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A TAXONOMIC STUDY OF
THE GENUS *LETHRINOPS* REGAN
(PISCES: CICHLIDAE) FROM LAKE MALAWI

PART 3

by

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ABSTRACT

The group of species considered all have short moderate snouts and a group of slightly to strongly enlarged teeth on the lower pharyngeal bone, the anterior and lateral teeth of which are bicuspid, with the posterior cusp turned forwards. *Lethrinops parvidens* Trewavas, *L. aurita* (Regan), *L. macrophthalmas* (Boulenger), *L. macrochir* (Regan), *L. longimanus* Trewavas and *L. macracanthus* Trewavas are re-described, and *L. mylodon* n. sp. is described, the latter being divided into two geographically separated sub-species. While *L. longimanus* and *L. macracanthus* co-exist with very slight overlap of morphological characters in the south of Lake Malaŵi, an apparently intermediate population is reported from another part of the Lake.

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INTRODUCTION

In parts 1 and 2 of this series (Eccles and Lewis 1977, 1978), two well defined species groups were examined and their component members described. The present work continues the study of the genus, considering a group of species which possess a short snout, with a terminal mouth set low on the profile. All except *L. aurita* have a group of more or less enlarged teeth on the central area of the lower pharyngeal bone and in every species the anterior and lateral teeth of the lower pharyngeal bone, as in the two previous groups discussed, have a rounded anterior cusp and a blade-like posterior cusp with the end turned forwards.

The species in this paper are grouped together for convenience as they are similar in overall form, and we do not suggest that the group as a whole is of phyletic significance. Where close phyletic affinity is suspected, this is discussed under the species headings.

The species now considered range from shallow to moderately deep water, and show a range of adaptations in the degree of enlargement of the pharyngeal teeth and in the number and structure of gill rakers. In one species the degree of enlargement of the pharyngeal bone is extreme, and the basal apophyses of the skull are modified beyond the normal range of this genus but, since all the other characters show marked similarities to some of the other species described, this modification is considered to be adaptive and of no phyletic significance.

The methods of measurement and explanations of the terms used are given in Part 1 of this series.

ABBREVIATIONS

Abbreviations used for collections or institutions are as follows:

- LMTS - Lake Malaŵi Trawling Survey
- BMNH - British Museum (Natural History)
- RUSI - J.L.B. Smith Institute of Ichthyology, Rhodes University, Grahamstown, South Africa
- QVM - Queen Victoria Museum, Salisbury, Rhodesia
- USNM - United States National Museum
- AMNH - American Museum of Natural History
- MACT - Musée de l'Afrique centrale, Tervuren
- MFRU - Malaŵi Fisheries Research Unit

Lethrinops parvidens Trewavas (Fig. 1)

Lethrinops parvidens Trewavas, 1931:141; Jackson, 1961:585; Jackson et al, 1963:84; Axelrod and Burgess, 1976:181 (fig.).

DIAGNOSIS

A medium sized species moderately compressed and of moderate depth, attaining a standard length of 140mm and having a group of enlarged teeth posteriorly on the inner few series on the lower pharyngeal bone. Differs from all other species of this group in the smaller number of gill rakers (8-11) and from *L. macrophthalmus* in the smaller eye and in the possession of only 2 rows of teeth in each jaw.

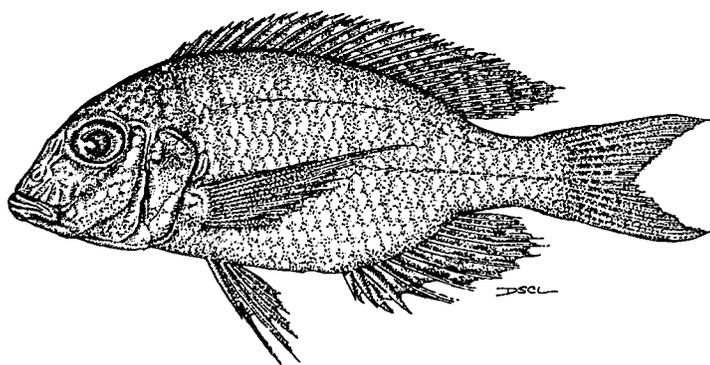
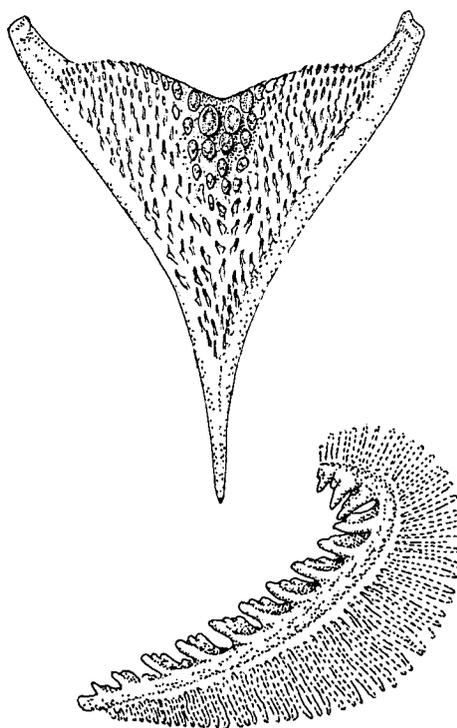


FIG. 1

Lethrinops parvidens (male 150mm total length); oclusal aspect of lower pharyngeal bone; lateral aspect of 1st gill arch.



MATERIAL EXAMINED

Measurements based on the types and 9 other specimens, 2 females of 82 and 135mm S.L., 6 males of 110-125mm S.L. and 1 immature of 86mm S.L. which has been physically compared with the types.

Types:

The type series, including the holotype, have been examined superficially and photographed, but no detailed counts or measurements were made. The specimens were from the eastern shore of the South East Arm (BMNH 1930.1.31.62-67).

Other material:

1 male 116mm S.L. (Fig 1) trawled in Mazinzi Bay (14°07'S, 34°58'E) 28 April 1970 - BMNH 1978-10.31:34; 1 immature male of 125mm S.L. - MFRU; 2 males 120 and 125mm S.L. - RUSI 8320; 1 male 115mm S.L. - QVM 3808; 1 male 120mm S.L. - USNM 218875; all from gill net set just outside Monkey Bay (14°04'S, 34°56'E) 20 November 1968; 1 female 135mm S.L. - MFRU and 1 immature 86mm S.L. - MACT 78-32-P-11; both trawled in 15 fathoms off Nkhota Kota (12°55'S, 34°21'E) 24 September 1977; 1 immature 82mm S.L. seined in south bay at Nkhata Bay (11°36'S, 34°18'E) 7 June 1958, MFRU.

DESCRIPTION

Body moderately deep and compressed. Mouth terminal but set low on head profile, jaws equal anteriorly, maxilla almost reaching level of eye, premaxillary pedicel to end of nasals snout straight or convex, inter-orbital and occipital regions convex, forming a smooth curve continuous with the dorsal outline. Greatest depth at about level of fifth dorsal spine. Caudal forked or crescentically emarginate, moderately scaled in smaller specimens, densely scaled in adults.

Proportional measurements

	In standard length
Body depth	2.6-2.9
Head length	2.8-3.0
Caudal peduncle	4.8-6.3
Caudal fin	2.7-3.6
Pectoral fin	2.4-3.0
Pelvic fin	3.3-4.2

	In head length
Eye	2.8-3.5
Snout	3.2-4.2
Lower jaw	2.5-2.9
Pre-orbital depth	4.3-5.5
Inter-orbital width	3.6-4.6
Premaxillary pedicel	2.9-4.0
Lower pharyngeal fork	3.8-4.1

In fork length of pharyngeal bone

Pharyngeal bone length	0.8-0.9
Pharyngeal bone width	0.9-1.0
Pharyngeal bone depth	3.0-3.2
Pharyngeal bone blade length	2.9-3.3
Pharyngeal bone blade depth	3.4-4.1

Caudal peduncle 1.2-1.7 times as long as deep.
Longest ray of caudal 1.5-2.0 times length of shortest ray.

FINS:

Dorsal XV-XVII, 9-11(12); anal III, 8-9(10). Dorsal with well developed lappets and with longest rays extending posteriorly to posterior third of caudal peduncle in juveniles, to base of caudal in adult females and males. Anal not extending quite as far back as dorsal. Pectorals from 1.0-1.3 times as long as head extending to base of first or second anal spine in females and between bases of first and last anal soft rays in males. Pelvics not reaching base of anal in females, but extending to base of anal spine in males. Caudal forked, juveniles with rays scaled, adults with surface densely scaled except for extreme distal parts and posterior part of central and adjacent membranes.

SQUAMATION:

Upper lateral line 23-30; lower 12-18, scales in longitudinal series; 5-7 scales between lateral line and base of first dorsal spine; 3-4 across cheek.

DENTITION:

Dentaries inclined outwards antero-laterally but less so anteriorly, so that antero-lateral teeth are procumbent and visible from below. Teeth in two rows anteriorly. Teeth of outer row of upper jaw erect or recumbent, bicuspid in smaller specimens but often mainly simple in larger individuals. Teeth of outer row of lower jaw mainly bicuspid, but some simple in larger specimens. 64-88 in outer series of upper jaw and 41-58 in lower jaw.

LOWER PHARYNGEAL BONE:

Y-shaped, moderately indented posteriorly with anterior blade decurved about 15°, posterior teeth of inner two to three series slightly to moderately enlarged, but not molariform. Row across posterior margin of bone larger than penultimate rows and laterally compressed. 36-46 across posterior margin, 12-18 along median axis.

GILL RAKERS:

2-4; 1; 8-11 on outer surface of first gill arch, outer lobe triangular with crenellated inner margin, inner lobe small, rounded.

COLOURATION:

Mature females silvery overall with orange flush on the nape and a pinkish sheen dorsally. Snout and inter-

orbital region olive brown, cheek silver, opercular silvery with yellow flecks. Gular and branchiostegal membranes white. Nape yellowish, scales silvery, those on flanks with yellowish centres shading to olive centres dorsally. Traces of orange between pectoral and pelvics in some specimens. Traces of 8 darker bars below dorsal fin. Dorsal mottled greyish white and yellowish, diagonally barred posteriorly, lappets grey or yellow-brown. Anal whitish, dusky distally spotted with numerous medium sized yellow ocelli. Pelvics yellow basally, dusky distally, with white outer margin. Pectorals yellowish hyaline.

Preserved specimens silvery or brownish, depending on the length of time in preservation, with 7-9 darker bars below the dorsal. The third to fifth bars emphasised just above lateral line to form a darker patch. In males anal darkened anteriorly and with 8-10 large spots posteriorly.

ECOLOGY

FEEDING:

The predominant item in the gut is chironomid larvae, together with sand grains and diatoms. Both tube dwelling and free chironomid larvae are taken. In one specimen the major component of the gut contents was the small bivalved mollusc *Pisidium*. Copepods are also frequently taken.

DISTRIBUTION:

Widespread in the area covered by the Lake Malawi Trawling Survey, where it is found in depths from about 5 to 35 fathoms. It is often very abundant, and may form a large proportion of the trawl catch in depths of 5-20 fathoms.

This species has also been collected from Nkhota Kota (12°54'S, 34°19'E), Metangula (12°43'S, 34°48'E) and Nkhata Bay (11°35'S, 34°18'E) and is known to occur between Nkhota Kota and Nkhata Bay.

Lethrinops macrophthalmus (Boulenger) (Fig. 2)

Tilapia macrophthalmus (part) Boulenger, 1908:242;
Tilapia macrophthalmus (part) Boulenger, 1915:261, fig. 176; *Haplochromis macrophthalmus* Regan, 1921:714; *Lethrinops macrophthalmus* Trewavas, 1931: 143; Jackson, 1961:586; Jackson et al, 1963:85.

DIAGNOSIS

A moderately sized species attaining a standard length of about 120mm, belonging to a group of species characterised by the possession of a relatively short snout and deepish body and of a group of enlarged teeth posteriorly on the lower pharyngeal bone. Differs from most of the group in the possession of 11-14 gill rakers on the first ceratobranchial, from *L. aurita* in the larger eye and form of gill rakers, from *L. macrochir* in the larger eye, more rounded head profile, less deep body and shorter pectoral, and from *L. mylodon* in the convex snout and less extreme development of the pharyngeal mill.

MATERIAL EXAMINED

Types:

Lectotype, an immature fish of 65mm S.L. - BMNH 1908.10.27:95; paralectotype, an immature fish of 61.4mm S.L. - BMNH 1908.10.27:96. The remaining two paralectotypes BMNH 1980.10.27:97-98 - have been examined superficially and photographed. All types collected by E.L. Rhoades, locality given as 'Lake Nyasa'.

Other Material:

7 females 65-97mm, 6 males 88-106mm and 1 undetermined specimen of 95mm S.L. as follows: 2 females 65 and 85.3mm S.L. - MFRU; 1 female, 84mm S.L. - QVM 3806; 1 female 97mm S.L. and 1 male 110mm S.L. BMNH 1978.10.31:25-26; 1 male 105mm

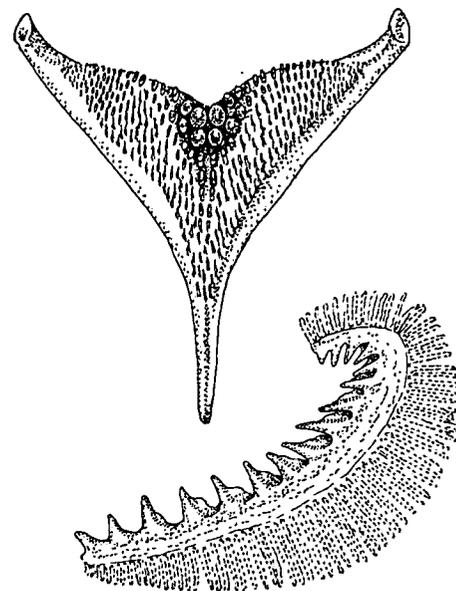
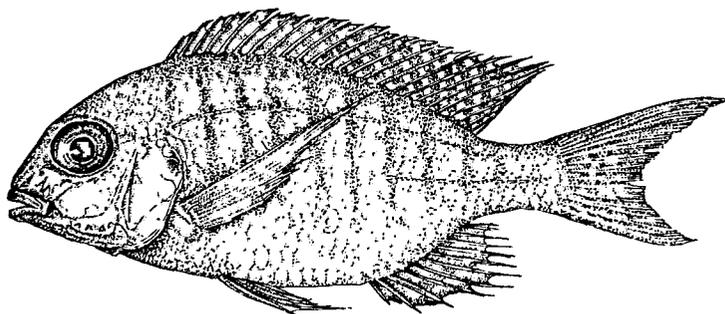


FIG. 2

Lethrinops macrophthalmus (male 137mm total length)
occlusal aspect of lower pharyngeal bone; lateral aspect of
1st gill arch

S.L. and 1 female 82.5mm S.L. - USNM 218876; 1 female 87mm S.L. - MACT 78-32-P-8; all trawled in 5-6 fathoms on bank about 2-3 miles NNE of old jetty at Nkhota Kota (12°54'S, 34°19'E) 28 September 1977; 1 male 116mm S.L. - MFRU; 1 male 105.5mm S.L. (Fig. 2) - BMNH 1978.10.31:24; 1 male 8mm S.L. - QVM 3807; 1 male 105mm S.L. and 1 female 85.2mm S.L. - RUSI 8321; and 1 undetermined specimen 99.5mm S.L. - MFRU, all trawled in the same area as first sample on 3rd May 1978.

DESCRIPTION

Body moderately deep and compressed, with greatest depth at about level of 5th-7th dorsal spines. Snout steep, convex; inter-orbital and occipital regions convex, running into gently arched dorsal margin with no marked inflection. Mouth set low on head profile, jaws equal anteriorly, or lower slightly shorter, rarely a small mental knob present; maxilla from just short of eye to just beyond anterior border of eye; premaxillary pedicel reaching end of nasals. Eye large, 2.5-3.2 times in head length. Caudal forked or crescentically emarginate, densely scaled almost to tip of lower lobe, less so on upper lobe.

Proportional measurements (lectotype in bold, Nkhota Kota specimens in parentheses).

In standard length	
Body depth	2.8, 2.9 (2.4-2.7)
Head length	3.2 (2.9-3.3)
Caudal peduncle	6.2, 6.4 (5.0-6.9)
Caudal fin	4.0, 4.2 (3.1-4.0)
Pectoral fin	2.9 (2.5-3.1)
Pelvic fin	3.8, 4.2 (3.1-4.4)
In head length	
Eye	2.5 (2.5-3.2)
Snout	4.4, 4.6 (3.5-4.8)
Lower jaw	2.9 (2.5-2.9)
Pre-orbital depth	6.0, 6.3 (4.6-6.5)
Inter-orbital width	4.8 (3.9-4.5)
Premaxillary pedicel	3.8, 3.9 (2.9-3.7)
Pharyngeal fork	4.3 (3.6-4.3)
In fork length of pharyngeal bone	
Total pharyngeal bone length	0.8 (0.8-0.8)
Pharyngeal bone width	0.8 (0.8-1.0)
Pharyngeal bone depth	3.0 (2.8-3.3)
Pharyngeal bone blade length	3.0 (2.5-3.2)
Pharyngeal bone blade depth	4.8 (3.2-5.0)
Caudal peduncle	1.3, 1.4 (1.2-1.5) times as long as deep.
Longest ray of caudal	1.3 (1.5-1.9) times length of shortest ray.

FINS:

Dorsal **XV, 11**; XVI, 10(11); (XVI-XVII, 8(9)-10(11)), anal **III, 8(9)** (III, 8(9)-9(10)). Dorsal with well developed lappets, longest rays extending to just past middle of caudal peduncle in juveniles (including types), from between three fifths of

the caudal peduncle and the end of the caudal peduncle in females and from between the end of the caudal to the basal third of the median rays of the caudal in males. Anal not extending quite as far back as dorsal. Pectorals 1.0-1.2 times length of head and extending to base of second anal spine in juveniles, between bases of second anal spine and second anal ray in males. Pelvics to between vent and first anal spine in females and non-breeding males, to base of third anal spine in breeding males. Caudal forked or crescentically emarginate, upper lobe longer than lower, densely scaled all over lower lobe and to about level of fork on upper lobe.

SQUAMATION:

Upper lateral line **24, 27** (23-28) sometimes including several scales on caudal peduncle, lower **12, 14** (12-18); **32, 34** (32-34), usually 33, in longitudinal series; 4-6 between upper lateral line and base of first dorsal, 3 across cheek.

DENTITION:

Outer teeth in both jaws small, bicuspid, close set and slightly raked towards symphysis anteriorly, outer teeth of upper jaw recumbent, antero-lateral teeth of lower jaw procumbent and visible from below. Teeth in both jaws in 2 rows anteriorly in juveniles and in 3-4 rows in adults. Second row predominantly bicuspid, but interspersed with simple and tricuspid teeth. **55, 61** (51-100) teeth around outer margin of upper jaw. **39, 46** (37-65) around lower jaw. Outer row in lower jaw interrupted at the symphysis and in-curved to end immediately behind inner rows.

LOWER PHARYNGEAL BONE:

Y-shaped, slightly thickened, with fairly short decurved blade and short posterior arms; moderately indented posteriorly, with slightly rounded postero-lateral margins. Teeth well spaced, those in posterior row simple and enlarged, central ones conical, lateral ones compressed. Posterior 3-4 teeth of inner 2-4 series on each side enlarged, a few sometimes molariform, anterior and lateral teeth bicuspid, with anterior cusp rounded and posterior cusp curved forwards. **37, 43** (36-50) teeth across posterior margin of bone, **11-12** (10-14) along median axis.

GILL RAKERS:

Types with **4; 1; 12**, others with 3-6; 1; 10-14 on anterior arch. Outer lobes triangular, inner small and rounded.

COLOURATION:

Live females and males with developing gonads silvery, with bright gold iridescence dorsally. Snout light greyish with pale yellow iridescence, pre-orbital with greenish iridescence, cheek silvery, gular and branchiostegal membranes white. Chest with small light lemon yellow patches in front of bases of pelvics; in

larger males these patches may coalesce. Barring barely discernable. Dorsal greyish hyaline with 1 (anteriorly) to 6 (posteriorly) rows of yellowish brown spots coalescing to form diagonal bars posteriorly. Lappets white with orange tips. Caudal hyaline with yellowish reticulation, lower margin yellowish. Anal milky at base with 5-6 yellow spots on posterior membranes. Pelvics pale orange-yellow, with dusky shading distally, outer margin white. Pectorals yellow hyaline.

No live males with ripe gonads have been examined.

Preserved specimens, pale brownish above, silvery below, with 7-9 (usually 9) narrow vertical bars below dorsal. Third to fifth bars thickened and darkened on or immediately above lateral line. 2 faint bars on caudal peduncle. Snout darkish; chin, gular region and branchiostegal membranes pale; a dark opercular spot. Dorsal fin spotted anteriorly, the spots coalescing to diagonal bars posteriorly, with bars and spaces approximately equal in width, the outer border of the membrane in the spinous region darker, lappets grey with white tips. Caudal fin dusky with reticulate markings. Anal pale basally, lappets and distal part of membrane shaded, about 6 large dark spots posteriorly. Pelvics pale basally, shaded laterally and distally. Pectorals hyaline.

ECOLOGY

FEEDING

The guts of all specimens examined contained sand grains, and diatoms and root material were found in most of them, indicating a benthic feeding habit. The food appears to consist mainly of chironomid larvae, ostracods and copepods, with cladocera and larger insects occasionally taken.

DISTRIBUTION:

Lethinops macrophthalmus is known only from the Nkhota Kota area. There, it has twice been taken in trawl hauls in depths of 4-6 fathoms on a shelf some 2 miles offshore, but sheltered by an off-shore sand spit from the heavy seas raised by the south east winds.

It has not been found in waters of similar depth which are exposed to heavy seas outside the protection of the sand spit. It may be more widespread in the lake, but little exploratory trawling has been done in relatively sheltered shallow waters.

NOTE

This species was described by Boulenger from 6 specimens, and a skeleton. In 1921 Regan designated the largest specimen, of 100mm total length, as the type for *Lethinops alba*, and a single specimen of 75mm total length from the type series as the type for *Haplochromis argyrosoma*. The four remaining types, from 70 to 80mm remained as *H. macroph-*

thalmus and were transferred to *Lethrinops* by Trewavas in 1931.

These four specimens are small and in poor condition, having lost many scales. Two have been examined by us in detail and were found to have undeveloped gonads. Two collections from Nkhota Kota appear to belong to this species. The smallest, with a standard length of 65mm and total length of 84mm, although slightly larger than the types, appears to be conspecific with them, and forms a series with the remaining 13 specimens. Although meristic differences between the larger specimens and similar sized specimens of *L. macrochir* are slight, they are constant, as are differences in head profile, in live colouration and in dentition, *L. macrophthalmus* specimens always having bicuspid teeth in the inner rows. We therefore consider that the two species are distinct.

Lethrinops aurita (Regan) (Fig. 3)

Haplochromis auritus Regan, 1921:699, fig. 14; *Lethrinops aurita* (part) Trewavas, 1931:144; Trewason (part), 1961; Jackson et al (part), 1963:85; *non L. aurita* Axelrod and Burgess, 1976:180 (Fig.)

DIAGNOSIS

A small species attaining a standard length of about 75mm and breeding at about 60mm. Differs from *L. macrochir* in relatively shorter head, shallower body, larger eye and shorter premaxillary pedicel, in the squat form of the gill rakers, the smaller adult size and in habitat preference, from *L. macrophthalmus* by the lesser degree of enlargement of the pharyngeal teeth, the squat form of the gill rakers, the straighter snout and smaller adult size, and from *L. parvidens* in the greater number of gill rakers and their squat form.

MATERIAL EXAMINED

Measurements based on the holotype from an unknown part of Lake Malawi and 18 specimens, 9 males 61.5-71.8mm S.L. and 9 females 61.0-75.0mm S.L. from Monkey Bay (14°05'S, 34°55'E), in southern Lake Malawi which are deemed to be conspecific with the holotype.

Holotype:

Male 63mm S.L., BMNH 1921.9.6.133 collected by Wood; locality given as 'Lake Nyasa'.

Other material:

3 males 61.6, 67.0 and 67.4mm S.L. and 2 females 60.4 and 63.5mm S.L. - BMNH 1978.10.31:2-6; 1 male 71.8mm S.L. and 1 female 71.0mm S.L. - MFRU; 1 female 61.0mm S.L. (Fig.3) - BMNH 1978.10.31:1; 1 male 63.6mm S.L. and 1 female 60.5mm S.L. - RUSI 8317/1-2; 1 male 63.0mm S.L. and 1 female 67.0mm S.L. - QVM 3805; 1 male 62.0mm S.L. and 1 female 61.0mm S.L. - USNM 218877; 1 male 61.5mm S.L. and 1 female 75.0mm S.L. - AMNH 1978-X-

29:37901; 1 male 65.4mm S.L. and 1 female 62.4mm S.L. - MACT 78-32-P- 1 & 2; all taken in seine from sandy beach in Monkey Bay 23 May 1978.

DESCRIPTION

Body of average depth and moderately compressed. Dorsal margin forming smooth curve from snout to end of dorsal with greatest depth at level of 4th to 8th dorsal spines. Snout considerably shorter than eye and slightly concave. Mouth small with jaws of more or less equal length. Maxilla extending from just short of to just past anterior margin of eye, premaxillary pedicels approximately to posterior margin of nasal bones. Caudal forked with lobes of more or less equal length.

Proportional measurements (holotype in bold, 18 specimens from Monkey Bay in parentheses).

In standard length

Body depth	2.8 (2.5-2.9)
Head length	3.2 (3.1-3.4)
Caudal peduncle	5.9 (5.6-6.7)
Caudal fin	3.3 (3.0-3.7)
Pectoral fin	3.2 (2.6-3.0)
Pelvic fin	3.4 (3.1-4.0)

In head length

Eye	2.7 (2.5-2.9)
Snout	4.4 (3.8-4.8)
Lower jaw	2.5 (2.5-3.0)
Pre-orbital depth	5.7 (5.2-6.9)
Inter-orbital width	4.0 (4.1-4.6)
Premaxillary pedicel	3.6 (3.1-3.8)
Lower Pharyngeal fork	(3.6-4.1)

In fork length of lower pharyngeal bone

Total pharyngeal length	(0.8-0.9)
Pharyngeal width	(0.8-0.9)
Pharyngeal depth	(2.8-3.9)

Pharyngeal blade length	(2.4-3.1)
Pharyngeal blade depth	(3.7-5.1)

Caudal peduncle **1.4** (1.1-1.5) times as long as deep. Longest ray of caudal **1.4** (1.5-1.7) times length of shortest ray.

FINS:

Dorsal **XV, 10(11)**(XV-XVII, 9-11), anal **III, 9**(III, 8-10). Dorsal with well developed lappets extending to about two thirds way along caudal peduncle in females, to about half way along caudal fin in breeding males. Anal not extending quite as far back as dorsal. Caudal forked with lobes of equal length or dorsal lobe slightly longer. Pelvics to between vent and first anal spine or to beyond third anal spine in breeding males. Pectoral to third anal spine or first anal ray.

SQUAMATION:

Upper lateral line **23**(21-27), lower (10-15); **31**(31-32) scales in longitudinal line and base of first dorsal spine; **3**(2-4) scales across cheek.

DENTITION:

Teeth in **2** (2-3, but usually 2) rows in each jaw anteriorly. Teeth in outer row of each jaw closely spaced and equally bicuspid becoming unequally bicuspid or simple posteriorly. Inner teeth minute and tricuspid. **59**(47-60) teeth around margin of upper jaw, **44**(33-45) around lower jaw. Number of teeth in outer rows usually greater in larger specimens. Outer tooth row in lower jaw sharply incurved posteriorly to end behind inner row.

LOWER PHARYNGEAL BONE:

Slender and deeply notched posteriorly, anterior blade straight and of average length. Teeth small and well spaced, those in centre of posterior and penultimate rows slightly enlarged, but never flattened. **36**(33-40) teeth across posterior margin of bone, (10-13) along median axis.

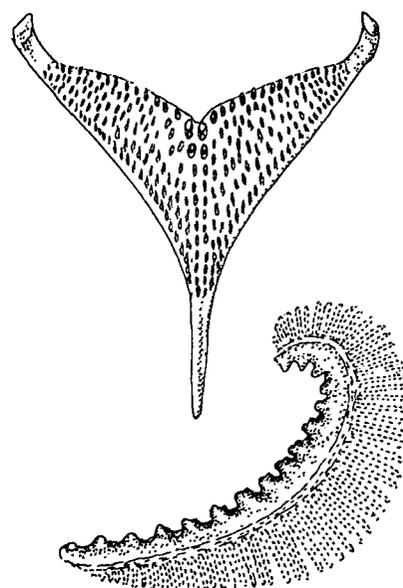
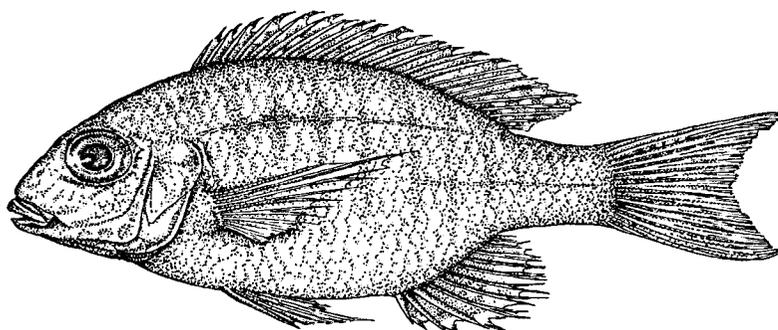


FIG. 3

Lethrinops aurita (female 79mm total length); occlusal aspect of lower pharyngeal bone; lateral aspect of 1st gill arch.

GILL RAKERS:

4;1;13 (3-5;1;12-13) gill rakers on anterior arch. Individual rakers short and squat with rather squared ends, those on lowermost part of arch usually rudimentary.

COLOURATION:

Live females with between 7 and 9 dark bars of variable prominence below dorsal fin and a dark spot on the upper lateral line formed by intensified pigmentation of the 2nd-4th or 3rd-5th vertical bars. Head olive-grey dorsally, silvery laterally with gular region and branchiostegal membranes white or yellowish. Dorsal dusky with clear spots, more prominent in rayed region. Caudal yellowish with clear spots on central membranes. Anal hyaline with yellowish tinge, with or without lemon yellow ocelli. Pelvics lemon yellow, pectorals hyaline with yellowish tinge.

Live males silvery with 7 to 9 dark bars below dorsal and a dark spot on upper lateral line at 2nd-4th or 3rd-5th vertical bars. Head olive grey to dark grey dorsally, silvery laterally, nape orange, gular region and branchiostegal membranes yellowish. Dorsal dusky with yellowish spots on membranes, more prominent in rayed region, darkish submarginal bar, lappets white, tipped with orange. Caudal yellowish with numerous small yellow spots on membranes. Anal hyaline proximally, darkish distally with a variable number of lemon yellow ocelli. Pelvics hyaline with lemon yellow tinge and dark outer margin. Pectorals hyaline with yellow tinge.

Preserved specimens with markings as for live specimens, but with colours lacking.

ECOLOGY

FEEDING

The gut contents of the specimens used for this description consisted mainly of detritus, pennate

diatoms, sand grains and small invertebrates, particularly copepods of the genera *Mesocyclops* and *Diaptomus*.

DISTRIBUTION

L. aurita is common on sandy shores in the southern part of Lake Malawi. It is frequently taken in seine hauls, but rarely occurs in trawl catches suggesting that it is restricted to shallow water. Its distribution in the central and northern regions of the lake is not known.

Lethrinops macrochir Regan (Fig. 4)

Lethrinops macrochir Regan, 1921:712, (Fig. 24); *Lethrinops aurita* loc. cit. (part), Trewavas, 1931:144; Jackson, 1960:586; Jackson et al, 1963:85; *Lethrinops aurita* Axelrod and Burgess, 1976:180 (Fig.3).

DIAGNOSIS

A medium sized species attaining a standard length of about 120mm. Differs from most other members of the group in gill raker number (11-14) as opposed to 19-22 in *L. macracanthus*; 15-17 in *L. longimanus* and 8-10 in *L. parvidens*. Differs from all other species including *L. aurita* in bright yellow colouration of lower part of head and gular region. Differs from *L. macrophthalmus* in smaller eye, deeper body, straighter head profile and longer pectoral, and from *L. mylodon* in less extreme development of the pharyngeal mill.

MATERIAL EXAMINED

Measurements based on lectotype and paralectotype (coll. Wood) and 19 specimens from various parts of southern Lake Malawi which are deemed to be conspecific with the types.

Types:

Two specimens of unknown sex, 108 and 105mm S.L. from an unrecorded part of Lake Malawi. The

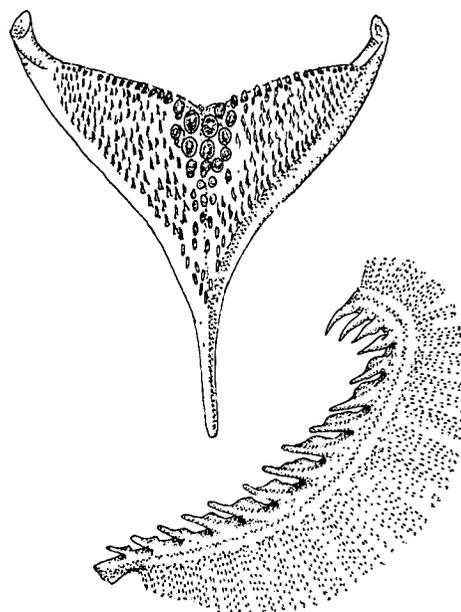
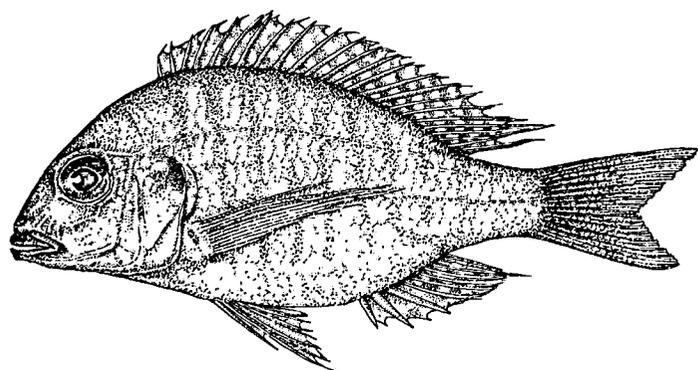


FIG. 4

Lethrinops macrochir (male 145mm total length); occlusal aspect of lower pharyngeal bone; lateral aspect of 1st gill arch.

108mm specimen (BMNH 1921:9:6:186) is now designated as lectotype and the 105mm specimen (BMNH 1921:9:6:187) as paralectotype.

Other Material:

1 male 112mm S.L. (Fig. 4) - BMNH 1978.10.31:13; 1 male 118mm S.L. and 1 female 98mm S.L. - USNM 218878; 1 male 108mm S.L. - RUSI 8322; 1 female 98mm S.L. - QVM 3804; 1 female 76mm S.L. - MACT 78-32-P-6; all trawled in 12-15 fathoms off Kanjedza Island, Mazinzi Bay (14°06'S, 34°57'E) 15 June 1977; 5 males, 97, 98, 113, 121 and 133mm S.L. and 1 female 118mm S.L. - BMNH 1978.10.31:15-20; 2 males, 105 and 108mm S.L. - AMNH 1978-X-29:37900; all trawled in 7 fathoms off Chigubi Point, Mazinzi Bay (14°07'S, 34°57'E) 26 June 1978; 1 male 104mm S.L. trawled in 10-15 fathoms, LTMS station White House I (14°06'S, 34°35'E) 20 July 1971 - RUSI 8323; 1 male 111mm S.L. - MFRU; 1 male 119mm S.L. - BMNH 1978.10.31:14; both trawled in 10-15 fathoms, LTMS station White House I, 6 February 1973; 1 male 92mm S.L. - QVM 3803; 1 male 91mm S.L. - MACT 78-32-P-7; both trawled in about 10 fathoms, LTMS station Foo I (14°07'S, 35°10'E) 17 January 1973.

DESCRIPTION

Body fairly deep and strongly compressed. Dorsal margin rounded forming a smooth curve from eye to posterior end of dorsal. Greatest depth at level of 7th-9th dorsal spines. Snout shorter than eye diameter, straight or slightly convex and sloping at an angle of about 60°. Mouth set low on head profile; jaws of equal length; maxilla exposed posteriorly or for most of length, extending approximately to level of anterior margin of eye. Premaxillary pedicels to end of nasal bones. Caudal forked and densely scaled over basal two thirds.

Proportional measurements (lectotype in bold followed by paralectotype. Other material in parenthesis).

	In standard length	
Body depth	2.3,2.4	(2.2-2.5)
Head length	3.0,3.1	(2.9-3.2)
Caudal peduncle	6.3,6.0	(5.6-7.2)
Caudal fin	3.6,4.0	(3.0-3.8)
Pectoral fin	2.7,2.7	(2.2-3.1)
Pelvic fin	3.9,4.0	(3.2-4.2)
	In head length	
Eye	3.3,3.1	(2.9-3.5)
Snout	3.3,3.6	(3.4-4.0)
Lower jaw	2.6,2.6	(2.5-2.8)
Pre-orbital depth	4.5,4.9	(4.1-5.7)
Inter-orbital width	4.0,4.0	(3.8-4.7)
Premaxillary pedicel	3.0,3.4	(2.7-3.3)
Lower pharyngeal fork	3.9,4.0	(3.5-4.1)
	In fork length of lower pharyngeal bone	
Total pharyngeal length	0.8,0.8	(0.8-0.9)
Pharyngeal width	0.9,0.9	(0.9-1.0)

Pharyngeal depth	3.5,3.1	(2.9-3.8)
Pharyngeal blade length	2.7,2.5	(2.3-3.0)
Pharyngeal blade depth	(4.1-4.8)	

Caudal Peduncle **1.3,1.3** (1.1-1.4) times as long as deep. Longest ray of caudal **1.6,1.4** (1.4-1.8) times length of shortest ray.

FINS:

Dorsal **XVI,9(10)-10**; (XV-XVII,9-11) anal **III,8(9)**, (III,8-10). Dorsal with well developed lappets and with longest rays extending posteriorly to about three-quarter-way along caudal peduncle in females and non-breeding males. Anal usually not extending quite as far back as dorsal. Pectorals longer than head and extending to base of 1st-3rd anal spine in females and non-breeding males and up to 5th anal ray in breeding males. Pelvics to between vent and 1st anal spine or to 1st anal ray in breeding males. Caudal moderately forked with dorsal lobe longer than ventral.

SQUAMATION:

Upper lateral line **26,28** (22-27); lower **14,14** (11-17); **32,33** (32-33) scales in longitudinal series; **5,5** (5-6) between upper lateral line and base of 1st dorsal spine; **3,3** (3-4) across cheek. Caudal fin densely scaled almost to posterior margin.

DENTITION:

Outer teeth in both jaws small, bicuspid and slightly raked towards symphysis anteriorly. Anterolateral teeth in lower jaw procumbent and visible from below. In both jaws teeth in 2-4 rows anteriorly, inner teeth minute and tricuspid with reduced lateral cusps. **88,86** (67-87) teeth around margin of lower jaw, **66,56** (45-60) teeth around margin of lower jaw. In lower jaw outer row of teeth curved inwards posteriorly to end behind inner rows.

LOWER PHARYNGEAL BONE:

Y-shaped with long, slightly decurved anterior blade and short posterior arms; moderately indented posteriorly with slightly rounded posterolateral margins. Teeth mainly slender and well spaced, those in posterior row enlarged and compressed. Central **10-20** teeth usually, but not invariably, enlarged and flattened. **38,39** (31-42) teeth across posterior margin of bone; **13,10** (10-15) along median axis.

GILL RAKERS:

6;1;14, **5;1;14** (3-5;1;11-14) on anterior arch. Individual rakers pointed, with flattened inner lobes.

COLOURATION:

Live females and non-breeding males silvery with yellow head and ventral region. Dorsal part of head grey; preopercular, subopercular, lower jaw, gular region and throat lemon yellow; opercular silvery with grey spot on posterior margin; yellowish patch above and behind eye; body silvery with variable yellow

sheen; 9 faint vertical bars below dorsal fin (barely visible in most specimens). Dorsal pale grey with grey or yellow-grey spots on membranes. Lappets tipped with orange or orange-brown in most specimens. Caudal grey with small grey or yellowish spots on membranes, especially at centre. Anal hyaline at base, yellow distally with creamy white or yellow spots on posterior membranes. Pelvics golden-yellow anteriorly, clear posteriorly. Pectoral hyaline with yellow tinge. Mature males as females except with blue-green iridescence on head and distal parts of anal crimson.

ECOLOGY

FEEDING:

The guts of all specimens examined contained numerous sand grains, chironomid larvae and pupae and ostracods. Also recorded were cyclopoid copepods, cladocera, oligochaetes and higher plant detritus.

DISTRIBUTION:

L. macrochir is normally found in water of between 5 and 10 fathoms in depth and has been recorded from the South East Arm, South West Arm, Domira Bay and Lake Malombe. It is possibly more widespread than the trawling survey indicates, as very few stations were at depths of less than 10 fathoms.

NOTE

Trewavas (1931) considered that *L. macrochir* (Regan) was conspecific with *L. aurita* and that the differences between the two nominal species could be ascribed to individual variation. Unfortunately, the contents of the body cavity of the type of *L. aurita* have been removed although a small scrap of remaining tissue appears to be part of a ripe testis indicating that this specimen had attained maturity by 63mm S.L.

and was not a young specimen as Trewavas implied. The elongation and pigmentation of the fins supports this. Examination of recently collected material confirms that in *L. aurita* sexual maturity is attained by the time a length of about 60mm S.L. is reached. Taking into account the differences in proportions, size, live colouration and habitat it is no longer possible to consider these forms as conspecific and *L. macrochir* must be considered as distinct.

Lethrinops longimanus Trewavas (Figs. 5,6)

Lethrinops longimanus Trewavas, 1931:145; Jackson 1961:586; Jackson et al, 1963:85.

DIAGNOSIS

A medium sized species attaining a standard length of about 150mm. Very similar in morphology to *L. macrochir* and *L. macracanthus*, but differs from both in gill raker count (15-19 as opposed to 11-14 in *L. macrochir* and 19-23 in *L. macracanthus*). Differs from all other known members of the group except *L. aurita* and *L. mylodon* in possessing seven vertical bars below the dorsal fin (8-9 in other species).

MATERIAL EXAMINED

Measurements based on holotype and 18 specimens. 10 males 109-153mm S.L. and 8 females 110-135mm S.L., from the South East Arm of Lake Malawi which conform closely with the holotype and are deemed to be conspecific. Less detailed counts and measurements have been made on a further 15 specimens, from various parts of Lake Malawi south of 11°30'.

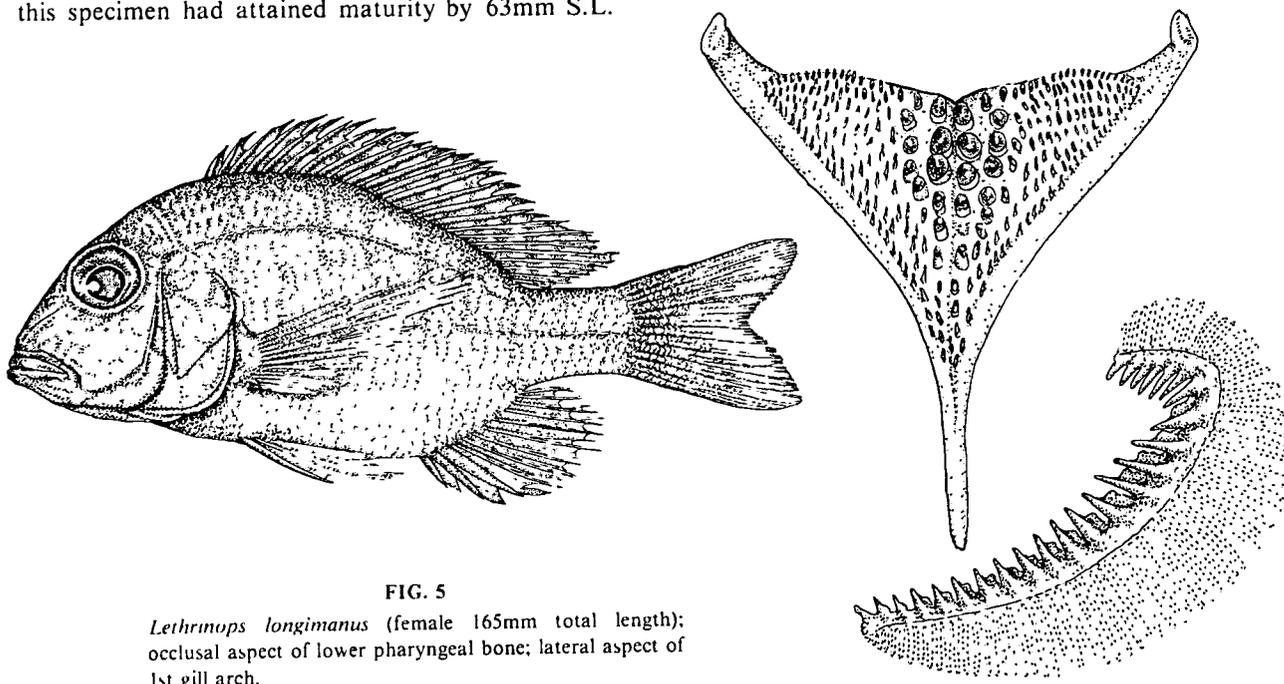


FIG. 5

Lethrinops longimanus (female 165mm total length); occlusal aspect of lower pharyngeal bone; lateral aspect of 1st gill arch.

Holotype:

A mature male 110mm S.L. from between Malembo (14° 13'S, 34° 48'E) and Bar House (14° 23'S, 35° 12'E) in southern Lake Malawi - coll. Christy - BMNH 1930.1.31.83.

Other Material:

2 males 138 and 153mm S.L. and 1 female 110mm S.L. - BMNH 1978.10.31:8-10; 1 male 109mm S.L. - RUSI 8325/1; all trawled in 18 fathoms off Namiasi (14° 18'S, 35° 12'E) 20 April 1978; 1 male 121mm S.L. and 1 female 133mm S.L. - BMNH 1978.10.31:11-12; 1 female 130mm S.L. (Fig. 5) - BMNH 1978.10.31:7; 1 male 141mm S.L. - RUSI 8325/2; 1 male 114mm S.L. and 1 female 135mm S.L. - USNM 218879; 1 male 114mm S.L. and 1 female 115mm S.L. - AMNH 1978.X.29:37902; 1 male 122mm S.L. and 1 female 117mm S.L. - QVM 3802; 1 male 134mm S.L. and 1 female 130mm S.L. - MFRU; 1 male 114mm S.L. and 1 female 135mm S.L. - MACT 78-32-P-3&4; all trawled in 30-35 fathoms, Mazinzi Bay (14° 06'S, 34° 58'E) 26 April 1978.

DESCRIPTION

Body fairly deep and strongly compressed. Dorsal margin rounded forming a smooth curve from snout to end of dorsal. Greatest depth at level of 4th-9th (usually 6th-7th) dorsal spines. Snout straight and sloping at an angle of 50°-60°, slightly shorter, equal, or slightly longer than eye diameter. Mouth set low on head profile; jaws equal in length; maxilla either covered anteriorly by pre-orbital or completely exposed and extending almost to level of anterior margin of eye. Premaxillary pedicels approximately to end of nasal bones. Caudal forked and densely scaled over basal two thirds.

Proportional measurements (holotype in bold, other material in parentheses).

	In standard length	
Body depth	.....	2.3 (2.2-2.6)
Head length	.....	3.0 (2.7-3.2)
Caudal peduncle	.....	6.1 (5.0-6.6)
Caudal fin	.....	3.8 (3.2-4.2)
Pectoral fin	.....	2.3 (2.2-2.6)
Pelvic fin	.....	3.9 (3.4-4.2)

	In head size	
Eye	.....	3.3 (2.9-3.4)
Snout	.....	3.2 (3.1-4.1)
Lower jaw	.....	2.5 (2.4-3.1)
Pre-orbital depth	.....	(4.0-4.9)
Inter-orbital width	.....	4.1 (3.7-4.6)
Premaxillary pedicel	.....	2.8 (2.6-3.2)
Lower pharyngeal fork	.....	3.7 (3.4-4.0)

	In fork length of lower pharyngeal bone	
Total pharyngeal length	.....	0.8 (0.8-0.9)
Pharyngeal width	.....	1.0 (0.9-1.0)

Pharyngeal depth	.....	3.6 (2.9-3.8)
Pharyngeal blade length	.....	2.1 (2.2-2.9)
Pharyngeal blade depth	.....	5.3 (3.7-5.7)
Caudal peduncle	1.3 (1.2-1.7) times as long as deep.	
Longest ray of caudal	1.4 (1.5-1.7) times as long as shortest ray.	

FINS:

Dorsal **XVI,9(10)** (XV-XVII, 10-12), anal **III,9(10)** ((III, 9-10)). Dorsal with well developed lappets and with longest rays extending to between three quarter way along caudal peduncle and caudal base in females or to as much as half way along caudal fin in breeding males. Anal extending as far back as dorsal. Pectorals to between base of 4th anal ray and beyond base of anal. Pelvics to 1st anal spine in females and to 3rd spine or 1st ray in males. Caudal moderately forked with lobes of equal length or dorsal lobe longer than ventral.

SQUAMATION:

Upper lateral line **28** (21-27), lower **15** (12-18); **33** (31-34) scales in longitudinal series. **5** (4-5) scales between base of 1st dorsal spine and upper lateral line **3** (3-4) across cheek. Caudal densely covered with small scales.

DENTITION:

In both jaws teeth in **3** (3-4) rows anteriorly. Teeth in outer row of each jaw small and deeply bicuspid with cusps almost equal in size. Inner teeth very small, mixed tricuspid, bicuspid and simple. **100** (78-124, usually about 110) around margin of upper jaw; **66** (60-85) around margin of lower jaw. In lower jaw, outer row sharply incurved posteriorly to end behind inner rows.

LOWER PHARYNGEAL BONE:

Very variable; ranging from slender and Y-shaped with shallow blade to stout and triangular with deep blade, blade not decurved. Anterior and lateral teeth compressed, with small anterior cusp and major cusp turned forward. Central teeth always enlarged and flattened though number of enlarged teeth very variable (see Fig. 6). **36** (31-50) teeth across posterior margin; **10** (9-15) along median axis.

GILL RAKERS:

5:1:16 (4-6:1:15-18) gill rakers on anterior arch. Individual rakers with long pointed outer lobe and flattened convoluted inner lobe.

COLOURATION:

Live females silvery with a pinkish iridescence. Head grey dorsally, silvery with pink iridescence laterally; gular region and branchiostegal membranes white. Body silvery with pinkish iridescence; 7 dark bars below dorsal. Dorsal fin milky with yellowish spots and pale grey lappets; caudal dusky with no obvious markings; anal milky or

yellowish with yellow ocelli and hyaline lappets; pelvics hyaline with yellowish tinge; pectorals yellow.

Live males dark metallic grey with bronze iridescence. Head grey with purple and blue iridescence on pre-orbital, suborbital, preopercular and opercular; gular region and branchiostegal membranes grey. Body purple-grey dorsally, silvery laterally and ventrally with 7 prominent grey-brown bars below dorsal. Pronounced bronze iridescence over whole body. Dorsal dusky with series of dull yellow spots through spinous and rayed region; the dark bars of the rayed region usually being wider than the spaces between them; lappets and tips of rays dark grey; caudal dusky with yellow spots on inner membranes (yellow-brown reticulation on caudal of 153mm S.L. specimen); anal dusky with large yellow ocelli; pelvics grey with yellow tinge; pectorals yellow.

ECOLOGY

FEEDING:

Examination of stomach contents suggest that the larvae of chironomids constitute the largest component of the diet; though other small benthic invertebrates are also eaten. All guts examined contained considerable amounts of sand.

DISTRIBUTION:

Widely distributed in the southern part of Lake Malawi where it has been recorded from depths of between 10 and 40 fathoms; most common between 25 and 35 fathoms and often makes up a sizeable proportion of trawl catches from this depth range. Northern limit not known, but recorded from between 10 and 15 fathoms in area around Bandawe and from 55 fathoms off Nkhota Kota.

Lethrinops macracanthus Trewavas (Fig.7)

Lethrinops macracanthus Trewavas, 1931:145, Fig. 5B; Jackson 1961:586; Jackson et al, 1963:85.

DIAGNOSIS

A relatively large species, attaining a standard length of 190mm. Differs from all other members of the genus in the possession of numerous (19-23) gill rakers on the first ceratobranchial together with enlarged, often molariform, teeth on the pharyngeal bone.

MATERIAL EXAMINED

Measurements based on the holotype of undetermined sex, 163mm S.L. and 15 specimens, 11 males 100-190mm S.L., 2 females, 133 and 146mm S.L. and two juveniles of 81 and 90mm S.L. Less detailed counts and measurements have been made on a further 51 specimens from the South East and South West Arms.

Holotype:

A specimen of undetermined sex, 163mm S.L. from Monkey Bay (14°04'S, 34°56'E) - BMNH 1930.1.31.101.

Other Material:

1 juvenile of 81mm S.L. - MFRU; 1 juvenile of 90mm S.L. - BMNH 1978.10.31:22; 1 male of 100mm S.L. - BMNH 1978.10.31:21; all trawled in

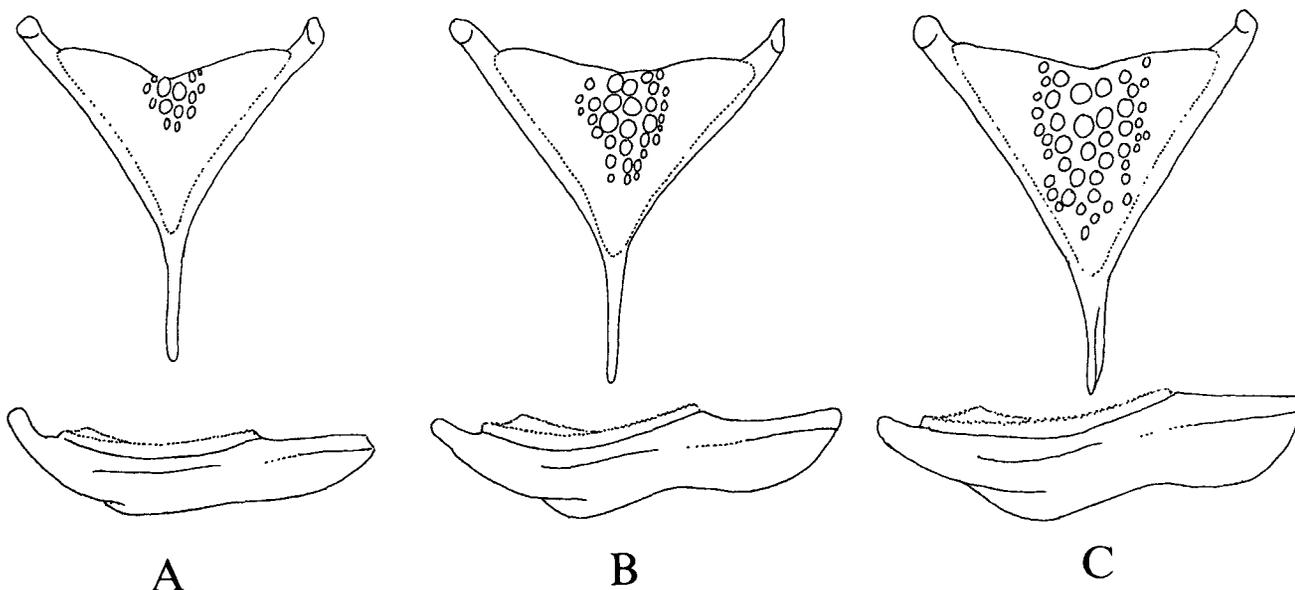


FIG. 6 Occlusal and lateral aspects of lower pharyngeal bone of three specimens of *L. longimanus* between 122 and 135mm S.L. taken in the same trawl haul in 30-35 fathoms from Mazinzi Bay (South East Arm of Lake Malawi) showing variation in stoutness and number of flattened teeth.

depth of body relative to standard length increases at a greater rate in *L. macracanthus* than in *L. longimanus*. Analysis of the regression coefficients of body depth on standard length for large samples show a highly significant difference at the 0.1% level (Fig. 8). There are also more subtle and less readily quantifiable differences. In profile *L. macracanthus* has a more strongly arched dorsal margin, while the premaxilla is somewhat more robust in *L. longimanus*. In addition to the differences in form there are also differences in colouration. While *L. longimanus* usually has 7 bars on the flanks below the dorsal, the usual number for *L. macracanthus* is 8, and in some of the individuals with 7 bars below the dorsal there is a bar in front of the first dorsal spine. The live colouration of *L. longimanus* is generally darker than that of *L. macracanthus* of the same sex and state of reproductive activity, and the darker bars in the dorsal broader than in *L. macracanthus* of the same size. These small differences are sufficient to enable an experienced worker to distinguish individuals in the field with a high degree of certainty, which can be confirmed by an examination of the gill rakers, there being scarcely any overlap in the frequency distributions for this character in the two species (Table I).

A single sample of 87 fish, trawled off Sungu Point (13°33'S, 34°31'E) in July, 1971 could not be assigned

with any certainty to either species. The numbers of gill rakers are intermediate between those two characteristic for the two species (Table I) and there is considerable overlap with each of them. While the body form of these specimens is essentially similar to *L. longimanus*, the mean of the ratio of standard length to depth at any length is considerably greater than in that species. However, the difference is not statistically significant, and there is no difference in the slope of the regression lines (Fig. 8). While the characteristics of the population distinguish it quite clearly from both *L. longimanus* and *L. macracanthus*, it is impossible to distinguish individuals in the size range 80-120mm from either of these species, although at larger sizes the ratio of standard length to depth is outside the range of *L. macracanthus*.

The status of this population is difficult to assess. It is unfortunate that the exact position and depth at which the sample was taken was not recorded as, although the general area is known, it has not proved possible to obtain further material so that the habitat and the live colouration are unknown. The fact that in this sample 52 of the 87 individuals had 19 gill rakers on at least one side, while this situation was found in only 4 of the 67 individuals of *L. macracanthus* (one of which was from a nearby station), and 1 of the 133

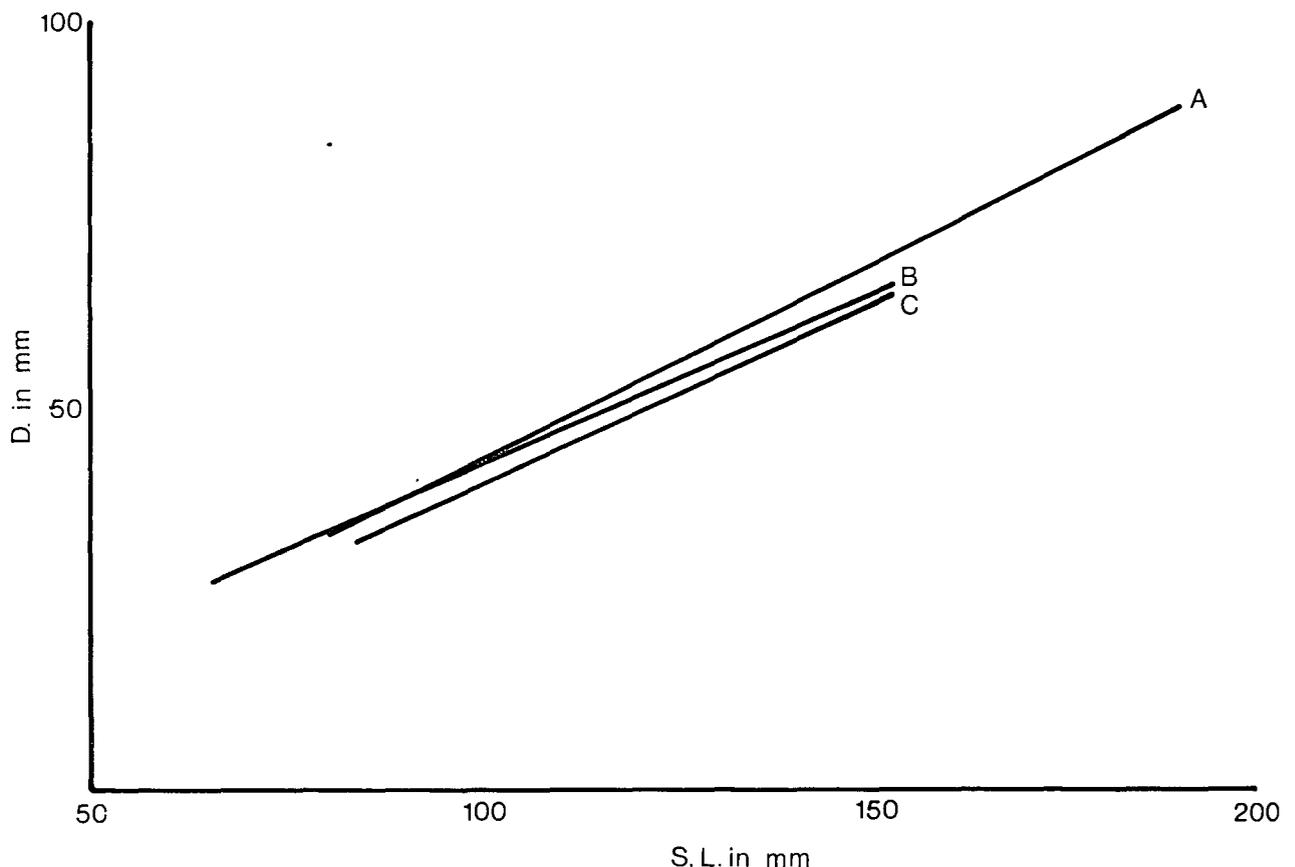


FIG. 8 Regression lines of depth on standard length for (A) *L. macracanthus*, (B) *L. longimanus* and (C) population of uncertain affinities from Sungu.

Species		<i>L. longimanus</i>	Sungu Point Sample	<i>L. macracanthus</i>
Number of fish		133	87	67
Size range		66-153	84-152	81-190
Number of gill rakers	14	5	-	-
	15	62	-	-
	16	115	-	-
	17	63	12	-
	18	18	54	-
	19	2	75	5
	20	-	29	11
	21	-	4	54
	22	-	-	38
	23	-	-	21
24	-	-	3	
Ratio S.L.: D	2.1	-	-	15
	2.2	11	1	18
	2.3	51	13	16
	2.4	51	34	16
	2.5	14	26	2
	2.6	6	10	-
	2.7	-	2	-
	2.8	-	1	-
Regression Coefficient		.443±.009	.463±.010	.507±.010
Intercept		-2.07	-6.32	-7.67
Number of bars	6	3	2	-
	7	256	170	17
	8	8	2	99
	9	-	-	18

Table I. Meristic data of *Lethrinops longimanus*, *L. macracanthus* and unassigned sample.

individuals of *L. longimanus* examined, coupled with the fact that the two latter species are often found together, indicate that this is probably not a case of hybridisation. Thorpe and McCarthy (1978) have discussed possible interpretations of a somewhat analogous situation on African house snakes, although the present situation differs in that both species co-occur on either side of the intermediate form. We suggest that the sample may represent a sibling species closely allied to *L. macracanthus* and *L. longimanus*. We consider hybridisation unlikely due to co-existence of the species elsewhere in their range and we do not consider that the unassigned population represents part of a cline connecting *L. longimanus* with *L. macracanthus* as this would not explain the existence of typical examples of each species both to north and to south of the intermediate population.

***Lethrinops mylodon* n. sp. (Fig 9,10,11)**

A large species attaining a standard length of more than 200 mm. Differs from all other known species of

Lethrinops by possessing massive molariform pharyngeal bones with greatly enlarged molariform teeth which form a powerful grinding mill. In association with this feature, the pharyngobranchial apophysis on the base of the neurocranium is also greatly enlarged.

NOTE

There are a number of differences between the specimens of *L. mylodon* from Nkhata Bay and those from further south. These differences are consistent and of sufficient magnitude for us to consider the two populations as representing different subspecies. The southern form we have assigned to the subspecies *L. mylodon mylodon* and the northern form to the subspecies *L. mylodon borealis*. Proportional measurements of the two subspecies are listed separately. Unless otherwise stated, descriptions of morphological characters refer to both subspecies.

MATERIAL EXAMINED

L. mylodon mylodon ssp. nov.

Description based on 20 specimens, 10 males 125-175mm and 10 females 122-161mm S.L. from the Monkey Bay region of Lake Malaŵi. Live colouration noted from additional specimens of *L. m. mylodon*.

Holotype:

A mature female 155mm S.L. trawled in 30-40 fathoms east of Monkey Bay (14°04'S, 34°58'E) 11 September 1977 - BMNH 1978.10.31:27.

Paratypes:

2 males 153 and 175mm S.L. caught in gill net at unknown depth off Monkey Bay (14°04'S, 34°56'E) 9 September 1965 - BMNH 1978.10.31:28-29; 1 female 127mm S.L. caught in gill net in 30-40 fathoms off Monkey Bay 31 January 1968 - BMNH 1978.10.31:32; 1 male 125mm S.L. caught in gill net at unknown depth off Monkey Bay 9 February 1968 - MACT 78-32-P-9; 1 female 132mm S.L. caught in gill net in 50 fathoms off Monkey Bay 4 April 1968 - Mact 78-32-P-10; 1 male 140mm S.L. (Fig. 10) - BMNH 1978.10.31:31; 1 female 146mm S.L. - BMNH 1978.10.31:30; 1 male 141mm S.L. and 1 female 152mm S.L. - RUSI 8335/1-2; 1 male 141mm S.L. and 1 female 140mm S.L. - QVM 3800; 1 male 139mm S.L. and 1 female 128.5mm S.L. - USNM 218881; 1 female 134mm S.L. and 2 males 128 and 143mm S.L. - MFRU; all trawled 22-24 fathoms off Monkey Bay (14°05'S, 34°57'E); 1 male 147mm S.L. and 1 female 149mm S.L. caught in gill net at unknown depth off Monkey Bay 21 March 1968 -

AMNH 1978-X-29:37904; 1 female 140mm S.L. (skeleton) gill netted in 40 fathoms off Monkey Bay (14°03'S, 35°01'E) 17 April 1968 - MFRU.

L. mylodon borealis ssp. nov.

Descriptions based on 9 specimens, 3 females of 180-190mm S.L. and 6 males of 177-202mm S.L. Unfortunately, all but two have been mislaid subsequent to being measured, so that only two type specimens are designated. All were from the Nkota Bay area.

Holotype:

A female of 190mm S.L. gill netted at a depth of approximately 50 fathoms off the light house at Nkhata Bay (11°36'S, 34°18'E) 12 October 1960 - BMNH 1978.10.31:33.

Paratype:

A female of 180mm S.L. taken by gill net off the point between the bays at Nkhata Bay, 7 June 1960 - MFRU.

Other material:

1 male 177mm S.L. 30 May 1961; 1 female 180mm S.L. 14 February 1961; 1 male 186mm S.L. undated; 1 male 190mm S.L. undated; 1 male 199mm S.L. undated; 1 male 200mm S.L. 3 March 1961; 1 male 202mm S.L. 2 November 1960; all gill netted within two miles of Nkhata Bay.

DESCRIPTION (both subspecies)

Body deep and compressed with greatest depth level of 6th-8th dorsal spines. Dorsal margin steeply arched. Profile of snout variable, very slightly

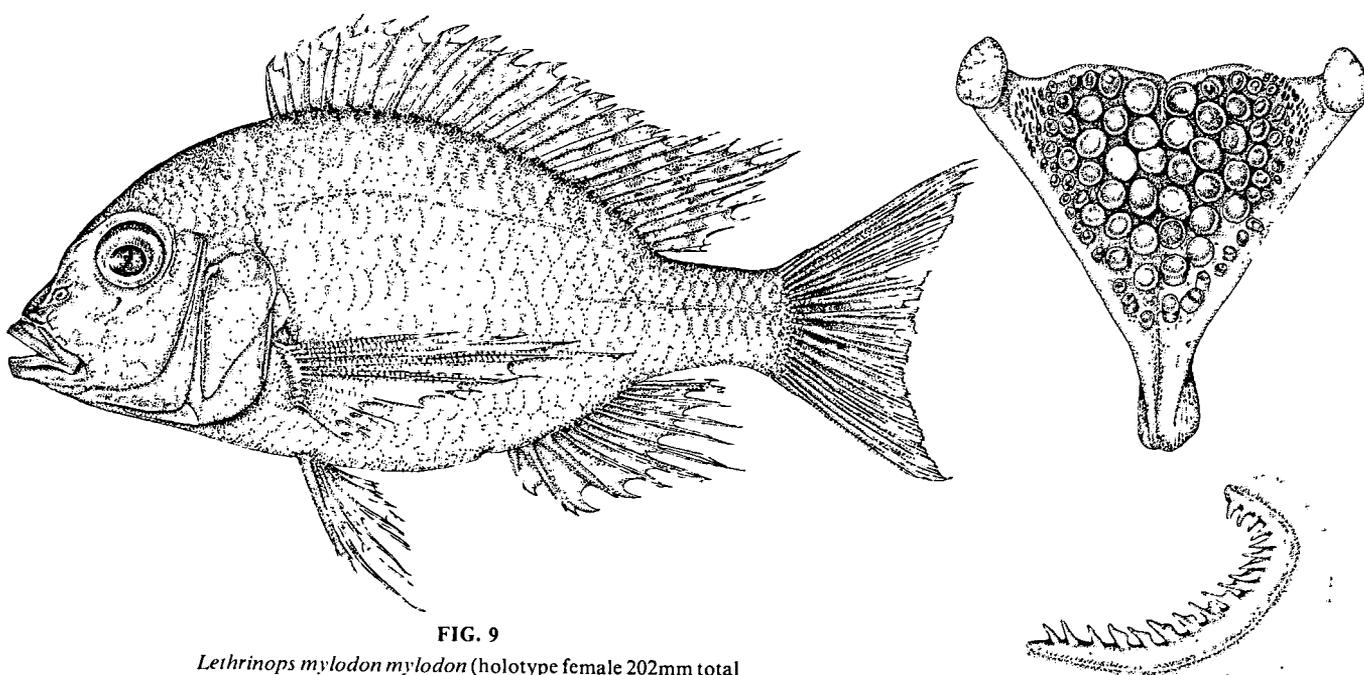


FIG. 9

Lethrinops mylodon mylodon (holotype female 202mm total length); occlusal aspect of lower pharyngeal bone; lateral aspect of 1st gill arch.

concave in juveniles and becoming more concave in larger specimens, inter-orbital region often bulbous especially in breeding males (Fig. 10). Mouth set low on profile of head, jaws approximately equal in length. Maxilla extending approximately to anterior margin of eye. Caudal moderately forked.

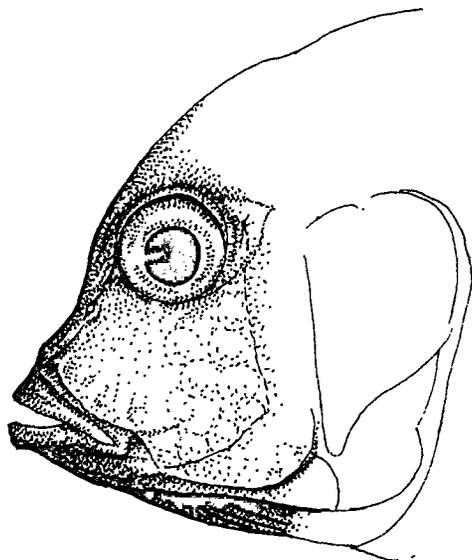


FIG. 10

Lethrinops mylodon mylodon head of breeding male (paratype of 182mm total length) to show gibbous inter-orbital region.

Proportional measurements (holotypes in bold, non-type material of *L. borealis* in parenthesis).

In standard length

	<i>L.m.mylodon</i>	<i>L.m.borealis</i>
Body depth	2.0-2.2-2.5	2.2,2.4(2.1-2.3)
Head length	2.9,3.3	2.7,2.8(2.6-2.9)
Caudal peduncle	4.7-5.6-7.8	6.2,6.8(6.1-7.1)
Caudal fin	3.0-3.2-3.8	3.4,3.8(3.2-3.8)
Pectoral fin	2.1-2.3-2.9	2.2,2.4(2.3-2.6)
Pelvic fin	2.1-3.6-4.0	3.7,4.7(3.0-3.7)

(pelvic fin about 2 in breedins males)

In head length

	<i>L.m.mylodon</i>	<i>L.m.borealis</i>
Eye	3.1-3.8-4.1	3.9-4.0(4.1-4.5)
Snout	3.2-3.4-4.3	3.0,3.4(3.0-3.5)
Lower jaw	2.2-2.9	2.3,2.4(2.3-2.6)
Pre-orbital depth	3.8-4.2-4.6	3.9,4.3(3.7-4.3)
Inter-orbital width	3.3-3.9-4.2	3.0,3.3(3.3-3.6)
Premaxillary pedicel	2.9,3.9	3.2,3.5(3.2-3.5)
F.L. pharyngeal bone	2.3-2.7-2.8	2.4,2.4(2.3-2.6)

In fork length of pharyngeal bone

Total pharyngeal bone length	0.9-1.0	1.0,1.0(0.9-0.0)
Pharyngeal bone width	0.9-1.0	1.0,1.0(0.9-1.0)
Pharyngeal bone depth	2.2-2.3-2.8	2.7,2.9(2.6-2.9)
Pharyngeal bone blade length	3.2-3.5-4.2	6.7,7.2(4.7-6.5)
Pharyngeal bone blade depth	2.9-3.3-3.9	

Caudal peduncle 1.2-1.6 times as long as deep in *L. m. mylodon* and 1.2,1.4 (1.2-1.3) in *L.m. borealis*. Longest ray of caudal 1.5-1.8 times length of shortest ray in *L. m. mylodon* and 1.5,1.6(1.3-1.6) in *L. m. borealis*.

FINS:

Dorsal XV-XVI, 9-10-11; anal III, 7-9 in *L. m. mylodon*, XVI 10, XVI 10 (XV-XVI, 9-10) anal III 8,9(III 8-9) in *L. m. borealis*. Dorsal with well developed lappets; longest rays extending to base of caudal or, in breeding males, almost to caudal fork. Anal not extending quite as far back as dorsal. Pectorals to between 2nd anal ray and just beyond last anal ray. Pelvics to between vent and 1st anal ray or to beyond end of anal in breeding males. Caudal forked with lobes of equal length or with dorsal lobe slightly longer.

SQUAMATION:

Scales minutely denticulate around the free border. In *L. m. mylodon* upper lateral line 22-27-28, lower 12-15-16; 32-34 in longitudinal series. 4-5 between upper lateral line and base of first dorsal, 2-3-4 across cheek. In *L. m. borealis* upper lateral line 22,24 (21-25) lower 14,15 (11-15); 33,33 (32-33) in longitudinal series, 3.4 (3-4) across cheek.

DENTITION:

In *L. m. mylodon* teeth in both jaws in 2-4-5 rows anteriorly, 58-64-110 teeth around upper jaw, 42-44-80 around lower jaw. In *L. m. borealis* teeth 2-3 rows anteriorly, with 80-95-100 around upper jaw, 45-60-80 lower. Outer teeth bicuspid or mainly unicuspid, sloping towards symphysis anteriorly. Teeth in inner rows smaller, simple, recurved. In lower jaw outer tooth row incurved posteriorly to end behind inner rows, but some specimens have a short single posterior series of 1-3 teeth.

LOWER PHARYNGEAL BONE:

It is in the shape of the pharyngeal bone that the two subspecies differ most (Fig. 11). In both subspecies the pharyngeal bone is massive and almost all the teeth stout and molariform though a patch of minute slender teeth is present at the postero-lateral extremity of the dentigerous area on each side. The bone of *L. m. mylodon* is almost triangular with very short postero-lateral arms and a short stout anterior blade. The dentigerous area is heart-shaped and the occlusal surface almost flat. In *L. m. borealis* the bone is more elongated, the sides concave when viewed from the occlusal aspect, the anterior blade extremely short, and the occlusal surface markedly dished. In both subspecies the shape of the bone appears to be independent of the size of the fish. Number of teeth along posterior border of bone 15-18-25 in *L. m. mylodon* (including minute lateral teeth), 16,23 (19-20) in *L. m. borealis*. Number of teeth along median axis of bone 7-11 in *L. m. mylodon* and 12-13, 13-15 (12-15) in *L. m. borealis*.

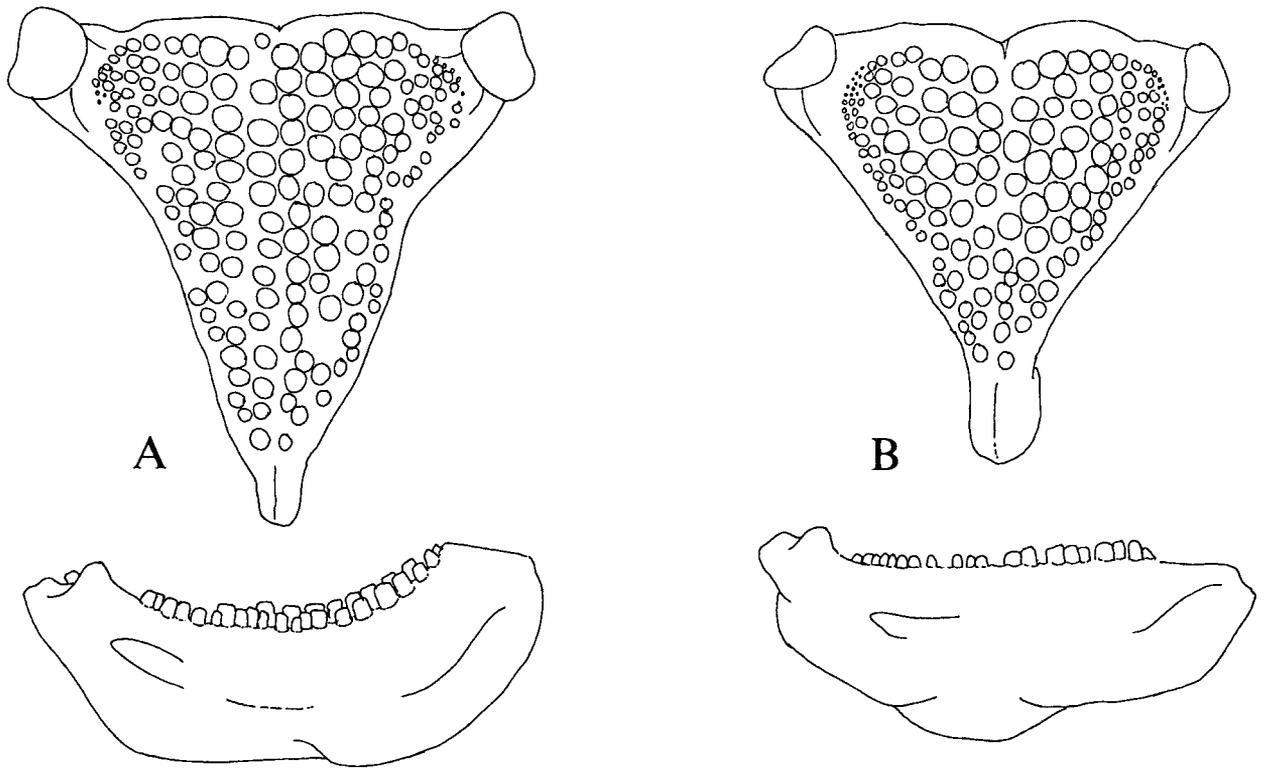


FIG. 11 Occlusal and lateral aspects of lower pharyngeal bones of (A) *L. mylodon borealis* (B) *L. mylodon mylodon*.

GILL RAKERS:

3-4-5;1;10-12-14 gill rakers on first arch in *L. m. mylodon*, 3,4;1;10,11 (3-4;1;10-12) in *L. m. borealis*. Individual gill rakers somewhat flattened with outer lobe produced and pointed.

COLOURATION

L. mylodon mylodon

Females overall appearance silvery with a golden sheen. Head olive dorsally shading to silvery laterally and white ventrally. Gular and branchiostegal regions, chest and belly white. Body silvery with olive sheen, traces of 7 darker bars below the dorsal. Dorsal dusky with faint brownish spots, more prominent in the rayed region. Lappets with dark tips. Caudal dusky with dark spots at the centre. Anal and pelvics hyaline, pectoral yellowish.

Males overall appearance golden bronze with blue head. Head dark blue-grey with brilliant blue, purple and green iridescence - darker dorsally than laterally, blue iridescence on nape. Gular region and branchiostegals pale grey to black. Body golden or bronze with or without purple blue iridescence. 7 orange-brown, dark brown or dark grey bars below dorsal. Chest and belly black. Dorsal milky anteriorly, with numerous large orange-brown spots on membranes, especially in rayed region. Gaps between the spots less than $\frac{1}{4}$ width of the spots; spots sometimes merging with one another. In some individuals a bar of blue iridescence along the base of the dorsal. Lappets pale with dark tips. Caudal dusky or yellowish with pale spots. Anal dark grey to

black with numerous large pale yellow ocelli. Pelvics dark grey to black, sometimes with pale patches. Pectorals yellowish. Colouration of specimens from Nkhota Kota and the S.E. Arm of the lake is similar.

No live specimens of the *L. m. borealis* have been available.

ECOLOGY

FEEDING:

Where identifiable, gut contents have consisted of snails belonging to the genera *Melanoides*, *Bellamya* and *Bulinus*.

DISTRIBUTION:

L. m. mylodon is widespread in the southern part of Lake MalaWi in depths of 20-35 fathoms, occasionally being found at other depths, but it is nowhere abundant. It has also been taken off Nkhota Kota at a depth of 55-60 fathoms on the outer slope of the off-shore sand spit. It is possible that the greater depth range at Nkhota Kota is related to the nature of the bottom or the greater water transparency in the area, the main area of upwelling in the lake being the south-east and south-west arms. A number of other species, have been found at Nkhota Kota at depths considerably below their normal range in the southern part of the lake, and this haul included *Lethrinops longipinnis* Eccles and Lewis, *Haplochromis anaphyrmus* Burgess and Axelrod, *Haplochromis speciosus* Trewavas and *H. trimaculatus* Iles, all but the first of these rarely extending deeper than 40 fathoms in the South East Arm.

L. m. borealis is known only from the immediate vicinity of Nkhata Bay where extensive gill-netting was carried out by Jackson and his team in the 1950's (Jackson *et al* 1963).

ETYMOLOGY

The trivial name refers to the grossly enlarged teeth of the pharyngeal apparatus.

DISCUSSION

This group of species highlights a dilemma inherent in the taxonomic study of many Lake Malaŵi cichlids. The problem is that of deciding whether the morphological differences displayed by a series of specimens can be attributed to intraspecific variability or whether they are indicative of specific distinctness. All species exhibit variability and, even within a sample taken from a single population, variation will be apparent in gill raker counts, head shape, pharyngeal form and, in all the meristic counts and measurements used for species diagnosis. The differences between specimens of the same species taken from different populations are likely to be greater and may be genetically or ecologically based. Conversely, it is known amongst the cichlids of Lake Malaŵi there are distinct species which, although extremely similar to one another morphologically, are reproductively isolated and may show dramatically different breeding livery. An example of such a group of sibling species is the endemic *Sarotherodon* flock consisting of *S. squamipinnis* (Günther), *S. saka* (Lowe), *S. lidole* (Trewavas) and *S. karongae* (Trewavas) (Bertram, Borley and Trewavas, 1942; Lowe, 1952). Recent observations suggest that a similar situation may exist amongst some species groups within the genus *Lethrinops*. For example, the breeding male of *Lethrinops longipinnis* Eccles and Lewis is a dark metallic grey with a purple-grey head (Eccles and Lewis, 1978). However, a few specimens of breeding males, indistinguishable from *L. longipinnis*, but with markedly different colouration, have been taken in deep water catches off Monkey Bay. These specimens are silvery brown rather than metallic grey and have a large orange-brown patch covering the dorsal part of the head and nuchal region. These colour forms are so different that they almost certainly represent two distinct species.

Colouration of living fish and to a lesser extent of preserved material, often shows subtle differences which are of considerable taxonomic value, but only the most gross aspects of the colour pattern of preserved specimens have hitherto been used by taxonomists. We have found, in certain cases, that it is possible to distinguish between species which are very similar morphologically on the basis of the number of vertical bars on the flanks. *Lethrinops stridei* Eccles and Lewis can be separated from *L. microdon* Eccles and Lewis, and *L. longimanus* from *L. macracanthus* with a high degree of certainty using

this character. Similarly, the distinctive live colouration of *L. macrochir* led us to reject Trewavas's synonymising of this species with *L. aurita* and to maintain its separation from *L. macracanthus*.

It should occasion no surprise that colour may be a valuable taxonomic character. It is to be expected that, in fish living in clear water and exhibiting complex colour patterns, colour vision would play an important part in the behaviour of the fish, especially in recognition of their own species.

One is thus faced with a state of affairs in which a single species may show considerable variation in a number of features while a number of species may be almost indistinguishable morphologically. The taxonomic difficulties such a situation engenders are further exacerbated by the vast size of Lake Malaŵi which increases the chances of isolation of populations and hence of interpopulation variability and also promotes the formation of clines. Whether the two subspecies of *L. mylodon* described above represent populations unlinked by morphological intermediates or merely points on a cline has not been ascertained.

In order to reduce the degree of taxonomic error likely to result from the study of such complex communities we have tried, when redescribing poorly described species, to obtain specimens from the exact type localities. This has usually been possible when dealing with the types collected by Christy during his 1925-26 collecting trips, but not with the types collected by Johnson, Rhoades or Wood, which were merely labelled 'Lake Nyasa'.

While the Lake Malaŵi Trawling Survey included 68 stations in the southern part of the lake (Tarbit, 1972), most of these were between 10 and 70 fathoms, only one station 'Sungu East' (13°27'S, 14°35'E) being at a depth of less than 10 fathoms. Although some additional hauls have been made in shallow waters, collecting from the 3 to 10 fathoms depth range has been limited and species characteristic of these shallow waters are underrepresented in our collections. These, however, together with inshore species which are readily taken by seine nets, are those which would have been most readily available to earlier collectors. Since the Lake Malaŵi Trawling Survey has demonstrated that most species of cichlids in Lake Malaŵi have restricted vertical distributions it is quite probable that some of the species described by earlier workers are valid, although we have seen no further material of them and have been unable to determine their area of distribution or range of variation.

Turner (1977 a, b) has shown that the introduction of demersal trawling in Lake Malaŵi has had marked effects on the size range and the species composition of the stocks in the south east arm of the lake. Amongst the species which have declined in abundance are *L. stridei* and *L. macracanthus*. In the case of the former, earlier records did not differentiate between *L. stridei* and *L. microdon*, the latter being common in deeper water north of Boadzulu Island

while *L. stridei* is found in shallower water to the south of the island where its abundance has declined dramatically. The morphological differences between *L. longimanus* and *L. macracanthus* in the south east arm, where they have been examined most intensively and where they co-exist, are of similar magnitude to those between *L. stridei* and *L. microdon*.

There are instances where species have been described by earlier workers, but we have been able to obtain further material. Such a case is *Lethrinops lunaris* Trewavas, described from six specimens, only one of which was recognised by Eccles and Lewis (1978) as distinct from *L. leptodon*. In other instances small, but consistent morphological differences are found between sympatric populations which, if they

were allopatric, might be regarded as con-specific. In such cases we recognise the species concerned as distinct, despite their similarities, since they may be affected differently by future development of the fisheries, as in the case of *L. microdon* and *L. stridei*.

When describing new species (or subspecies) we have included only those specimens which show an even gradation of diagnostic characters. By doing so we may have understated the actual morphological range exhibited by that species, but at the same time, we are less likely to have produced polyspecific type series. The problems of sibling species can usually only be surmounted by recourse to lengthy ethological studies which we have had neither time nor facilities to pursue and the possibility that some of our type series may include sibling species must be borne in mind.

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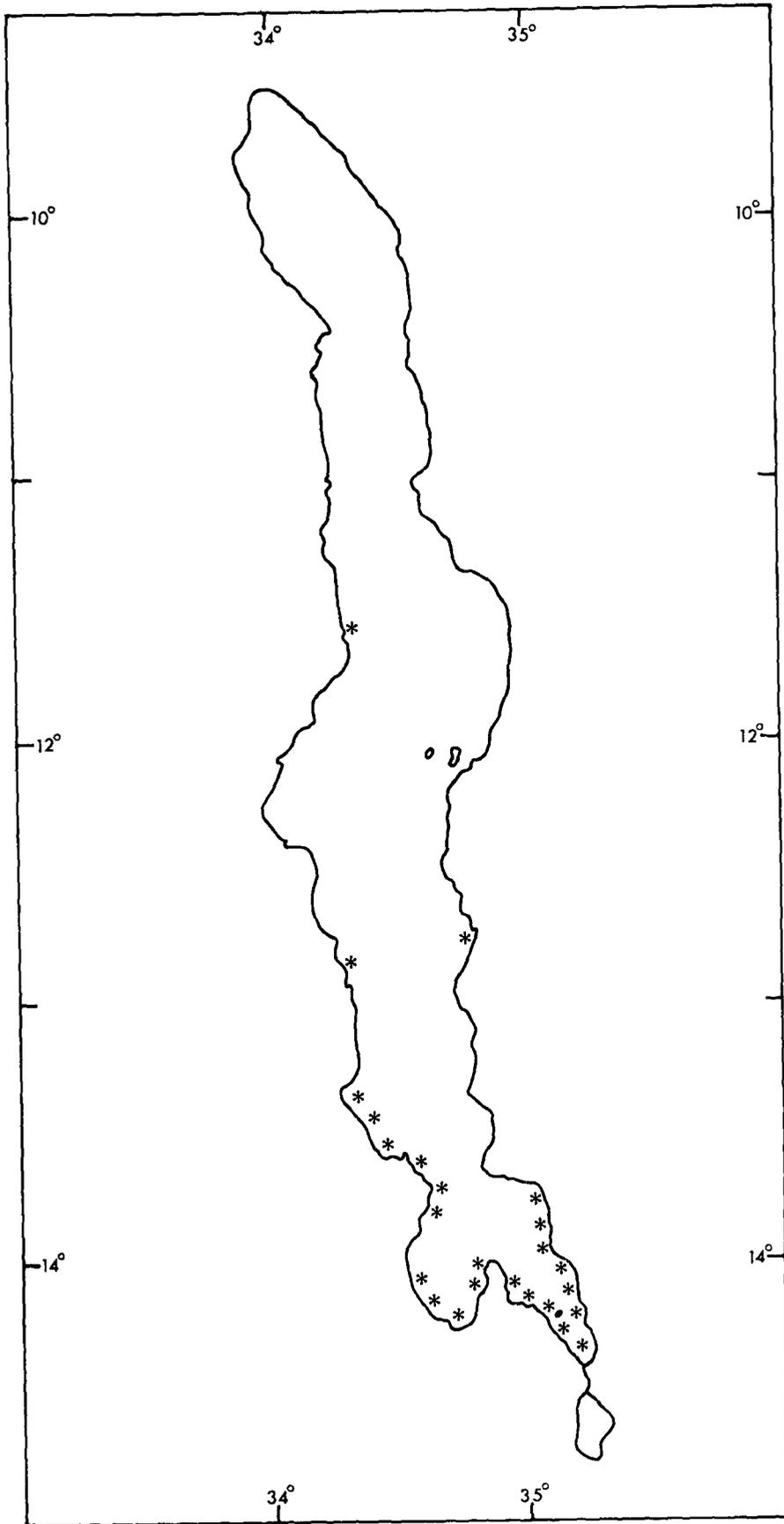


FIG. 12 Distribution of *Lethrinops parvidens* in Lake Malawi.
 ★ Sites where *L. parvidens* has been recorded by FRU.

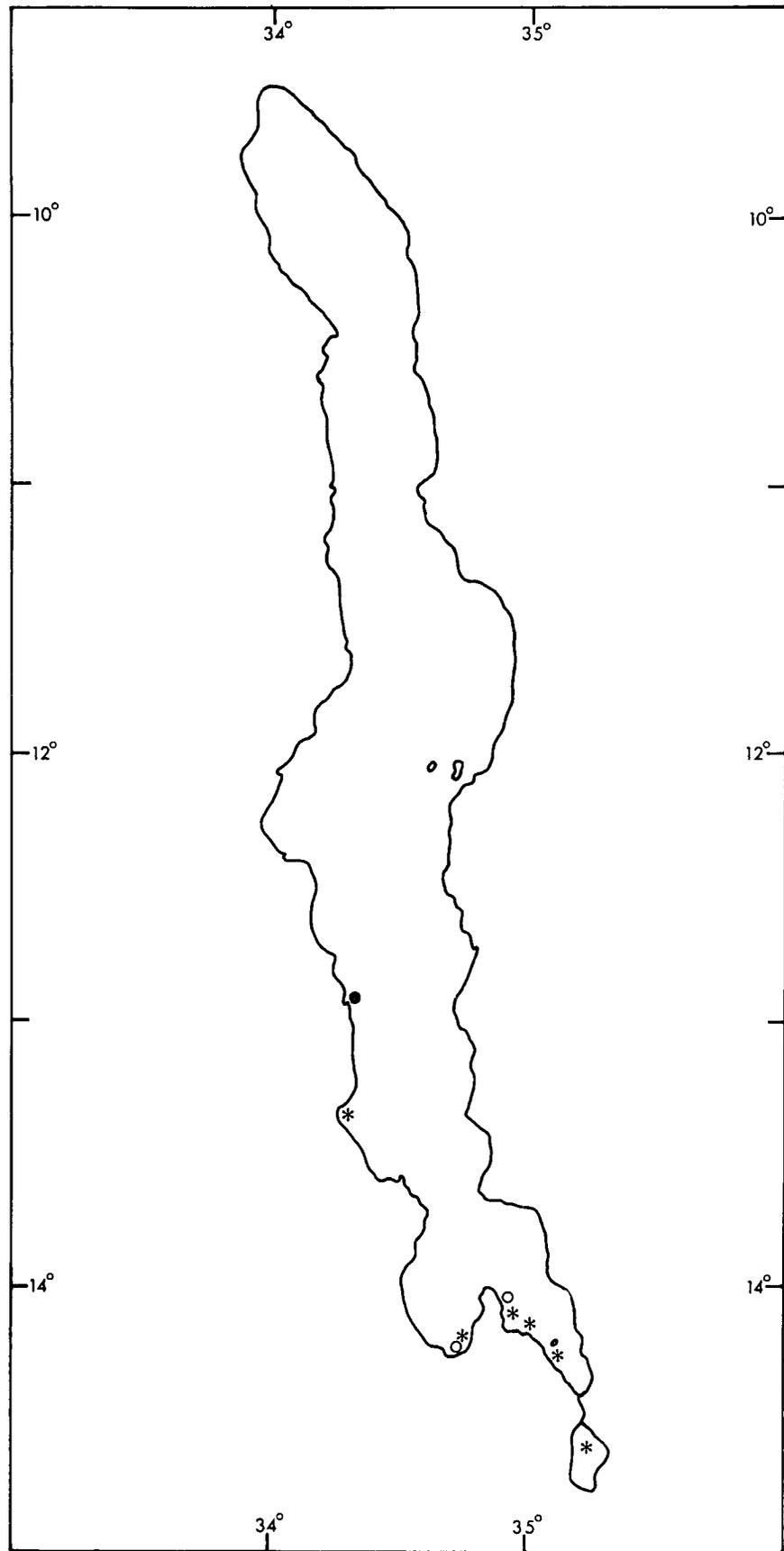


FIG. 13 Distribution of *Lethrinops macrophthalmus*, *L. aurita* and *L. macrochir* in Lake Malawi.

- Sites where *L. macrophthalmus* has been recorded by FRU.
- Sites where *L. aurita* has been recorded by FRU.
- ★ Sites where *L. macrochir* has been recorded by FRU.

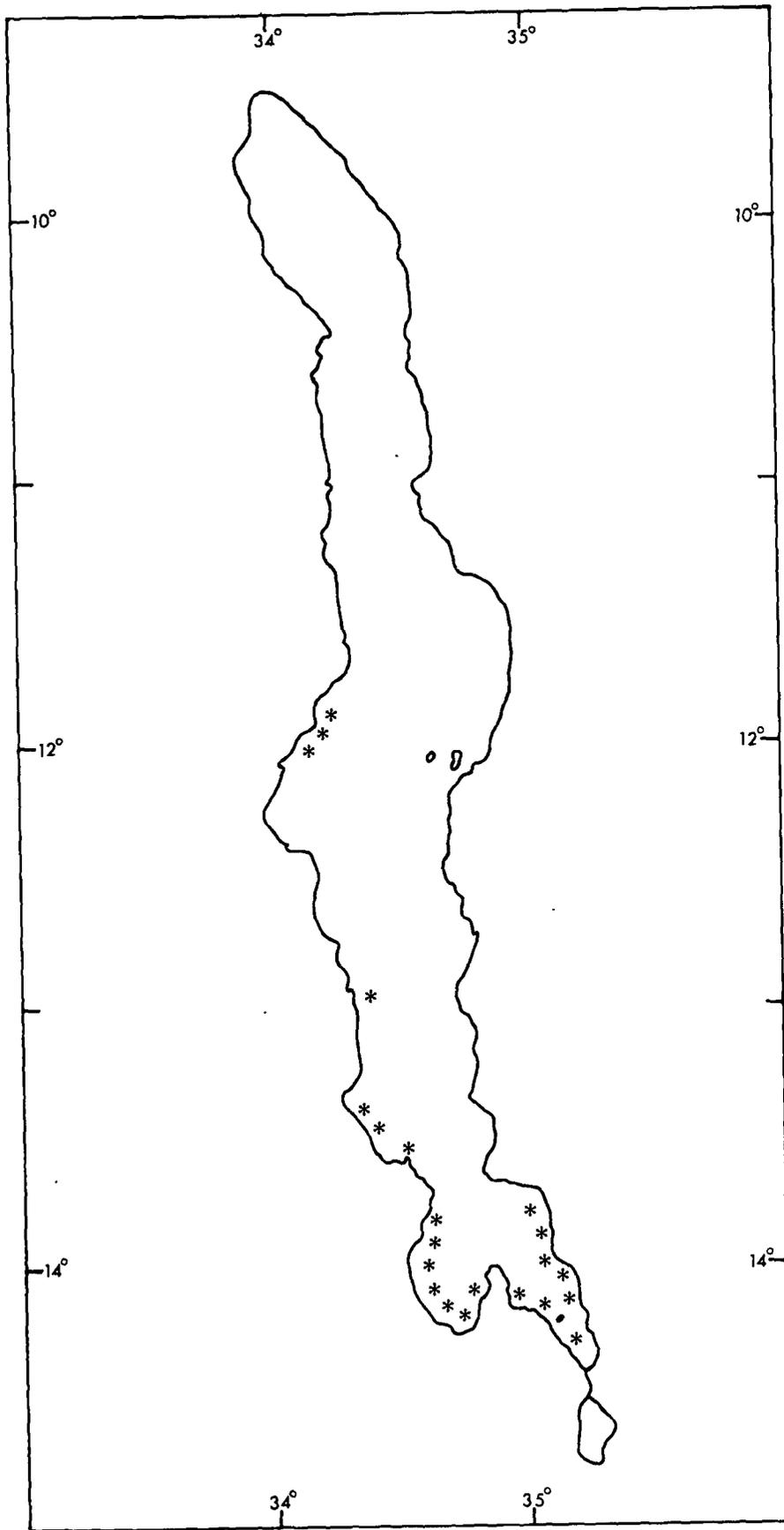


FIG. 14 Distribution of *Lethrinops longimanus* in Lake Malawi.
 ★ Sites where *L. longimanus* has been recorded by FRU.

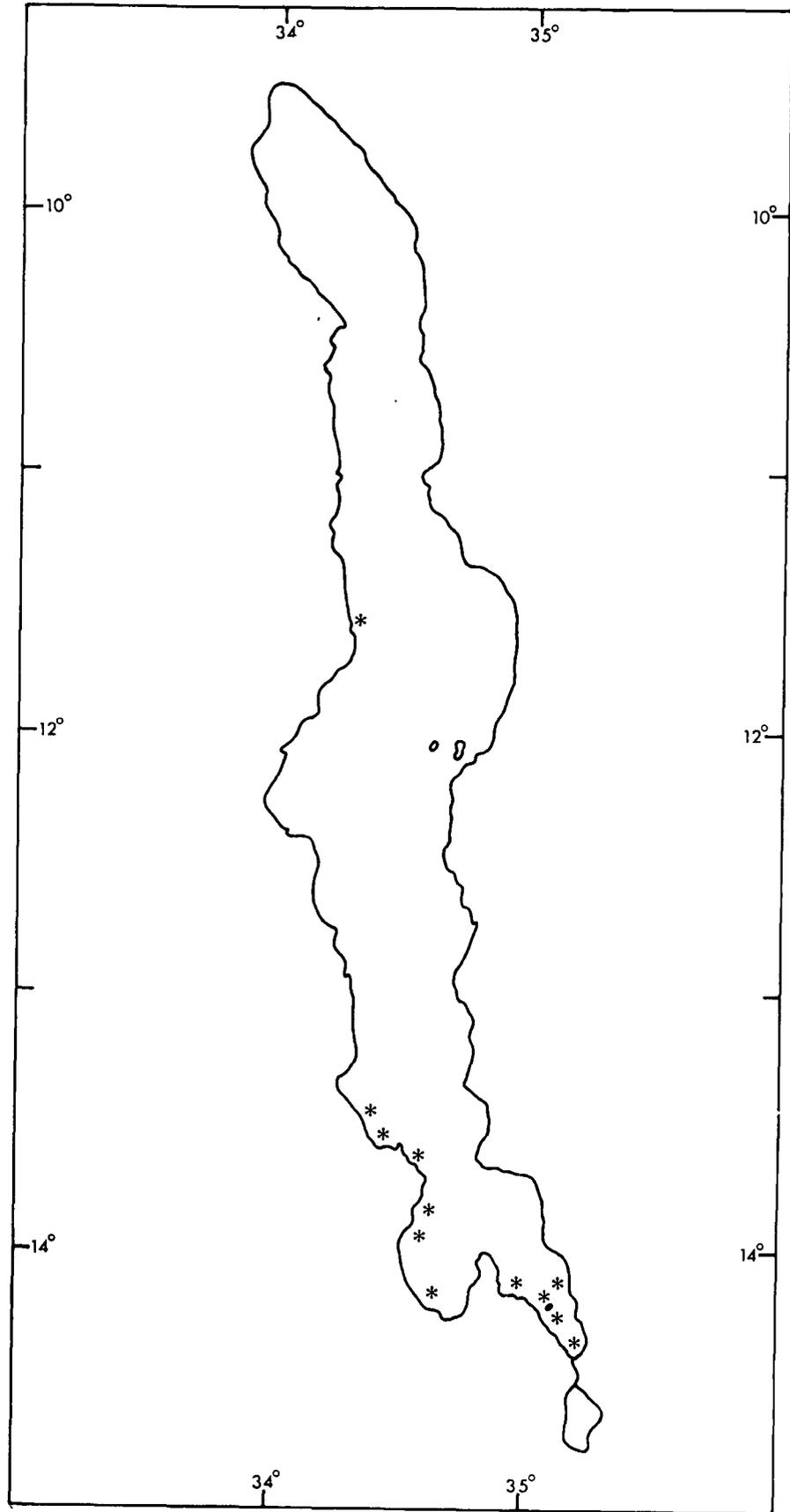


FIG. 15 Distribution of *Lethrinops macracanthus* in Lake Malaŵi.
★ Sites where *L. macracanthus* has been recorded by FRU.

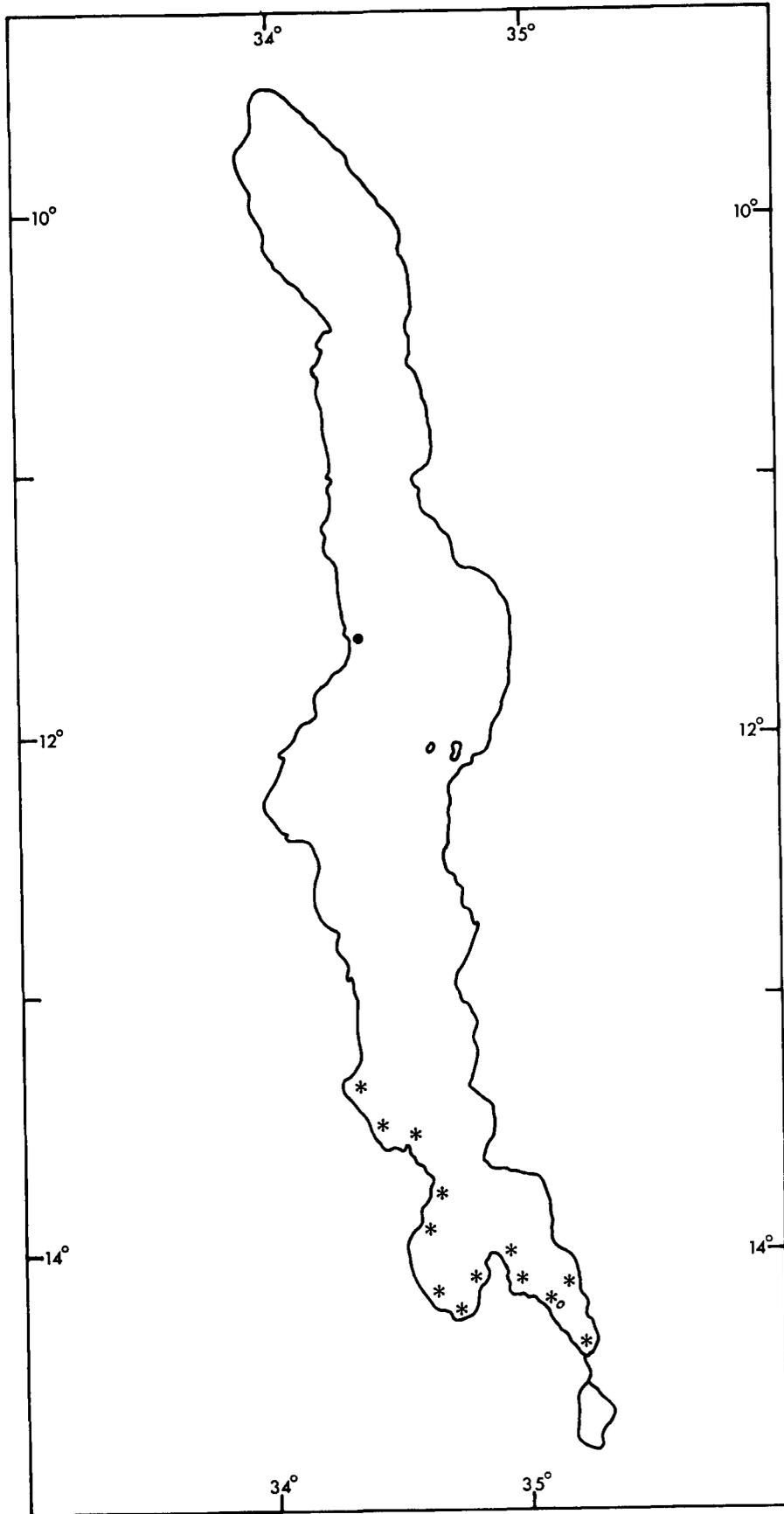


FIG. 16 Distribution of *Lethrinops mylodon mylodon* and *Lethrinops mylodon borealis* in Lake Malawi.

- ★ Sites where *L. mylodon mylodon* has been recorded by FRU.
- Sites where *L. mylodon borealis* has been recorded by FRU.