A new species of deepwater *Lethrinops* (Cichlidae) from Lake Malawi.

George F. Turner

School of Natural Sciences, Bangor University, Bangor, Gwynedd LL57 2UW, UK
& Vertebrates Division, Natural History Museum, Cromwell Road, London SW7, U.K.
email bss608@bangor.ac.uk, Orcid: 0000-0003-0099-7261

Abstract

A new species of cichlid fish, *Lethrinops atrilabris* is described from specimens collected by trawling at a depth of around 90m off Monkey Bay, southern Lake Malawi. It is assigned to the genus *Lethrinops* on the basis of its vertical flank barring, lack of enlarged cephalic lateral line canal pores and the form of the lower jaw dental arcade. It can be distinguished from congeneric species by its male breeding dress of contrasting flank barring and dark ventral surface, most strikingly on the lips, throat and chest, its relatively small maximum size (<75mm SL), large eyes (38-41% head length), laterally compressed body (depth 2.5-2.7 times max head width) and lower gillraker count (13-14).

Keywords: New species, Lake Malawi, cichlidae, *Lethrinops*

1. INTRODUCTION

Lake Malawi hosts an enormous number of endemic cichlid fishes, in one recent guide, estimated to be over 800 species (Konings, 2016). Although this extraordinary adaptive radiation is of great interest to evolutionary biologists, conservationists, fishing communities and aquarium fish enthusiasts, the rate of species description is slow and many species – even some well-known ones - remain undescribed, rendering them ineligible to receive IUCN redlisting, or incorporation into standard reference systems such as FishBase, GBIF etc. The aim of the present study is to formally describe a deepwater species conforming to the current definition of the genus *Lethrinops* Regan 1922, known informally as *Lethrinops* 'black chin' (Turner, 1996).

2. MATERIALS AND METHODS

Specimens were obtained from a research trawl survey carried out by the Monkey Bay Fisheries Research Station (now known as the Fisheries Research Unit, FRU) of the Malawi Government, using the trawler Ethelwynn Trewavas, in 1992, intended to estimate standing stocks of food fishes. The majority of the catch was sold for human consumption, but on this occasion, a few specimens were preserved for research. These were already dead when selected and were pinned and photographed before being preserved in formalin, later being washed and transferred to 70% ethanol for long-term preservation. Counts and measurements were carried out following the methods of Snoeks (2004).

3. RESULTS

***Lethrinops atrilabris* sp. nov.**

Holotype: BMNH 2022.4.20.1, male, 72mm SL, collected from trawl catch NE of Monkey Bay, at a reported depth of 84-94m, 13th April 1992.

Paratypes: BMNH 2022.4.20.2-7, six males 66.2-72.9mm SL, collected with holotype.

Etymology: 'atri-' from plural of the adjective 'ater' (Latin) = black + 'labris' from plural of labrum (Latin)= lip.

Diagnosis: the posterior end of inner and outer tooth rows in the lower jaw dental arcade terminate more or less together with the outer row arcade bending inwardly (*Lethrinops*-type: Trewavas 1931, Turner 1996, Ngatunga & Snoeks 2004), among Malawian haplochromines, a character state once diagnostic for the genus *Lethrinops*, now split into the genera *Lethrinops*, *Taeniolethrinops* and *Tramitichromis* (Eccles & Trewavas 1989), although the state is also reported from the species *Ctenochromis pictus* (Trewavas 1935). Mature males show a melanic pattern of strongly contrasting vertical flank bars, not exhibited by any known species of *Ctenochromis*, *Taeniolethrinops* or *Tramitichromis*. Among the described *Lethrinops* species, males of the shallow-water group (sensu Ngatunga & Snoeks 2004) do not show such strong vertical flank barring and tend to be less deep-bodied and laterally compressed and confined to shallower water (generally <50m, compared to 84-94m for *L. atrilabris*). This group comprises *Lethrinops albus* Regan 1922, *Lethrinops auritus* (Regan 1922), *Lethrinops furcifer* Trewavas 1931, *Lethrinops lethrinus* (Günther 1893), *Lethrinops leptodon* Regan 1922, *Lethrinops lunaris* Trewavas 1931, *Lethrinops macrochir* (Regan 1922), *Lethrinops macrophthalmus* (Boulenger 1908), *Lethrinops marginatus* Ahl 1927, *Lethrinops microstoma* Trewavas 1931, *Lethrinops parvidens* Trewavas 1931, *Lethrinops turneri* Ngatunga & Snoeks 2003 and a number of undescribed species. Among the remaining, 'deep-water' *Lethrinops* species are 10 described species. *Lethrinops atrilabris* has a greater number of lower gillrakers (13-14) than *Lethrinops christyi* Trewavas 1931 (8-9), *Lethrinops longipinnis* Eccles & Lewis 1978 (9-10) and *Lethrinops altus* Trewavas 1931 (10-11). These three species can further be distinguished by their head and jaw shape: *L. christyi* has small pointed jaws and concave upper profile of snout v rounded head profile in *L. atrilabris; L. longipinnis* has a longer snout; *L. altus* has hooked maxillae, showing a markedly curved lower profile. *Lethrinops atrilabris* has fewer lower gillrakers (13-14) than *Lethrinops micrentodon* (Regan 1922) (15-19), *Lethrinops gossei* Burgess & Axelrod 1973 (18-19), *Lethrinops stridei* Eccles & Lewis 1977 (19-23), *Lethrinops macracanthus* Trewavas 1931 (21-24) and *Lethrinops microdon* Eccles & Lewis 1977 (24-29). *Lethrinops mylodon* Eccles & Lewis 1979 generally has fewer lower gillrakers (10-14 v 13-14 in *L. atrilabris*) and also differs in having a very heavily-built lower pharyngeal bone with stout molariform teeth (v lightly-built, with small slender teeth in *L. atrilabris*) and in attaining a much larger size (>200mm SL v <80 mm SL in *L. atrilabris*). *Lethrinops longimanus* Trewavas 1931 generally has a higher count of lower gillrakers:15-19 according to Eccles & Lewis 1979, although Eccles & Trewavas (1989) give 14 as the lower limit, v 13-14 in *L. atrilabris*. *Lethrinops longimanus* can also be distinguished by its larger maximum size (150mm SL v <8cm SL) and male breeding dress of a bronze colour, weakly barred v the strongly barred black and silver of *L. atrilabris*.

The dental arcade trait can be difficult to see without a powerful microscope and appropriate lighting, so this trait is of little use to fieldworkers. Other deep-bodied, deep-water species with similar barred patterns are presently classed in the genera *Alticorpus*, *Aulonocara* and

Placidochromis. Members of the first two genera are distinguished by having very large cephalic lateral line pores, particularly on the underside of the head, but distinguishing *Placidochromis* species can be more problematic, as these lack this diagnostic trait. A number of deep-water species were described by Hanssens in 2004, several superficially resembling *L. atrilabris*. From these, *L. atrilabris* can be distinguished by its lower-arch gillraker counts, which are lower than those of *Placidochromis chilolae* Hanssens 2004 (14-16), *Placidochromis lukomae* Hanssens 2004 (14-18), *Placidochromis nigribarbis* Hanssens 2004 (16-18), *Placidochromis obscurus* Hanssens 2004 (18-21) and higher than *Placidochromis domirae* Hanssens 2004 (8-9), *Placidochromis koningsi* Hanssens 2004 (10), *Placidochromis msakae* Hanssens 2004 (12), *Placidochromis pallidus* Hanssens 2004 (11-12), *Placidochromis rotundifrons* Hanssens 2004 (11) and *Placidochromis turneri* Hanssens 2004 (9-10). Other species in the genus can be differentiated quite readily on physical appearance, such as having a shallower body, smaller eyes, a longer, more pointed snout, larger jaws or a mouth in a more terminal position or more upwardly-angled (see illustrations in Hanssens 2004 or Konings 2016).

Description

Body measurements and counts are presented in table 1. *Lethrinops atrilabris* is a small (<80mm SL) laterally-compressed (maximum body depth 2.6-2.7 times maximum width) cichlid fish with a short, rounded snout (27-30% HL), a small mouth low down on the head and very large eyes (40-41% HL). To date, only mature males have been identified and these have conspicuously barred flanks and a black underside to the head and chest (Figure 1).

The size range of the seven specimens is 66-73mm SL. As all specimens collected showed clear evidence of male breeding dress, it can be assumed that all are adult males, probably collected on a breeding ground. In haplochromine cichlids, the largest males are typically larger than the largest females, and there is not usually a great deal of variation in the size of adult males on breeding grounds. As the specimens were collected from an unselective trawl catch along with many much larger individuals of other species, it seems likely that the maximum adult size of this species is less than 80mm SL, at least in the SE Arm of the lake.

All specimens are relatively deep-bodied and laterally compressed, with the deepest part of the body generally well behind the first dorsal fin spine. The anterior upper lateral profile is convex and gently curving, without a sharp inflection in the curve above the eye. The lower anterior lateral profile is also gently curving, so that the tip of the snout lies well above the insertion of the pelvic fins. The mouth is relatively small, low on the head, and although slightly upwardly-angled, the snout is well below the horizontal plane from the bottom of the eye. The eye is extremely large and circular and generally appears to be more or less touching the anterior upper lateral head profile. The lachrymal is much wider than deep and has 5 openings.

The flank scales are weakly ctenoid, with the cteni becoming reduced dorsally, particularly anteriorly above the upper lateral line, where they transition into a cycloid state. The scales on the chest are relatively large and there is a gradual transition in size from the larger flank scales, as is typical in non-mbuna Malawian endemic haplochromines (Eccles & Trewavas 1989). A few small scales are scattered on the proximal part of the caudal fin.

The cephalic lateral line pores are inconspicuous and the flank lateral line shows the usual cichlid pattern of separate upper and lower portions.

The pectoral fin is very long when intact, extending well past the first anal spine. The pelvic fins extend past the vent in all specimens and past the first anal spine in some: this may be a sexually dimorphic trait, with female haplochromines often having shorter pelvic fins. The tips of the dorsal and anal fins are also prolonged, extending well past the plane through the base of the caudal fin in some specimens- again probably a sexually dimorphic trait, exaggerated in males. The tailfin is crescentic.

Lower jaw is relatively small, with thin mandibular bones, but is not flattened as it is in some *Placidochromis*, such as *P. hennydaviesae*. The jaw teeth are small, short and erect. The outer series in both the upper and lower jaw are largely unequally bicuspid, becoming more equally bicuspid posteriorly, notably in the upper jaw. These is a single inner series of very small tricuspid teeth.

The lower pharyngeal bone is small, lightly-built, Y-shaped, and carries small, short, laterally compressed slightly hooked, blunt, simple teeth. The middle-lying 5-6 teeth on each side of the posterior row are slightly larger than the others, but there is no molarization. There are about 12 teeth in the midline row and about 20 on each side on the posterior row. The gill rakers are simple, erect, fairly long and well-spaced, with few, if any, reduced to small stubs near anterior part of the arch.

Colouration of the females and immatures is unknown, but from experience of other species from this habitat, can be expected to be countershaded, sandy-coloured dorsally, with silvery flanks and probably faint vertical flank bars. All known specimens appear to be males in breeding dress. Colour notes are based on a photograph of a freshly collected type specimen and an additional specimen collected in 2016, but not yet located in the collection at Cambridge University (Figure 2). They show strong dark brownish vertical flank bars on a silvery-white background: 6 bars under the dorsal fin, 2 more on the caudal peduncle and 1-2 on the nape. The head is dark brown on the upper surface, but paler laterally, sometimes with a dark lachrymal mark running from the eye toward the mouth. The eye is golden brown, darker along the axis of the lachrymal stripe. The lips, lower jaw, throat and chest are black. The dorsal fin is a dark golden-brown, with a series of irregular white spots or oblique stripes angled forwards from the base, with a broad black margin and broader white submarginal band. The pectoral fins are translucent, but brownish-tinted. The pelvic fins are black, fading to dark grey on the posterior rays. The anal fin is black, fading to dark grey basally and marked with irregular yellowish spots and stripes. The caudal fin has dark grey to black upper and lower margins, but is otherwise dark golden-brown with three thin irregular vertical white bands.

163 TABLE 1. Morphometric and meristic characters of *Lethrinops atrilabris*.

	Holotype	Paratypes (n=6) mean & range
Standard Length	72.0	69.2 (66.2-72.9)
As % SL		
Maximum Body Depth	38.6	39.2 (38.1-39.8)
Head Length	32.9	32.9 (32.1-33.6)
Dorsal Fin Base Length	57.2	57.0 (53.7-58.8)
Anal Fin Base Length	18.8	17.4 (16.7-18.4)
Predorsal Length	39.6	37.5 (36.6-38.1)
Preanal Length	64.4	66.5 (65.4-69.2)
Prepectoral Length	32.8	33.9 (32.3-34.8)
Prepelvic Length	39.9	39.8 (38.1-41.5)
Caudal Peduncle Length	16.7	16.2 (15.6-16.9)
Caudal Peduncle Depth	12.1	11.9 (11.6-12.2)
As % Head Length		
Head Width	44.7	46.1 (45.0-47.5)
Interorbital Width	22.8	23.9 (22.1-27.4)
Snout Length	32.1	29.1 (26.7-30.4)
Lower Jaw Length	39.2	39.0 (37.2-41.1)
Premaxillary Pedicel Length	27.0	25.3 (24.2-26.1)
Cheek Depth	16.9	17.3 (16.6-18.2)
Eye Diameter	40.9	39.8 (38.3-40.8)
Lachrymal Depth	21.1	21.1 (20.4-22.9)
Ratios		
Body Depth/Head Width	2.62	2.58 (2.51-2.67)
Caudal Peduncle Length/Depth	1.38	1.36 (1.30-1.43)

Counts	**Holotype**	**Paratypes range**
Upper Gillrakers	5	4-5
Lower Gillrakers	14	13-14
Dorsal Fin	XVI, 9	XV-XVI, 9-10
Anal Fin	III, 7	III, 7-9
Longitudinal Line Scales	32	31-34
Cheek Scales	2	2

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166 4. DISCUSSION

167 The cichlid genus *Lethrinops* is endemic to Lake Malawi and its catchment and the
168 outflowing Shire River, its expansion in Lake Malombe and continuation to the
169 biogeographic barrier represented by the falls on the middle Shire, notably the Kapichira
170 rapids, below which the fish fauna is essentially lower Zambezian (Tweddle & Willoughby
171 1979). Originally defined by Regan (1922) based on its dentition- principally in having small,

weak teeth in narrow bands- it originally included just 4 species, including the type *L. lethrinus*. Trewavas (1931) revised the genus, her definition emphasising the semicircular shape of the lower jaw dental arcade, and increasing the number of included species to 23. The revision by Eccles & Trewavas (1989) split the genus into three. Five small, short-snouted species were moved into *Tramitichromis*, characterised by the shape of the lower pharyngeal bone, in which the upper margin of the blade is turned sharply downwards and the anterior end of the dental arcade is broad and rounded. In addition, four large, long-snouted species were grouped into *Taeniolethrinops*, characterised by having an oblique dark stripe on the flanks of female and immature fishes. Thus, *Lethrinops* was left without any defining synapomorphy: characterised by its dental arcade- shared with *Tramitichromis* and *Taeniolethrinops*- but lacking the diagnostic traits of the latter two genera.

Early molecular studies using mitochrondrial DNA restriction fragment analyses placed the deep-water *Lethrinops gossei* in a surprising grouping with the mbuna species, along with a number of *Aulonocara* species, and not with the major 'Haplochromis' group from sandy or muddy habitats (Moran et al. 1994). However, later studies placed a number of shallow water-*Lethrinops* and a *Taeniolethrinops* species in the 'sand-dweller' group, suggesting the genus to be polyphyletic (Joyce et al. 2011, Genner & Turner 2012). In addition, the deep water species were shown to affinity with *Alticorpus* and some deep-water *Placidochromis* species. Early nuclear gene analyses presented rather inconsistent pictures, but whole genome sequencing (Malinsky et al. 2018) has continued to support the distinctness of the deep-water and shallow water *Lethrinops* species, and the affinity of the former to *Aulonocara* and *Alticorpus* (deep-water *Placidochromis* were not investigated).

On the basis of the emerging mitochondrial data, Ngatunga and Snoeks (2004) informally split the genus into deep-water and shallow-water groups, with the type species, *Lethrinops lethrinus* clearly a member of the latter, suggesting that the deep-water species will be in need of a new generic classification. However, this has yet to be attempted and at present the distinction is unclear. Generally, the deep-water species mostly occur at depths of 50m or more and seem to be relatively deep-bodied and laterally compressed. Males in breeding dress tend to express strong vertical barring on their flanks, as do species of *Alticorpus*, *Aulonocara* and *Placidochromis* from the same habitat, while shallow water *Lethrinops* males are usually unbarred or weakly-barred with a range of bright colours including red, orange, yellow, blue and green: see illustrations in Konings (2016), for example. A few species, such as *L. altus*, *L. christyi*, *L. longimanus*, *L. longipinnis* and *L. micrentodon* are more problematic, with forms exhibiting a mix of traits, and often being found at depths of 20-60m. However, *Lethrinops atrilabris* is unambiguously a member of the deep-water group, with its strongly barred males and relatively deep, laterally compressed body. The species shows superficial similarities to a number of species of the genus *Placidochromis*, which also includes a number of deep-water, vertically-barred species. From these, it can be distinguished by the shape of the lower jaw dental arcade (Hanssens 2004). However, it is not clear whether this trait really has much phylogenetic significance: this will probably require extensive whole genome sequencing and phylogenetic analysis.

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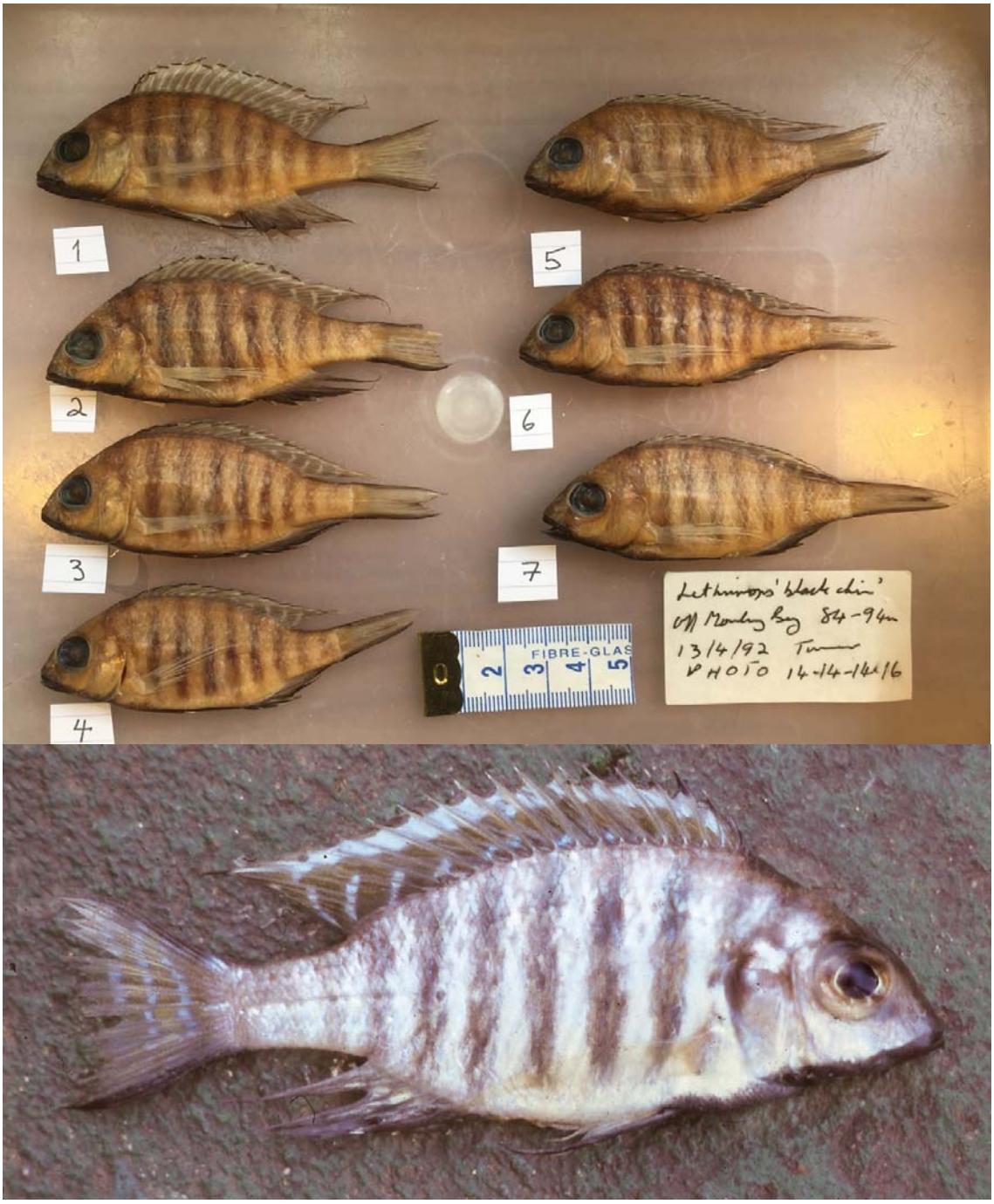

Figure 1: *Lethrinops atrilabris* sp. nov. Above: preserved type series, with holotype labelled #1: BMNH 2022.4.20.1, male, 72mm SL, collected from trawl catch NE of Monkey Bay, at a reported depth of 84-94m, 13th April 1992; paratypes labelled 2-7: BMNH 2022.4.20.2-7, six males 66.2-72.9mm SL, collected with holotype. Below: one of the type specimens (probably the holotype) photographed shortly after capture.