluish with orange-red interspine membranes and a well-defined black submarginal band; lappets white with orange-red tips; rayed portion of dorsal fin blue-grey with orange trailing edge and a variable number of orange ocelli. Caudal fin inter-ray membranes mauve, rays dark grey with orange tinge; trailing edge orange. Anal fin dark grey, almost black, but blue at base with a white leading edge and an orange egg-dummy. Pelvic fins dusky grey with narrow black submarginal bands and white leading edges.

Ruarwe females: Body brownish dorsally, beige ventrally with faint brown bars. Head beige, but grey-brown dor-

sally. Dorsal fin beige, with prominent black submarginal band which is flanked by white bands to form a well-defined and distinctive feature; lappets white with orange-yellow tips. Caudal fin brownish-yellow with white spots. Anal fin light brown with orange trailing portion, black submarginal band and a white leading edge. Pelvic fins ochre with black submarginal bands and white leading edges.

Geographical variation. Males at Chitande and Mpanga Rocks are darker blue than those of Ruarwe and usually have only 5 broad, black vertical bars. The dorsal fin has an overall darker appearance, being deep red rather than orange-red. The submarginal band, however, is narrower. Pelvic fins are orange-red and not dusky grey. Females are orange-grey with more distinct barring and faint grey mid-lateral and dorso-lateral bands. The submarginal band which is a distinctive feature of Ruarwe females is relatively narrow in the Chitande and Mpanga Rock forms, and fades posteriorly.

Habitat. *P. tropheops* 'red-fin' is most common among small and medium-sized rocks though it does occur in the intermediate zones. In areas such as Mpanga Rocks where boulders and slabs predominate, it occurs over large, open rock-faces. The depth distribution of this species is from 2 to at least 25 m depth though most individuals occur between 7 and 15 m.

Territoriality. Territorial males normally defend areas among small and medium-sized rocks though other areas are also used. When territories are over sand, nests are excavated. Males are highly aggressive and at Mpanga Rocks gardens were evident in some territories. Females are usually solitary and are not territorial.

Feeding. Members of this species feed by nipping and jerking at the Aufwuchs in a manner which suggests that filamentous algae are harvested.

33. *Pseudotropheus tropheops* 'weed'

Synopsis. A fish of shallow intermediate, often vegetated, habitats.

Distribution. Dankanya Bay (U), Usisya (U) and Chitande (U). It was not found at Ruarwe where we studied the rocky environment only.

Coloration. Chitande males: Body violet-blue with 8 grey bars traversing flanks, but usually not extending all the way to base of dorsal fin or to the ventral part of the belly. The 5 anterior bars broad and dark grey, but 3 posterior bars dull grey; shoulder and chest rusty-yellow. Head dark grey dorsally, black ventrally with two iridescent metallic-blue interorbital bars, the lower bar being particularly bright. Dorsal fin blue ventrally, yellow-orange dorsally. Caudal fin orange distally, dusky proximally with light blue inter-ray membranes. Anal fin dark grey anteriorly, fading to hyaline posteriorly with a single large yellow egg-dummy. Pelvic fins ochre-yellow with black submarginal bands and white leading edges.

Chitande females: Body grey-brown with 8 dark grey bars. Head dark grey with 2 light grey interorbital bars flanked by black interorbital bars. All fins grey.

Habitat. *P. tropheops* 'weed' lives among scattered rocks

in areas covered by macrophytes. This species was not found below 6 m depth.

Territoriality. Males are territorial, females are not. Male aggression is restricted mainly to conspecifics.

Feeding. Members of this species were seen to feed from rock and sand substrata and from plants, but it is not known which components of the Aufwuchs are taken.

Note: This species is superficially similar to *P. cf. novemfasciatus*, but has a steeper snout profile and heavier barring.

34. *Pseudotropheus tropheops* 'chitande yellow' (Plate 5h)

Synopsis. This species inhabits sediment-rich, sheltered zones and intermediate habitats in shallow water. Males are predominantly yellow; females are grey-brown.

Distribution. Chitande (C), harbour jetty at Chilumba (C).

Coloration. Chitande males: Body yellow, particularly bright on shoulder, pectoral region and chest, but with bluish cast on flanks; caudal peduncle mauve. Head yellow with grey-blue patch on forehead and snout; opercular spot black with green sheen. Dorsal fin inter-ray and inter-spine membranes blue-violet, spines and rays golden-yellow; lappets yellow. Caudal fin grey-mauve with yellow rays. Anal fin greyish-blue with a dark grey leading edge and violet-blue patch along its base; usually a single large egg-dummy. Pelvic fins golden-yellow with narrow black submarginal bands and white leading edges.

Chitande females: Body grey-brown though some individuals are khaki-brown; a narrow dorso-lateral band of grey blotches and a broad mid-lateral band of grey blotches running the length of the body; occasionally 7–9 faint grey bars visible. Head grey-brown or khaki-brown. Dorsal and caudal fins pale brown. Anal fin grey-brown with light brown leading edge. Pelvic fins khaki-yellow with black submarginal bands and white leading edges.

Habitat. *P. tropheops* 'chitande yellow' is most numerous in the intermediate zone. It lives along the rock-sand interface which it follows down to a depth of at least 12 m at Chitande. It also occurs in rocky zones where it favours sediment-covered areas in sheltered, shallow waters.

Territoriality. Males are territorial and where territories are over sand, nests are excavated. Females usually occur singly and do not hold territories.

Feeding. Members of this species were observed to feed from the Aufwuchs mat on rocky substrata, but it is not known which components of the Aufwuchs are harvested.

***Pseudotropheus williamsi* (Günther 1893) species-complex (Figures 8a–c)**

Members of this species-complex are anatomically similar; all species inhabit the shallows, usually less than 4 m; males of all populations are weakly territorial, and non-territorial individuals normally form schools. Most allopatric populations differ in coloration and markings and some differ in maximum adult size and in preferred habitat. By virtue of the way in which we apply the specific mate recognition hypothesis to the biological species concept, those populations which differ markedly from one another are regarded as distinct species. The distribution of the members of the *P. williamsi* species-complex is given in Table 5.

1. *Pseudotropheus williamsi* 'nkudzi' (Plate 5i)

Synopsis. A large, cryptic and apparently uncommon lithophilous species of shallow water.

Distribution. Nkudzi (R–U), Boadzulu I. (U), Monkey Bay (R), Nkhata Bay (R).

Coloration. Nkudzi males: Body lilac-blue with yellow-orange chest and yellowish belly; 5 faint darker blue bars present. Head lilac-blue dorsally with golden-yellow snout, chin, cheek, gular region and branchiostegal membranes; 2 iridescent blue interorbital bars. Dorsal fin pale blue with a broad submarginal band that runs its entire length; lappets blue-white, rays black. Caudal fin inter-ray membranes violet-blue, rays black. Anal fin blue with black submarginal band and white leading edge; 3–5 yellow egg-dummies. Pelvic fins yellow with black submarginal bands and white leading edges.

Nkudzi females: Body grey with two rows of black spots running along its length (Figure 8a). Head grey. Fins grey with black submarginal bands on all but caudal fin which is light grey proximally and dark grey distally.

Geographical variation. Males at Boadzulu Island have almost identical colours and markings at those of Nkudzi,

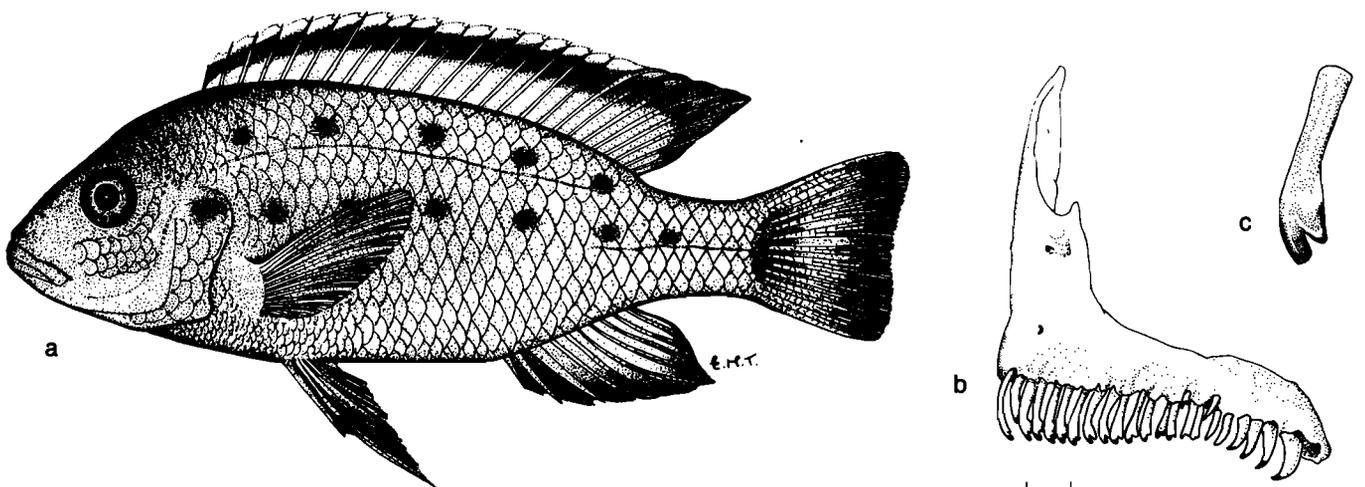


Figure 8 (a) *Pseudotropheus williamsi* 'nkudzi', Nkudzi Point, 121 mm SL. (b) Lateral aspect of left premaxilla of *P. williamsi* 'nkudzi' (Scale = 1 mm). (c) Anterior outer row tooth of *P. williamsi* 'nkudzi'.

Table 5 The members of the *Pseudotropheus williamsi* species-complex. 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 (-)

Species	Maximum size		Distribution													
	mm (SL)	Locality	1	Ila	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. <i>Pseudotropheus williamsi</i> 'nkudzi'	114	Boadzulu I.	+	+	+	-	-	-	-	-	-	-	-	+	-	-
2. <i>P. williamsi</i> 'makanjila'	not	caught	-	-	-	+	-	-	-	-	-	-	-	-	-	-
3. <i>P. williamsi</i> 'maleri'	104	Maleri I.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
4. <i>P. williamsi</i> 'namalenje'	108	Namalenje I.	-	-	-	-	-	-	-	-	+	-	-	-	-	-
5. <i>P. williamsi</i> 'mbenji'	not	caught	-	-	-	-	-	-	-	-	-	+	-	-	-	-
6. <i>P. williamsi</i> 'maingano'	101	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
7. <i>P. williamsi</i> 'khuyu'	110	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
8. <i>P. williamsi</i> 'chisumulu'	106	Chisumulu I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-

but differ in that the lower half of the head and the chest are a deep golden-orange and not yellow-orange. Furthermore, in the Boadzulu form the two interorbital bars are a more intense iridescent blue and the submarginal band in the dorsal fin, although conspicuous, is narrower. At Monkey Bay this species is rare and none was caught for detailed examination of male coloration, but observations in the lake indicate that males are very similar, perhaps identical, to those of Nkudzi. Females of all populations appeared to be identical.

Habitat. This species lives amongst medium-sized and medium-large rocks in the sediment-free zones within 3 m of the surface.

Territoriality. Males are weakly territorial and slowly patrol areas of 3–4 m diameter, occasionally chase intruders and frequently stop and hover 50–100 cm above the rocks. Although rare at most sites, on the south-western corner of Boadzulu Island territorial males are sufficiently close together to have abutting boundaries where occasional displays between neighbours were observed. In general, this species has cryptic behaviour and is not easily observed. Females, juveniles and non-territorial males occur in small groups which swim along the 0–3 m depth zone, but these groups are not often seen. At Monkey Bay, where this species appears to be rare, and where groups of non-territorial fishes had not been seen in about 800 h diving, a school of about 50 individuals was seen swimming in surface waters on the sheltered side of the Island of Thumbi East in April 1981. This sudden appearance, and subsequent disappearance, of numerous non-territorial individuals is unexplained.

Feeding. This species was seen to feed occasionally from Aufwuchs and also from the water column. Stomachs of five individuals caught at Boadzulu Island and one caught at Nkudzi were almost empty, but each contained remains of both adult and larval insects and smaller proportions of zooplankton, C2 and loose Aufwuchs.

Note: Two males which had similar coloration and markings to the Boadzulu Island population were found among medium-large rocks in 1 to 2 m of water at Nkhata Bay. As these fishes appeared superficially identical (none was caught and as both hid among the rocks no detailed comparison was possible) to the Boadzulu form they are considered as conspecifics for the time being.

2. *Pseudotropheus williamsi* 'makanjila'

Synopsis. A large fish of the rocky and intermediate habitats of shallow water.

Distribution. The reefs off Makanjila Point (R), Masinje Rocks (R).

Coloration. *Makanjila males:* Body pale blue with light yellow chest and yellowish-white belly. Head pale blue with 2 lilac-blue interorbital bars; snout, chin, lower half of each operculum and branchiostegal membranes pale yellow. Dorsal fin blue with a broken, narrow, black submarginal band; lappets white; rays black and a conspicuous black dorsal fin-spot in rayed portion. Caudal fin pale blue with black rays. Anal fin blue with a black submarginal band and white leading edge; 2–6 yellow egg-dummies. Pelvic fins pale yellow with black submarginal bands and white leading edges.

Makanjila females: Identical to those of *P. williamsi* 'nkudzi', but without the prominent submarginal band of the dorsal fin.

Geographical variation. Although slight differences in the intensity of coloration were noted between populations, they all appeared essentially the same. However, D.S.C. Lewis (pers. comm.) found a population on one of the reefs off Makanjila which had a red dorsal fin and an unbroken submarginal band.

Habitat. This species frequents rocky reefs from just below the surface to 4 m depth. It was seen over the rocks forming the reef and at the rock-sand interface. This area is usually wave-washed.

Territoriality. Males hold territories among the rocks or at the sand-rock interface. These are weakly defended, perhaps because heterospecifics are largely ignored and conspecifics are widely separated and therefore intraspecific encounters are rare.

Feeding. On the rare occasions when this species was seen feeding it appeared to take detritic material which had accumulated among the rocks.

3. *Pseudotropheus williamsi* 'maleri' (Plate 5j)

Synopsis. A cryptic medium-large lithophilous species of shallow, sediment-free zones. Males have orange-red dorsal fins.

Distribution. Maleri I. (U), Nankoma I. (R–U), Nakantenga I. (U).

Coloration. Maleri Island males: Body blue with a golden-yellow patch that covers the chest, lower shoulder (pectoral region) and anterior part of the belly. Head and face golden-yellow with a single light blue interorbital bar and lilac-blue occipital region. Dorsal fin orange-red; submarginal band faint except posteriorly where it contributes to the dorsal fin-spot; rays black. Caudal fin grey-blue with black rays fanning out distally; trailing edge orange. Anal fin pale blue with a black submarginal band and a white leading edge; 2–4 yellow egg-dummies. Pelvic fins orange with black submarginal bands and white leading edges.

Maleri Island females: Body grey with two longitudinal rows of dark grey spots. Fins grey with a black submarginal band in the anal and pelvic fins, but not in the dorsal fin.

Geographical variation. The colour pattern of males is the same at all three Maleri islands, but the population at Nakantenga has a brighter red dorsal fin, a deeper blue body and a more golden head and chest than the populations at Maleri and Nankoma Islands.

Habitat. This species lives among medium-sized and medium-large rocks. Most individuals were found at less than 3 m depth, but one territorial male was found at 5 m.

Territoriality. Males are territorial and usually hover motionless in the water column, but are stimulated into a frenzy of activity when conspecifics intrude, either courting females or chasing males. Usually the males ignore heterospecific intruders, but at times of courtship or active patrolling of the territories all intruders are chased.

Feeding. This species was occasionally observed feeding from the rocks or from the water column, but relative to other Mbuna it appears to feed very seldom. Stomachs of five territorial males caught at Nakantenga were all empty.

4. *Pseudotropheus williamsi* 'namalenje' (Plate 6a)

Synopsis. A darkly barred species of medium-large rocks in shallow waters.

Distribution. Namalenje I. (U).

Coloration. Males: Body iridescent, silvery-blue with 7–9 black bars and a tarnished gold chest and gular region. Head grey-blue along occipital region and snout with 2 silvery-blue interorbital bars; cheeks, chin and branchiostegal membranes tarnished gold. Dorsal fin pale blue with a prominent black submarginal band and black patches where each body bar enters the fin; orange patches immediately below the submarginal band increasing in size posteriorly; lappets light blue with orange-yellow tips; rays black and trailing edge orange-red. Caudal fin blue-grey with black rays that fan outwards posteriorly; trailing edge red. Anal fin pale blue with yellow cast, black submarginal band and white leading edge; 2–4 yellow egg-dummies. Pelvic fins golden-brown with black submarginal bands and white leading edges.

Females: Grey with dark grey barring and black submarginal bands in fins.

Habitat. This species lives among medium-large and large rocks in the upper 3 m of water.

Territoriality. The cryptic behaviour of this species made it difficult to observe territoriality. Limited observations, however, suggest that males are territorial. Females, juveniles and non-territorial males were seen once in a school numbering about 40 individuals.

Feeding. These fishes were not seen to feed and none were caught for analysis of stomach contents.

5. *Pseudotropheus williamsi* 'mbenji'

Synopsis. A large species which inhabits the shallows among small and medium-sized rocks close to sandy, sedimented areas.

Distribution. Mbenji I. (R–U).

Coloration. Males: Body slate-blue with a yellow cast on the chest and belly. Head slate-blue with a light blue interorbital bar and a yellowish cast to the cheeks and chin. Dorsal fin slate-blue with a wide, black submarginal band running entire length of fin; lappets red. Caudal fin inter-ray membranes blue, rays black fanning out posteriorly; trailing edge red. Anal fin pale blue with a thin black submarginal band and white leading edge; 2–4 large yellow egg-dummies. Pelvic fins yellowish with black submarginal bands and white leading edges. **Females:** Body blue-grey with two rows of dark grey spots running along the length of the body. Head blue-grey. Dorsal fin light grey with black submarginal band. Caudal fin dark grey distally, grey at base. Anal fin and pelvic fins blue-grey with darker leading edges.

Habitat. Most individuals at Mbenji Island were found in less than 2 m of water over small and medium-sized rocks, close to areas of sand. Some were found at the rock-sand interface and a few were found over medium-sized rocks in purely rocky environs.

Territoriality. Males are weakly territorial. Non-territorial individuals occur in small groups of 5–15 members.

Feeding. Non-territorial fish were seen to feed occasionally upon detritic material, but territorial males were not observed feeding.

6. *Pseudotropheus williamsi* 'maingano'

Synopsis. A large lithophilous species of the shallows of the north-eastern shore of Likoma Island.

Distribution. Maingano (U) and Membe Point (R) at Likoma Island.

Coloration. Males: Body uniform slate-blue. Head slate-blue with a pale blue interorbital bar. Dorsal fin slate-blue with a prominent black submarginal band and light blue lappets. Caudal fin slate-blue with black upper and lower borders and black rays. Anal fin slate-blue with black submarginal band and white leading edge; 2–4 yellow egg-dummies. Pelvic fins hyaline with faint yellow cast, black submarginal bands and white leading edges. **Females:** Body blue-grey with a row of black spots running mid-laterally and another running dorso-laterally. Head blue-grey. Fins greyish with black submarginal bands.

Habitat. This species was found among medium-sized and medium-large rocks in sediment-free areas. Most individuals live within 1.5 m of the surface, but some were found to

a depth of at least 3 m.

Territoriality. Males hold territories about 3 m in diameter which they patrol slowly. Quite frequently they spend many minutes hovering motionlessly above the rocks. Females and other non-territorial individuals were seen most often in small groups.

Feeding. This species was seen to feed from the Aufwuchs and also from the water column. Stomachs of two individuals contained mostly zooplankton, which was abundant at that time (August 1980), some insect remains and small proportions of loose Aufwuchs and C1.

7. *Pseudotropheus williamsi* 'khuyu'

Synopsis. A large species which lives among small rocks in the intermediate zones of shallow water.

Distribution. Khuyu Bay (R–U), Likoma I.

Coloration. Males: Body pale blue, with two longitudinal rows of black spots, usually characteristic of females, clearly visible; most of the flank with a pale yellow cast; chest, pectoral region and much of the belly yellowish-white. Head pale blue, but opercula, cheek, chin and branchiostegal membranes pale yellow. Dorsal fin blue with a narrow, broken, black submarginal band; lappets white with yellow tips; rays black with yellow inter-ray membranes. Caudal fin blue with yellow cast, orange trailing edge and black upper and lower borders. Anal fin pale blue with black submarginal band and white leading edge; 1–4 yellow egg-dummies. Pelvic fins pale blue with black submarginal bands and white leading edges.

Females: Body grey with two longitudinal rows of black spots; faint yellowish cast on chest and belly. Head grey, but faintly yellow ventrally. Fins grey with black markings which are similar to those of males.

Habitat. This species was found among small rocks in the intermediate zone, most individuals occurring in less than 2 m of water. This area is rich in sediment.

Territoriality. Males were seen defending territories, but little is known of their territorial behaviour as they are extremely wary fish which hide when approached by divers. Females and other non-territorial fishes were seen in groups of up to 15 individuals.

Feeding. Stomach contents of four individuals were examined: two were empty and the other two were less than half-full and contained remains of larval and adult insects

and small proportions of loose Aufwuchs and C1.

8. *Pseudotropheus williamsi* 'chisumulu'

Synopsis. A large, shallow-water species which inhabits areas of small and medium-sized rocks.

Distribution. Chisumulu I., at Same Bay (U) and Liwelo Bay (R).

Coloration. Males: Body uniform slate-blue with golden-yellow gular region and chest. Head slate-blue with a light blue interorbital bar and golden-yellow cheeks, chest and branchiostegal membranes. Dorsal fin slate-blue with prominent black submarginal band and light blue lappets. Caudal fin slate-blue with black upper and lower borders, black rays and an orange trailing edge. Anal fin blue with a black submarginal band and white leading edge; 1–4 yellow egg-dummies. Pelvic fins golden-yellow with black submarginal bands and white leading edges.

Females: Grey with the two rows of black spots running longitudinally across the flanks. Fins grey with black submarginal bands.

Habitat. This species lives among small and medium-sized rocks, usually in water less than 2 m deep.

Territoriality. Males are territorial. Non-territorial fishes were seen in schools.

Feeding. The stomach contents of three individuals were examined: two contained remains of larval and adult insects, loose Aufwuchs and C1; the other stomach was empty.

Note: This species shares colour patterns with both of the Likoma Island populations and it inhabits an environment which is intermediate between that of the Khuyu form and that of the Maingano form.

Pseudotropheus elongatus species-group (Figures 9a–c)

The principal criterion for considering the fishes listed in Table 6 together is that they are elongate, resembling *Pseudotropheus elongatus* Fryer, 1956. This group is undoubtedly polyphyletic as it includes species which show differences in head shape and dentition. Furthermore, while some species are extremely long and slender, such as that illustrated by Figure 9a, others are deeper bodied and may eventually prove to have tenuous claims to membership of this group.

Members of this group inhabit a variety of habitats and

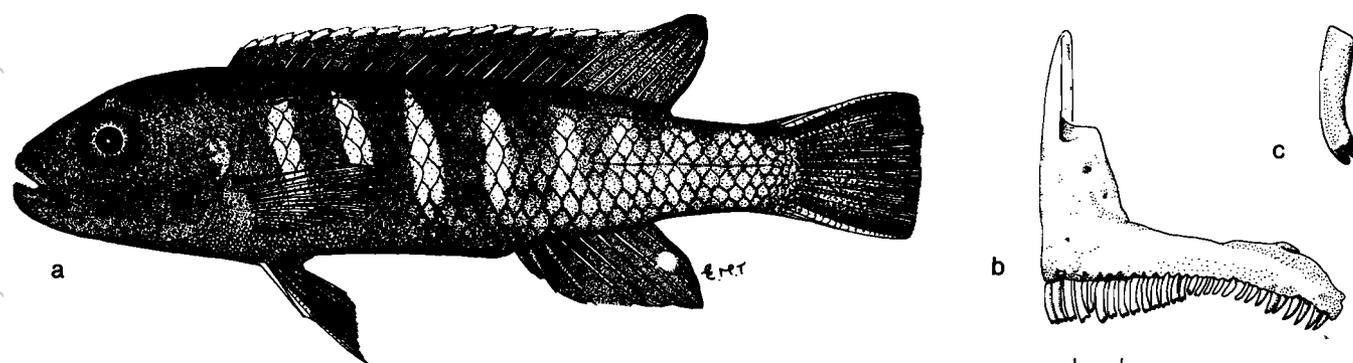


Figure 9 (a) *Pseudotropheus elongatus*, Nkhata Bay, 80 mm SL. (b) Lateral aspect of left premaxilla of *P. elongatus* 'black' of Chinyankwazi I. (Scale = 1 mm). (c) Anterior outer row tooth of *P. elongatus* 'black' of Chinyankwazi I.

Table 6 The members of the *Pseudotropheus elongatus* species-group. 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 (-)

Species	Maximum size		Distribution													
	mm (SL)	Locality	I	IIa	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. <i>Pseudotropheus elongatus</i> 'aggressive'	111	Zimbabwe I.	+	+	-	-	-	+	+	-	-	-	-	-	-	-
2. <i>P. elongatus</i> 'yellow tail'	98	Zimbabwe I.	+	+	-	-	-	+	+	-	-	-	-	-	-	-
3. <i>P. elongatus</i> 'boadzulu'	72	Boadzulu I.	-	-	+	-	-	-	-	-	-	-	-	-	-	-
4. <i>P. elongatus</i> 'reef'	79	Eccles Reef	-	-	-	+	-	-	-	-	-	-	-	-	-	-
5. <i>P. elongatus</i> 'brown'	96	West Reef	-	-	-	+	-	-	-	-	-	-	-	-	-	-
6. <i>P. elongatus</i> 'dinghani'	70	Chinyankwazi I.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
7. <i>P. elongatus</i> 'chinyamwezi'	76	Chinyamwezi I.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
8. <i>P. elongatus</i> 'black'	94	Chinyankwazi I.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
9. <i>P. elongatus</i> 'slab'	84	Mumbo I.	-	-	-	-	-	+	+	+	-	-	-	-	-	-
10. <i>P. elongatus</i> 'bar'	66	Nakantenga I.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
11. <i>P. elongatus</i> 'namalenje'	97	Namalenje I.	-	-	-	-	-	-	-	-	+	-	-	-	-	-
12. <i>P. elongatus</i> 'mbenji blue'	83	Mbenji I.	-	-	-	-	-	-	-	-	-	+	-	-	-	-
13. <i>P. elongatus</i> 'mbenji brown'	92	Mbenji I.	-	-	-	-	-	-	-	-	-	+	-	-	-	-
14. <i>P. elongatus</i> 'mbako'	69	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
15. <i>P. elongatus</i> 'ndumbi'	111	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
16. <i>P. elongatus</i> 'ornatus'	93	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
17. <i>P. elongatus</i> 'gold bar'	86	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
18. <i>P. elongatus</i> 'chisumulu'	84	Chisumulu I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
19. <i>P. elongatus</i>	76	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
20. <i>P. elongatus</i> 'nkhata brown'	81	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
21. <i>P. elongatus</i> 'mara'	57	Mara Rocks	-	-	-	-	-	-	-	-	-	-	-	-	+	-
22. <i>P. elongatus</i> 'bee'	86	Chitande	-	-	-	-	-	-	-	-	-	-	-	-	+	+
23. <i>P. elongatus</i> 'mpanga'	72	Mpanga Rocks	-	-	-	-	-	-	-	-	-	-	-	-	-	+
24. <i>P. elongatus</i> 'ruarwe'	66	Ruarwe	-	-	-	-	-	-	-	-	-	-	-	-	-	+

the behaviour of the species varies from strongly territorial to non-territorial. Territories of some members of this species-group are so aggressively defended that only the resident feeds there, thus the filamentous algae grows to a larger size than in surrounding areas, clearly marking the territories. These areas of apparently rich growth are referred to as algal gardens.

Of the 24 species recorded in Table 6 only *P. elongatus* has already been described.

1. *Pseudotropheus elongatus* 'aggressive' (Plate 6b)

Synopsis. A darkly coloured highly aggressive species which lives among small and medium-sized rocks.

Distribution. Nkudzi (C), Kanchedza I. (U), Monkey Bay (C-N), Nankumba Peninsula (C), Domwe I. (C), Zimbabwe I. (C), Thumbi West I. (C), Mumbo I. (U).

Coloration. *Monkey Bay males:* Body black with 5-6 blue bars. Head black. Dorsal fin black with light blue lap-pets. Caudal fin black with light blue edges and longitudinal blue streaks. Anal fin black with a light blue leading edge and 1-3 egg-dummies. Pelvic fins black with light blue leading edges.

Monkey Bay females: Coloration similar to that of males except that the body bars tend to be brownish rather than blue and the blue edges to the fins are not as intense.

Geographical variation. The populations at Nkudzi, Kanchedza Island, Thumbi West Island and Mumbo Island appear deeper bodied and are not as intensely coloured as those of Monkey Bay, Nankumba and Domwe Island.

At Zimbabwe the individuals are larger than those of Monkey Bay, deeper bodied and almost jet-black with hardly any indication of barring, and the dorsal, caudal and anal fins have orange trailing edges.

Habitat. The preferred habitat is among small and medium-sized rocks though some individuals take up residence in gaps between large rocks and boulders. This species is most numerous in the shallows, but occurs to at least 25 m depth.

Territoriality. Males, females and juveniles larger than 60 mm hold territories which they defend fiercely against all intruders. These territories are usually in gaps between rocks or in rocky fissures. Territories are so fiercely defended that once they become established they invariably have gardens of long green Aufwuchs which are in marked contrast with the heavily cropped regions that surround them.

Feeding. Territorial fishes feed from within their 'gardens' and on plankton in the water column. The stomach contents of 97 territorial individuals caught in 1-3 m depth at Monkey Bay contained on average 50% loose Aufwuchs, 20% benthic Invertebrata, 18% C1, 6% C2 and 6% plankton. The stomach contents of 28 non-territorial individuals contained on average 58% loose Aufwuchs, 19% plankton, 10% benthic Invertebrata, 8% C1, and 5% C2.

2. *Pseudotropheus elongatus* 'yellow tail'

Synopsis. An elongate species which lives in holes and caves among the rocks, usually beyond 10 m depth. It is frequently seen on the roofs of caves swimming upside down.

Distribution. Nkudzi (C), Mpandi I. (U), Kanchedza I. (R), Monkey Bay (U – C), Nankumba Peninsula (U – C), Domwe I. (C), Zimbabwe I. (C), Thumbi West I. (U), Mumbo I. (C).

Coloration. Monkey Bay males: Body sky-blue with 4 – 5 pitch-black bars anterior to the vent and 3 – 4 faint bars posterior to the vent; barring so faint on caudal peduncle that it appears unbarred in many individuals; belly yellowish. Head black with two bright blue interorbital bars. Dorsal fin light blue suffused with yellow; prominent black submarginal band running most of the fin's length; vertical black bars of the body penetrating the fin in some individuals to merge with the submarginal band; lappets bright blue tending to white with yellow flecks and yellow tips; trailing edge orange-yellow. Caudal fin blue with yellow cast, black upper and lower borders and light blue outer edges. Anal fin black with hyaline trailing edge, light blue leading edge; 2 – 5 orange-yellow egg-dummies. Pelvic fins black with light blue leading edges.

Monkey Bay females: Body blue-grey with dark grey barring. Head dark grey with blue-grey interorbital bars. Dorsal fin blue-grey with black submarginal band. Caudal fin blue-grey with black upper and lower borders. Anal and pelvic fins black.

Geographical variation. A clinal gradation with regard to adult male coloration was found: the tail and caudal peduncle become progressively more yellow as the distance from Monkey Bay increases northwards along the Nankumba Peninsula, Domwe Island and eventually to Zimbabwe Island. At the islands of Thumbi West and Mumbo, males resemble closely the yellow-tailed form which occurs at Zimbabwe. To the south of Monkey Bay, at Nkudzi, Mpandi Island and Kanchedza Island males have, in addition to the yellow tail and caudal peduncle, a brighter yellow belly and dorsal fin than has the Monkey Bay form. Females appear alike in all areas, but south of Monkey Bay have a yellow cast on the belly, caudal peduncle and tail.

Habitat. This species is most common among large rocks and boulders but also occurs among smaller rocks. It is usually associated with holes and caves which are provided by rounded or broken rocks. *P. elongatus* 'yellow tail' appears to be most common at depths greater than 10 m and occurs to at least 40 m depth at the islands of Thumbi West, Domwe and Zimbabwe. It also lives in shallow water, and at Kanchedza Island and Mpandi Island it is restricted to the shallows as these islands are in water which goes to sand in less than 10 m.

Territoriality. Aggression of territorial males is directed at conspecifics only, but as individuals of this species are fairly widely spaced, encounters are uncommon.

Feeding. This species always orientates with its belly towards the rock surface, thus it is typically found upside down beneath rocky overhangs where it crops Aufwuchs from the underside of rocks; it also feeds from vertical and horizontal surfaces. It has also been seen feeding on plankton. Analysis of the stomach contents of 13 individuals caught between 5 and 15 m depth in Monkey Bay revealed that they had ingested on average 65% loose Aufwuchs, 28% phytoplankton, 3% zooplankton, 2% benthic Invertebrata and about 1% C1 and C2.

3. *Pseudotropheus elongatus* 'boadzulu'

Synopsis. A blue and black barred, lithophilous species endemic to Boadzulu Island.

Distribution. Boadzulu I. (C).

Coloration. This species is similar in coloration and markings to *P. elongatus* 'slab' except that in males the belly is black and the rayed portions of the dorsal and caudal fin are blue and not yellow. However, these fins do have yellow spots on the trailing portions. Female coloration is similar to that of males, but slightly darker.

Habitat. The preferred habitat of *P. elongatus* 'boadzulu' is among small and medium-sized rocks. The depth distribution of *P. elongatus* 'boadzulu' is from 3 to at least 40 m.

Territoriality. Males of this species were found to be weakly territorial and females are apparently not territorial. Non-territorial individuals are solitary.

Feeding. It was seen to feed by nipping at the Aufwuchs mat and catching plankton in the water column.

4. *Pseudotropheus elongatus* 'reef' (Plate 6c)

Synopsis. A heavily barred species found at rocky reefs.

Distribution. Eccles Reef (C), West Reef (C).

Coloration. Eccles Reef males: Body royal blue with 10 prominent, black bars which all merge dorsally to form a black dorsomedial band; belly black. Head black with a blue occipital bar and blue interorbital bar. Dorsal fin blue, but dominated by a broad, pitch-black submarginal band; lappets blue-white; rays pale blue. Caudal fin blue with black rays and black upper and lower borders; edges white. Anal fin black with 1 – 4 yellow egg-dummies. Pelvic fins black with blue-white leading edges.

Eccles Reef females: Markings identical to males, but ground colour grey-blue and the barring and banding dark brown.

Habitat. The preferred habitat is over medium-sized and large rocks from 3 to 15 m depth.

Territoriality. No definite territorial defence was seen. Members of this species normally occur singly.

Feeding. Seen to feed from the Aufwuchs mat and upon plankton.

5. *Pseudotropheus elongatus* 'brown' (Plate 6d)

Synopsis. A brown species which inhabits rocky reefs.

Distribution. Eccles Reef (C), West Reef (C).

Coloration. Eccles Reef males and females: Body and head uniform chocolate-brown with a faint blue-grey interorbital bar. Dorsal fin grey-brown with a black submarginal band running its full length; lappets white with orange tips. Caudal fin brown at base, black distally with light blue inter-ray membranes; upper and lower borders pitch-black with white edges. Anal fin black with a single orange-yellow egg-dummy. Pelvic fins black with white leading edges.

Habitat. The preferred habitat appears to be over the upper surfaces of large rocks, boulders and slabs in water 3 – 12 m deep. The total depth range extends from the surface to 18 m.

Territoriality. Males defend territories in gaps between rocks or in cracks or fissures within rocks or alongside protuberances on slabs or boulders. Both conspecific and heterospecific aggression is fierce and algal gardens occur in most territories. Females and other non-territorial individuals are normally solitary, occasionally forming small groups.

Feeding. This species feeds by nipping at the Aufwuchs and employing an upward or sideways jerk of the head to wrest filamentous algae from the rocks. It remains close to the rock surface, but will nevertheless feed upon plankton in the water immediately above the rocks.

6. *Pseudotropheus elongatus* 'dinghani' (Plate 6e)

Synopsis. A common yellow-and-black species of the rocky shores of Chinyankwazi Island.

Distribution. Chinyankwazi I. (C – N).

Coloration. Males: Body olive-yellow with 7–8 black vertical bars, but the 3–4 posterior bars are faint; chest and belly black. Head grey-brown tending to black with 2 olive-yellow interorbital bars and 1 occipital bar; chin and gular region black. Dorsal fin olive-yellow with a prominent black submarginal band and yellow lappets. Caudal fin yellowish with black upper and lower borders and black rays. Anal fin black with a whitish-blue leading edge, a hyaline trailing portion and usually only 1 yellow egg-dummy. Pelvic fins black with whitish-blue leading edges.

Females: Similar to males except that ground coloration is beige-brown rather than olive-yellow and black markings are dull.

Habitat. The preferred habitat is among small and medium-sized rocks at 8–15 m depth, but it also occurs over large rocks, boulders and slabs and has a depth range from the surface to at least 35 m.

Territoriality. Males hold territories in crevices and gaps between rocks. All intruders are chased aggressively. None of the territories had clearly defined gardens at the time of the survey (Jan./Feb. 1980). Non-territorial individuals may occur in large schools of several hundred individuals, most of which stay in the water column a metre or more above the substratum. The remaining individuals are solitary and occur among the rocks.

Feeding. Territorial males feed from Aufwuchs within their territories and also upon plankton. Non-territorial individuals feed almost exclusively in the water column. The stomach contents of 14 individuals caught at 6–8 m depth contained on average 90% phytoplankton (*Anabaena* spp.), 7% loose Aufwuchs and small quantities of C1 and C2. Three specimens had ingested a few Copepoda and one had eaten two insect larvae. This result was biased by a phytoplankton bloom at the time of sampling (Jan./Feb. 1980).

The stomach contents of a sample of 6 specimens caught in Dec. 1980 were dominated by zooplankton (50%) and also contained C1 (22%), phytoplankton (10%) and the remainder comprised C2, loose Aufwuchs, benthic crustaceans and insects. Possibly in the absence of plankton *P. elongatus* 'dinghani' would feed mainly on Aufwuchs.

7. *Pseudotropheus elongatus* 'chinyamwezi' (Plate 6f)

Synopsis. A blue and yellowish-brown, lithophilous species

common at Chinyamwezi.

Distribution. Chinyamwezi I. (C – N).

Coloration. Males: Body sky-blue with 8 grey-brown bars; belly, gular region and the ventral part of the chest tan coloured tending to orange in some individuals. Head tan on cheeks, chin and opercula; occipital region and snout dark grey-brown with a light blue occipital bar and 2 interorbital bars. Dorsal fin golden-brown with a narrow black submarginal band and light blue lappets; dorsal fin-spot black and elongate. Caudal fin violet-blue with orange trailing edge and black upper and lower borders. Anal fin black with bluish-grey trailing portion and 2–4 yellow egg-dummies. Pelvic fins orange-brown with black submarginal bands and white leading edges. **Females:** Coloration and markings similar to males, but relatively drab.

Habitat. The preferred habitat is among small and medium-sized rocks between 3 and 17 m though individuals are present from the surface to at least 43 m.

Territoriality. Males aggressively defend areas around caves, crevices and gaps among the rocks. Many territories contained algal gardens. Territorial males were common to about 20 m depth and though males in breeding dress were found from 20 to 43 m it was not ascertained whether they were defending territories. Females, juveniles and non-territorial adult males usually occur in groups of about 30 individuals, but sometimes as many as 70 individuals shoaled together.

Feeding. Stomachs of 8 specimens caught in Jan./Feb. 1980, when a phytoplankton bloom was present contained on average 70% *Anabaena* spp., 12% loose Aufwuchs, 6% zooplankton and small proportions of C1, C2 and benthic Invertebrata. Six specimens caught in December 1980 had eaten zooplankton (65%), phytoplankton (15%), loose Aufwuchs (10%) and filamentous algae (10%).

8. *Pseudotropheus elongatus* 'black' (Plate 6g)

Synopsis. An uncommon black, lithophilous species occurring over large rocks.

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

Coloration. Males and females: Uniformly black except for a blue interorbital bar, bluish-white dorsal fin lappets and yellow egg-dummies.

Habitat. This species was found over the upper surfaces of medium-sized and large rocks, and boulders. At Chinyankwazi it was found between 6 and 12 m only, but at Chinyamwezi it occurs between 3 and 15 m.

Territoriality. Territoriality ranges from extremely fierce defence of crevices in which algal gardens develop, to no indication of territoriality at all. Males were found defending territories most often, but territorial females were also found.

Feeding. *P. elongatus* 'black' was seen to nip and jerk at the Aufwuchs and to feed upon plankton.

9. *Pseudotropheus elongatus* 'slab' (Plate 6h)

Synopsis. This elongate, barred species is common over upper surfaces of slabs, boulders and large rocks.

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

Nakantenga I. (U).

Coloration. Thumbi West males: Body blue with 4 distinct black bars anteriorly and 4–5 faint bars posteriorly. Head pitch-black with bright blue interorbital and occipital bars. Dorsal fin blue with the 4 anterior bars of the body extending into the fin where they merge with the prominent, black submarginal bar; lappets white; rayed portion yellowish with an orange-yellow trailing edge. Caudal fin pale blue with orange-yellow trailing edge and black upper and lower borders. Anal fin blue with black submarginal band and white leading edge; 1–3 yellow egg-dummies. Pelvic fins black with white leading edges.

Thumbi West females: Body light yellowish-brown with a blue cast and grey barring. Head grey-brown with blue interorbital and occipital bars. Fin colours and markings similar to those of males, but fainter.

Geographical variation. The population at Mumbo Island appears identical with that at Thumbi West, but that at Nakantenga has a black belly and 6 distinct bars on the anterior part of the body which extend into the dorsal fin to merge with the submarginal band. The rayed part of the dorsal fin is blue having less yellow than the Thumbi West form.

Habitat. The preferred habitat appears to be over the upper surfaces of large rocks, boulders and slabs. This species is found from the surface waters down to a depth of at least 35 m, but is most abundant between 3 and 15 m.

Territoriality. Males hold territories along cracks or crevices in slabs or in clefts between adjacent rocks. They defend these territories so aggressively against all intruders that algal gardens develop. Preliminary observations suggest that most males are not territorial from April to July. Females, juveniles and non-territorial adult males usually form schools of up to 150 individuals which remain close to the surfaces of large rocks and slabs. Solitary individuals may be found among small and medium-sized rocks.

Feeding. This species feeds by nipping at the Aufwuchs with rapid upward and sideways jerks of the head. It also feeds on plankton, but remains close to the rock surface when doing so.

10. *Pseudotropheus elongatus* 'bar' (Plate 6i)

Synopsis. A heavily barred, aggressive species of large rocks, boulders and slabs.

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

Coloration. Maleri Island males: Body pale blue with a tan cast and 8–9 grey-brown bars. Head pale brown with a grey-brown occipital region and snout; 2 pale blue interorbital bars and 2 pale blue occipital bars. Dorsal fin pale blue with a conspicuous black submarginal band running its full length; lappets blue-white with yellow-orange tips. Caudal fin blue-grey with black upper and lower borders and white edges. Anal fin black with white leading edge and bluish trailing portion; 2–4 yellow egg-dummies. Pelvic fins grey-brown with black submarginal bands and white leading edges.

Maleri Island females: Markings similar to males, but the ground colour dull grey and the barring brown.

Habitat. It is most common over large rocks, boulders and slabs in 5 to 15 m depth. Its full depth range is from the surface to at least 28 m.

Territoriality. Males and occasionally females are highly aggressive in territorial defence, frequently chasing intruding conspecifics 3–4 m. They also exclude heterospecifics. Territories are usually held in crevices and although well defended against all intruders, few had conspicuous algal gardens when studied (March/April 1980).

Feeding. It feeds by nipping at the Aufwuchs and also collects plankton from the water immediately above the rock surfaces, but seldom ventures more than 30–40 cm from the rocks to feed.

11. *Pseudotropheus elongatus* 'namalenje'

Synopsis. A deep-bodied member of the *P. elongatus* species-group which inhabits the upper surfaces of large rocks, boulders and slabs.

Distribution. Namalenje I. (C–N).

Coloration. Males: Body pale blue with 8–9 dark grey-brown bars, the posterior 3 normally being faint. Head dark grey-brown with a light blue occipital bar and an interorbital bar; chin, cheeks, opercular and gular regions ochre-brown. Dorsal fin pale blue with black bars from the body crossing its base to merge with the prominent black submarginal band; lappets white with yellowish-orange tips. Caudal fin blue with a yellow tinge and black upper and lower borders. Anal fin yellowish-blue posteriorly, black submarginally with a white leading edge; 1–3 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Markings similar to those of males but dull grey-brown against a yellowish-blue ground colour.

Habitat. This species is common over the upper surfaces of large rocks, boulders and slabs which are characteristic of Namalenje Island. It occurs from the surface waters down to the rock-sand interface at 10 m depth.

Territoriality. Males vigorously defend territories which are centred around crevices, fissures or gaps in the rocks. Females form schools with non-territorial conspecifics.

Feeding. This species feeds from the rock surface and although it takes plankton also, it does not venture more than 10–20 cm into the water column.

12. *Pseudotropheus elongatus* 'mbenji blue' (Plate 6j)

Synopsis. A blue and black barred species which lives over the upper surfaces of large rocks and boulders in sediment-free zones.

Distribution. Mbenji I. (C).

Coloration. Males: Body royal blue with 7–8 black bars, caudal peduncle tarnished yellow; belly black in most individuals, ochre-yellow in some individuals; dorso-medial ridge black. Head black dorsally with a blue occipital bar and 2 blue interorbital bars; chin and cheeks brownish-yellow. Dorsal fin penetrated by black bars from body that merge with a broad, black submarginal band that runs the full length of the fin; windows of blue occur between the bars; lappets whitish with yellow tips. Caudal fin tarnished yellow with black upper and

lower edges. Anal fin black with 3–7 yellow egg-dummies. Pelvic fins black with light blue leading edges.

Females: Markings as those of males, but the bars are grey-brown and the ground colour blue-grey.

Habitat. This species is most numerous over the upper surfaces of large rocks, boulders and slabs and occurs from 2 to 16 m depth.

Territoriality. Males are territorial, defending areas between rocks, or in cracks in rocks. Females and other non-territorial individuals are usually solitary.

Feeding. It feeds from the upper surface of rocks and upon plankton.

13. *Pseudotropheus elongatus* 'mbenji brown' (Plate 7a)

Synopsis. A dark brown fish occurring on vertical faces of large rocks.

Distribution. Mbenji I. (U).

Coloration. Males: Body dark brown with darker brown barring. Head dark brown with 2 light blue interorbital bars and an incomplete light blue occipital bar. Dorsal fin brown with a black submarginal band, white lappets with orange tips and orange-tinged trailing edge. Caudal fin brownish-yellow with black upper and lower borders. Anal fin black with 1–3 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Darker in colour than males, tending to be uniformly black with white dorsal fin lappets.

Habitat. This species is usually found on the vertical surfaces of large rocks, particularly where vertical pillars of rock are close to one another. Its depth range is from 5 to 18 m.

Territoriality. Males are weakly territorial and females are not territorial. This species is normally solitary, but occasionally it is found in small groups, though the members of such groups usually behave independently of one another.

Feeding. It crops the Aufwuchs growing on vertical surfaces of rocks and in this respect differs from *P. elongatus* 'mbenji blue' which feeds mainly from upper surfaces.

14. *Pseudotropheus elongatus* 'mbako' (Plate 7b)

Synopsis. A small, relatively deep-bodied member of the *P. elongatus* species-group occurring among small and medium-sized rocks and in intermediate habitats.

Distribution. Found along the north-eastern shores of Likoma Island at Maingano (U), Mbako Point (C) and Makulawe Point (C).

Coloration. Males: Body bright royal blue with 8–9 broad black bars. Head black except for 2 light blue interorbital bars and a light blue occipital bar which may be fragmented to form blue patches. Dorsal fin blue, but crossed by extensions of the vertical bars of the flanks which merge with the prominent, broad, black submarginal band; lappets light blue. Caudal fin royal blue with black rays, and black upper and lower borders with white edges. Anal fin black with 1–4 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Almost identical to males, but blue duller and egg-dummies smaller and less intensely coloured.

Habitat. It is most common over the upper surfaces of small

and medium-sized rocks, but it also lives over large rocks and in the intermediate zones of the rock-sand interface. It occurs from the surface waters, where it lives in a sediment-free environment, down to depths of at least 40 m where it encounters sediment-covered rocks, but nowhere is it really numerous and so its preferred habitat is not known.

Territoriality. Most individuals are not territorial, though some are weakly territorial, defending areas among small and medium-sized rocks.

Feeding. This fish feeds by nipping at the Aufwuchs and has been seen to take zooplankton.

15. *Pseudotropheus elongatus* 'ndumbi'

Synopsis. A truly elongate species from large rocks, where both sexes defend territories containing algal gardens.

Distribution. Likoma Island at Ndumbi Rocks (U), Makulawe Point (C), Masimbwe Islet (C).

Coloration. Makulawe males and females: Uniformly dark blue-grey with traces of darker barring. A light blue interorbital bar provides the only break in the uniformity of colour.

Habitat. Its preferred habitat is among large rocks and boulders in exposed, sediment-free zones. It is most common from 4 to 15 m depth, but its range is from the surface to about 23 m.

Territoriality. Territories are held within cracks or gaps among the rocks and are so aggressively defended that algal gardens are apparent. Both sexes are territorial. Territories at Makulawe Point are on average 112 cm long (range 86–147 cm), 21 cm wide (range 8–43 cm) ($N=8$) and all were in rocky fissures that were at least 40 cm deep. The distance between neighbours depends upon the distance between suitable refuges and although the fishes are highly aggressive they tolerate neighbours as close as 38 cm.

Feeding. Members of this species feed from within their territories and the stomach contents of 11 individuals caught at Makulawe Point in 6–8 m depth contained on average 84% loose Aufwuchs, 11% zooplankton and the remaining 5% comprised benthic crustaceans and filamentous algae.

16. *Pseudotropheus elongatus* 'ornatus' (Plate 7c)

Synopsis. Black and blue barred males, yellowish females, restricted to Ndumbi Rocks and Makulawe Point.

Distribution. Likoma Island at Ndumbi Rocks (C) and Makulawe Point (U).

Coloration. Ndumbi males: Body royal blue with 8 black bars; chest and belly black. Head black with a royal blue occipital bar and 2 royal blue interorbital bars. Dorsal fin black with white lappets and pale blue inter-ray membranes. Caudal fin black at base, but with blue inter-ray membranes distally and black upper and lower borders. Anal fin black anteriorly, hyaline posteriorly with 2–7 yellow egg-dummies. Pelvic fins blue-grey with black submarginal bands and white leading edges.

Ndumbi females: Body pale yellow with a light blue cast and faint grey barring. Head grey with blue-yellow interorbital and occipital bars. Dorsal fin blue-yellow with a conspicuous broad, black submarginal band; lappets bluish-white. Anal and pelvic fins yellow with narrow

black submarginal bands and white leading edges.

Habitat. This species occurs over the upper surfaces of large rocks, boulders and slabs. Although it occurs down to at least 40 m depth, most adults live in the shallows.

Territoriality. Males apparently defending territories were found occasionally, but this is not usually a territorial species. Mixed groups containing adults and juveniles of both sexes congregate over the upper surfaces of rocks. These groups may contain more than 100 members, but they usually comprise less than 30 individuals.

Feeding. Members of this species pluck Aufwuchs from rocks and feed on plankton.

17. *Pseudotropheus elongatus* 'gold bar' (Plate 7d)

Synopsis. A gold and brown barred species which frequents intermediate habitats of sediment-rich areas in shallow water.

Distribution. Likoma I. at Khuyu Bay (C), Chisumulu I. at Liwelo Bay (C).

Coloration. Likoma males: Body golden with 7–8 dark brown bars and a black belly. Head black with 2 bluish-yellow interorbital bars and an occipital bar. Dorsal fin black with yellow lappets and a yellow-orange trailing edge. Caudal fin yellow at base, but black distally with black upper and lower borders and yellowish-white edges. Anal fin tarnished yellow posteriorly, black submarginally and with white leading edges; 1–3 yellow egg-dummies. Pelvic fins gold posteriorly with black submarginal bands and white leading edges.

Likoma females: Identical to males in markings, but ground colour relatively dull yellow with dark grey-black barring.

Geographical variation. The population at Chisumulu Island is slightly deeper bodied, has broader black bars and more black on the belly. Furthermore, the fins are almost totally black with traces of yellow in the trailing portions. Females are also darker than the Likoma Island population.

Habitat. This species lives in water which is less than 6 m deep. It occupies intermediate habitats or lives among rocks close to intermediate habitats. Both Khuyu Bay and Liwelo Bay are areas which are rich in sediment.

Territoriality. Males are aggressively territorial defending areas among small and medium-sized rocks, sometimes excavating sand-scrape nests. Females are not territorial and are normally solitary.

Feeding. This species feeds from the Aufwuchs and forages in the sand.

18. *Pseudotropheus elongatus* 'chisumulu' (Plate 7e)

Synopsis. A darkly barred, weakly territorial species.

Distribution. Chisumulu I. (C).

Coloration. Males: Body pale blue with yellowish tinge and 8–9 broad, black bars and black belly. Head black with pale blue occipital bar and 2 pale blue interorbital bars. Dorsal fin black with pale blue lappets. Caudal fin black with pale blue inter-ray membranes and yellowish trailing edge. Anal fin black with light blue leading edge and 2–3 golden-yellow egg-dummies. Pelvic fins black with

light blue leading edges.

Females: Markings identical to those of males, but ground colour is beige-yellow.

Habitat. Its preferred habitat is among large rocks, but it occurs in a variety of rocky habitats and sometimes in the intermediate zone. Its full depth range is from the surface to at least 30 m, but it is most numerous between 5 and 15 m.

Territoriality. Males are weakly territorial and females are not territorial. This species normally occurs singly or in small groups.

Feeding. It feeds from all rock surfaces, but appears to favour vertical surfaces.

19. *Pseudotropheus elongatus* Fryer, 1956

Synopsis. A darkly coloured, aggressive fish of medium-sized rocks in shallow water.

Distribution. Nkhata Bay (U), and probably also on the rocky shores to the north and to the south.

Coloration. Males: Body black with 8 royal blue wedges of colour extending from the base of the dorsal fin to half-way across the flanks. Head black with violet sheen on the posterior and ventral edges of opercula, 2 blue interorbital bars. Dorsal fin black with turquoise lappets and an orange trailing edge to the rayed portion. Caudal fin black with turquoise upper and lower edges. Anal fin dark grey with 2–6 yellow egg-dummies. Pelvic fins black with blue leading edges.

Females: Black but usually without the half-barring and turquoise edges to the fins; the yellow egg-dummies inconspicuous.

Habitat. It occurs mainly over medium-sized rocks in shallow water.

Territoriality. Males are strongly territorial, defending areas within crevices between rocks. Algal gardens occur in many territories. Some individuals in female coloration were also seen defending territories, but none were caught to establish their sex.

Feeding. Fryer (1959a) noted that it collects loose Aufwuchs from the rock surfaces.

20. *Pseudotropheus elongatus* 'nkhata brown'

Synopsis. An uncommon reddish-brown lithophilous species in deepish water.

Distribution. Nkhata Bay (U), but probably also on the rocky shores to the north and south.

Coloration. Males: Body and head brown with a reddish tinge. Dorsal fin brown with a narrow, but prominent, black submarginal band running the full length of the fin; lappets yellow; trailing edge of rayed portion reddish-orange. Caudal fin dark brown, but orange-red distally and on the upper and lower borders. Anal fin black with a reddish-brown trailing portion and white leading edge; egg-dummy yellow, usually only one present, but absent in some individuals. Pelvic fins orange-red posteriorly with black submarginal bands and white leading edges.

Females: Dark chocolate-brown tending to black, with orange-brown trailing edges to the fins.

Habitat. This species lives among medium-sized and large rocks in sediment-rich zones from 8 to 30 m.

Territoriality. Males are weakly territorial. In general the individuals of this species are solitary.

Feeding. This species feeds from all rock surfaces, though preliminary observations suggest that it favours vertical surfaces.

21. *Pseudotropheus elongatus* 'mara' (Plate 7f)

Synopsis. A small species of the rock-sand interface.

Distribution. Mara Rocks (C).

Coloration. Males: Body pale blue with 6–7 faint grey bars. Head pale blue with a grey occipital region and snout. Dorsal fin orange with a light blue rayed portion and yellow lappets. Caudal fin blue with black rays. Anal fin black with 2–4 yellow egg-dummies. Pelvic fins pale blue with white leading edges.

Females: Not known.

Habitat. This species lives over sand at the rock-sand interface in 7–10 m depth.

Territoriality. Males are territorial, usually excavating nests beneath rocks.

Feeding. No information.

22. *Pseudotropheus elongatus* 'bee' (Plate 7g)

Synopsis. An elongate yellow and black barred species which inhabits intermediate zones.

Distribution. Chitande (C), Mara Rocks (C).

Coloration. Chitande males: Body yellow with 7–8 black bars and a black belly. Head black with 2 yellowish-blue interorbital bars. Dorsal fin yellowish with a prominent, broad, black, submarginal band and yellow lappets. Caudal fin blue with a yellow cast and prominent black upper and lower borders with white edges. Anal fin black with white leading edges and 2–5 yellow egg-dummies. Pelvic fins black with white leading edges.

Chitande females: With a similar but duller pattern of yellowish-brown and black markings.

Geographical variation. Males of the Mara Rocks population are bluish-yellow and relatively faintly barred. The head has a distinct blue cast. Each fin has a greater area of yellow than the Chitande form. The Mara Rocks females are similar to the Chitande form.

Habitat. This species occupies the intermediate zones and is most numerous along the rock-sand interface. At Chitande it follows this habitat from 3 to at least 40 m depth and at Mara Rocks it occurred from 6 to 15 m depth.

Territoriality. Territorial males dig sand-scrape nests alongside or beneath rocks. Females are not territorial and are normally seen in small groups with other non-territorial individuals.

Feeding. Members of this species feed from rocky and sandy substrata.

23. *Pseudotropheus elongatus* 'mpanga'

A fish which appears similar in colour and markings to *P. elongatus* 'slab' of Thumbi West Island was seen at Mpanga

Rocks in 3–5 m of water. This species is uncommon and no details of coloration and markings were obtained. As it was seen over the upper surfaces of boulders it may be inferred that this is its usual habitat.

24. *Pseudotropheus elongatus* 'ruarwe'

Synopsis. A small vividly marked blue and black barred lithophilous species of shallow waters.

Distribution. Ruarwe (C).

Coloration. Males: Body bright royal blue with 9–10 pitch-black bars. Head black with 2 bright royal blue interorbital bars and one occipital bar. Dorsal fin pitch-black with whitish-blue lappets; trailing edge pale blue. Caudal fin blue with black rays and black upper and lower borders; edges of fin white. Anal fin black with hyaline trailing portion and white leading edges; 1–3 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Similar to males but with duller markings.

Habitat. This species lives among small and medium-sized rocks in the sediment-free zones from the surface to 15 m, but is most common between 3 and 8 m.

Territoriality. Males defend territories which are usually situated between the rocks, but sometimes their territories are over the upper surfaces of rocks. Most aggression is directed towards conspecifics, though they also chase heterospecific intruders. Females, juveniles and non-territorial adult males are usually solitary, but sometimes form small groups over the upper surfaces of rocks.

Feeding. This species was seen to feed from the upper surfaces of sediment-free rocks.

Pseudotropheus 'aggressive' species-group

It is unlikely that the morphologically diverse species listed in Table 7 represent a natural group as they possess no apparent uniting morphological characteristic. The group emerged from the results of this study as a convenient categorization of strongly territorial fishes which live among small and medium-sized rocks in shallow water. The territories of these fishes are so aggressively defended that they develop algal gardens. The possession of algal gardens by at least some individuals within each species is a characteristic of the members of this species-group. A further characteristic is that it is usual for both sexes to practise territoriality.

Several members of the *P. elongatus* species-group also show strong territoriality and possess algal gardens, but these fishes are slender-bodied whereas those of the *P.* 'aggressive' species-group are relatively deep-bodied.

Of the 12 species listed in Table 7, four are described. *Pseudotropheus* cf. *Melanochromis perspicax* has been placed in this group as we believe that it has closer ties with the strongly territorial *Pseudotropheus* species than with the weakly territorial *Melanochromis* species (p.207–209).

1. *Pseudotropheus* 'aggressive blue' (Plate 7h)

Synopsis. A small, highly aggressive species which lives among small rocks in shallow water.

Distribution. Monkey Bay (C), Tsano Rock (C), Thumbi West I. (C), Nankoma I. (C) and Maleri I. (C).

Coloration. Monkey Bay males: Body sky-blue with golden-

Table 7 The members of the *Pseudotropheus* 'aggressive' species-group. 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 (-)

Species	Maximum size		Distribution													
	mm (SL)	Locality	I	Ila	Ilb	Ilc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. <i>Pseudotropheus</i> 'aggressive blue'	74	Monkey Bay	+	-	-	-	-	+	-	+	-	-	-	-	-	-
2. <i>P.</i> 'aggressive brown'	93	Thumbi West	-	-	-	-	-	+	-	-	-	-	-	-	-	-
3. <i>P.</i> 'aggressive yellow head'	84	Maleri I.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
4. <i>P.</i> 'aggressive grey head'	76	Maleri I.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
5. <i>P.</i> 'aggressive zebra'	101	Mbenji I.	-	-	-	-	-	-	-	+	-	+	+	-	-	-
6. <i>P. tursiops</i> 'mbenji'	102	Mbenji I.	-	-	-	-	-	-	-	-	-	+	-	-	-	-
7. <i>P. tursiops</i>	94	Chisumulu I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
8. <i>P.</i> 'aggressive grey'	103	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
9. <i>P.</i> 'aggressive yellow fin'	94	Chisumulu I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
10. <i>P. fuscus</i>	77	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
11. <i>P. fuscooides</i>	86	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
12. <i>P. cf. M. perspicax</i>	66	Chilumba	-	-	-	-	-	-	-	-	-	-	-	-	-	+

yellow gular region, chest, shoulder and belly; 6–7 faint grey-blue bars. Head pale blue dorsally, but snout, cheek, opercular region, chin and branchiostegal membranes golden-yellow; a dark grey interorbital bar and black opercular spot. Dorsal fin pale blue with black rays that fan outwards to produce a blackish trailing edge. Caudal fin pale blue with black rays, black upper and lower borders and yellowish-white edges. Anal fin yellowish-blue with a black patch at its base; 1–3 yellow egg-dummies. Pelvic fins golden-yellow with black submarginal bands and white leading edges.

Monkey Bay females: Body khaki-brown with 6–7 dark brown bars and a dark brown mid-lateral band. Head khaki-brown with a grey interorbital bar and black opercular spots. Dorsal and caudal fins pale brown with black rays. Anal and pelvic fins pale brown with black submarginal bands.

Habitat. This species lives among small rocks, and at Nankoma Island it also lives among pebble-sized rocks. It is most numerous between 3 and 6 m, but occurs from the surface to 9 m depth.

Territoriality. Adults and subadults of both sexes hold territories, about 80 cm in diameter, which are aggressively defended against all intruders. Although algal gardens were apparent in territories among small rocks, they were not readily discernible in territories held among pebbles at Nankoma Island. Territories are centred on gaps between the rocks. Where the rocks or pebbles lie on a sandy substratum, small mounds of sand mark the entrance to each excavated burrow. Gravid females leave their territories to spawn. Four females were found brooding eggs while also defending territories which suggests that at least some return to territories after spawning.

Feeding. Territorial members of this species feed from within their territories. The stomach contents of 25 individuals caught at Monkey Bay contained on average 60% loose Aufwuchs, 28% benthic Invertebrata, 5% phytoplankton, 5% C2 and 2% C1.

2. *Pseudotropheus* 'aggressive brown'

Synopsis. A brown fish which inhabits small and medium-

sized rocks in shallow water where both sexes aggressively defend territories.

Distribution. Thumbi West I. (C).

Coloration. Males: Body and head chocolate-brown. Dorsal fin brown with a black submarginal band. Caudal fin pale brown with black rays that fan outwards posteriorly. Anal fin black anteriorly, brown posteriorly with 2–3 yellow egg-dummies. Pelvic fins black anteriorly, orange-brown posteriorly.

Females: With similar coloration but lighter, the submarginal band in the dorsal fin not as conspicuous and the egg-dummies not as bright as those of males.

Habitat. It lives among small and medium-sized rocks in water which is less than 6 m deep.

Territoriality. Adults of both sexes are highly aggressive in the defence of their territories. Many territories develop algal gardens.

Feeding. This species probably harvests loose Aufwuchs, as it feeds by combing its teeth through the filamentous algae.

3. *Pseudotropheus* 'aggressive yellow head' (Plate 7i)

Synopsis. A small blue and yellow fish of small rock and intermediate habitats in shallow water.

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

Coloration. Nakantenga males: Body sky-blue with 6–7 grey-blue bars; chest and gular region golden-brown. Head blue-grey dorsally on occipital region and snout; cheeks, chin, opercular regions and branchiostegal membranes golden-brown; opercular spot black. Dorsal fin light blue with white lappets. Caudal fin light blue with black upper and lower borders and white edges. Anal fin blue with a black submarginal band and white leading edge. Pelvic fins ochre with black submarginal bands and white leading edges.

Nakantenga females: Similar to males in coloration, but not as bright.

Habitat. It is common among small rocks and where small

rocks are surrounded by mud or sand. Its greatest numbers occur between 5 and 10 m, but its full depth distribution is from 2 to 18 m.

Territoriality. Both sexes are aggressively territorial and will chase most intruders. Algal gardens were found in about 20% of the territories. Nests are occasionally excavated alongside rocks, but usually the fishes tunnel beneath rocks. Two mouth-brooding females were seen defending territories which suggests that they leave their territories to spawn, and resume territoriality thereafter.

Feeding. This species was seen to feed upon plankton and from rock surfaces. It nips at the Aufwuchs, apparently combing its teeth through the filamentous strands. Stomach contents of seven individuals caught in 6–8 m at Nakantenga contained on average 55% zooplankton, 30% loose Aufwuchs, 10% filamentous algae (C1 and C2) and 5% phytoplankton.

4. *Pseudotropheus* 'aggressive grey head' (Plate 7j)

Synopsis. A small, grey-headed aggressive Mbuna found among small rocks in the shallows of the Maleri Islands.

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

Coloration. *Nakantenga males:* Body deep blue with 6–7 grey-brown bars; chest and gular region tan coloured. Head grey-brown, tending to rusty-brown in some individuals. Dorsal fin blue with white lappets and a prominent black dorsal fin-spot. Caudal fin blue with black rays; upper and lower borders black with white edges. Anal fin black with white leading edge; 1–2 small yellow egg-dummies. Pelvic fins ochre with black submarginal bands and white leading edges.

Nakantenga females: Ground colour of females brown, otherwise with similar markings and colours as males.

Habitat. It lives among small rocks in 1–12 m of water, but is most numerous between 3 and 8 m.

Territoriality. Males are aggressively territorial and about 60% of territories contained algal gardens. Females keep conspecifics out of their territories and chase away some heterospecific intruders, but no algal gardens were found in areas defended by them.

Feeding. This species feeds in a *P. zebra*-like manner and also on plankton. Stomach contents of 6 individuals caught at 6–8 m depth contained on average 45% zooplankton, 18% phytoplankton, 36% loose Aufwuchs and 1% filamentous algae.

5. *Pseudotropheus* 'aggressive zebra' (Plate 8a)

Synopsis. A sombre fish which resembles *P. zebra* superficially but is highly aggressive in the defence of its territories. It occurs in shallow water among small and small to medium-sized rocks and has stouter teeth than *P. zebra*.

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

Coloration. *Maleri Island males:* Body dark blue with 6–7 black bars and an ochre-yellow chest and gular region. Head dark grey-blue on occipital region and snout with 2 light blue interorbital bars; cheeks, chin and lower parts of opercular regions ochre-yellow. Dorsal fin dark blue, almost black, with a narrow red-orange sub-

marginal band and white lappets; rayed portion orange. Caudal fin rays black with light blue inter-ray membranes, edges of fin orange-red. Anal fin dusky with a black submarginal band and white leading edge; 2–5 yellow egg-dummies. Pelvic fins golden-brown with black submarginal bands and white leading edges.

Maleri Island females: Similar to males but darker in colour.

Geographical variation. No differences were apparent between the populations of the three Maleri Islands. The population at Mbenji Island is also very similar to the Maleri populations, but does not have as much red on the dorsal and caudal fins and is generally lighter coloured. The Likoma Island population differs from the other populations in that it is darker in colour, has less gold on the head and chest, and does not have any red on the fins.

Habitat. This species lives among small and medium-sized rocks in less than 10 m of water and is most numerous between 2 and 7 m.

Territoriality. Both sexes are territorial, but males are highly aggressive and almost all of their territories contain algal gardens. In areas where this species is numerous intraspecific interactions are frequent. Territories centre around a refuge in the rocks.

Feeding. This species feeds with its mouth pressed against the rock surface and with its body at right angles to the rock. Although it remains very close to the substratum it does also take plankton. Stomach contents of 8 specimens, caught at Nakantenga Island at 4–6 m depth, contained on average 80% loose Aufwuchs, 10% benthic Invertebrata particularly insect larvae, and 10% plankton. Stomach contents of 11 specimens caught at Maingano, Likoma Island, at about 4 m depth, contained on average 85% loose Aufwuchs, 10% zooplankton and 5% benthic Invertebrata.

6. *Pseudotropheus tursiops* 'mbenji' (Plate 8b)

Synopsis. A darkly barred species with an elongate rounded snout living among medium-sized rocks of the shallows.

Distribution. Mbenji I. (C).

Coloration. *Males:* Body deep metallic-blue with 9–10 black bars; belly black. Head black with 2 narrow, blue interorbital bars. Dorsal fin black with whitish-blue lappets that are orange tipped; inter-ray membranes light blue. Caudal fin black with light blue streaks and light blue edges. Anal and pelvic fins black with white leading edges; 1–4 yellow egg-dummies on anal fin.

Females: Khaki-brown with dark brown bars and dark brown fins.

Habitat. This species lives among medium-sized rocks in sediment-free zones. Most individuals live between 1 and 3 m, but some occur to 6 m depth.

Territoriality. Territorial males are aggressive towards all intruders. Some females are territorial and those which are not territorial occur singly. Algal gardens were found in about 15% of territories in May 1980 and in 30% of territories in September 1980.

Feeding. This species feeds with the terminal part of its mouth, but it and *P. tursiops* are unusual among the Mbuna in that they can also use the side of their elongate jaws. This

enables them to utilize food in cracks that would be inaccessible to fishes of similar size which feed at right angles to the rock face.

7. *Pseudotropheus tursiops* Burgess & Axelrod, 1975

Synopsis. An aggressive lithophilous species which lives among small and medium-small rocks in shallow water.

Distribution. Chisumulu I. (C).

Coloration. Males: Body bluish-purple with a faint mid-lateral band broken into 10–12 black patches and a dorso-lateral band comprising 7–9 small black patches. Head bluish-purple with a single bright blue interorbital bar and an iridescent light blue band along lower jaw and bases of opercula; prominent black opercular spot. Dorsal fin slate-blue with black rays and an orange-brown trailing edge. Caudal fin blue at base with black rays and hyaline inter-ray membranes distally; trailing as well as upper and lower edges reddish-brown. Anal fin grey-brown with a black submarginal band and whitish leading edge; 3–6 golden egg-dummies. Pelvic fins grey-brown with black submarginal bands and white leading edges.

Females: Body brown with 2 faint, black mid-lateral and dorso-lateral bands. Head brown with prominent black opercular spot. Fins yellowish-brown with black dorsal and caudal fin rays, and black submarginal bands in anal and pelvic fins.

Habitat. It occurs among small and medium-sized rocks from the extreme shallows to 8 m depth.

Territoriality. Both males and females are territorial and males are particularly aggressive in the defence of their territories. In August 1980 about 70% of male territories contained algal gardens. Territories are normally centred around a gap or crevice among the rocks in which the fish might take refuge or spawn. The algal growth around the entrances to those holes was particularly dense. Not all adult females are territorial and those which did not defend territories occurred singly.

Feeding. This species fed from the Aufwuchs mat by using both the terminal and lateral parts of the jaw.

8. *Pseudotropheus 'aggressive grey'* (Plate 8c)

Synopsis. A highly aggressive greyish fish from small and medium-sized rocks in shallow water.

Distribution. Common all around Likoma Island.

Coloration. Males: Body blue-grey with 7 dark grey bars, a grey chest and a grey caudal peduncle. Head dark grey-brown with two blue-grey interorbital bars. Dorsal fin pale blue with a yellowish tinge, white lappets and a large black dorsal fin-spot. Caudal fin dark grey, with black upper and lower borders, black rays distally and pale blue inter-ray membranes. Anal fin black with a white leading edge and 2–3 yellow egg-dummies. Pelvic fins black with white leading edges.

Females: Similar in colour and markings to males, but grey-brown rather than blue-grey and with inconspicuous egg-dummies.

Habitat. It inhabits areas of small and medium-sized rocks, usually in water between 4 and 10 m deep, but its depth distribution may extend from the surface to at least 13 m.

Territoriality. Both sexes aggressively defend territories, and algal gardens were found in more than 50% of territories in August 1980.

Feeding. Members of this species feed mainly from within their territories, but they also take plankton. Stomach contents of 9 individuals caught at Maingano at about 6 m depth contained on average 80% loose Aufwuchs, 10% insects, 4% filamentous algae with plankton and benthic crustaceans comprising the remaining 6%.

9. *Pseudotropheus 'aggressive yellow fin'* (Plate 8d)

Synopsis. A deep-bodied yellow-finned, aggressive species of the rocky zones in shallow water.

Distribution. Chisumulu I. (C).

Coloration. Males: Body dark blue with darker blue barring. Head dark blue. Dorsal fin pale blue anteriorly, but yellow posteriorly. Caudal fin blue, but yellow distally. Anal fin yellow with a blue-grey base; 2–4 bright yellow egg-dummies. Pelvic fins bright yellow with whitish-blue leading edges.

Females: Dark, almost black, with dull yellow fin markings.

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

Territoriality. Males are highly aggressive and most have algal gardens in their territories. Females do not appear to hold territories. Non-territorial individuals are solitary.

Feeding. Males feed from the rock surfaces within their territories and also take plankton from the water column, but remain close to the rocks at all times. Non-territorial fishes also stay close to the rocks even when feeding on plankton.

10. *Pseudotropheus fuscus* Trewavas, 1935

Synopsis. A small sombre species which lives in the shallows among small and medium-sized rocks.

Distribution. Nkhata Bay (A) and Lion's Cove (U).

Coloration. Nkhata Bay males: Body dark metallic, royal blue with 7–8 black bars, a black belly, chest and caudal peduncle. Head black with dark greenish-black opercular spot. Dorsal fin dark blue with a broken black submarginal band and large dorsal fin-spot; trailing edge with 2–6 bright orange ocelli. Caudal fin black with royal blue inter-ray membranes, and an orange trailing edge. Anal fin black with blue leading edge and 2 or 3 large yellow-orange egg-dummies. Pelvic fins black with blue leading edges.

Nkhata Bay females: Body and head dark brown. Dorsal fin light brown with orange trailing edge and dark brown fin-spot. Caudal fin light brown with black rays and an orange trailing edge. Anal and pelvic fins black with blue-white leading edges and orange trailing edges.

Habitat. This species lives among small and medium-sized rocks, usually in a purely rocky environment, but also along the rock-sand interface. However, it always remains very close to the rocks. It is most numerous in less than 5 m of water and is rare beyond 6 m depth.

Territoriality. This is a highly aggressive species and adults of both sexes hold territories. Algal gardens were apparent in about 60% of male territories and about 15% of female

territories in October 1980. However, in winter (June 1981) very few gardens were discernible. Some of those males which hold territories among rocks which lie on a sandy substratum excavate burrows under the rocks.

Feeding. Food is nipped, nibbled and wrenched from the rocks but in spite of these feeding methods filamentous algae are not removed and stomach contents are comprised almost entirely of loose Aufwuchs (Fryer 1959a).

11. *Pseudotropheus fuscoides* Fryer, 1956

Synopsis. A sombre, lithophilous species, the members of which aggressively defend territories among small and medium-sized rocks in shallow water.

Distribution. Nkhata Bay (C) and Lion's Cove (C).

Coloration. The coloration and markings of *P. fuscoides* are almost identical with those of *P. fuscus* and we experienced considerable difficulty in distinguishing between the two species within the lake. This is especially so since the habitat requirements and depth distributions overlap. In general, *P. fuscoides* males are a lighter blue than those of *P. fuscus*, though they do turn dark when disturbed. Females could not be told apart in terms of coloration and markings.

Habitat. *P. fuscoides* lives among small and medium-sized rocks and is most numerous between 3 and 8 m depth, but it does occur to 12 m depth.

Territoriality. Adults of both sexes are highly aggressive and algal gardens were present in about 20% of male and 10% of female territories (October 1980).

Feeding. This species was seen to feed from the Aufwuchs and Fryer (1959a) records that the stomachs he examined contained mainly insect larvae.

Note: The similarity of *P. fuscus* and *P. fuscoides* made it very difficult to distinguish between them when counting fishes within the transects and it is possible therefore that considerable error exists. In addition to noting that *P. fuscoides* is lighter blue, we noted that it is more elongate and slightly smaller. At no stage, however, were we absolutely confident that we were not dealing with a single species; the smaller, elongate paler members living in slightly deeper water than the large, deeper bodied members. The differences in dentition and relative eye size may possibly reflect differences in age and size. At Monkey Bay, *Pseudotropheus elongatus* 'aggressive' moves from deeper to shallower water as it grows (Sharp 1981). It is possible that a parallel situation exists at Nkhata Bay and further investigation may show that *P. fuscus* and *P. fuscoides* are the same species. For the time being we have endeavoured to separate the two taxa.

12. *Pseudotropheus* cf. *Melanochromis perspicax*

Synopsis. A small, aggressive, lithophilous species of the shallows of the north-western lake.

Distribution. Ruarwe (C) and Chilumba (U).

Coloration. *Chilumba* males: Body powder-blue with faint grey barring and yellow-gold chest. Head pale blue with yellow-gold cheeks, snout, chin, gular region and branchiostegal membranes. Dorsal fin pale blue with whitish lappets and orange spots in the rayed section. Caudal

fin blue with orange spots in the inter-ray membranes; rays black. Anal fin pale blue with a black submarginal band and white leading edge; one large yellow egg-dummy. Pelvic fins blue with black submarginal bands and white leading edges.

Chilumba females: Body and head khaki-brown with faintly yellow chest, cheeks, chin and gular region. Fins pale brown but caudal fin with black rays and anal and pelvic fins with black submarginal bands.

Geographical variation. Ruarwe males appear identical to those of the Chilumba population, except that the yellow on the ventral side of the head and chest is pale. Furthermore, this population lacks the black rays which are prominent in the caudal fin of the Chilumba form. Females of the two populations are identical except that the Ruarwe form does not have black rays in the caudal fin.

Territoriality. Males are particularly aggressive in the defence of their territories, expelling all intruders. Some territories contain well-defined algal gardens. About 50% of females are territorial and an estimated 20% of their territories contained algal gardens. Non-territorial individuals occur singly.

Feeding. This species feeds from the Aufwuchs mat on the rocks and territorial individuals appear to feed exclusively from within their defended areas. Stomach contents of 4 males and 1 female caught at 6 m depth at Chilumba contained on average 90% loose Aufwuchs, 8% benthic Invertebrata and 2% filamentous algae.

Note: Superficially this species resembles *Melanochromis perspicax*, and may prove to be conspecific. By virtue of its aggressive behaviour and its lack of longitudinal barring, it has been placed in the *Pseudotropheus* 'aggressive' species-group for the time being.

Pseudotropheus 'miscellaneous' species-group

Those members of the genus which show no clear affinity with the other five groups (Tables 2 to 7) are listed in Table 8. The species listed here are morphologically and behaviourally diverse and the group is undoubtedly polyphyletic. Three species have been described. A further described species *Pseudotropheus purpuratus* Johnson, 1976, cannot be matched with any of the fishes found during this survey.

1. *Pseudotropheus lucerna* 'brown'

Synopsis. This species inhabits shallow, intermediate zones in the south-eastern arm of Lake Malawi. Males are brown and mauve. Females are brown. The large black dorsal fin-spot is a prominent feature of this species.

Distribution. Kanchedza I. (U), Chigubi (C), Nkudzi (C), Mpandi I. (U), Nkopola (U).

Coloration. *Nkudzi* males: Body brownish ground colour with mauve, sometimes purple, back and a yellowish-brown chest and belly. Head brownish, but mauve dorsally with yellow chin and gular region. Dorsal fin mauve with conspicuous, large black fin-spot. Detailed notes on other fin colours are not available.

Nkudzi females: Body light brown with numerous black blotches on the flanks. Most readily recognized by the conspicuous black dorsal fin-spot.

Table 8 The members of the *Pseudotropheus* 'miscellaneous' species-group. 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)

Species	Maximum size		Distribution													
	mm (SL)	Locality	I	IIa	IIb	IIc	III	IV	V	VI	VII	VIII	IX	Xa	Xb	Xc
1. <i>Pseudotropheus lucerna</i> 'brown'	not	caught	-	+	-	-	+	-	-	-	-	-	-	-	-	-
2. <i>P.</i> 'chinyankwazi'	70	Chinyankwazi I.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
3. <i>P.</i> 'tiny'	62	Thumbi West I.	-	-	-	-	-	+	-	-	-	-	-	-	-	-
4. <i>P. socolofi</i>	67	Thumbi West I.	-	-	-	-	-	i	-	-	-	-	-	-	-	-
5. <i>P.</i> 'dumpy'	58	Maleri I.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
6. <i>P.</i> 'burrower'	60	Maleri I.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
7. <i>P.</i> 'red dorsal'	81	Mbenji I.	-	-	-	-	-	-	-	-	-	+	-	-	-	-
8. <i>P.</i> 'yellow tail'	90	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
9. <i>P.</i> 'ndumbi gold'	82	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
10. <i>P.</i> 'cobalt'	97	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
11. <i>P.</i> 'thin stripe'	not	caught	-	-	-	-	-	-	-	-	-	-	+	-	-	-
12. <i>P.</i> 'fin spot'	94	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
13. <i>P.</i> 'membe deep'	61	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
14. <i>P.</i> 'lime'	52	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
15. <i>P.</i> 'kingsizei'	76	Likoma I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
16. <i>P.</i> 'jacksoni'	92	Chisumulu I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
17. <i>P.</i> 'newsi'	72	Chisumulu I.	-	-	-	-	-	-	-	-	-	-	+	-	-	-
18. <i>P. minutus</i>	66	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	+	+
19. <i>P. lucerna</i>	93	Nkhata Bay	-	-	-	-	-	-	-	-	-	-	-	+	-	-
20. <i>P.</i> 'polit'	58	Lion's Cove	-	-	-	-	-	-	-	-	-	-	-	+	-	-

Habitat. This species frequents intermediate zones, favouring regions where small rocks occur over sand. *P. lucerna* 'brown' has not been found below 4 m depth and is most numerous in the upper 2 m.

Territoriality. Males are aggressively territorial, but females are not territorial, occurring singly or in small groups.

Feeding. Members of this species were observed feeding from the Aufwuchs mat.

2. *Pseudotropheus* 'chinyankwazi'

Synopsis. A lithophilous fish which looks like *Pseudotropheus zebra*, but is smaller and has stouter dentition.

Distribution. Chinyankwazi I. (N).

Coloration. Males: Body blue with 8–10 wide black bars. Head black with 2 pale blue interorbital bars. Dorsal fin blue, but dominated by a very broad, black submarginal band.

Females: Same markings as males, but grey and not blue.

Habitat. It lives among small and medium-sized rocks from 3 to at least 35 m depth, but is most common between 15 and 25 m.

Territoriality. Males defend territories of about 1 m diameter principally against conspecifics, but they also evict other intruders. Females, juveniles and non-territorial adult males remain about 1–2 m above the rocks in large schools.

Feeding. The feeding behaviour of this species resembles that of *Petrotilapia* spp. and *Pseudotropheus zebra* in that it adopts a position perpendicular to the rock face. At the time of the survey (Jan./Feb. 1980) plankton was abundant at Chinyankwazi and few fish fed from the rock surfaces.

The stomachs of 7 non-territorial individuals contained on average 85% phytoplankton (*Anabaena* spp.) and 15% zooplankton. Stomachs of 5 territorial individuals contained on average 48% phytoplankton, 25% zooplankton, 30% C2 and 7% C3.

3. *Pseudotropheus* 'tiny' (Plate 8e)

Synopsis. Individuals of this species are small. They inhabit intermediate zones, mainly pockets of sand among rocks and the rock-sand interface.

Distribution. Thumbi West I. (C).

Coloration. Males: Body deep blue with 5–7 broad, black bars. Head with a black occipital region, and snout with a light blue interorbital bar; cheeks, chin and opercular areas dark brown. Dorsal fin blue, but with the black bars from the body extending into it to merge with the prominent black submarginal band that runs the length of the fin; lappets whitish-blue. Caudal fin blue with black rays and light blue edges. Anal fin mainly black with a white leading edge and pale blue trailing edge; 2–4 yellow egg-dummies. Pelvic fins mainly black with white leading edges and blue-grey trailing edges.

Females: Same markings as males, but grey instead of blue and therefore with a darker overall appearance.

Habitat. This species occurs in intermediate habitats, particularly where small pockets of sand occur in a predominantly rocky area. It also occurs over rocky slabs and at the rock-sand interface. It is most common between 3 and 15 m, but at Mitande Rocks, off Thumbi West, it was found to 25 m.

Territoriality. Males hold territories over sand alongside rocks and some individuals dig sand-scrape nests beneath

rocks. Territorial aggression appears to be directed at conspecifics mainly, though heterospecifics may also be chased. Females and juveniles occur singly.

Feeding. Members of this species feed by nipping at the epilithic algae, picking items from the sand and snapping up plankton.

Note: Superficially this species resembles *Pseudotropheus minutus* Fryer, 1956a.

4. *Pseudotropheus socolofi* Johnson, 1974 (Plate 8f)

Synopsis. This is a small species which inhabits the intermediate zones in shallow water. Both sexes are pale blue.

Distribution. Otter Point (U) and Thumbi West I. (R). These populations were probably introduced by exporters of aquarium fishes. Its provenance is believed to be along the Mozambique coast.

Coloration. Males and females: Body pale blue with 9–10 slightly darker blue bars. Head pale blue. Dorsal fin blue with a narrow black submarginal band and white lappets, dorsal fin rays black. Caudal fin pale blue with black rays. Anal fin black with a white leading edge and a blue antero-dorsal section; 1–2 yellow egg-dummies. Pelvic fins black with white leading edges.

Habitat. This species occurs over sand near to rocks at 4–10 m depth.

Territoriality. Males defend territories over sand near to rocks, but owing to the rarity of this species at Thumbi West and Otter Point little is known of its behaviour.

Feeding. No data are available.

5. *Pseudotropheus 'dumpy'* (Plate 8g)

Synopsis. A dumpy, barred species of the mud-rock substrata in deepish water.

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

Coloration. Maleri males: Body pale blue with a yellowish cast and 6–7 dark grey bars; lower chest tan-yellow. Head pale blue dorsally with a dark grey occipital bar and 2 dark grey interorbital bars; snout grey; cheeks, chin, lower opercular regions and branchiostegal membranes tan-yellow. Dorsal fin pale blue with a black submarginal band; the black bars of the body extending across the base of the fin; lappets white with yellow tips. Anal fin hyaline with a black submarginal band and white leading edge; a single large yellow egg-dummy. Pelvic fins black with white leading edges.

Maleri females: A nondescript sandy colour with conspicuous barring.

Habitat. This species was found from 13 to 28 m where it inhabits areas of small rocks set in the muddy substratum which are characteristic of these depths at the Maleri Islands (p.269).

Territoriality. Males defend territories against conspecifics. Nests are excavated beneath the rocks by digging away the underlying mud and sand. Females are solitary and not territorial.

Feeding. This species was observed feeding from both rock and mud substrata, and upon plankton.

6. *Pseudotropheus 'burrer'* (Plate 8h)

Synopsis. A small fish of the intermediate habitats. Males are sky-blue, but females are reddish-brown. Males dig burrows in which to spawn and find refuge.

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

Coloration. Maleri males: Body and head uniform sky-blue. Dorsal fin sky-blue with white lappets that have orange tips. Caudal fin blue with black rays, white upper and lower edges and an orange distal edge. Anal fin black with a white leading edge and a yellow egg-dummy. Pelvic fins blue with black submarginal bands and white leading edges.

Maleri females: Body and head reddish-brown. Dorsal fin orange-brown with blue tints. Caudal fin orange-brown with orange edges. Anal and pelvic fins orange-brown with black submarginal bands and white leading edges.

Habitat. This species inhabits the intermediate zone, from 3 to 24 m depth.

Territoriality. Males are territorial and direct most of their aggression towards conspecifics, but they will chase heterospecific intruders, some of which are much larger than themselves. Territories may be so close to one another that nests of different males are only 60–80 cm apart. To build nests this species burrows under rocks, carrying the sand to the entrance where it is deposited in a mound which marks the excavation. The entrances to these burrows may be so narrow that the residents need to turn on their sides to enter. Females are not territorial, but are solitary and remain close to the substratum.

Feeding. This species feeds by nipping at the Aufwuchs. It was also seen to take particulate matter from the sediment which is prevalent in its habitat.

7. *Pseudotropheus 'red dorsal'* (Plate 8i)

Synopsis. This species has a rounded head, a subterminal mouth and conspicuous red markings on the dorsal fin. It is lithophilous and lives in the shallows.

Distribution. Mbenji I. (C–N).

Coloration. Males: Body deep metallic-blue with 7 black bars and a faint black mid-lateral band. Head dark blue with a light blue interorbital bar and a black opercular spot. Dorsal fin grey-blue with a black submarginal band, red lappets, black rays and a narrow orange trailing edge. Caudal fin dark blue with black rays. Anal fin black anteriorly, blue posteriorly with 2–3 yellow egg-dummies. Pelvic fins reddish-orange with black submarginal bands and white leading edges.

Females: Body khaki-brown with 7 black bars and with black mid-lateral and dorso-lateral bands. Head brown with a greyish interorbital bar and black opercular spot. Dorsal fin brown with a broken black submarginal band. Caudal fin brown with black rays. Anal fin black. Pelvic fins orange-brown with black submarginal bands and white leading edges.

Habitat. This species occurs mainly on exposed shores, particularly on the south-east side of Mbenji Island. It lives among medium-sized and large rocks in less than 10 m

depth.

Territoriality. Males are territorial and direct most of their aggression towards conspecifics. Females, juveniles and non-territorial adult males occur in large schools numbering several hundred individuals. These schools occur in less than 2 m depth among large rocks and between rocky pillars.

Feeding: Territorial males feed from the Aufwuchs in their territories and upon plankton in the water column above their territories. All non-territorial individuals feed on plankton in the water column.

8. *Pseudotropheus* 'yellow tail'

Synopsis. An elongate, essentially planktivorous, lithophilous species. Its yellow caudal peduncle and tail are distinguishing features.

Distribution. Likoma I., at Masimbwe Islet (N), Ndomo Point (C), Khuyu Bay (R) and Makulawe Point (R).

Coloration. *Mazimbwe Islet males:* Body turquoise-blue with 6 brown, wedge-shaped bars; chest, belly and caudal peduncle yellow. Head brown on occipital region and snout with 2 light blue interorbital bars and a light blue occipital bar; cheeks, lips and chin mauve. Dorsal fin completely black anteriorly, tapering to a submarginal bar posteriorly; lappets white; remainder of fin yellow. Caudal fin yellow with black upper and lower borders. Anal fin yellow with black submarginal band and white leading edge; 1–3 bright yellow egg-dummies. Pelvic fins ochre-yellow with black submarginal bands and white leading edges.

Mazimbwe Islet females: Similar to males but coloration is not as bright.

Habitat. This species occupies regions of medium-sized and large rocks. It is most numerous between 1 and 10 m, but its distribution extends to a depth of at least 30 m.

Territoriality. Males are weakly territorial, sometimes leaving their territories to feed elsewhere. Females, juveniles and non-territorial adult males form schools at Mazimbwe Islet and at Ndomo Point where this species is common, but at Khuyu Bay and Makulawe Point it is rare, and non-territorial fish are normally solitary.

Feeding. This species feeds almost entirely upon plankton, but occasionally from the rock surfaces.

9. *Pseudotropheus* 'ndumbi gold' (Plate 8j)

Synopsis. A golden lithophilous species of deepish water. It has a terminal mouth and heavy jaws.

Distribution. Likoma I. at Ndumbi Rocks (U).

Coloration. Both males and females golden with a greyish cast on the body and black submarginal bands on the pelvic fins.

Habitat. It occurs among medium-sized and large rocks and also over boulders. It is most common at 15–25 m, with a full depth range of 8 to at least 40 m.

Territoriality. This fish does not appear to be territorial, but occurs singly or in pairs.

Feeding. It appears to take detritic material from crevices

and cracks among the rocks and was seen to feed on plankton.

Note: In its behaviour and general appearance this species is not unlike *Iodotropheus sprengerae*, but it is relatively large and differently coloured.

10. *Pseudotropheus* 'cobalt' (Plate 9a)

Synopsis. A medium-large species with a rounded head and subterminal mouth. It inhabits areas of small and medium-sized rocks in shallow, often intermediate, zones. Males are cobalt-blue at Chisumulu Island.

Distribution. Likoma I. at Khuyu Bay (C), Ndomo Point (C); Chisumulu I. at Same Bay (C), Membe Islet (U), Mkanila Bay (R).

Coloration. *Khuyu males:* Body blue-grey, but light blue ventrally with faint grey barring and brown flecks on the flanks. Head blue-grey, but lighter blue on cheek, chin, gular region and branchiostegal membranes; opercular spot black. Dorsal fin pale blue with a yellow-orange tinge to the rayed portion and an orange trailing edge. Caudal fin blue with a red hue and a yellow distal portion. Anal fin pale blue with an orange-yellow tinge, a faint black submarginal band and a white leading edge; one large yellow egg-dummy. Pelvic fins yellowish-blue, with black submarginal bands and white leading edges. *Khuyu females:* Grey-blue with 8 grey bars. Fins light grey.

Geographical variation. Males at Chisumulu Island have a lighter cobalt-blue body and head than males of Likoma Island. The fins are also lighter blue and have the merest hint of yellow. Females of both populations appear identical.

Habitat. *P.* 'cobalt' inhabits the shallows, seldom occurring below 4 m depth. It is most numerous among small and medium-sized rocks in sediment-rich areas, usually in intermediate zones or close to such habitats.

Territoriality. Males defend territories against conspecifics vigorously, but are less aggressive towards heterospecifics. Territories are among rocks, but occasionally over sand between rocks. Nests may be excavated in sand at the base of a rock. Females are not territorial and usually occur in small groups of less than 10 individuals. They remain close to the rocks, seldom venturing more than 1 m onto sand or 50 cm into the water column.

Feeding. Although the oral teeth are stout and appear suitable for cutting filamentous algae, stomach contents of 5 individuals caught at Same Bay each comprised over 90% loose Aufwuchs. The remaining 10% comprised small insects, benthic crustaceans and filamentous algae.

Note: The Chisumulu population is sold as 'Chisumulu cobalt' in the aquarist trade.

11. *Pseudotropheus* 'thin stripe'

Synopsis. A medium-sized, deep-bodied species with a blunt head and terminal mouth. Males are dark blue with narrow light blue bars. Females are dark blue, almost black, with grey bars.

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

Coloration. Membe Point males: Body dark blue with 6–7 narrow, light blue bars. Head dark blue, almost black, with light blue interorbital and occipital bars. Dorsal fin dark blue with whitish-blue lappets. Caudal fin dark blue, almost black. Anal fin black with a white leading edge and 2–4 yellow egg-dummies. Pelvic fins black with white leading edges.

Membe Point females: Body dark blue, almost black, with 6–7 narrow, grey bars. Fins black.

Habitat. This species inhabits areas of medium-sized rock between 10 and 25 m depth.

Territoriality. Males are territorial, but as they are cryptic in their behaviour and spend most of their time hidden, little is known of their behaviour. Females are solitary and are apparently not territorial.

Feeding. Not recorded.

Note: Little is known of this fish which is difficult to approach.

12. *Pseudotropheus* 'fin-spot'

Synopsis. A grey fish with a prominent black dorsal fin-spot. It lives among small rocks of the intermediate zones in shallow water.

Distribution. Likoma Island at Membe Point (C), Maingano (C), Mbako (C), Khuyu (C), Ndomo Point (U), Mbuzi (U) and on a submerged reef of small rocks on the shoreward side of White Rock (C).

Coloration. Maingano males: Body and head uniform blue-grey. Dorsal fin pale grey with a broken, black submarginal band and a large black dorsal fin-spot. Caudal fin pale grey-blue with black rays and black upper and lower borders. Anal fin black anteriorly, hyaline posteriorly with 1–3 yellow egg-dummies. Pelvic fins bright orange with black submarginal bands and white leading edges.

Maingano females: Grey with black fin markings similar to those of males, but without the orange of the pelvics which is a conspicuous feature of males.

Habitat. This species is usually associated with small and medium-sized rocks in intermediate zones close to sandy areas. It was not found in water deeper than 7 m and is most numerous between 1 and 4 m.

Territoriality. Males defend territories vigorously against conspecifics, but they are less aggressive towards heterospecifics. Females occur singly or in small groups and are not territorial.

Feeding. This species feeds from the Aufwuchs and on plankton. Stomach contents of 8 individuals contained on average 92% loose Aufwuchs, 6% C1 and the remaining 2% was insect and crustacean remains.

Note: The closest relationship of this species may lie with *Pseudotropheus lucerna* Trewavas, 1935.

13. *Pseudotropheus* 'membe deep'

Synopsis. A small species in intermediate zones in deepish water. Males are predominantly light blue and black; females are grey and black.

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

Coloration. Males: Body pale blue, almost white, with a black chest. Head black except for a light blue interorbital bar and a blue flare on the occipital region. Dorsal fin pale blue with a prominent black submarginal band and contrastingly white lappets. Caudal fin pale blue with black upper and lower borders. Anal fin pale blue with a black submarginal band and white leading edge; 1–2 yellow egg-dummies. Pelvic fins pale blue with black submarginal bands and white leading edges.

Females: Same markings as males, but body colour grey-brown and fins light grey.

Habitat. This species lives between 10 and 35 m depth in sediment-rich intermediate zones in areas where rocks are small.

Territoriality. Males hold territories among small rocks and sometimes alongside a single rock in the sand several metres from other rocks. In many territories sand-scrape nests are dug alongside or beneath the rocks. Females are not territorial and are usually solitary.

Feeding. This species was seen to feed from the rocks and in the water column, but its members usually did not venture more than about 40 cm above the substratum to catch plankton.

Note: This species resembles superficially *P. 'dumpy'* of Maleri Island in general appearance, behaviour and preferred habitat. However, it is not barred and has different coloration.

14. *Pseudotropheus* 'lime'

Synopsis. This is probably the smallest of the Mbuna species and appears to have one of the most limited distributions. It lives in intermediate habitats of deep water. It is predominantly a lime-yellow colour.

Distribution. Likoma I. at Membe Point (C).

Coloration. Males: Body and head lime-yellow with an intensification of the yellow on the chin, gular region, branchiostegal membranes and lower chest; opercular spot dark grey. Dorsal fin lime-yellow. Caudal fin lime-yellow with a black upper border distally and black lower border which runs the full length of the fin. Anal fin black anteriorly, hyaline posteriorly with a single, bright yellow egg-dummy. Pelvic fins pale yellow with black submarginal bands and narrow white leading edges.

Females: Brownish-yellow with the same black markings as males.

Habitat. It lives in sediment-rich, intermediate zones from 15 to 35 m depth and is most numerous at about 25 m. At Membe Point the intermediate zone at this depth is characterized by small rocks in a sand-mud substratum.

Territoriality. Males are territorial and appear to chase conspecifics only. Within almost every territory there are 1–3 excavated burrows in which males may seek refuge and, presumably, in which they spawn.

Feeding. Individuals of this species were seen to feed from rock, sand and mud substrata and from the water column. Observations of feeding were limited, however, as individuals of this cryptic species hid when divers approached.

15. *Pseudotropheus* 'kingsizei' (Plate 9b)

Synopsis. A small, barred species of the intermediate zone.

It has an extremely limited distribution.

Distribution. The distribution of the species is limited to about 1 000 m² in what appears to be an ancient river bed at Maingano, Likoma Island.

Coloration. Males: Body pale blue with 6 well-defined black bars anteriorly and 3 to 4 faint bars posteriorly, belly black in some individuals. Head pale blue dorsally, but dark grey, almost black, below the level of the orbit; 2 light blue interorbital bars. Dorsal fin pale blue, tending to white; black patches along the base of the fin where the body bars extend into it; rays black. Caudal fin pale blue with black rays. Anal fin black with white leading edge and a pale blue trailing portion; 2–4 yellow egg-dummies. Pelvic fins black with white leading edges. **Females:** Grey-brown with black markings similar to those of males.

Habitat. *P. 'kingsizei'* occurs among small rocks within an intermediate sand-rock habitat. It is most numerous between 10 and 20 m, but has a depth range from 4 to 30 m.

Territoriality. Males are territorial, defending areas which are centred around sand-scrape spawning sites which are excavated beneath or alongside rocks. Females, juveniles and non-territorial adult males are solitary or occur in small groups of up to 10 individuals.

Feeding. This species feeds upon Aufwuchs, but at the time specimens were caught (August 1980) plankton was abundant and so the stomachs of 11 individuals were crammed with zooplankton (90%) and phytoplankton (10%).

Note: The trade name for this species is *P. 'kingsizei'*.

16. *Pseudotropheus 'jacksoni'*

Synopsis. A shallow-water, lithophilous fish with a pointed head and terminal mouth. Males are blue-grey with bright orange-red anal and pelvic fins; females are blue-grey with dull orange-red fins.

Distribution. Chisumulu I. at Same Bay (C).

Coloration. Males: Body blue-grey, darker dorsally than ventrally, with a mid-lateral and a dorso-lateral line each of 8 faint, grey-black blotches. Head blue-grey, darker dorsally than ventrally, with an inconspicuous pale blue interorbital bar and a prominent black opercular spot. Dorsal fin pale blue, with whitish-blue lappets, black rays and an orange trailing edge. Caudal fin blue-grey with black rays, blue-white upper and lower edges and an orange trailing edge. Anal fin red, tending to orange posteriorly, with a red-black submarginal bar and a blue-white leading edge; 2–4 yellow egg-dummies. Pelvic fins bright orange, tending to red in some individuals, with black submarginal bands and blue-white leading edges. **Females:** Greyish with prominent black patches in 2 rows on the flanks. Fins grey with a hint of orange on the anal and pelvic fins.

Habitat. It was found in less than 2 m depth among small and medium-sized rocks.

Territoriality. Males defend territories aggressively against conspecifics and are usually intolerant of heterospecific intruders. Females are not territorial, but occur singly or in small groups among the rocks.

Feeding. This species feeds on Aufwuchs, and stomach

analyses of 4 territorial individuals revealed that they had eaten mainly loose Aufwuchs (85%), benthic Invertebrata (10%) and small proportions of filamentous algae and plankton.

Note: This fish is known in the aquarium trade as *P. 'jacksoni'*.

17. *Pseudotropheus 'newsi'* (Plate 9c)

Synopsis. A small species of the intermediate zones. Males are predominantly pale blue and females reddish-gold.

Distribution. Chisumulu I. at Same Bay (C), Membe Islet (C), Machili Islet (C), Mkanila Bay (C).

Coloration. Males: Body and head usually powder-blue, but sometimes with faint darker blue barring and a greyish-blue head. Dorsal fin pale blue with white lappets, black rays, and 2–3 yellow ocelli on the trailing edge. Caudal fin pale blue with black rays, black upper and lower borders and white edges. Anal fin pale blue with a broad, black submarginal band and white leading edge; 3–6 orange-yellow egg-dummies. Pelvic fins blue with black submarginal bands and white leading edges. **Females:** Reddish-gold body, head and fins. Faint darker red barring on flanks. Blackish markings on the fins similar to those of males.

Habitat. This species inhabits areas of small rocks on sandy substrata usually in 3 to 10 m of water. The full depth range of *P. 'newsi'* is from the extreme shallows to at least 25 m.

Territoriality. Males are aggressively territorial. The foci of territories are either holes or gaps in the rocks or burrows which are excavated beneath rocks. Females are not territorial, but occur with juveniles and non-territorial adult males in small groups which remain close to the substratum.

Feeding. This species was seen to feed on plankton and upon Aufwuchs which is removed in a sideways, jerking manner from the rocks.

Note: (i) This species is referred to as *P. 'newsi'* in the aquarist press (Staeck 1977). (ii) An orange-red fish resembling *P. 'newsi'* females, though differing in that it has broad black submarginal bands in the dorsal, anal and pelvic fins, was found at Chisumulu Island. We originally considered this species to be conspecific with *P. 'newsi'* but as it did not show any behaviour which might confirm conspecificity we now believe it to be a separate species about which we know very little.

18. *Pseudotropheus minutus* Fryer, 1956

Synopsis. A small blue and black barred species which lives among small rocks.

Distribution. Nkhata Bay (C), Lion's Cove (U), Ruarwe (C), Chitande (C).

Coloration. Nkhata Bay males: Body bright royal blue with 7–9 black bars. Head black with 2 blue interorbital bars. Dorsal fin blue with a black submarginal band and white lappets. Caudal fin blue with black rays, black upper and lower borders and white edges. Anal fin black with a white leading edge and 2–5 yellow egg-dummies. Pelvic fins black with white leading edges. **Nkhata Bay females:** Similar to males, but with a grey ground colour.

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 inter-orbital 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; Loiseau 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