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# Two new species of *Stigmatochromis* (Teleostei: Cichlidae) from Lake Malawi, Africa

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# Two new species of *Stigmatochromis* (Teleostei: Cichlidae) from Lake Malaŵi, Africa

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*Abstract.*—Species of *Stigmatochomis* are haplochromine cichlids endemic to Lake Malaŵi, and the genus currently includes four species, *S. woodi* (type species), *S. modestus, S. pholidophorus*, and *S. pleurospilus*. The latter two are known from only their holotypes. Herein, we describe two additional species, *Stigmatochromis macrorhynchos* and *Stigmatochromis melanchros* from southern Lake Malaŵi.

**Keywords:** haplochromine cichlids, sand-dwelling cichlids

Historically, the Lake Malaŵi sand-dwelling cichlid genera have been diagnosed primarily on the basis of their melanin pattern (Eccles & Trewavas 1989). Members of *Stigmatochromis* possess a supra-pectoral, supra-anal, and a pre-caudal spot; the first two spots do not extend to the base of the dorsal fin, as in *Hemitilapia, Trematocranus,* and *Tramitichromis intermedius*. The spot or blotch at the nape and a series of small spots along the base of the dorsal fin distinguish *Stigmatochromis* from the spotted species of *Copadichromis*, which lack such pigmentation. Currently, *Stigmatochromis* is comprised of four species: *S. woodi* (type species), *S. modestus, S. pholidophorus*, and *S. pleurospilus*. Species of *Stigmatochromis* over 60 mm SL differ from those of *Otopharynx* by a snout that is longer or about as long as the post-orbital head length, while the snout in *Otopharynx* is always shorter. *Stigmatochromis* is further characterized by a prognathous lower jaw and by numerous unicuspid teeth in the outer series of the oral jaws. In three of the four species (not in *S. pleurospilus*) there are 50 to 74 teeth in the outer row of the upper jaw (Eccles & Trewavas 1989). The unique holotype of *Stigmatochromis pleurospilus* does not comply with this diagnosis and we agree with Eccles & Trewavas (1989) that it probably represents a juvenile of another species in the genus. We have no doubt that the type is a juvenile specimen, which is not only suggested by the relatively large eye, but also by its overall size. The purpose of this paper is to describe two additional species of *Stigmatochromis* from Lake Malaŵi.

## Materials and Methods

Fishes were collected in Lake Malaŵi by chasing them into a monofilament block net while SCUBA diving. All fishes were anesthetized with clove oil, euthanized in 1% formalin, pinned in trays so that the bodies were flat and the fins erect, preserved in 10% formalin, and placed in permanent storage in 70% ethanol. Pigmentation patterns and colors were recorded in the field via direct observation, photography, and videography. Counts and measurements follow Stauffer (1991) and Stauffer & Konings (2006).

Morphometric data were analyzed using a sheared principal component anal-

ysis, which factors the covariance matrix and restricts size variation to the first principal component (Humphries et al. 1981, Bookstein et al. 1985). Meristic data were analyzed using a principal component analysis in which the correlation matrix was factored. Differences among species were illustrated by plotting the sheared second principal components (SPC2) of the morphometric data against the first principal components (PC1) of the meristic data (Stauffer & Hert 1992). Institutional abbreviations follow Leviton et al. (1985).

## Results

The diagnoses and descriptions of *S. modestus*, *S. woodi* (Table 1), and *S. pleurospilus* (Table 2) were summarized by Cleaver et al. (2009). Morphometric and meristic data are given below for all other *Stigmatocrhomis* species, including the description of two additional taxa.

### *Stigmatochromis pholidophorus* (Trewavas)
Fig. 1A, Table 2

*Holotype*.—BMNH 1935.6.14.1544, 85.7 mm SL, collected by Christy from northern Lake Malaŵi.

*Diagnosis*.—The presence of a supra-pectoral and supra-anal spots, which do not extend to the base of the dorsal fin, plus a precaudal spot and a series of small spots along the base of the dorsal fin places this species in *Stigmatochromis*. *Stigmatochromis pholidophorus* is further diagnosed by the presence of mostly unicuspid teeth in the outer rows of the lower jaws. The short head length (33.3 vs. 36.3–39.8% SL) and the distance between snout and dorsal-fin origin (34.5 vs. 34.8–43.2% SL) distinguish this species from all other *Stigmatochromis* species.

*Description*.—Jaws prognathous; teeth on jaws in 3 rows; teeth in outer row unicuspid; 22 teeth in outer row of left lower jaw; scale rows on cheek 4; lateral-line scales 30; 1 pored scale posterior to hypural plates. Gill rakers on first ceratobranchial 11, with 4 on epibranchial. Principal morphometric ratios and meristics in Table 2.

### ***Stigmatochromis macrorhynchos***, new species
Fig. 2, Table 3

*Holotype* (Fig. 2A).—PSU 4774, 128.2 mm SL, off Domwe Island, Lake Malaŵi, Malaŵi, Africa 13°59.56′S, 34°51.26′E; 108 m deep, 7 Mar 1995, collected by the Malaŵi Fisheries Department.

*Paratypes*.—PSU 4775, 4, 116.6–124.8 mm SL, data as for holotype.

*Diagnosis*.—The presence of supra-pectoral and supra-anal spots, which do not extend to the base of the dorsal fin, combined with a snout length longer than the post-orbital head length distinguishes this species as a member of *Stigmatochromis*. It is further diagnosed by the presence of mostly unicuspid teeth in the outer rows of the lower jaws. *Stigmatochromis macrorhynchos* has a narrower interorbital width than *S. melanchros* (13.7–16.2 vs. 19.3–20.5% HL) and a shorter snout to pelvic-fin origin (38.4–40.3% SL) than *S. melanchros* (42.2–44.6% SL) and *S. modestus* (42.2–46.9% SL). The distance between the dorsal fin origin and the posterior anal fin insertion is shorter in *S. macrorhynchos* (51.2–51.8% SL) than in all other *Stigmatochromis* species (53.5–57.2% SL). The distance between the anterior dorsal fin to pelvic-fin origin of *S. macrorhynchos* (27.7–30.0% SL) is shorter than in *S. modestus* (30.3–33.8% SL), *S. woodi* (31.9–38.1% SL) and *S. melanchros* (35.7–36.1), and longer than in *S. pholidophorus* (26.8% SL) and *S. pleurospilus* (27.5% SL). The snout length of *S. macrorhynchos* (38.0–41.2% HL) is longer than in *S. modestus* (33.5–37.4% HL) and *S. pholidophorus* (37.1% HL). The smaller

Table 1.—Morphometric and meristic values of *Stigmatochromis modestus* and *Stigmatochromis woodi*.

| | *Stigmatochromis modestus* ($n$ = 7) | | | *Stigmatochromis woodi* ($n$ = 12) | | |
|---|---|---|---|---|---|---|
| | Holotype | $\bar{X}$ | Range | Lectotype | $\bar{X}$ | Range |
| Standard length, mm | 120.0 | 93.6 | 67.3–124.1 | 173.2 | 151.0 | 104.0–173.2 |
| Head length, mm | 45.2 | 34.7 | 26.6–47.6 | 64.8 | 56.7 | 38.6–65.7 |
| Percent standard length | | | | | | |
| Head length | 37.7 | 38.8 | 37.7–39.8 | 37.4 | 37.5 | 36.4–38.3 |
| Snout to dorsal-fin origin | 39.6 | 41.2 | 39.2–43.2 | 39.8 | 39.7 | 34.8–41.8 |
| Snout to pelvic-fin origin | 42.2 | 44.8 | 42.2–46.9 | 38.5 | 40.5 | 38.5–44.6 |
| Dorsal-fin base length | 51.4 | 51.9 | 49.5–53.3 | 51.1 | 50.8 | 50.0–52.5 |
| Anterior dorsal to anterior anal | 45.1 | 43.8 | 42.0–45.9 | 43.3 | 45.5 | 43.0–48.2 |
| Anterior dorsal to posterior anal | 55.9 | 55.4 | 53.6–57.2 | 55.0 | 54.8 | 53.5–56.9 |
| Posterior dorsal to anterior anal | 27.6 | 27.3 | 25.9–28.0 | 28.6 | 28.7 | 26.3–30.0 |
| Posterior dorsal to posterior anal | 15.0 | 14.4 | 13.9–15.0 | 14.8 | 15.2 | 14.1–15.9 |
| Posterior dorsal to ventral caudal | 18.2 | 17.6 | 15.8–19.1 | 18.8 | 19.4 | 18.4–21.1 |
| Posterior anal to dorsal caudal | 18.7 | 19.3 | 18.5–21.7 | 20.9 | 21.6 | 20.8–23.5 |
| Anterior dorsal to pelvic-fin origin | 31.9 | 32.2 | 30.3–33.8 | 33.9 | 35.2 | 31.9–38.1 |
| Posterior dorsal to pelvic-fin origin | 48.1 | 49.0 | 47.2–50.7 | 50.8 | 50.5 | 49.5–51.9 |
| Caudal-peduncle length | 12.9 | 13.4 | 12.8–14.5 | 14.7 | 15.2 | 14.4–15.7 |
| Least caudal-peduncle depth | 12.2 | 11.8 | 11.4–12.3 | 10.4 | 11.0 | 10.1–11.6 |
| Percent head length | | | | | | |
| Snout length | 37.4 | 35.5 | 33.5–37.4 | 40.2 | 39.6 | 37.9–42.0 |
| Postorbital head length | 38.5 | 35.9 | 33.3–38.6 | 36.1 | 35.6 | 34.0–38.6 |
| Horizontal eye diameter | 27.9 | 30.2 | 26.7–33.8 | 28.3 | 28.8 | 27.0–32.6 |
| Vertical eye diameter | 25.6 | 27.5 | 23.6–31.1 | 24.6 | 24.8 | 22.8–28.1 |
| Preorbital depth | 22.9 | 19.3 | 17.1–22.9 | 26.5 | 24.8 | 22.6–26.5 |
| Cheek depth | 24.8 | 20.4 | 17.5–24.8 | 24.6 | 24.3 | 21.6–27.2 |
| Lower-jaw length | 48.3 | 46.4 | 45.2–48.3 | 42.1 | 43.6 | 42.1–47.0 |
| Head depth | 69.0 | 66.9 | 63.3–70.0 | 64.1 | 72.2 | 64.1–75.8 |
| Interorbital width | 19.5 | 17.0 | 14.7–19.5 | 15.8 | 16.5 | 14.5–20.0 |
| Premaxillary pedicel length | 27.4 | 25.2 | 23.3–27.4 | 23.9 | 23.9 | 21.3–26.2 |
| Percent eye diameter | | | | | | |
| Preorbital depth/vertical eye diameter | 89.5 | 71.2 | 55.2–89.5 | 98.4 | 100.4 | 80.4–112.0 |
| Preorbital depth/horizontal eye diameter | 82.0 | 64.6 | 50.8–82.0 | 89.3 | 86.6 | 69.3–94.9 |
| Counts | | Mode | Range | | Mode | Range |
| Dorsal-fin spines | 17 | 16 | 16–17 | 16 | 16 | 15–16 |
| Dorsal-fin rays | 11 | 11 | 10–12 | 10 | 10, 11 | 10–11 |
| Anal-fin spines | 3 | 3 | 3 | 3 | 3 | 3 |
| Anal-fin rays | 9 | 9 | 8–10 | 9 | 9 | 9 |
| Pectoral-fin rays | 13 | 13 | 12–13 | 13 | 13, 14 | 13–14 |
| Pelvic-fin rays | 5 | 5 | 5 | 5 | 5 | 5 |
| Lateral-line scales | 29 | 30 | 29–31 | 31 | 31 | 30–32 |
| Pored scales posterior to lateral line | 1 | 2 | 0–2 | 1 | 2 | 1–2 |
| Scale rows on cheek | 3 | 3 | 3 | 3 | 3 | 2–4 |
| Gill rakers on first ceratobranchial | 11 | 11 | 10–12 | 9 | 11 | 9–12 |
| Gill rakers on first epibranchial | 3 | 4 | 3–5 | 4 | 4 | 3–5 |
| Teeth in outer row of left lower jaw | 28 | 27 | 24–28 | 21 | 20 | 16–24 |
| Tooth rows on upper jaw | 3 | 3 | 3–4 | 3 | 3 | 2–3 |
| Tooth rows on lower jaw | 3 | 3 | 2–3 | 3 | 3 | 2–3 |

head depth of *S. macrorhynchos* (59.8–63.6% HL) further distinguishes it from *S. woodi* (64.1–75.8% HL) and *S. melanchros* (67.8–76.8% HL).

*Description.*—Jaws strongly prognathous (Fig. 2A); teeth on jaws in 3 rows; teeth in outer row unicuspid; 21–26 teeth in outer row of left lower jaw; scale rows

Table 2.—Morphometric and meristic values of holotypes of *Stigmatochromis pholidophorus* and *Stigmatochromis pleurospilus*.

| | *Stigmatochromis pholidophorus* | *Stigmatochromis pleurospilus* |
|---|---|---|
| Standard length, mm | 85.7 | 40.3 |
| Head length, mm | 28.5 | 13.5 |
| Percent standard length | | |
| Head length | 33.3 | 33.5 |
| Snout to dorsal-fin origin | 34.5 | 36.1 |
| Snout to pelvic-fin origin | 38.8 | 39.4 |
| Dorsal-fin base length | 51.6 | 53.0 |
| Anterior dorsal to anterior anal | 41.9 | 43.4 |
| Anterior dorsal to posterior anal | 54.4 | 56.5 |
| Posterior dorsal to anterior anal | 28 | 27.5 |
| Posterior dorsal to posterior anal | 14.6 | 14.3 |
| Posterior dorsal to ventral caudal | 18.1 | 18.1 |
| Posterior anal to dorsal caudal | 21.4 | 21.1 |
| Anterior dorsal to pelvic-fin origin | 26.8 | 27.5 |
| Posterior dorsal to pelvic-fin origin | 49.5 | 46.4 |
| Caudal-peduncle length | 16.6 | 17.0 |
| Least caudal-peduncle depth | 11.2 | 10.7 |
| Percent head length | | |
| Snout length | 37.1 | 20.7 |
| Postorbital head length | 33.1 | 35.8 |
| Horizontal eye diameter | 33.9 | 42.6 |
| Vertical eye diameter | 29.5 | 36.7 |
| Preorbital depth | 22.2 | 14.9 |
| Cheek depth | 16.7 | 15.9 |
| Lower-jaw length | 41.6 | 37.0 |
| Head depth | 69.8 | 73.5 |
| Interorbital width | 20.8 | 19.8 |
| Premaxillary pedicel length | 29.1 | 24.1 |
| Percent eye diameter | | |
| Preorbital depth/vertical eye diameter | 75.4 | 40.5 |
| Preorbital depth/horizontal eye diameter | 65.6 | 35.0 |
| Counts | | |
| Dorsal-fin spines | 16 | 15 |
| Dorsal-fin rays | 11 | 12 |
| Anal-fin spines | 3 | 3 |
| Anal-fin rays | 10 | 9 |
| Pectoral-fin rays | 13 | 14 |
| Pelvic-fin rays | 5 | 5 |
| Lateral-line scales | 30 | 29 |
| Pored scales posterior to lateral line | 1 | 1 |
| Scale rows on cheek | 4 | 3 |
| Gill rakers on first ceratobranchial | 11 | 9 |
| Gill rakers on first epibranchial | 4 | 3 |
| Teeth in outer row of left lower jaw | 22 | 17 |
| Tooth rows on upper jaw | 3 | 4 |
| Tooth rows on lower jaw | 3 | 3 |

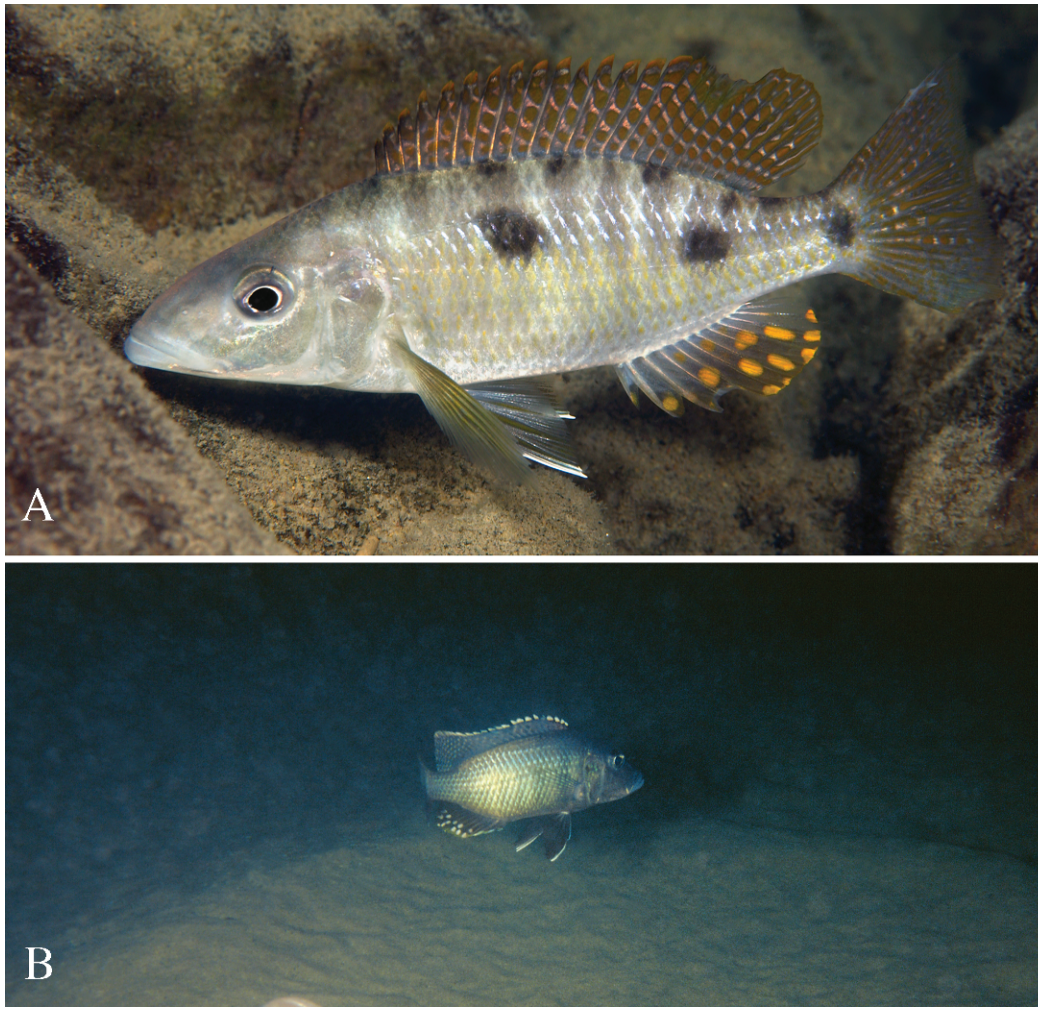


Fig. 1. A, *Stigmatochromis pholidophorus*; adult individual (approximately 13 cm TL) at Chiofu Bay, Malaŵi in Lake Malaŵi. B, territorial male *Stigmatochromis woodi* (approximately 22 cm TL) guarding his sand bower at Luwala Reef, Malaŵi, Lake Malaŵi.

on cheek 3; holotype with 33 lateral-line scales; paratypes with 32–34; pored scales posterior to hypural plates 1–2. Gill rakers on first ceratobranchial 10–12, with 4 on epibranchial. Principal morphometric ratios and meristics in Table 3.

Males (Fig. 2B) with dark gray head anteriorly fading to light gray/silver posteriorly; pale yellow outline of lower jaw. Laterally dark blue/gray dorsally, fading to silver ventrally with 9 dark gray bars. Scales with blue highlights. Dorsal fin pale yellow with light yellow/white markings; blue/white lappets with dark submarginal band. Caudal fin light gray with blue/white markings. Anal fin with black spines and membranes; dark gray rays and membranes with light red and yellow ocelli. Pelvic fins black and pectoral fins clear.

Females with dark gray interorbital and white/silver cheeks and operculum. Laterally, silver with yellow highlights. Dorsal fin clear with faint orange marginal bar and yellow highlights. Caudal fin clear with yellow markings in membranes. Anal fin clear with several yellow


Fig. 2. *Stigmatochromis macrorhynchos*. A, PSU4774, holotype, 128.2 mm SL, off Domwe Island, Malaŵi, Lake Malaŵi. B, non-territorial male (approximately 12 cm TL) at Mumbo Island, Malaŵi, Lake Malaŵi.

ocelli. Pelvic fin clear with white leading edge; pectoral fin clear.

*Etymology*.—Specific epithet a noun in apposition from Greek *makros* meaning "long" and *rhynchos* meaning "snout," referring to the elongated snout of this species.

***Stigmatochromis melanchros***, new species
Fig. 3, Table 3

*Holotype* (Fig. 3A).—PSU 4944, 160.73 mm SL, Mazinzi Reef, Lake Malaŵi, Malaŵi, Africa; 13°53′S, 34°53′E, 10 Mar 1996, J. Stauffer.

*Paratypes*.—PSU 4945, 1, 154.15 mm SL, Mazinzi Reef, Lake Malaŵi, Malaŵi, Africa, 23 Mar 1996, J. Stauffer; PSU 4947, 1, 154.68 mm SL, Mazinzi Reef, Lake Malaŵi, Malaŵi, Africa, 7 Mar 1995, J. Stauffer; PSU 4609, 1, 114.5 mm SL, Mazinzi Reef, Lake Malaŵi, 5 Mar 2002, J. Stauffer.

*Diagnosis*.—The presence of supra-pectoral and supra-anal spots, which do not extend to the base of the dorsal fin, plus a precaudal spot and a series of small spots along the base of the dorsal fin, combined with a snout length longer than the post-orbital head length distinguishes this species as a member of *Stigmatochromis*. It is further diagnosed by the presence of mostly unicuspid teeth in the outer rows of the lower jaws. *Stigmatochromis melanchros* is distinguished from *S. macro-*

Table 3.—Morphometric and meristic values of *Stigmatochromis macrorhynchos* ($n$ = 5) and *Stigmatochromis melanchros* ($n$ = 4).

| | *Stigmatochromis macrorhynchos* | | | *Stigmatochromis melanchros* | | |
|---|---|---|---|---|---|---|
| | Holotype | $\bar{X}$ | Range | Holotype | $\bar{X}$ | Range |
| Standard length, mm | 128.2 | 121.6 | 116.6–128.2 | 160.7 | 146 | 114.5–160.7 |
| Head length, mm | 46.5 | 45.6 | 44.5–46.5 | 60.9 | 54.7 | 43.4–60.9 |
| Percent standard length | | | | | | |
| Head length | 36.3 | 37.5 | 36.3–38.4 | 37.9 | 37.5 | 36.8–37.9 |
| Snout to dorsal-fin origin | 36.6 | 38.2 | 36.6–40.0 | 34.8 | 36.1 | 34.8–37.2 |
| Snout to pelvic-fin origin | 38.4 | 39.5 | 38.4–40.3 | 44.6 | 43 | 42.2–44.6 |
| Dorsal-fin base length | 49 | 48.8 | 48.4–49.3 | 50.3 | 50.3 | 49.4–51.4 |
| Anterior dorsal to anterior anal | 39.5 | 41 | 39.5–42.2 | 44.4 | 46.5 | 44.4–47.7 |
| Anterior dorsal to posterior anal | 51.3 | 51.5 | 51.2–51.8 | 54.2 | 55 | 54.2–56.6 |
| Posterior dorsal to anterior anal | 27.1 | 26.8 | 26.0–27.4 | 29.7 | 29.5 | 29.0–29.7 |
| Posterior dorsal to posterior anal | 14 | 14.3 | 14.0–14.8 | 14.8 | 15.2 | 14.8–15.5 |
| Posterior dorsal to ventral caudal | 20.4 | 19.4 | 19.0–20.4 | 18.4 | 19.7 | 18.4–21.1 |
| Posterior anal to dorsal caudal | 23.3 | 22.2 | 21.4–23.3 | 22.3 | 22.6 | 22.2–23.5 |
| Anterior dorsal to pelvic-fin origin | 27.7 | 28.7 | 27.7–30.0 | 35.7 | 36 | 35.7–36.1 |
| Posterior dorsal to pelvic-fin origin | 49.1 | 48.2 | 46.7–49.1 | 50.1 | 50.4 | 49.4–51.6 |
| Caudal-peduncle length | 18.1 | 17 | 16.0–18.1 | 15.1 | 15.1 | 13.5–16.2 |
| Least caudal-peduncle depth | 11 | 10.7 | 10.3–11.1 | 10.7 | 11.3 | 10.7–11.9 |
| Percent head length | | | | | | |
| Snout length | 38.9 | 39 | 38.0–41.2 | 38.7 | 38.6 | 36.2–40.2 |
| Postorbital head length | 35 | 34.1 | 32.4–35.0 | 37.5 | 37.7 | 37.0–38.3 |
| Horizontal eye diameter | 29.1 | 30.6 | 29.1–31.4 | 26 | 26 | 25.2–26.8 |
| Vertical eye diameter | 26.2 | 26.8 | 26.2–27.9 | 21 | 22.2 | 21.0–23.7 |
| Preorbital depth | 22 | 21.9 | 20.5–23.3 | 22.6 | 23 | 22.6–23.4 |
| Cheek depth | 20.8 | 19.8 | 18.6–20.9 | 23.5 | 24.8 | 23.5–26.3 |
| Lower-jaw length | 44 | 44.2 | 42.4–47.7 | 42.7 | 42.7 | 40.7–44.4 |
| Head depth | 62.9 | 62.1 | 59.8–63.6 | 76.8 | 72.8 | 67.8–76.8 |
| Interorbital width | 16.2 | 14.7 | 13.7–16.2 | 19.8 | 19.9 | 19.3–20.5 |
| Premaxillary pedicel length | 22.1 | 20.2 | 19.0–22.1 | 21.2 | 21.7 | 20.5–23.7 |
| Percent eye diameter | | | | | | |
| Preorbital depth/vertical eye diameter | 84.2 | 81.8 | 73.5–86.9 | 107.6 | 103.8 | 95.8–109.3 |
| Preorbital depth/horizontal eye diameter | 75.6 | 71.8 | 65.3–76.4 | 86.9 | 88.4 | 84.7–92.9 |
| Counts | | Mode | Range | | Mode | Range |
| Dorsal-fin spines | 16 | 16 | 15–16 | 16 | 16 | 15–16 |
| Dorsal-fin rays | 10 | 10 | 10–11 | 10 | 10, 11 | 10–11 |
| Anal-fin spines | 3 | 3 | 3 | 3 | 3 | 3 |
| Anal-fin rays | 8 | 9 | 8–9 | 8 | 8, 9 | 8–9 |
| Pectoral-fin rays | 13 | 13 | 13 | 13 | 13, 14 | 13–14 |
| Pelvic-fin rays | 5 | 5 | 5 | 5 | 5 | 5 |
| Lateral-line scales | 33 | 32, 33 | 32–34 | 32 | 31, 32 | 31–32 |
| Pored scales posterior to lateral line | 2 | 2 | 1–2 | 2 | 2 | 2–3 |
| Scale rows on cheek. | 3 | 3 | 3 | 3 | 3 | 3 |
| Gill rakers on first ceratobranchial | 11 | 11 | 10–12 | 12 | 12 | 9–12 |
| Gill rakers on first epibranchial | 4 | 4 | 4 | 4 | 4 | 3–5 |
| Teeth in outer row of left lower jaw | 21 | 21, 22, 23, 25, 26 | 21–26 | 13 | 13, 17, 18, 19 | 13–19 |
| Tooth rows on upper jaw | 3 | 3 | 2–3 | 4 | 3, 4 | 3–4 |
| Tooth rows on lower jaw | 3 | 3 | 2–3 | 3 | 3 | 3 |

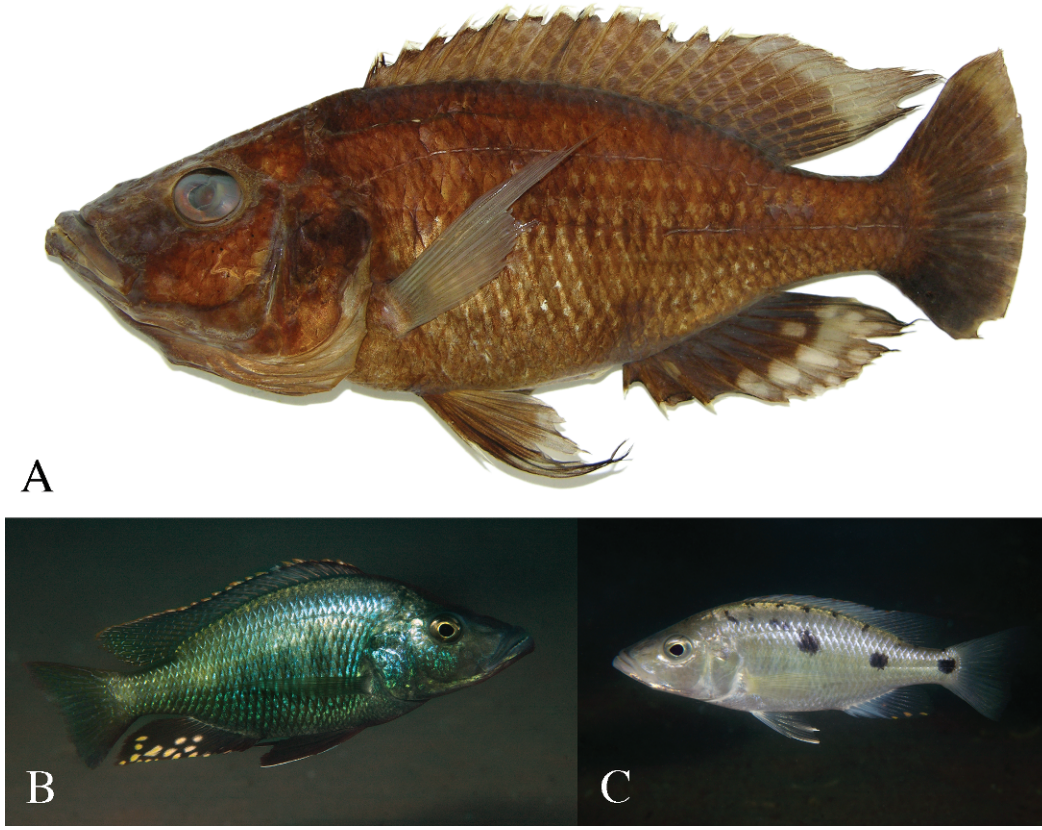


Fig. 3. *Stigmatochromis melanchros*. A, PSU4944, holotype, 160.7 mm SL, Mazinzi Reef, Malaŵi, Lake Malaŵi. B, male (approximately 19 cm TL). C, female (approximately 17 cm TL) at Mazinzi Reef, Malaŵi, Lake Malaŵi.

*rhynchos* by a wider interorbital width (19.3–20.5 vs. 13.7–16.2% HL) and from *S. pholidophorus* by a larger preorbital depth in relation to the vertical eye diameter (95.8–109.3% vs. 75.4%). *Stigmatochromis melanchros* is distinguished from *S. modestus* by a shorter lower jaw (40.7–44.4% HL vs. 45.2–48.3% HL) and by fewer teeth in the outer row of the left lower jaw (13–19 vs. 24–28). *Stigmatochromis melanchros* has a smaller horizontal eye diameter (25.2–26.9% HL) than *S. woodi* (27.0–32.6% HL).

*Description*.—Jaws prognathous (Fig. 3A); teeth on jaws in 3–4 rows; teeth in outer row unicuspid; teeth in outer row of left lower jaw 13–19; scale rows on cheek 3; holotype with 32 lateral-line scales; paratypes with 31–32; pored scales posterior to hypural plate 2–3. Gill rakers on first ceratobranchial 9–12, with 3–5 on epibranchial. Principal morphometric ratios and meristics in Table 3.

Males (Fig. 3B) with anterior portion of head dark gray and posterior portion light gray/silver with green highlights. Laterally, dark blue/black with scales outlined in blue/green. Dorsal fin dark gray with blue/green highlights and orange and white tips. Caudal fin dark gray with blue/white markings. Anal fin black with pale yellow/white ocelli. Pelvic fins black with white leading edge. Pectoral fins with gray rays and clear membranes.

Females (Fig. 3C) with gray interorbital and gray/white cheeks and operculum. Laterally, silver with pale orange outline

of scales; three lateral spots and a series of black markings along base of dorsal fin. Dorsal fin clear with faint orange markings. Caudal fin clear with gray markings in membranes. Anal fin clear with several yellow ocelli. Pelvic fin clear with white leading edge; pectoral fin clear.

*Etymology*.—Specific epithet is a noun in apposition derived from the Greek *melas*, meaning "black" and from *khros* meaning "skin" or "surface of body" in reference to the overall black color of the breeding males.

*Remarks*.—*Stigmatochromis melanchros* is a piscivore that breeds in rocky reefs where territorial males defend the vertical face of a large boulder near the sandy bottom. This differs from the sympatric *S. woodi*; males of which build large bowers on the open sand away from any rocks (Fig. 1B).

## Discussion

Eccles & Trewavas (1989) originally diagnosed *Stigmatochromis* based on the melanin pattern that consisted of a small supra-pectoral spot below the upper lateral line, a small supra-anal spot between the upper and lower lateral line, and a spot near the end of the caudal peduncle. Cleaver et al. (2009) expanded on this diagnosis and stated that the anterior two spots of *Stigmatochromis* do not extend to the base of the dorsal fin, which separates *Stigmatochromis* from *Hemitilapia, Trematocranus,* and *Tramitichromis intermedius*, which have spots that extend to the base of the dorsal fin. Additionally, the absence of a series of small spots along the base of the dorsal fin distinguishes *Stigmatochromis* from spotted *Copadichromis*, which lack such spots. Finally, they stated that in members of *Stigmatochromis* greater than 60 mm SL, the snout is longer or equal to the postorbital-head length, which differentiates them from those of *Otopharynx*, in which the snout length is always shorter than the postorbital-head length.

When the sheared second principal components of the morphometric data are plotted against the principal components of the meristic data, the minimum polygon clusters of the five species of *Stigmatochromis* do not overlap apart from that of *S. woodi* and *S. melanchros* (Fig. 4). The latter two species occur sympatrically and have distinguishable breeding strategies. Males of *S. woodi* construct large spawning platforms in the sand (Fig. 1B), away from the rocky substrate, whereas those of *S. melanchros* defend the vertical face of a large boulder that sits on the sand, usually at the edge of a rocky reef.

*Stigmatochromis pleurospilus* is problematic as reported earlier (Cleaver et al. 2009). Eccles & Trewavas (1989) placed this species in *Stigmatochromis* based on pigment patterns. Examination of the holotype reveals that it has bicuspid teeth in the outer row of the lower jaw, which we also found in some juveniles of *S. woodi* and *S. melanchros* (non-type material). A detailed examination of the holotype (BMNH 1935.6.14.1475) revealed that many of its scales are reversed, possibly by maltreatment of the specimen or that a deformed individual was preserved. We have retained *S. pleurospilus* in *Stigmatochromis*, because at this time we cannot justify its placement in any of the other Lake Malaŵi genera.

## Comparison Material

*Stigmatochromis woodi*. Lectotype: BMNH 1921.9.6.139–144, 173.1 mm SL; Paralectotypes: BMNH 1921.9.6.139–144, 5, 103.99–170.2 mm SL; PSU 4610, 2, 171.7–174.0 mm SL, Mazinzi Reef, Lake Malaŵi, Malaŵi, Africa, J. Stauffer, 7 Mar 1995; PSU 4946, 2, 147.3–162.6 mm SL, Mazinzi Reef, Lake Malaŵi, J. Stauffer, 5 Mar 1996; PSU 4948, 2, 142.5–177.4 mm SL, Mazinzi Reef, Lake Malaŵi, J. Stauffer, 5 Mar 2002.

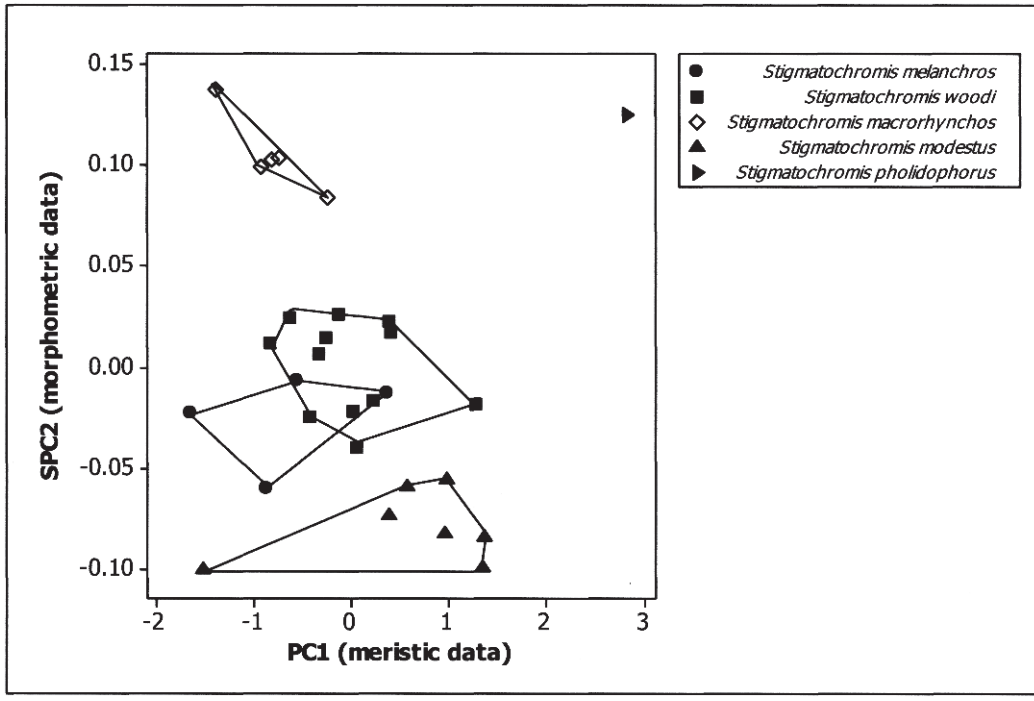


Fig. 4. Second sheared principal components (morphometric data) plotted against first principal components (meristic data) of *Stigmatochromis* spp.

*Stigmatochromis modestus*. Holotype: BMNH 1893 1.17.5, 120.0 mm SL, Lake Malawi, Williams, 1891; PSU 4466, 6, 67.3–124.1 mm SL; Malawi: Lake Malawi: Nametumbwe, 13°38.290′S, 34°51.334′E, Stauffer & Konings, 25 Jan 2007.

*Stigmatochromis pleurospilus*. Holotype: BMNH 1935.6.14.1475, 40.3 mm SL, Tanzania, Lupembe Sandbank, Christy, 1925–1926.

*Stigmatochromis pholidophorus*. Holotype: BMNH 1935.6.14.1544, 85.7 mm SL, Malawi, Lake Malawi, Vua, Christy, 1925–1926.

## Key to the Species of *Stigmatochromis*

1a. Head length less than 35 SL ..... 2
1b. Head length greater than 35 SL .... 3
2a. Snout length less than 30% HL ... ..... *S. pleurospilus*
2b. Snout length greater than 30% HL ... ..... *S. pholidophorus*
3a. Snout to pelvic-fin origin less than 41% SL ..... 4
3b. Snout to pelvic-fin origin greater than 41% SL ..... 5
4a. Anterior dorsal to pelvic-fin origin less than 31% SL ..... *S. macrorhynchos*
4b. Anterior dorsal to pelvic-fin origin greater than 31% SL ..... *S. woodi* (in part)
5a. Posterior dorsal fin to anterior anal fin greater than 28.5% SL ..... 6
5b. Posterior dorsal fin to anterior anal fin less than 28.5% SL ..... *S. modestus*
6a. Horizontal eye diameter 25.2–26.9% HL ..... *S. melanchros*
6b. Horizontal eye diameter 27.0–32.6% HL ..... *S. woodi* (in part)

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