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Review of the Lake Malaŵi genus *Melanochromis* (Teleostei: Cichlidae) with a description of a new species

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Abstract

The Lake Malaŵi genus *Melanochromis* included five species at its inception and was originally distinguished from *Pseudotropheus* on the basis of morphology, including the arrangement of teeth on the lower pharyngeal bone. The diagnosis has been extended twice, first to include all elongate mbuna that possess horizontal stripes and U-shaped tooth bands and later to exclude mbuna that do not exhibit a sex-related reversal in their colour pattern. Recently, the diagnosis of the genus was refined on the basis of the melanin pattern. The genus now includes only species with a basic melanin pattern, which consists of two black horizontal lateral stripes on a light background. Most adult members of the genus, thus defined, have a sex-related reversal of pigmentation pattern. Here we describe *Melanochromis mpoto* n. sp. from the northwestern part of Lake Malawi, synonymize *M. parallelus* Burgess & Axelrod 1976 with *M. loriae* Johnson 1975, redescribe *M. chipokae* Johnson 1975 and *M. robustus* Johnson 1985, and reclassify and designate a lectotype for *M. brevis* Trewavas, 1935.

Key words: Cichlid, mbuna, melanin pattern

Introduction

The small, rock-dwelling haplochromine cichlid fishes in Lake Malaŵi, Africa, are commonly referred to as mbuna. The genus *Melanochromis* Trewavas 1935—one of thirteen genera currently recognized within the mbuna—was recently redefined by Tawil (2002) and Konings-Dudin *et al.* (2009). The diagnosis is based mainly on the basic melanin pattern, which consists of two black horizontal lateral stripes on a light background; the mid-lateral stripe, which is always solid in appearance, straddles the lower branch of the lateral-line system, and the dorso-lateral stripe, which can be fragmented, lies between the dorsal-fin base and the mid-lateral stripe. The solid, mid-lateral stripe is often wider, approximately 2–3 scales, than the dorso-lateral one which is 1–2 scales wide. The second diagnostic character refers to the reversal in colour pattern in breeding males: in many species there is a redistribution of the melanic areas (reversal) in dominant individuals (males and, perhaps, old females) (Tawil 2002). In nine species, including the type species *M. melanopterus*, the basic pattern, always visible in juveniles and females, becomes reversed in adult males, i.e. the entire body of the breeding male first becomes (very) dark—blue, brown, or black—and, secondly, in the former position of the two black stripes there are then two light-coloured solid stripes—white, yellow, or blue. This sex-related reversed pigmentation pattern is unique among Malaŵi cichlids. In four species, *M. lepidiadaptes*, *M. wochepa*, *M. kaskazini*, and the new species, *M. mpoto*, this reversal is incomplete. The basic melanin pattern is present in females and juveniles, but in male breeding colouration, which is entirely sky-blue for all four species, the background colour becomes darker (sky-blue), and the black stripes disappear, although these are not converted to a lighter, contrasting colour.

The genus *Melanochromis* consists of both predatory and herbivorous species. The predatory group of species is characterized by slender bodies, long snouts, and long lower jaws, while the herbivorous group exhibits stockier bodies, shorter snouts, and shorter lower jaws. Some species, e.g. *Melanochromis loriae*, share characteristics of both groups.

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Melanochromis brevis is one of the five species originally described by Trewavas (1935). There are two syntypes of *M. brevis*, one of which was collected at Monkey Bay and the other, an immature specimen, at Nkhudzi. Trewavas (1935) did not give a colour description of the types, but on the basis of an assumed colour pattern Johnson (1975) proposed transferring *M. brevis* to *Pseudotropheus*. A few years later and without any reason declared, Johnson (1978) reconsidered his proposition and returned *M. brevis* to *Melanochromis*. In 1979, Loiselle, who had seen the types, suggested placing *M. brevis* in *Pseudotropheus* again based on its colour pattern. However, Ribbink *et al*. (1983) disagreed with Loiselle's suggestion and transferred it back to *Melanochromis*. The latter publication is the first that discussed *M. brevis* (referred to as *M*. cf. *brevis*) from wild populations, but we suspect they included several different species under this name. According to them, *M*. cf. *brevis* occurs at the islands of Chinyankwazi, Chinyamwezi, Mumbo, and Boadzulu and at Monkey Bay and Nkhudzi (Ribbink *et al*. 1983). Their drawing of a specimen from Chinyankwazi Island and a colour description of the Monkey Bay population closely match those of *Melanochromis robustus* Johnson 1985, which is redescribed herein.

In 1975 Johnson described *Melanochromis loriae* and *M. chipokae*; after we examined the holotypes of these species we realized that he had interchanged the colour photographs that accompanied the descriptions, which explains why some subsequent authors confused the two species (e.g., Mayland 1982; Schraml 1998). Johnson also interchanged the female specimens, described as "allotypes" but correctly maintained as paratypes at USNM. Johnson's (1975) description (colour and meristics) of his female allotype of *M. chipokae* matches that of *M. loriae*, while the description and morphology of his female allotype of *M. loriae* matches that of *M. chipokae*. Johnson (1975) admitted that both species appeared similar but alluded to the fact that they can be distinguished by colouration. This validated his description even though the distinction was based on the colouration of the females, which he had interchanged. Johnson's publication went unnoticed by Burgess & Axelrod (1976), who described *Melanochromis parallelus* without comparing their new species with those of Johnson (1975). After a morphological comparison, we determined that *M. parallelus* is conspecific with *M. loriae*, and thus *M. parallelus* is a junior synonym of *M. loriae*. An expanded description is given herein for the latter species as well as for *M. chipokae*.

Ribbink *et al*. (1983) reported an undescribed species, which they referred to as *Melanochromis* 'blue', occurring on the northwestern coast of Lake Malawi. This species belongs to the predatory group of *Melanochromis* and is here described as *Melanochromis mpoto* n. sp. and compared to other predatory members.

A species originally included in *Melanochromis*, as *M. labrosus* Trewavas 1935, was recently re-evaluated and placed in a genus of its own, *Abactochromis* (Oliver & Arnegard 2010).

Materials and methods

Fishes were collected by the authors in Lake Malaŵi (Fig. 1) by chasing them into a monofilament net while SCUBA diving. Fishes were anesthetized with clove oil, preserved in 10% formalin, and placed in 70% ethanol for permanent storage. All counts and measurements were made on the left side of the fish, with the exception of gill-raker counts. Counts and measurement followed Barel *et al*. (1977) and Stauffer (1991; 1994) with the following exceptions. Head depth was measured from the hyoid symphysis to the top of the (non-expanded) head at a 90° angle to the horizontal body axis (horizontal line drawn through the lower part of lateral line). Body depth was measured from the origin of the fifth dorsal spine to the origin of the pelvic fins. The pre-orbital depth was measured as the length of the intersection of the lachrymal bone with a line continuing the radius of the orbit and parallel to the snout profile, bisecting the lachrymal bone (Eccles & Trewavas 1989). Institutional abbreviations follow Leviton *et al*. (1985).

Pigmentation patterns were recorded in the field, in territorial and non-territorial males, females, and juveniles. The different patterns are variable in all species examined; in our descriptions such variation is recorded by placing a slash between the two colours between which the specific pattern varies, e.g., blue/white is used to designate that the colour ranges from blue to white and includes intermediate shades in certain individuals. The angle of the ethmo-vomerine block was assessed in prepared skulls by measuring the angle between the horizontally-aligned parasphenoid and a line bisecting the vomer (in lateral view) into two equal halves.

Morphometric data were analyzed using sheared principal component analysis (SPCA), with the covariance matrix factored (Humphries *et al*. 1981; Bookstein *et al*. 1985). Meristic data were analyzed with principal component analysis (PCA), with the correlation matrix factored. Differences between species were illustrated by plotting the sheared second principal components of the morphometric data against the first principal components of the meristic data (Stauffer & Hert 1992).

FIGURE 1. Map of Lake Malaŵi with localities mentioned in the text.

Results

Melanochromis robustus Johnson 1985
(Fig. 2; Table 1)

Melanochromis cf. *brevis* (*non* Trewavas) Ribbink et al. 1983
Melanochromis brevis (*non* Trewavas) Konings 1995

Material examined. AMNH 35386, holotype, male, 124.2 mm SL, Malaŵi: Lake Malaŵi: "Chizimulu Island", Davies et al.; PSU 8090, 6, 101.3–124.0 mm SL, Malaŵi: Lake Malaŵi: Chinyankwazi Island: 13° 50.3'S, 34° 57.4'E, A. Konings, 11 Oct 2009; PSU 10565, 1, 125.8 mm SL, Malaŵi: Lake Malaŵi: Chinyankwazi Island: 13° 50.3'S, 34° 57.4'E, J. Stauffer & A. Konings, 9 Feb. 2003; PSU 8091, 3, 87.0–95.1 mm SL, Malaŵi: Lake Malaŵi: Mumbo Island: 13° 59.1'S, 34° 45.3'E, J. Stauffer & A. Konings, 8 Feb 2003.

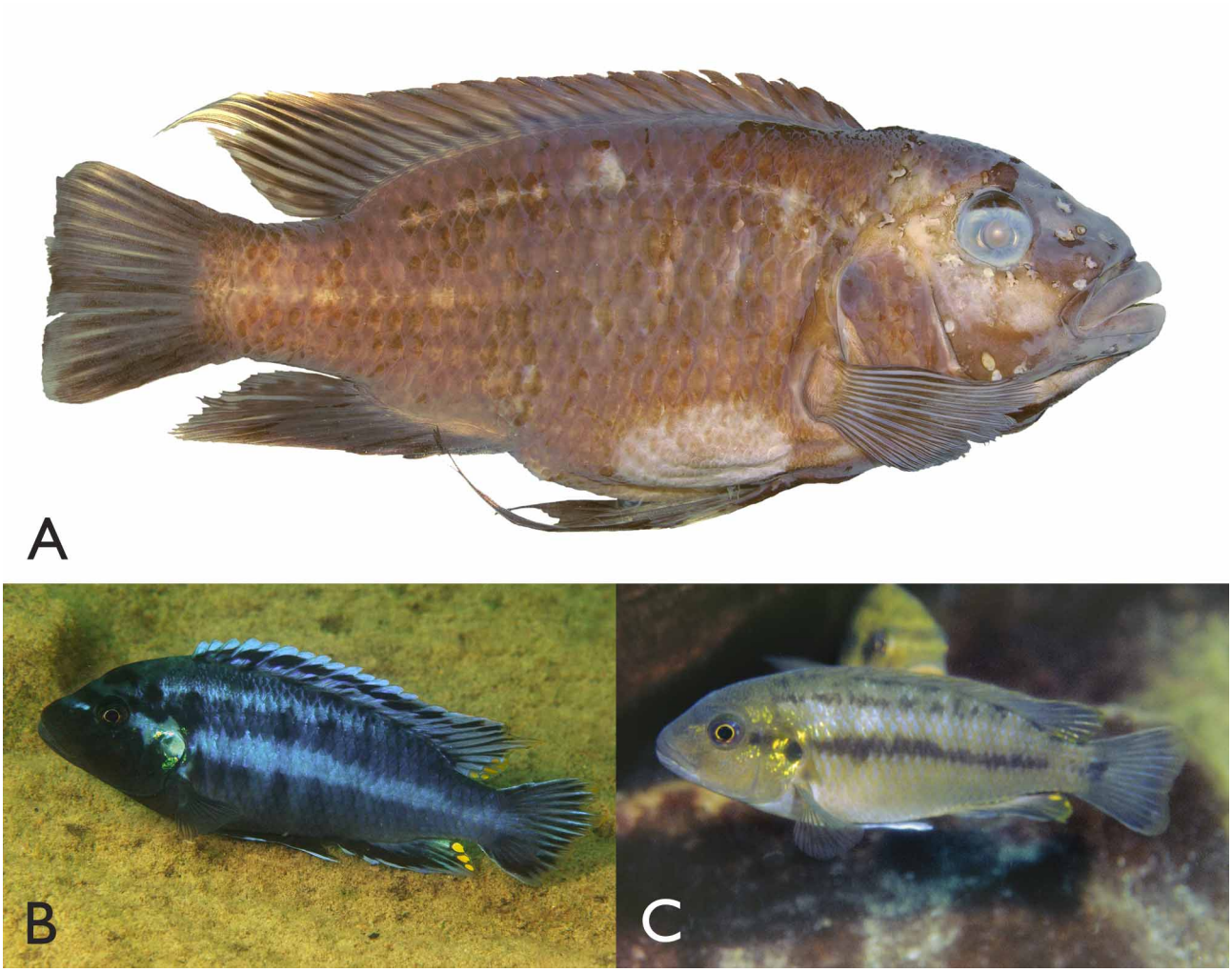

FIGURE 2. A. *Melanochromis robustus*, holotype, AMNH 35386, 124.2 mm SL, Malaŵi: Lake Malaŵi: "Chizimulu Island", Davies et al., because of damage on left side of specimen shown from right side; B. *M. robustus*, male in breeding colouration (approx. 110 mm SL) at Chinyankwazi Island, Lake Malaŵi, Malaŵi; C. *M. robustus*, female (approx. 100 mm SL) at same locality as male.

Diagnosis. *Melanochromis robustus* has a basic melanin pattern consisting of two longitudinal black stripes on the body, of which the mid-lateral stripe reverses colour with the background in the breeding male—a character that makes it a member of *Melanochromis*. Female *M. robustus* are distinguished from all other congeners, except those of *M. melanopterus*, *M. vermivorus*, and *M. mpoto*, by a gray to brown coloured body (white to yellow in other congeners). Mouthbrooding females may have additional vertical bars on the flanks, but these are more

diffuse than the horizontal stripes. Both male and female *M. robustus* are distinguished from *M. melanopterus*, *M. vermivorus*, and *M. mpoto* by a broader interorbital breadth, the width of which is 26.1–29.6 % of HL (16.6–20.6 % in *M. melanopterus*, 18.5–25.5 % in *M. vermivorus*, and 14.8–21.8 % HL in *M. mpoto* n. sp.). Male *M. robustus* in breeding colouration are distinguished from all other congeners by a dark-blue body colour and two light blue horizontal stripes on the flank superimposed with dark-blue to black vertical bars. The bars are interrupted by the light-coloured horizontal lines. None of the other known species of *Melanochromis* has a male colouration where the horizontal and vertical elements of the pattern are expressed simultaneously. Superficially, breeding males of the sympatric and smaller *M. heterochromis* have a similar colouration (albeit lacking the vertical bars). *Melanochromis heterochromis* can also be distinguished by its light-coloured mid-lateral stripe, which rarely spans more than two scales but is usually three to four scales deep in *M. robustus*. *Melanochromis robustus* is further distinguished from *M. heterochromis* by a longer snout, 33.8–38.0 % HL vs. 26.8–31.5 % in *M. heterochromis*, and by a deeper caudal peduncle, 12.9–14.4 % SL vs. 9.8–11.7 % in *M. heterochromis*.

Description. Morphometric ratios and meristic values as shown in Table 1. Medium-sized to large mbuna, ovoid body (mean BD 37.3% SL) with greatest depth at about second to fourth dorsal spine. Dorsal body profile with gradual curve downward, more acute towards the caudal peduncle; ventral body profile slightly convex between pelvic fins and base of rays of anal fin with upward taper to caudal peduncle. Dorsal head profile rounded, with continuous curve between interorbital and dorsal-fin origin; horizontal eye diameter (mean 27.3% HL) greater than preorbital depth; majority of eye (along horizontal axis) positioned in anterior half of head; snout straight to slightly concave in some individuals; jaws isognathous; tooth bands with 3–5 rows in lower and upper jaws; teeth in anterior outer row unequally bicuspid with lateral teeth primarily unicuspid, and teeth in inner rows unicuspid (some teeth shouldered); at junction of outer and innermost row teeth as single series of small unicuspids.

Dorsal fin with XVI–XVIII (mode XVII) spines and 8–10 (mode 9) soft rays. Anal fin with III spines and 6 to 8 (mode 7) soft rays. First 3 or 4 dorsal spines becoming gradually longer posteriorly with fourth spine about 1.5 times length of first; last 13 spines becoming slightly longer posteriorly with last spine longest, about three times length of first; soft dorsal with rounded (females) or rounded to subacuminate (males) tip, third or fourth ray longest, reaching approximately base of caudal fin in females and approximately ¼ length of caudal in males. Anal spines progressively increasing in length posteriorly; third or fourth ray longest, reaching base of caudal fin; 1–3 small yellow spots on posterior anal fin in females and 2–10 yellow spots on posterior anal fin in males. Caudal fin subtruncate to emarginate. Pelvic fin not reaching anal fin in females, but extending to second or third spine of anal fin in large males. Pectoral fin short and paddle-shaped, reaching superimposed vertical line through base of 10th or 11th dorsal spine.

Flank scales large, ctenoid with abrupt transition to small scales on breast; cheek with 3–5 (mean 4) rows of small scales; caudal fin with tiny scales to margin; no scales on other fins.

TABLE 1. Morphometric and meristic data for *Melanochromis robustus* from Mumbo Island, Malaŵi (n=3), from Chinyankwazi Island, Malaŵi (n=7), and for the holotype ("Chizimulu Island"). Mean values as well as the ranges for these localities do not include those of the holotype because of it being grossly disproportionate.

Melanochromis robustus	**mean**	**holotype**	**Mumbo range**	**Chinyankwazi range**
Standard length, mm	104.0	124.2	87.0–95.1	101.3–124.0
Head length, mm	34.1	40.8	28.9–31.2	32.0–40.2
% standard length				
Head length	32.8	32.8	32.7–34.7	31.0–34.1
Body depth	37.3	38.5	36.5–36.6	34.7–40.2
Snout to dorsal	35.0	33.1	34.7–36.5	34.0–35.7
Snout to pelvic	38.8	45.2	38.9–39.3	37.5–40.2
Dorsal-fin base length	61.6	57.3	60.8–62.2	60.7–62.3

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TABLE 1. (Continued)

Melanochromis robustus	**mean**	**holotype**	**Mumbo range**	**Chinyankwazi range**
Anterior dorsal to anterior anal	52.3	51.2	51.7–53.7	50.1–53.5
Anterior dorsal to posterior anal	65.4	61.0	64.7–66.0	64.2–67.0
Posterior dorsal to anterior anal	32.2	31.2	31.3–31.5	31.2–34.0
Posterior dorsal to posterior anal	17.4	17.5	16.4–17.6	16.6–18.9
Posterior dorsal to ventral caudal	19.7	20.1	19.1–20.5	18.8–21.3
Posterior anal to dorsal caudal	21.6	22.4	20.6–21.4	20.4–23.3
Anterior dorsal to pelvic-fin origin	37.6	38.4	36.3–37.7	35.8–40.2
Posterior dorsal to pelvic-fin origin	58.1	57.6	55.9–57.2	57.0–61.1
Caudal-peduncle length	13.9	15.0	12.8–14.3	13.1–14.7
Least caudal-peduncle depth	13.7	13.4	13.3–14.1	12.9–14.4
Pectoral-fin length	23.7	23.3	24.8–25.8	20.6–24.8
Pelvic-fin length	31.1	41.9	34.1–39.1	24.3–32.5
% head length				
Snout length	35.8	39.7	33.8–36.3	35.0–38.0
Postorbital head length	42.1	37.0	40.4–41.6	41.5–43.6
Horizontal eye diameter	27.3	28.7	29.1–30.6	24.0–27.6
Vertical eye diameter	26.8	28.2	27.6–30.0	23.2–27.2
Head depth	93.6	96.7	88.3–90.2	93.1–98.9
Preorbital depth	22.5	21.2	20.5–21.5	22.3–23.9
Cheek depth	25.0	22.7	23.0–26.4	23.8–26.2
Lower-jaw length	35.4	36.3	35.3–36.9	34.0–37.6
Interorbital width	27.7	26.2	26.1–28.1	26.3–29.6
Premaxillary length	26.2	28.7	24.9–27.1	24.1–30.1
Meristics	**mode**	**holotype**	**Mumbo range**	**Chinyankwazi range**
Dorsal-fin spines	17	17	17	16–18
Dorsal-fin rays	9	10	9–10	8–9
Anal-fin spines	3	3	3	3
Anal-fin rays	7	8	7–8	6–7
Pectoral-fin rays	14	14	13–14	13–14
Pelvic-fin rays	5	5	5	5
Lateral-line scales	32	32	32	31–32
Pored scales post lateral line	2	2	2	0–3
Cheek-scale rows	4	4	3–5	4–5
Gillrakers 1st ceratobranchial	11	12	11–13	10–12
Gillrakers 1st epibranchial	4	4	4	2–4
Teeth in outer series of left lower jaw	22	23	8–12	20–25
Tooth rows in upper jaw	4	5	4–4	4–5
Tooth rows in lower jaw	5	4	3–5	4–5

Colouration. Breeding males: head below eye dark blue/black with light-blue interorbital band, nape and post-orbital part of head light blue to gray. Body blue/dark blue with solid light-blue midlateral stripe and less well-defined light-blue dorso-lateral stripe; anteriormost 2–5 vertical bars darker and superimposed on pattern of horizontal stripes; vertical bars interrupted where intersecting light-blue horizontal stripes; caudal peduncle dark blue/gray with light-blue midlateral stripe extending onto caudal fin; belly and breast dark blue/black. Dorsal fin light blue with black submarginal band, in some males submarginal band not solid, and light-blue lappets. Caudal fin with dark-blue/black membranes, clear posterior margin, and light-blue rays. Anal fin blue with broad black submarginal band, light-blue anterior margin, and 2–10 small orange/yellow ocelli on posterior part of soft-rayed portion. Pelvic fin black with light-blue anterior margin. Pectoral fin with dark-gray/black rays and clear membranes. Females: head gray/green with green iridescent spots on post-orbital part and black opercular spot; dark interorbital bar with some green iridescent spots; short, dark horizontal stripe behind eye not extending to opercular spot. Body gray/green-yellow with solid black midlateral stripe extending to but not onto caudal peduncle, and interrupted black dorso-lateral stripe; faint dark vertical bars over horizontal stripes, more conspicuous in mouthbrooding females. Dorsal and anal fin gray with faint black submarginal band. Caudal fin with black spot at base; membranes light gray with dark submarginal band and outer margin clear; rays light-blue/white. Pelvic fin gray with narrow white/light-blue anterior margin. Pectoral fin clear with gray rays.

Distribution and field observations. *Melanochromis robustus* is uncommon in occurrence in the very shallow (< 5 m deep) rocky habitat at the islands of Chinyankwazi and Mumbo (Fig. 1). Ribbink *et al*. (1983) report the presence of this species (as *Melanochromis* cf. *brevis*) at other locations in the southeastern arm of the lake but we have not been able to confirm this.

Males in breeding colouration energetically defend spawning sites, which are located inside caves and crevices between the rocks, against conspecific males. Male territories have an estimated diameter of 2–3 meters. Territorial aggression against males of *M. heterochromis*, which is much more common at both islands, was not obvious, although the two species are sometimes difficult to tell apart on the basis of colouration, were it not for the much larger size of *M. robustus*. Females are rarely seen, and those that were have always been solitary; mouthbrooding females remain solitary and stay close to the rocky substrate. Ribbink *et al*. (1983) mention that stomach analyses of *M. robustus* revealed plankton and algae, and occasionally terrestrial insects such as ants and flies. The individuals we observed at the islands of Chinyankwazi and Mumbo suggest an opportunistic feeding behaviour in which the species is attracted to visible particles floating in the water column rather than collecting food by systematically browsing from the rocky substrate. Stomach analyses were not performed.

Melanochromis loriae Johnson 1975

(Fig. 3; Table 2)

Melanochromis parallelus Burgess & Axelrod 1976

Material examined. USNM 214175, holotype, male, 100.6 mm SL, Malaŵi: Lake Malaŵi: "Chipoka Island", Davies et al.; USNM 215029, holotype of *M. parallelus*, female, 76.2 mm SL, Malaŵi: Lake Malaŵi, Axelrod, Oct. 1974; USNM 215030, paratype of *M. parallelus*, male, 81.5 mm SL, same collection data as USNM 215029; USNM 215031, paratypes of *M. parallelus*, 2, 71.7–76.6 mm SL, Malaŵi: Lake Malaŵi: obtained from aquarium dealer, 1976; PSU 6042, 10, 69.1–85.5 mm SL, Malaŵi: Lake Malaŵi: Likoma Island: 12° 01.62'S, 34° 44.16'E, Konings, 7 Oct. 2009.

Diagnosis. Female and subadult *M. loriae* are distinguished from their congeners, except from those of *M. melanopterus*, *M. lepidiadaptes*, and *M. kaskazini*, by a white to cream coloured body (yellow to brown in other congeners), two black horizontal stripes on the flank, a black submarginal band in the dorsal fin, and black markings on the lower lobe of the caudal fin. *Melanochromis loriae* is distinguished from *M. melanopterus* and *M. kaskazini* by a shorter lower jaw, 31.9–35.2 %HL vs. 37.2–41.7 % in *M. melanopterus* and 36.4–44.6 % in *M. kaskazini*, and from *M. lepidiadaptes* by the higher number of tooth rows, 5–7 vs. 2 or 3. Male *M. loriae* in breeding colouration are distinguished from their congeners, except *M. melanopterus*, *M. simulans*, and *M. robustus*, by a broad black band in the spinous part of the dorsal fin, absent in all other congeners. *Melanochromis loriae* is distinguished from *M. melanopterus* and *M. simulans* by a shorter lower jaw, 31.9–35.2 %HL vs. 37.2–41.7 % in *M. melanopterus* and 40% (Eccles, 1974) in *M. simulans*, and from *M. robustus* by a shallower caudal peduncle, 11.7–12.6 %SL vs. 12.9–14.4 %.

FIGURE 3. A. *Melanochromis loriae*, holotype, USNM 214175, male, 100.6 mm SL; Malaŵi: Lake Malaŵi: "Chipoka Island", Davies *et al.*; B. *M. loriae*, male in breeding colouration (approx. 80 mm SL) at Thumbi West Island (population introduced by Davies et al.), Lake Malaŵi, Malaŵi; C. *M. loriae*, female (approx. 70 mm SL) at same locality as male.

Description. Morphometric ratios and meristic values as shown in Table 2. Small, oblong species (mean BD 35.5% SL) with greatest body depth at about base of ninth dorsal spine. Dorsal body profile with downward curve to caudal peduncle, in some specimens more acute curvature near posterior end of dorsal fin; ventral body profile straight to slightly convex between pelvic fins and vent, with upward taper along base of anal fin to caudal peduncle. Dorsal head profile rounded, with almost continuous curve between snout tip and dorsal fin origin; horizontal eye diameter (mean 28.7% HL) greater than preorbital depth; more than three quarters of eye (along horizontal axis) located in anterior half of head; moderate to steep head profile, straight to slightly convex snout and slightly retrognathous jaws; wide tooth bands with 5–7 rows in lower and upper jaws; teeth in outer row unequally bicuspid and teeth in inner rows tricuspid; single series of unicuspid teeth where outer and innermost rows meet.

Dorsal fin with XVIII–XIX (mode XIX) spines and 7–9 (mode 8) soft rays. Anal fin with III spines and 7 or 8 (mode 7) soft rays. First 3 or 4 dorsal spines becoming gradually longer posteriorly with first spine less than ½ length of fourth; last 15 spines becoming slightly longer posteriorly with last spine longest; soft dorsal with rounded (females) or rounded to subacuminate (males) tip, third or fourth ray longest, not reaching caudal fin in females and extending to approximately base of caudal fin in males. Anal spines becoming progressively longer posteriorly; third or fourth ray longest, not reaching base of caudal fin. Caudal fin subtruncate to emarginate. Pelvic fin short, not reaching anal fin. Pectoral fin rounded, paddle-shaped, short, reaching vertical line through base of 11th or 12th dorsal spine.

Flank scales large, ctenoid; abrupt transition to small scales on breast; cheek with 4–5 (mean 5) rows of small scales; bands of small scales on proximal margins of caudal fin; 75–90% of caudal fin covered with tiny scales; no scales on other fins.

TABLE 2. Morphometric and meristic data for *Melanochromis loriae*; holotype, our collection from Likoma Island (n=10), and the types of the synonymous *M. parallelus* (n=4). Ranges include the holotype.

Melanochromis loriae	**holotype**	**mean**	**range**
Standard length, mm	100.6	78.1	69.1–100.6
Head length, mm	30.5	24.6	21.0–30.5
% standard length			
Head length	30.3	31.5	30.3–33.0
Body depth	33.4	35.5	31.0–40.6
Snout to dorsal	30.5	34.5	30.5–37.9
Snout to pelvic	41.3	37.0	34.7–41.3
Dorsal-fin base length	62.6	61.2	59.5–62.9
Anterior dorsal to anterior anal	49.7	51.1	49.1–53.9
Anterior dorsal to posterior anal	63.7	63.8	63.0–65.2
Posterior dorsal to anterior anal	30.0	30.2	28.8–31.5
Posterior dorsal to posterior anal	15.7	15.8	15.1–16.8
Posterior dorsal to ventral caudal	19.2	18.5	16.3–19.8
Posterior anal to dorsal caudal	21.0	21.4	19.9–22.9
Anterior dorsal to pelvic-fin origin	34.9	35.3	32.1–38.3
Posterior dorsal to pelvic-fin origin	52.3	58.5	52.3–63.7
Caudal-peduncle length	15.3	14.7	11.9–16.7
Least caudal-peduncle depth	12.2	12.4	11.7–12.6
Pectoral-fin length	21.3	23.6	21.3–25.0
Pelvic-fin length	25.4	25.1	21.7–27.6
% head length			
Snout length	36.2	33.8	29.9–37.2
Postorbital head length	40.3	41.6	40.0–43.0
Horizontal eye diameter	23.9	29.0	23.9–31.0
Vertical eye diameter	24.1	28.4	24.1–30.9
Head depth	96.9	92.2	81.7–96.9
Preorbital depth	21.5	20.8	18.7–22.4
Cheek depth	23.1	22.5	20.1–24.5
Lower-jaw length	33.3	33.6	31.9–35.2
Interorbital width	28.5	25.9	24.3–28.5
Premaxillary length	24.7	25.6	23.8–28.6
Meristics	**holotype**	**mode**	**range**
Dorsal-fin spines	19	19	18–19
Dorsal-fin rays	7	8	7–9
Anal-fin spines	3	3	3

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TABLE 2. (Continued.)

Melanochromis loriae	**holotype**	**mean**	**range**
Anal-fin rays	8	7	7–8
Pectoral-fin rays	14	13	13–14
Pelvic-fin rays	5	5	5
Lateral-line scales	33	33	32–34
Pored scales post lateral line	0	2	0–2
Cheek-scale rows	5	5	4–5
Gillrakers 1st ceratobranchial	8	10	8–10
Gillrakers 1st epibranchial	3	3	2–3
Teeth in outer series of left lower jaw	26	26	23–29
Tooth rows in upper jaw	6	7	5–7
Tooth rows in lower jaw	6	6	5–7

Colouration. Breeding males: head dark blue/black with two light-blue interorbital bands; cheek and gular region black; nape dark blue/black. Body dark blue/black with solid light-blue midlateral stripe and more diffuse light-blue dorso-lateral stripe; caudal peduncle dark blue/black with blue midlateral stripe; belly and breast dark blue/black. Dorsal fin dark blue with broad black submarginal band and light-blue lappets, in some males posterior dorsal with yellow margin. Caudal fin with dark-blue/black membranes and some light-blue rays, light-blue margin with narrow yellow posterior edge. Anal fin black, with 0–3 orange/yellow ocelli on posterior margin and light-blue ventral margin. Pelvic fin black with light-blue anterior margin. Pectoral fin with gray/black rays and clear membranes.

Females: head gray/green on snout and nape, and cream/white on cheek and throat with two black interorbital bars and third bar on nape extending to dorso-lateral stripe. Body white/cream with broad black midlateral and dorso-lateral stripes, each 2–3 scales wide. Dorsal and anal fin white with broad black submarginal band, caudal fin white with clear margin and black spots and streaks throughout fin. Pelvic fin white with narrow white/light-blue anterior margin and black submarginal band. Pectoral fin clear.

Distribution and field observations. *Melanochromis loriae* has a wide distribution in the northern half of the lake. The northernmost points of distribution are Mphanga Rocks, Malawi, on the west coast of the lake, and Lutara, Tanzania, on the east coast. Kande Island, Malawi and Tumbi Point, Mozambique, are the respective southernmost points of distribution (Fig. 1). This species is also found at the islands of Chizumulu and Likoma but not at Taiwanee Reef. *M. loriae* occurs in small numbers at most localities throughout its range, but at Ndumbi Rocks, a reef off the northwestern point of Likoma Island, it is sometimes found in foraging groups of more than 50 individuals. Besides females and non-breeding males, such groups often contain non-territorial males in full breeding colouration. The preferred habitat is mostly rocky with little sand, and the majority of individuals occur at a depth ranging between five and 20 meters (Ribbink *et al.* 1983). *Melanochromis loriae* is an omnivore, feeding mainly from the *Aufwuchs* on rocks. In addition to algae, however, Ribbink *et al*. (1983) observed cichlid fry and catfish eggs in the stomach contents of six individuals collected at Likoma Island. *Melanochromis loriae* is attracted to stirred-up sediment, suggesting opportunistic feeding behavior. On several occasions one of us (AK) has observed adult females of *M. loriae* picking fungus and anchor worms (*Lernaea* sp.) from larger haplochromines (non-mbuna). In all instances the afflicted fish approached the “cleaner” and made clear, by lying on its side or hovering in a slanting, head-up position, that it would like to have a “treatment”. In all cases the dorsal fin was presented first. The female *M. loriae* then picked vigorously at the fungus or parasite and tore it off. Although this visibly hurt the “client’, it remained in the typical position. When the cleaning process was complete, which might take more than a minute, the larger haplochromine would resume its normal swimming position and disappear. Cleaning stations, as seen in marine fishes, were not observed: after the cleaning was done the female *M. loriae* would disappear from the scene as well.

***Melanochromis chipokae* Johnson 1975**
(Fig. 4; Table 3)

Melanochromis loriae (*non* Johnson) Mayland 1982; Schraml 1998

Material examined. USNM 214173, holotype, male, 87.8 mm SL, Malaŵi: Lake Malaŵi: "Chipoka Island", Davies et al.; PSU 6037, 3, 55.8–83.8 mm SL, Malaŵi: Lake Malaŵi: Chidunga Rocks: 13° 57.8'S, 34° 33.6'E, A. Konings, 14 Oct. 2009.

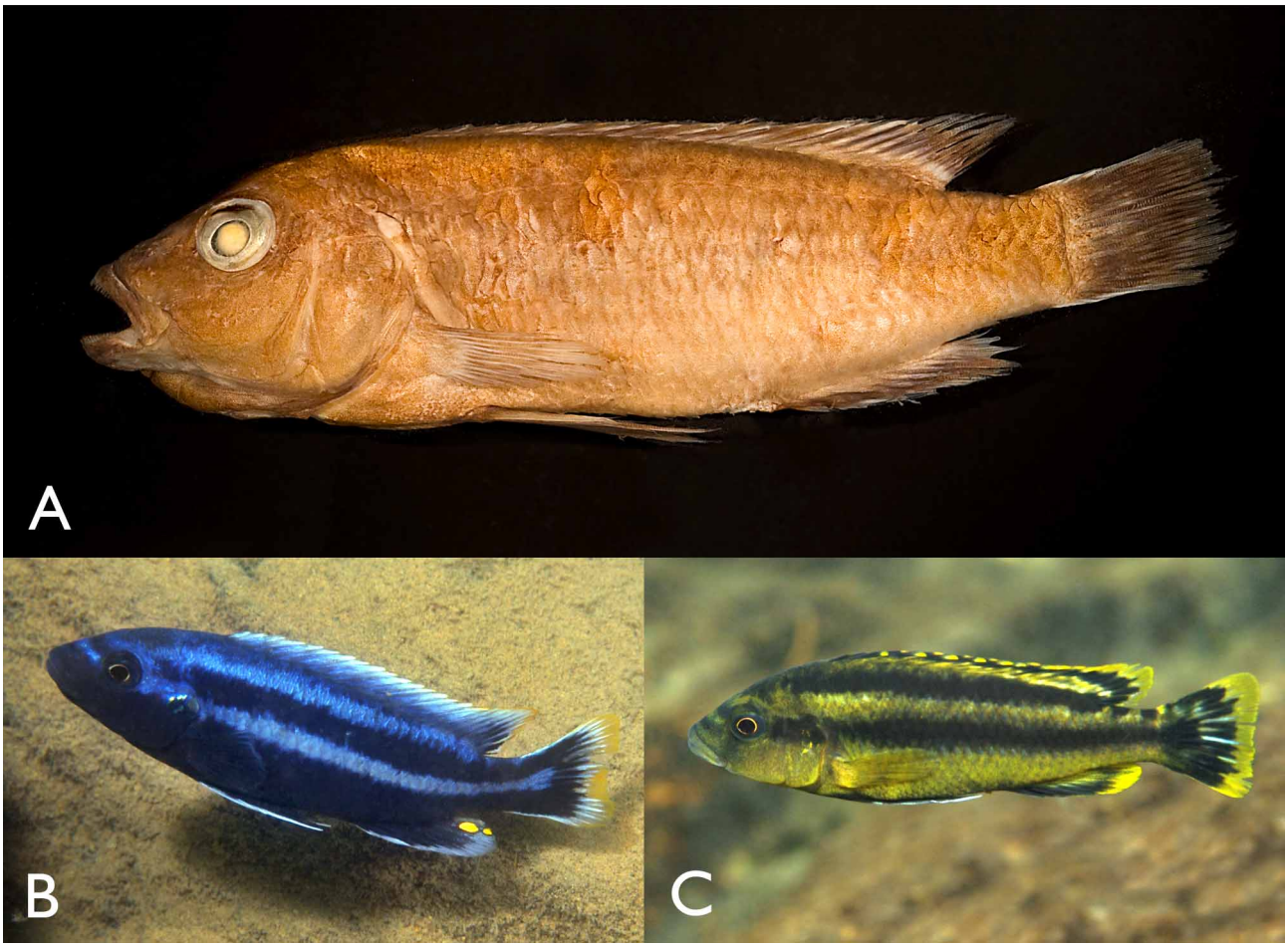

FIGURE 4. A. *Melanochromis chipokae*, holotype, USNM 214173, male, 87.8 mm SL; Malaŵi: Lake Malaŵi: "Chipoka Island", Davies *et al*.; B. *M. chipokae*, male in breeding colouration (approx. 85 mm SL) at Chidunga Rocks, Lake Malaŵi, Malaŵi; C. *M. chipokae*, female (approx. 70 mm SL) at same locality as male.

Diagnosis. Females and subadults of *M. chipokae* are distinguished from those of all other *Melanochromis* species by a yellow ground colour and a black submarginal band in the dorsal and anal fins. Male *M. chipokae* in breeding colour have a blue occipital region, a dark-blue/black body with two wide, light-blue horizontal stripes, and a blue dorsal fin with a wide white margin. They differ from males of most *Melanochromis* species with a similar colour pattern, except *M. robustus* and *M. heterochromis*, by the blue occipital region that is black or gray in *M. melanopterus*, *M. vermivorus*, *M. simulans*, *M. loriae*, *M. robustus*, and *M. mossambiquensis*. *Melanochromis chipokae* males and females differ from *M. robustus* by a narrower interorbital width (17.5–23.3 %HL vs. 26.1–29.6 %) and from *M. heterochromis* by a longer lower jaw (36.5–38.9 %HL vs. 29.3–34.6 %).

Description. Morphometric ratios and meristic values as shown in Table 3. Spindle-shaped species (mean BD 30.5% SL) with greatest body depth at approximately base of fourth dorsal spine. Dorsal body profile below dorsal fin slightly convex anteriorly and with downward curve along base of soft dorsal fin to caudal peduncle; ventral body profile with gradual upward curve to anal fin and with more acute curve to caudal peduncle. Dorsal head profile straight between snout tip and interorbital, at about 30–35° angle relative to body axis; profile rounded between interorbital and dorsal fin origin; horizontal eye diameter (mean 29.5% HL) much larger than preorbital

depth (mean 18.2% HL); ½ to ¾ of eye (along horizontal axis) located in anterior half of head. Snout long with isognathous jaws; teeth on lower jaw in 3–5 rows with anteriormost teeth of outer row large, unequally bicuspid in adult males and almost equally bicuspid in females; lateral teeth unicuspid; inner row teeth small, unequally tricuspid to unicuspid in posterior rows.

Dorsal fin with XVII or XVIII (mode XVIII) spines and 8 or 9 (mode 8) soft rays. Anal fin with III spines and 7 or 8 (mode 7) soft rays. First 3 or 4 dorsal spines becoming gradually longer posteriorly with first spine about ½ length of third; last 14 spines becoming slightly longer posteriorly with last spine longest; soft dorsal with rounded or subacuminate tip, fifth ray longest, extending almost to base of caudal fin in females and to approximately ¼ length of caudal fin in males. Anal spines becoming progressively longer posteriorly; fourth or fifth ray longest, extending to approximately base of caudal fin in males, but not in females. Caudal fin subtruncate to emarginate. Pelvic fin not reaching anal fin. Pectoral fin rounded, paddle-shaped, short, posterior tip extending to vertical line through base of 10th or 11th dorsal spine.

Flank scales large, ctenoid; abrupt transition to small scales on breast; cheek with 4 or 5 (mean 5) rows of small scales; proximal 75–90% of caudal fin covered with tiny scales, none on dorsal or anal fin.

TABLE 3. Morphometric and meristic data for *Melanochromis chipokae* from Chidunga Rocks, Malaŵi (holotype and three non-type specimens). Ranges include the holotype.

Melanochromis chipokae	**holotype**	**mean**	**range**
Standard length, mm		74.4	55.8–87.8
Head length, mm		23.8	17.7–28.7
% standard length			
Head length	32.6	31.9	31.0–32.6
Body depth	28.9	30.5	28.5–33.4
Snout to dorsal	32.9	32.5	32.2–32.9
Snout to pelvic	42.8	39.6	37.3–42.8
Dorsal-fin base length	54.5	57.6	54.5–60.1
Anterior dorsal to anterior anal	47.7	47.5	46.6–48.0
Anterior dorsal to posterior anal	59.2	60.5	58.2–62.9
Posterior dorsal to anterior anal	28.2	28.9	26.8–31.4
Posterior dorsal to posterior anal	14.7	15.1	14.4–16.2
Posterior dorsal to ventral caudal	18.0	18.2	17.7–19.1
Posterior anal to dorsal caudal	19.8	20.9	19.8–21.9
Anterior dorsal to pelvic-fin origin	28.4	30.5	28.4–33.1
Posterior dorsal to pelvic-fin origin	53.6	55.0	53.6–56.4
Caudal-peduncle length	15.5	14.9	14.2–15.5
Least caudal-peduncle depth	11.3	11.5	11.1–11.9
Pectoral-fin length	20.0	22.0	20.0–23.8
Pelvic-fin length	26.2	25.3	22.1–27.9
% head length			
Snout length	35.1	31.9	27.4–35.1
Postorbital head length	38.6	40.2	38.6–41.8
Horizontal eye diameter	29.7	30.1	28.0–32.8

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TABLE 3. (Continued.)

Melanochromis chipokae	**holotype**	**mean**	**range**
Vertical eye diameter	27.9	28.8	27.3–30.0
Head depth	77.1	79.1	73.1–85.6
Preorbital depth	19.8	18.2	15.8–19.9
Cheek depth	21.3	19.0	14.8–21.3
Lower-jaw length	38.9	37.4	36.5–38.9
Interorbital width	21.0	20.6	17.5–23.3
Premaxillary length	24.4	25.5	24.4–26.2
Meristics	**holotype**	**mode**	**range**
Dorsal-fin spines	18	18	17–18
Dorsal-fin rays	8	8–9	8–9
Anal-fin spines	3	3	3
Anal-fin rays	7	7	7–8
Pectoral-fin rays	13	13	13
Pelvic-fin rays	5	5	5
Lateral-line scales	33	32–33	32–33
Pored scales post lateral line	2	2	1–2
Cheek-scale rows	5	5	4–5
Gillrakers 1st ceratobranchial	9	9	9
Gillrakers 1st epibranchial	4	3	3–4
Teeth in outer series of left lower jaw	20	19–20	18–21
Tooth rows in upper jaw	4	4	3–5
Tooth rows in lower jaw	4	4	3–4

Colouration. Breeding males: head below orbit dark blue/black, two light-blue interorbital bands, upper interorbital band continuous with dorso-lateral stripe on flank; occipital region blue. Body dark blue/black with solid light-blue/white midlateral stripe 2–3 scales wide and solid light-blue dorso-lateral stripe; area between dorso-lateral stripe and base of dorsal fin blue to dark blue; caudal peduncle dark blue/black with light-blue midlateral stripe; belly and breast dark blue/black. Dorsal fin blue with broad white/light-blue margin and white lappets; proximal ½ to ¾ soft-rayed dorsal with black membranes and light-blue rays, remaining, distal part light blue. Proximal ½ to ¾ caudal fin dark blue/black with large light-blue spot at base as continuation of mid-lateral stripe; distal ¼ to ½ of caudal fin with light-blue rays and wide yellow margin. Anal fin black, with light-blue ventral margin and 1–3 orange/yellow ocelli on light-blue marginal region. Pelvic fin black with light-blue anterior edge. Pectoral fin with dark-blue/black rays and clear membranes.

Females: head yellow/gray with two black interorbital bars on snout and nape; cheek and throat cream/white; two black interorbital bars, and less distinct lachrymal stripe between eye and corner of mouth; occipital region with irregular black markings blending with dorso-lateral stripe; wide black band extending from posterior edge of eye and continuing as midlateral stripe on flank. Body lemon yellow to gray-yellow; two broad black stripes on flank, midlateral stripe solid, about 3 scales wide, with feathered margins; dorso-lateral stripe wide, merging with base of dorsal fin. Dorsal and anal fins lemon yellow with black submarginal band; caudal fin gray/yellow with large black spot at base, wide lemon-yellow margin, and black spots and streaks throughout. Pelvic fin gray/yellow with white/light-blue anterior margin and wide black submarginal band. Pectoral fin with yellow rays and clear membranes.

Distribution and field observations. *Melanochromis chipokae* is endemic to the shallow rocky reef known as Chidunga Rocks (Fig. 1). The deepest parts of the reef are about 6–7 m deep, depending on season. In general, only

solitary individuals are encountered, wandering through the intermediate habitat searching for larger invertebrates and, perhaps, small fishes. Underwater observations are sporadic, and this species may be less commonly encountered than it was previously. *Melanochromis chipokae* may have suffered over-fishing by collectors of ornamental fishes because this species was rather common in the aquarium hobby 20 to 30 years ago (AK, pers. obs.). Territorial males have not been encountered by the authors, but males in full breeding colouration have; they proceed through the habitat at a similar speed to females and non-breeding males and rarely spend much time investigating particular items. Spawning in the lake has not been witnessed.

Melanochromis mpoto **new species**
(Figs. 5 & 6; Table 4)

Melanochromis 'blue' Ribbink et al. 1983
Melanochromis robustus (*non* Johnson) Konings 1995
Melanochromis benetos (*non* Bowers & Stauffer) Schraml 1998
Melanochromis spec. 'Matema' Schraml 1998

Holotype. PSU 6039, 86.6 mm SL, male; Malaŵi, Lake Malaŵi, Katale Island, 10° 27.3' S, 34 17.2' E, A. Konings, 10 Oct 2009.

FIGURE 5. A. *Melanochromis mpoto*, holotype, PSU 6039, 86.6 mm SL, male; Malaŵi, Lake Malaŵi, Katale Island, A. Konings, 10 Oct 2009; B. *M. mpoto*, male in breeding colouration (approx. 80 mm SL) at Chitande Island, Lake Malaŵi, Malaŵi; C. *M. mpoto*, female (approx. 50 mm SL) at Katale Island, Lake Malaŵi, Malaŵi.

Paratypes. PSU 6040, 3, 66.9–91.1 mm SL, data as for holotype; PSU 6041, 7, 50.9–67.4 mm SL, Malaŵi, Lake Malaŵi, Chitande Island, 10° 23.8' S, 34° 15.3' E; A. Konings, 8 Oct 2009; BMNH 2012.1.31.1.1, 1, 74.0 mm SL, male, data as for holotype; BMNH 2012.1.31.1.2, 1, 53.7 mm SL, female, Malaŵi, Lake Malaŵi, Chitande Island, 10° 23.8' S, 34° 15.3' E, A. Konings, 8 Oct 2009; AMNH 255292, 1, 85.4 mm SL, male, data as for holotype; AMNH 255293, 1, 55.8 mm SL, female, Malaŵi, Lake Malaŵi, Chitande Island, 10° 23.8' S, 34° 15.3' E, A. Konings, 8 Oct 2009.

Diagnosis. Females and non-breeding males of *M. mpoto* are distinguished from all congeners, except *M. melanopterus, M. vermivorus,* and *M. baliodigma,* by a dark brown body and a melanin pattern, when discernible, consisting of two dark horizontal stripes combined with dark vertical bars. The only other *Melanochromis* species with such a pattern is *M. baliodigma,* but *M. mpoto* can be distinguished from the latter species by having vertical bars that are narrower than either horizontal stripe; in *M. baliodigma* the vertical bars are much wider than the horizontal stripes. Mouthbrooding females of *M. robustus* can exhibit vertical bars as well, but this species has a greater interorbital width compared to that of *M. mpoto* (26.1–29.6% HL vs. 14.8–21.8% in *M. mpoto*). *Melanochromis mpoto* differs from *M. melanopterus* and *M. vermivorus* by a shallower cheek depth (15.4–21.7% HL vs. 22.9–31.7% HL in *M. melanopterus* and 28.2–36.2% HL in *M. vermivorus*). Male *M. mpoto* in breeding colouration are light blue/blue without any bars or stripes visible on the flank. *Melanochromis mpoto* males are thus distinguished from those of most other *Melanochromis* species except *M. lepidiadaptes, M. kaskazini,* and *M. wochepa*. *M. mpoto* differs from *M. wochepa* males and females by its longer lower jaw (38.1–42.4% HL vs. 26.7–32.5% in *M. wochepa*), and from *M. lepidiadaptes* males by the black submarginal band in its anal fin, which is entirely light blue in fully coloured males of *M. lepidiadaptes*. In partially coloured males of the latter species the black horizontal stripes are visible, but no vertical bars present, as is the case in *M. mpoto*. Males of *M. mpoto* differ from those of *M. kaskazini* by possessing more teeth in the lower jaw (18–23 vs. 10–16 in *M. kaskazini*), by having a shallower preorbital depth (15.4 – 20.4% HL vs. 19.3–26.9% in *M. kaskazini*), and by possessing a shallower cheek (15.4–21.7% HL vs. 19.8–28.0% in *M. kaskazini*). Fully coloured males of *M. mpoto* and *M. kaskazini* are indistinguishable on the basis of colouration alone, but the basic melanin patterns of the two species, as seen in juveniles and adult females, differ dramatically.

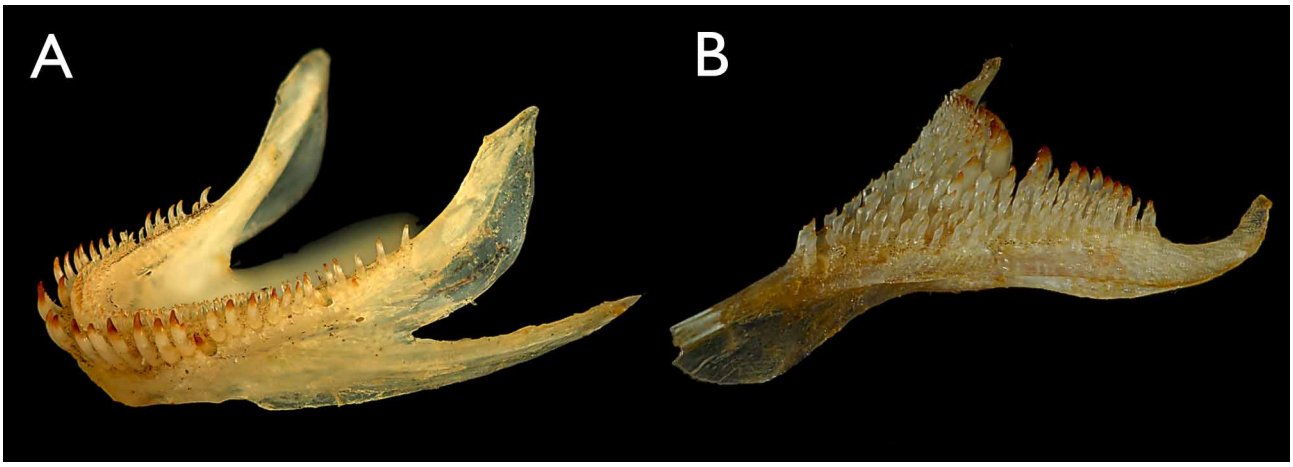

FIGURE 6. *Melanochromis mpoto,* PSU 10568, 79 mm SL, Malaŵi, Lake Malaŵi, Luwino Reef, 10° 26.88'S, 34° 16.97'E; A. latero-dorsal view of dentary; B. latero-dorsal view of lower pharyngeal jaw.

Description. Morphometric ratios and meristic values as shown in Table 4. Medium-sized mbuna, spindle-shaped body (mean BD 29.8% SL) with greatest depth at about 9th to 11th dorsal spine. Dorsal body profile with gradual curve towards caudal peduncle; ventral body profile straight to slightly convex in females and convex in adult males between pelvic fins and base of rays of anal fin; posteriorly, ventral body profile gradually curving dorsally toward caudal peduncle. Dorsal head profile slightly rounded, with continuous convex curve between interorbital and dorsal-fin origin; horizontal eye diameter (mean 27.7% HL) considerably greater than cheek depth; approximately ¾ of eye (along horizontal axis) located in anterior half of head; snout elongate and straight with isognathous jaws; tooth bands with 3–4 rows in lower and 3–5 rows in upper jaw, with noticeable gap between first and second row; teeth in anterior outer row equally to unequally bicuspid in females and unequally bicuspid to

unicuspid in males; teeth in inner rows mostly unicuspid (some teeth shouldered tricuspid); single series of unicuspid teeth at junction of outer and innermost rows (Fig. 6). Lower pharyngeal bone triangular with moderate posterior indentation; few median teeth slightly enlarged but with pointed tips; other pharyngeal teeth laterally compressed with blade-like, curved tips (Fig. 6).

Dorsal fin with XVII or XVIII (mode XVII) spines and 9 or 10 (mode 9) soft rays. Anal fin with III spines and 7 or 8 (mode 8) soft rays. First 4 or 5 dorsal spines becoming gradually longer posteriorly with fourth spine about twice length of first; last 12 spines becoming slightly longer posteriorly with last spine longest, about four times length of first; soft portion of dorsal fin with rounded (females) or rounded to subacuminate (males) tip, fourth or fifth ray longest, reaching base of caudal fin in females and to approximately ¼ length of caudal fin in males. Anal-fin spines becoming progressively longer posteriorly; fourth or fifth ray longest, reaching base of caudal fin. Caudal fin subtruncate to emarginate. Posterior tip of pelvic fin extending to approximately anal fin in females or to second or third spine of anal fin in large males. Pectoral fin paddle-shaped, posterior tip extending to vertical line through base of 11th or 12th dorsal spine.

Flank scales large, ctenoid, with abrupt transition to small scales on breast; cheek with 5–7 (mean 6) rows of small scales; 50–75% of caudal fin covered with tiny scales; no scales present on other fins.

TABLE 4. Morphometric and meristic data for *Melanochromis mpoto* from Katale Island, Malaŵi (holotype and 5 paratypes) and from Chitande Island, Malaŵi (9 paratypes). Ranges include the holotype.

Melanochromis mpoto	**holotype**	**mean**	**range**
Standard length, mm	86.6	67.5	50.9–91.1
Head length, mm	30.2	23.9	18.0–32.0
% standard length			
Head length	34.9	35.4	34.4–36.5
Body depth	32.3	29.8	26.8–33.4
Snout to dorsal	35.4	36.3	35.1–37.9
Snout to pelvic	39.8	39.5	37.5–40.8
Dorsal-fin base length	54.8	55.9	53.4–57.6
Anterior dorsal to anterior anal	45.7	44.3	41.7–47.9
Anterior dorsal to posterior anal	57.6	57.8	55.6–61.3
Posterior dorsal to anterior anal	27.3	27.3	25.8–29.4
Posterior dorsal to posterior anal	13.4	14.1	13.3–15.1
Posterior dorsal to ventral caudal	18.1	17.5	16.4–18.5
Posterior anal to dorsal caudal	20.6	20.0	18.7–20.9
Anterior dorsal to pelvic-fin origin	32.0	30.1	27.5–34.2
Posterior dorsal to pelvic-fin origin	54.9	54.1	51.3–57.8
Caudal-peduncle length	15.2	13.9	12.1–16.0
Least caudal-peduncle depth	12.0	11.5	10.6–12.7
Pectoral-fin length	22.1	22.5	21.2–24.5
Pelvic-fin length	27.6	27.3	22.1–33.4
% head length			
Snout length	34.1	32.9	29.0–36.8
Postorbital head length	41.0	40.5	39.4–42.0

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TABLE 4. (Continued)

Melanochromis mpoto	**holotype**	**mean**	**range**
Horizontal eye diameter	25.5	27.7	24.1–31.2
Vertical eye diameter	24.4	26.9	23.9–29.1
Head depth	72.2	68.9	63.3–73.2
Preorbital depth	19.6	17.8	15.4–20.4
Cheek depth	16.4	17.6	15.4–21.7
Lower jaw length	41.2	39.9	38.1–42.4
Interorbital width	19.6	17.2	14.8–21.8
Premaxillary length	28.4	27.1	24.2–29.1
Meristics	**holotype**	**mode**	**range**
Dorsal-fin spines	17	17	17–18
Dorsal-fin rays	9	9	9–10
Anal-fin spines	3	3	3
Anal-fin rays	7	8	7–8
Pectoral-fin rays	13	13	12–14
Pelvic-fin rays	5	5	5
Lateral-line scales	32	32	31–32
Pored scales post lateral line	1	2	0–3
Cheek-scale rows	6	6	5–7
Gillrakers 1st ceratobranchial	10	10	9–11
Gillrakers 1st epibranchial	3	3	3–4
Teeth in outer series of left lower jaw	19	22	18–23
Tooth rows in upper jaw	4	4	3–5
Tooth rows in lower jaw	4	3	3–4

Colouration. Breeding males: head and body cyan blue. Dorsal fin cyan blue with pale-blue distal margin and white lappets. Caudal fin cyan blue with pale-blue submarginal band and narrow yellow distal margin. Anal fin gray/blue with light-blue distal margin and 3–5 small yellow ocelli. Pelvic fin gray/blue with white/light-blue anterior margin. Pectoral fin with light-gray rays and clear membranes. Full male breeding colour conceals basic melanin pattern typical of females and juveniles.

Females: head brown/dark brown with gray/brown gular region. Body bluish-brown/dark brown, often with darker midlateral and dorso-lateral stripes and vertical bars. Dorsal and caudal fins gray/brown with broad yellow posterior edge; anal fin gray/brown with 1–3 tiny yellow spots. Pelvic fin brown with narrow white/light-blue anterior margin. Pectoral fin with brown rays and gray/yellow membranes.

Distribution and field observations. *Melanochromis mpoto* has a wide distribution in the northern part of the lake and has been encountered along the northwestern shore between Chitande Island, near Chilumba, and Nkhata Bay, and on the northeastern shore between Matema and Hongi Island, near Liuli (Fig. 1). Ribbink *et al*. (1983) also report this species from Likoma Island, but we have not been able to confirm this.

Habitat preference and behavior of *M. mpoto* are similar to those of *M. melanopterus* in the southern part of the lake. Like the latter species, *M. mpoto* is a non-specialized, non-territorial cichlid, which lives in rocky and intermediate habitats. *Melanochromis mpoto* is most often seen at depths of 20–40 m. It lives a predatory life but has also been seen feeding on plankton. Larger specimens appear to be mainly opportunistic piscivores. Adults are usually solitary but quick to form small "packs" of up to a dozen individuals when hunting opportunities arise. Such packs can contain more than a single male in breeding colouration. These small packs move quickly through the

habitat, apparently causing commotion among small prey fishes and invertebrates, and scavenging on anything that seems worth consuming. Stomach content analyses were not performed, but small fishes (fry), invertebrates such as insect larvae, and benthic crustaceans are energetically hunted and certainly part of the diet. Hunting packs are also attracted to disturbed sediment.

Territorial males have not been encountered; mouthbrooding females are solitary and sometimes found in water shallower than 10 m. Fry-guarding females have not been seen.

Etymology. The specific epithet, a noun in apposition, is derived from ChiTumbuka, the language spoken along the northwestern lake shore, and means "northern," referring to the distribution pattern of this species.

Discussion

We regard the basic melanin pattern one of the important characteristics in classifying Malawi cichlids, and species of *Melanochromis* have a unique stripe pattern that is reversed—incompletely in some cases—in adult males (Konings-Dudin *et al*. 2009). During the last 35 years the diagnosis of *Melanochromis* has been enhanced and refined, and since the erection of the genus by Trewavas (1935) many workers have suggested alternative classifications for its members. In Table 5 we give the chronology of these taxonomic statements as well as a list of all species previously and currently considered to be members.

TABLE 5. Nomenclatural events in the genus *Melanochromis* and distribution data of the currently accepted species. Note that we do not accept Lewis's (1980) suggestion of placing *Labidochromis joanjohnsonae* Johnson 1974 in *Melanochromis*. In the group column, members of the predatory group (including opportunistic omnivores) are designated with "P", and members of the herbivorous group with "H", while the species that exhibit an incomplete colour-pattern reversal in males are designated with "I". The locations mentioned in the distribution column are indicated in Fig. 1. Countries are abbreviated as follows: Mw = Malaŵi, Tz = Tanzania, and Mz = Mozambique.

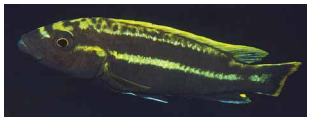
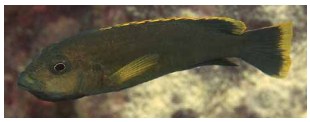
Species in *Melanochromis* Author(s)	**Suggested Reclassification Author(s)**	**Currently Residing in *Melanochromis***	**Group**	**Distribution**	**Photo of male (top) and female (bottom)**
Melanochromis melanopterus Trewavas 1935		*Melanochromis melanopterus*	P	N of Monkey Bay, Mw, along W shore to Mbenji Is., Mw, along E shore (incl. Likoma and Chizumulu Is.) to Liuli, Tz	 
Melanochromis vermivorus Trewavas 1935		*Melanochromis vermivorus*	P	Between Nkhudzi, Mw, and Boadzulu Is., Mw	 
Melanochromis brevis Trewavas 1935	*Pseudotropheus brevis* by Johnson 1975 and this paper				
Melanochromis perspicax Trewavas 1935	*Pseudotropheus perspicax* by Loiselle 1979 and Ribbink *et al*. 1983				

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TABLE 5 (continued)

Species in *Melanochromis* Author(s)	**Suggested Reclassification Author(s)**	**Currently Residing in *Melanochromis***	**Group**	**Distribution**	**Photo of male (top) and female (bottom)**
Melanochromis labrosus Trewavas 1935	*Haplochromis labrosus* by Burgess 1976 *Abactochromis labrosus* by Oliver & Arnegard 2010				
Pseudotropheus auratus Boulenger 1897	*Melanochromis auratus* by Burgess 1976	*Melanochromis auratus*	H	Between Nkhomo Reef, Mw, and Crocodile Rocks, Mw, along the southwestern shore	 
Pseudotropheus johannii Eccles 1973	*Melanochromis johannii* by Burgess 1976 *Pseudotropheus johannii* by Tawil 2002				
Melanochromis simulans Eccles 1973		*Melanochromis simulans*	P	Between Nkhungu Pt., Mz, and Makanjila Pt, Mw	 
Melanochromis exasperatus Burgess 1976	*Pseudotropheus joanjohnsonae* by Stock 1976				
Labidochromis joanjohnsonae Johnson 1974	*Pseudotropheus joanjohnsonae* by Stock 1976 *Melanochromis joanjohnsonae* by Lewis 1980				
Melanochromis parallelus Burgess and Axelrod 1976	*Melanochromis chipokae* by Schraml 1998 *Melanochromis loriae* this paper				
Melanochromis chipokae Johnson 1975		*Melanochromis chipokae*	P	Chidunga Rocks, Mw	 

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TABLE 5 (continued)

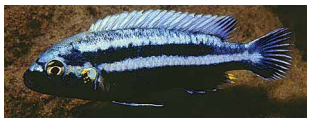
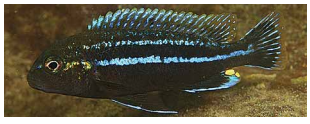
Species in *Melanochromis* Author(s)	**Suggested Reclassification Author(s)**	**Currently Residing in *Melanochromis***	**Group**	**Distribution**	**Photo of male (top) and female (bottom)**
Melanochromis loriae Johnson 1975	*Melanochromis chipokae* by Konings 2001	*Melanochromis loriae*	P/H	Along W shore (Mw) between Chilumba and Kande Is., Chizumulu and Likoma Is., Mw, and along E shore between Manda, Tz, and Mbweca, Mz. Intro duced at Thumbi West Is., Mw	 
Melanochromis interruptus Johnson 1975	Pseudotropheus interruptus by Tawil 2002				
Melanochromis mellitus Johnson 1976	*Melanochromis vermivorus* by Schraml 1998 and Konings 2001 *Melanochromis melanopterus* Konings-Dudin et al. 2009				
Melanochromis robustus Johnson 1985		*Melanochromis robustus*	P	Chinyankwazi Is., Mw, and Mumbo Is., Mw	 
Melanochromis crabro Ribbink and Lewis 1982	*Pseudotropheus crabro* by Trewavas 1984				
Melanochromis heterochromis Bowers and Stauffer 1993	*Melanochromis vermivorus* by Konings 1995 and Schraml 1998	*Melanochromis heterochromis*	P/H	Between Nkhotakota and Monkey Bay, and around Chinyankwazi Is. and Chinyamwezi Is. and reefs SE of Makan jila Point (all localities in Mw)	 
Melanochromis dialeptos Bowers and Stauffer 1997		*Melanochromis dialeptos*	H	Between the Lumessi River, Mz, and Makanjila Pt., Mw	 
Melanochromis cyaneorhabdos Bowers and Stauffer 1997	*Pseudotropheus cyaneorhabdos* by Tawil 2002				

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TABLE 5 (continued)

Species in *Melanochromis* Author(s)	**Suggested Reclassification Author(s)**	**Currently Residing in *Melanochromis***	**Group**	**Distribution**	**Photo of male (top) and female (bottom)**
Melanochromis perileucos Bowers and Stauffer 1997	*Pseudotropheus perileucos* by Tawil 2002				
Melanochromis baliodigma Bowers and Stauffer 1997		*Melanochromis baliodigma*	P	Between Mbweca, Mz, and Narungu, Mw, and also at Chizumulu Is., Mw and probably at Mbenji Is., Mw	 
Melanochromis xanthodigma Bowers and Stauffer 1997	*Melanochromis baliodigma* by Konings 2001 and Tawil 2002				
Melanochromis lepidiadaptes Bowers and Stauffer 1997		*Melanochromis lepidiadaptes*	P/I	Reefs SE of Makanjila Point, Mw	 
Melanochromis elastodema Bowers and Stauffer 1997	*Melanochromis interruptus* by Schraml 1998 and Konings 2001				
Melanochromis benetos Bowers and Stauffer 1997	*Melanochromis robustus* by Konings 2001 *Pseudotropheus benetos* Konings-Dudin *et al.* 2009				
Melanochromis kaskazini Konings-Dudin, Konings and Stauffer 2009		*Melanochromis kaskazini*	P/I	Between Nkanda, Tz, and Lundu, Tz	 
Melanochromis wochepa Konings-Dudin, Konings and Stauffer 2009		*Melanochromis wochepa*	H/I	Between Nkhungu Pt., Mz, and Lumessi, Mz	 

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TABLE 5 (continued)

Species in *Melanochromis* Author(s)	**Suggested Reclassification Author(s)**	**Currently Residing in *Melanochromis***	**Group**	**Distribution**	**Photo of male (top) and female (bottom)**
Melanochromis mossambiquensis Konings-Dudin, Konings and Stauffer 2009		*Melanochromis mossambiquensis*	H	Between Chuanga, Mz, and Nkhungu Reef, Mz	
Melanochromis mpoto Konings and Stauffer, this paper		*Melanochromis mpoto*	P/I	W shore between Chitande Is. and Nkhata Bay, Mw, and E shore between Matema and Hongi Is., Tz	

One major area of contention regarding the identification of species described in *Melanochromis* is that of *M. robustus*. The holotype of *M. robustus* is a grossly disproportionate male specimen that had been overfed in the aquarium before it was preserved. Johnson (1985) claimed that the holotype was preserved two weeks after it was captured; yet he provided a photo of the living holotype (in Johnson 1978; captioned as *Melanochromis* sp. n. 1) in which the condition of the pictured specimen does not resemble that of the preserved specimen. Overfeeding in captivity normally leads to larger fish that have longer fins and fat deposits in the abdomen, in extreme cases all over the body. The holotype may be the same individual as that depicted in the photograph, but it has fat deposits all over its body and exhibits pelvic fins that are much longer than when it (purportedly) was photographed alive. Such a dramatic change is unlikely to happen within two weeks, and we think that the holotype had been maintained in an aquarium for much longer, probably for more than a year. Johnson (1985) gave "Chizimulu Island" (Chizumulu) as the type locality, but since his specimen was obtained from a dealer in ornamental fish he may not have had a reliable source as to the specimen's provenance. *Melanochromis robustus* is a very large mbuna, and we have only ever found *Melanochromis* of similar bulk at Chinyankwazi Island; we thus think that Johnson's type locality is based on misinformation and that the type locality should be corrected accordingly to Chinyankwazi Island. His photograph of the living holotype agrees well in proportions and colouration with wild male specimens from that site.

Melanochromis robustus at the islands of Chinyankwazi and Mumbo was referred to by Ribbink *et al*. (1983) as *Melanochromis* cf. *brevis*, and the same species was later referred to as *M. brevis* (e.g., Konings 1995). We therefore compared *M. robustus* Johnson with *M. brevis* Trewavas, and found them to be distinct. The larger specimen (98.2 mm SL) of the two syntypes of *M. brevis*, BMNH 1935.6.14.318, was collected at Monkey Bay and is here designated lectotype of the species. The second specimen (SL 57.8 mm), BMNH 1935.6.14.319 collected at Nkhudzi, is here designated paralectotype. Other than a uniformly brown to dark brown flank and a darker dorsal and anal fin, the types to do not exhibit any more complicated melanin patterns, of bars or stripes for example. The lack of a black mid-lateral stripe in the juvenile, paralectotype, specimen, which has a lighter colour than the lectotype, precludes this species from assignment to *Melanochromis*, in which all member species exhibit a black mid-lateral stripe in the juvenile phase.

In addition, we found that *M. brevis* Trewavas corresponds to Ribbink *et al*.'s *Pseudotropheus* 'williamsi Nkhudzi'. Live specimens of *M. brevis* Trewavas 1935 display two horizontal rows of spots on the flank, which is a characteristic of *Pseudotropheus williamsi*, type species of the genus *Pseudotropheus*. We therefore remove *M. brevis* from *Melanochromis* and hereafter refer to this species as *Pseudotropheus brevis* (Trewavas 1935).

In contrast to Johnson's photograph of the living holotype of *M. robustus* (Johnson, 1978), which shows a colour pattern congruent with members of *Melanochromis*, no pattern is discernible in the preserved holotype (Fig. 2A). We therefore also compared the preserved holotype with *P. brevis*. We collected nine specimens of *P. brevis* at Boadzulu Island and compared these morphologically and meristically with the field collected material of *M. robustus* from Chinyankwazi Island (Fig. 7). When comparing specimens of similar size, we found that *P. brevis* has a wider body, which is manifested by a greater interorbital width, and a shallower posterior flank, expressed as a shorter distance between the posterior dorsal and posterior anal fin, relative to *M. robustus*. When these two characters are related to each other (IOW/PDPA) their ratio can diagnose either species when these two taxa are compared to each other: *M. robustus* 48.6–54.6 % (holotype 49.0%) and *P. brevis* 59.0–67.0 %.

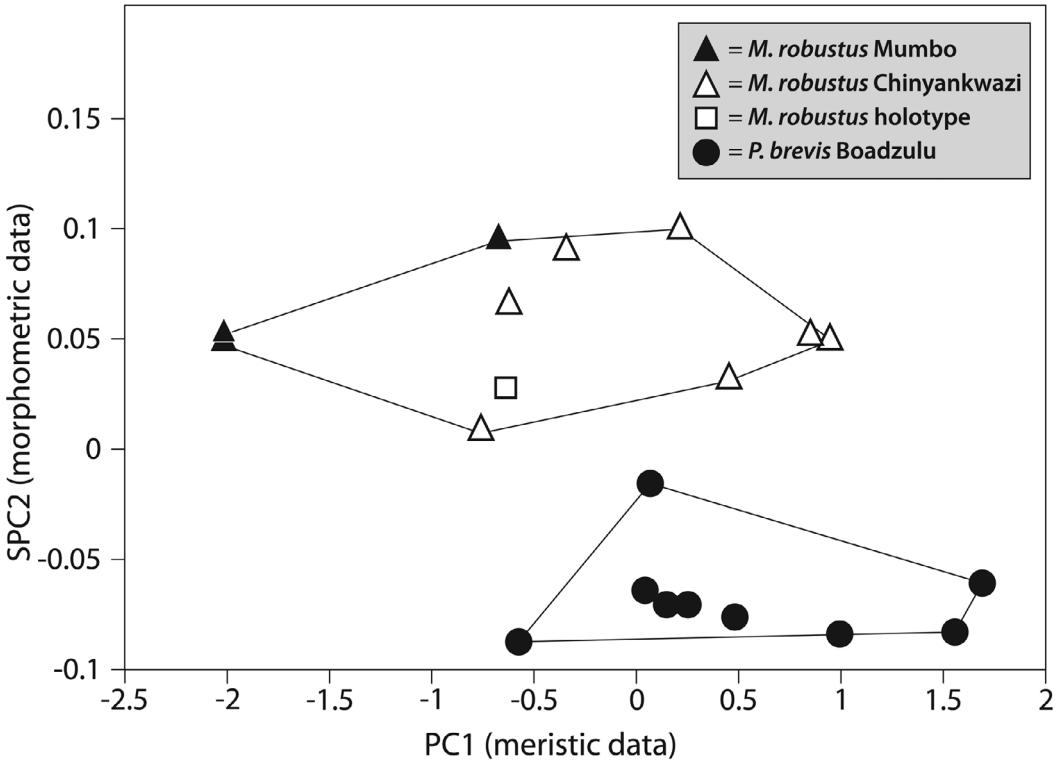

FIGURE 7. Plot of the first principal component of the meristic data (PC1) and the sheared second principal component of the morphometric data (PC2) of *Melanochromis robustus*, holotype, from Chinyankwazi Island (n=7), and from Mumbo Island (n=3) and of *Pseudotropheus brevis* from Boadzulu Island (n=9).

We also compared the types of *M. parallelus* and *M. loriae* with field-collected specimens. The holotype and one paratype of *M. parallelus* were collected at Likoma Island; the other two paratypes were obtained from the ornamental fish trade. The holotype of *M. loriae*, also obtained via the ornamental fish trade, is an over-sized aquarium specimen that was purportedly collected at "Chipoka Island". Such an island does not exist in Lake Malawi, but Chidunga Rocks near Chipoka may have been meant. On the other hand, *M. loriae*, which has never been encountered at Chidunga Rocks, was (and still is) regularly collected for the ornamental fish trade at Likoma Island, and our 10 field-collected specimens were obtained at Ndumbi Rocks, a reef less than 1 km north of Likoma Island. The minimum polygon clusters formed by plotting PC1 of the meristic data against SPC2 of the morphometric data for these three groups were not significantly different among groups along either axis of morphological variation. Thus, we pooled these data as *M. loriae* and compared them with *M. heterochromis*, which is a species that occupies an ecologically similar habitat in the southern half of the lake. The specimens of *M. heterochromis* for our comparison were collected at Thumbi East Island near Monkey Bay in the southern part of the lake.

The minimum polygon clusters formed by plotting PC1 of the meristic data against SPC2 of the morphometric data of *M. loriae* and *M. heterochromis* (Fig. 8) were significantly different between species along each axis. The variable that had the highest loading on the second principal component of the morphometric data was length of premaxillary pedicel (-0.85); while those with the highest loadings on the first principal component of the meristic

data were number of teeth in the left lower jaw (0.95), tooth rows in the upper jaw (0.92), and tooth rows in the lower jaw (0.86). The morphological difference between *M. loriae* and *M. heterochromis* is best expressed in the length of the premaxillary pedicel in relation to head length. In *M. loriae* (n=15), the premaxillary pedicel length ranges between 23.8–28.6 % HL, and in *M. heterochromis* (Thumbi East Island; n=20) the range is 13.7–25.4 % HL. The range of teeth in the lower jaw is non-overlapping: 46–58 teeth in *M. loriae* and 20–34 in *M. heterochromis*.

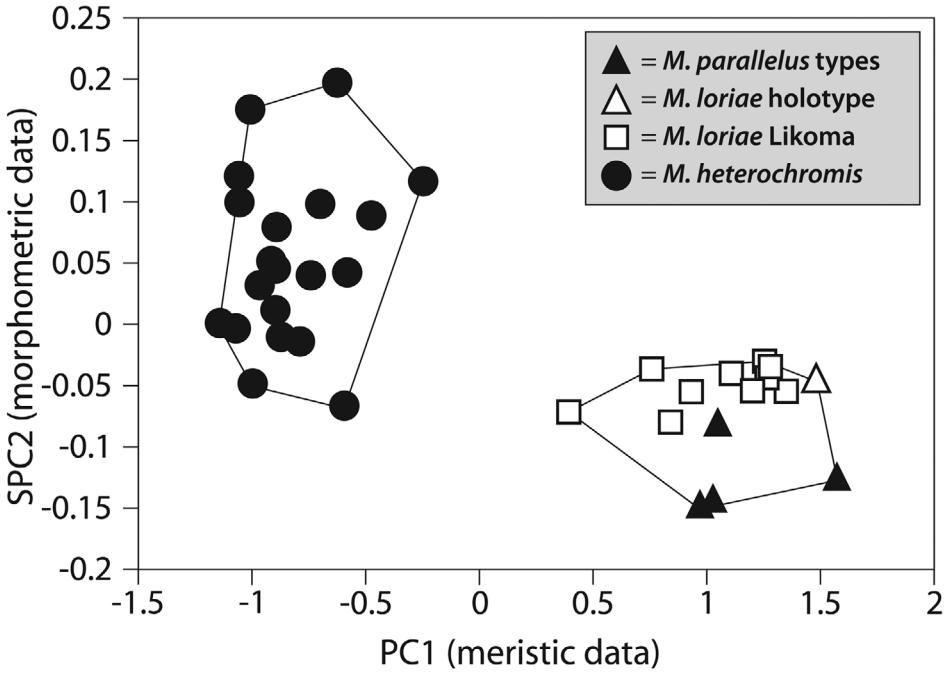

FIGURE 8. Plot of the first principal component of the meristic data (PC1) and the sheared second principal component of the morphometric data (PC2) of *Melanochromis loriae*, holotype, the four types of *M. parallelus*, and from Likoma Island (n=10), and of *M. heterochromis* from Thumbi East Island (n=20).

Because of an artificial introduction of *M. loriae* at Thumbi West Island in the southern part of the lake in the 1970s, both species, *M. loriae* and *M. heterochromis*, share the same habitat at this particular location. Although we have not determined how a hybrid between these two species would look, we have never encountered individuals that could be the result of hybridization. The most obvious visual difference between the two species is the black submarginal band in the fins of *M. loriae*, and this may be sufficient distinction for these two species to mate assortatively.

The holotype of *M. chipokae* was reported as coming from Chipoka Island (Chidunga Rocks), and we encountered and collected this species only at Chidunga Rocks. Ribbink *et al*. (1983) reported a form, which they referred to as *M.* cf. *chipokae* from the islands of Mumbo and Thumbi West. However, the male specimen depicted in their work (Fig. 9i; p. 221) does not appear to be conspecific with *M. chipokae*, although perhaps it could be conspecific with *M. melanopterus*. Moreover, the way Ribbink *et al*. (1983) describe females of *M.* cf. *chipokae* at Thumbi West Island is identical to the way they describe females of the Monkey Bay population of *M. melanopterus*, and is also applicable to the *M. melanopterus* females we encountered at Thumbi West Island. *Melanochromis chipokae* thus appears to be endemic to Chidunga Rocks, which constitutes the smallest distribution area, estimated at less than 100 meters in diameter, for any known *Melanochromis* species. The hypothesis that *M. chipokae* constitutes a mere geographical variant of the widely distributed *M. melanopterus* is rejected by the sympatric occurrence of both of these species at Chidunga Rocks.

We compared the morphological and meristic measurements of the holotype of *M. chipokae* to three field collected specimens of this species from Chidunga Rocks, to *M. loriae*, and to *M. melanopterus* to which it bears a physical resemblance. We found that, morphometrically, *M. chipokae* appears more similar to *M. loriae* than it is to *M. melanopterus*, which may also have caused the initial confusion of species by Johnson (1975).

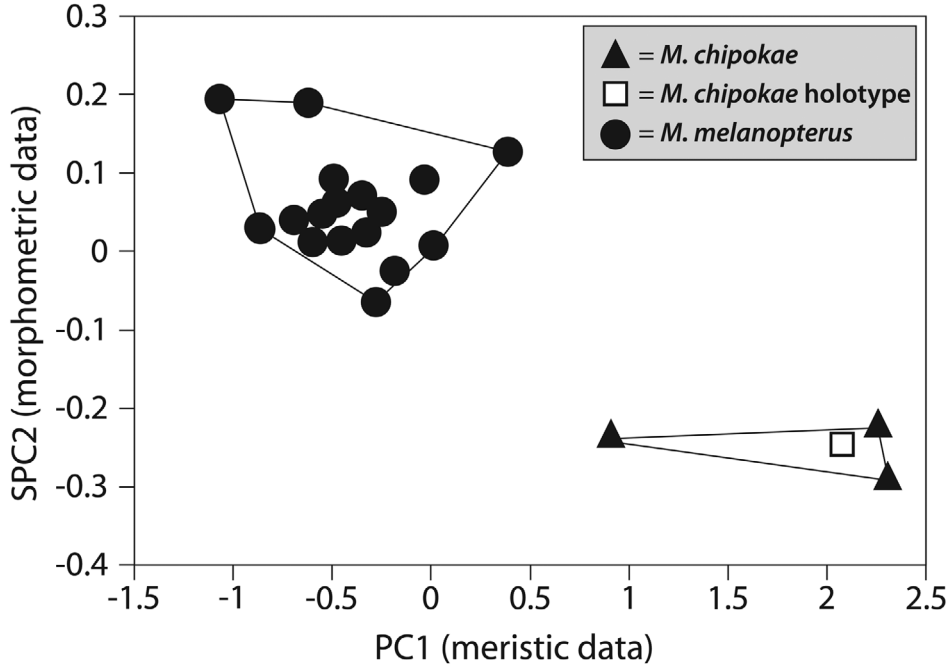

FIGURE 9. Plot of the first principal component of the meristic data (PC1) and the sheared second principal component of the morphometric data (PC2) of *Melanochromis chipokae*, holotype and from Chidunga Rocks (n=3), and of *M. melanopterus* from Thumbi East Island (n=20).

The minimum polygon clusters formed by plotting PC1 of the meristic data against SPC2 of the morphometric data of *M. chipokae* and *M. melanopterus* (Fig. 9) were significantly different between species along each axis of morphological variation. Variables that had the highest loading on the second principal component of the morphometric data were cheek depth (0.51), caudal peduncle length (0.40), and preorbital depth (0.38). The main morphological difference between *M. melanopterus* and *M. chipokae* is the depth of the cheek relative to head length, which varies between 22.9 and 31.7 % in *M. melanopterus* and between 14.8 and 21.3 % in *M. chipokae*.

Males of *M. mpoto* bear a strong resemblance to those of *M. kaskazini*, and our newly described species could be seen as a geographical variant of the latter on the opposite side of the lake. *Melanochromis mpoto* also appears to have a similar foraging behavior, but females and juveniles have a dramatically different colour pattern. Individuals with a putative intermediate colouration between that of *M. mpoto* and *M. kaskazini* have not yet been found. On the contrary, along the northeastern shore of the lake both species occur sympatrically over the entire range of *M. kaskazini*, i.e. from Nkanda to Lundu.

With our present diagnosis of *M. mpoto* there are, to the best of our knowledge, no more members of this genus awaiting formal description. Currently 15 species are recognized as members of *Melanochromis* and we provide an artificial key to these below. The placement of *Labidochromis joanjohnsonae* Johnson 1974 in *Melanochromis*, as suggested by Lewis (1980), is not followed. The species does not agree with the current diagnosis of the genus (Konings-Dudin *et al*. 2009) and we suggest that it remains in *Labidochromis* for the time being. We assert that *Melanochromis*, as defined herein on the basis of the diagnostic colour-reversal pattern, is monophyletic.

Artificial key to *Melanochromis*

1	Basic melanin pattern on flank with horizontal elements only	4
-	Basic melanin pattern on flank with both horizontal and vertical elements	2
2	Vertical bars of melanin pattern wider than horizontal stripes	*M. baliodigma*
-	Vertical bars of melanin pattern narrower than either horizontal stripe	3
3	Interorbital width less than 23 %HL (14.8–21.8 %HL)	*M. mpoto*
-	Interorbital width more than 25 %HL (26.1–29.6 %HL)	*M. robustus* (part)
4	Female and non-breeding male without black markings on posterior half caudal fin	5
-	Female and non-breeding male with black markings on posterior half caudal fin	8

5	Female and non-breeding male cream to gray ground colour	6
-	Female and non-breeding male brown to dark brown ground colour	7
6	Length of snout less than 32 %HL (26.8–31.5 %HL)	*M. heterochromis*
-	Length of snout more than 32 %HL (33.8–38 %HL)	*M. robustus* (part)
7	Interorbital width between 18.5–25.5 %HL and head depth between 80.5–99.4 %HL	*M. vermivorus*
-	Interorbital width between 16.6–20.6 %HL and head depth between 68.7–82.0 %HL	*M. melanopterus*
8	Female and non-breeding male with yellow spots/lines on flank	9
-	Female and non-breeding male with uniform white to cream ground colour	13
9	Female and non-breeding male with solid yellow cheek	10
-	Female and non-breeding male with mainly white cheek	11
10	Lower jaw with 3 or 4 tooth rows	*M. chipokae*
-	Lower jaw with 5–7 tooth rows	*M. auratus*
11	Male with light-blue midlateral stripe on dark background	12
-	Male with blue flank without contrasting midlateral stripe	*M. wochepa*
12	Distance between posterior dorsal fin and pelvic fin origin 52.9–60.7 %SL, snout length 29.2–40.3 %HL, and 3 or 4 rows of scales on cheek	*M. mossambiquensis*
-	Distance between posterior dorsal fin and pelvic fin origin 49.8–55.8 %SL, snout length 25.9–35.2 %HL, and 4–7 rows of scales on cheek	*M. dialeptos*
13	Female and non-breeding male with white to cream anal fin with black submarginal band	14
-	Female and non-breeding male with yellow/orange anal fin without black markings	*M. kaskazini*
14	Body depth less than 27% SL (Eccles 1973: 26 %SL)	*M. simulans*
-	Body depth more than 27% SL (27.3–40.6 %SL)	15
15	Dorsal-fin base length 59.5–62.9 %SL; male with dark flank and light-blue midlateral stripe	*M. loriae*
-	Dorsal-fin base length 51.0–58.2 %SL; male with light-blue flank without contrasting midlateral stripe	*M. lepidiadaptes*

Comparative material examined

Melanochromis heterochromis*:** PSU 4548, 18, 47.4–62.4 mm SL and AMNH 246009, 2, 56.2–59.1; Malaŵi, Lake Malaŵi, Thumbi East Island (Monkey Bay), 14° 3.84' S, 34° 55.26' E, Stauffer and Konings, 10 Oct. 2004. ***Melanochromis melanopterus*:** PSU 4547, 16, 54.5–76.4 mm SL and AMNH 246005, 2, 58.6–71.6; Malaŵi, Lake Malaŵi, Thumbi East Island, 14° 03.84' S, 34° 55.26' E, Stauffer and Konings, 10 Oct. 2004. ***Pseudotropheus brevis: PSU10566, 7, 91.6–116.3 mm SL; Malaŵi, Lake Malaŵi, Boadzulu Island, 14° 15.31' S, 35° 08.49' E, Stauffer and Konings, 4 Feb. 2003. ***Pseudotropheus brevis***: PSU10567, 2, 107.7–116.8 mm SL; Malaŵi, Lake Malaŵi, Boadzulu Island, 14° 15.31' S, 35° 08.49' E, Stauffer and Konings, 9 Feb. 2004.

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