

distribution of *E. perryi* other than its presence off the Caribbean coast of Colombia and Venezuela. Seven *E. virens* were taken syntopically at Oregon II station 11252.

An interesting feature of the color patterns in *E. perryi* and in *E. hillianus* is that some of the black areas appear to be produced by photophores and some by chromatophores or melanophores. In the series of post-pelvic black areas present on the ventral side in *E. perryi* and *E. hillianus* it can be seen with the low power microscope that the color may come either from comparatively large photophores, or from very small chromatophores. Fig. 3B shows the appearance in an example of *E. perryi* in which the middle black area is colored by melanophores and the other two areas by photophores.

*Etymology.*—Named for Perry W. Gilbert in recognition of his contributions to our knowledge of elasmobranch reproduction and to other aspects of shark biology.

#### ACKNOWLEDGMENTS

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#### LITERATURE CITED

Springer, S. 1979. A revision of the catsharks, family Scyliorhinidae. NOAA Tech. Rep. NMFS Circ. 422, 152 pp.

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## *Cyrtocara macrocleithrum*, A Deep-water Cichlid (Teleostei: Cichlidae) from Lake Malawi, Africa

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**A deep-water cichlid in the genus *Cyrtocara* is described from Lake Malawi, Africa. The appearance of the fish is dominated by an unusual ventral protuberance below the posterior part of the head. This protuberance is caused by the elongated tips of the cleithrum. We hypothesize that this species is most closely related to a group of undescribed deep water forms tentatively placed in the genus *Trematocranus*.**

THE rift valley lakes of Africa harbor the most speciose ichthyofauna of any of the world's lakes. The rich faunas of these lakes are primarily attributable to the explosive radiation and speciation of the endemic haplochromine cichlids (Regan, 1921; Trewavas, 1935; Greenwood, 1979). We estimate that over half of this fauna remains undescribed. Taxonomic revisions of the following Lake Malawi groups re-

cently have been made: *Docimodus* Boulenger (Eccles and Lewis, 1976), *Lethrinops* Regan (Eccles and Lewis, 1977, 1978, 1979, in prep.), *Labidochromis* Trewavas (Lewis, 1982) and a group of *Petrotilapia* Trewavas species (Marsh, 1983). A survey of the "mbuna" (rock-dwelling) cichlids has recently been published by Ribbink et al. (1983). Lewis is preparing a taxonomic revision of this group.

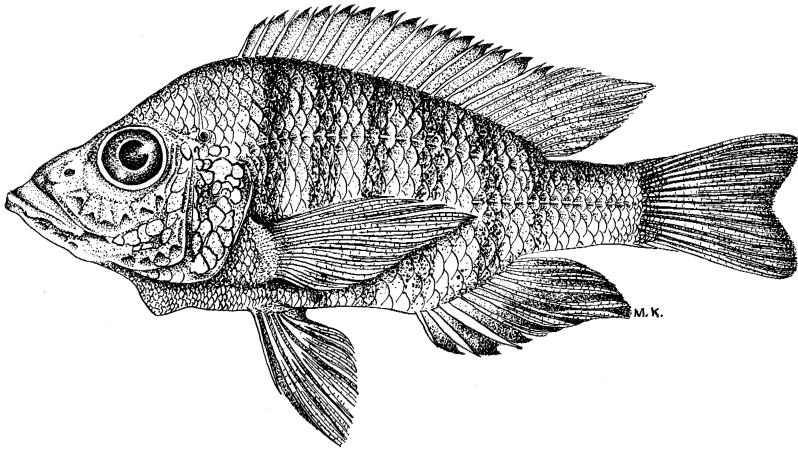


Fig. 1. Holotype (male) of *Cyrtocara macrocleithrum*, USNM 268475.

The purpose of this paper is to describe a species which has been mentioned in the aquarist literature. Axelrod and Burgess (1981:290) published a photograph of a species repeatedly called "*Cleithrochromis bowleyi*." A description of this species never appeared in the literature, thus, "*Cleithrochromis bowleyi*" is a *nomem nudum* under article 136 of the International Code of Zoological Nomenclature. A number of specimens have now been obtained, and thus the opportunity is taken to describe this species and place it in the genus *Cyrtocara*. *Cyrtocara* is currently being used as a replacement name for those species formally placed in *Haplochromis* from Lake Malawi (Greenwood, 1979).

#### METHODS

External counts and measurements follow Barel et al. (1977); however, head depth was measured at the widest part of the head to include the ventral protrusion caused by the cleithrum. The vertical length of the cleithrum is measured by placing the tips of the calipers on the most dorsal and ventral points of a dissected cleithrum.

#### *Cyrtocara macrocleithrum*, n. sp.

**Holotype.**—National Museum of Natural History (USNM) 268475, adult male 122.0 mm standard length (SL) Cape Maclear, Lake Malawi (longitude, 34°45'E, latitude, 14°4'S), Malawi, Africa, at 75 meters, 17 April 1984. Collected by McKaye and Stauffer, field collection number JRS-84-30.

**Paratypes.**—USNM 268476 (3 specimens 121.5, 112.8, 100.0 mm SL). Cape Maclear, Lake Malawi 75 meters, 17 April 1984; USNM 268477 (4 specimens 110.4, 125.2, 118.0, 120.1 mm SL), Monkey Bay, Lake Malawi, Malawi, Africa, 27 Feb. 1968. British Museum (Natural History) (BMNH) 1984.10.22:2-5 (4 specimens 126.4, 127.4, 118.1, 110.7 mm SL), Monkey Bay, Lake Malawi, Malawi, Africa, 73 meters, 10 March 1983.

**Description.**—This description is based upon the holotype (Fig. 1), 11 paratypes, a dissected cleithrum (Figs. 2, 3, USNM 268478), and two dissected pharyngeal bones (Fig. 4, USNM 268478). Principal morphometric ratios and meristics are presented in Table 1. Morphometric values are expressed as thousandths of the standard length except where noted, and given as the range.

**Body form.**—The appearance of the fish is dominated by an unusual ventral protuberance below the posterior part of the head (Fig. 1). This protuberance is caused by the elongated tips of the cleithrum (Fig. 2). The body is moderately compressed. Body depth, 367–404. Distances between snout and dorsal-fin origin and snout and pelvic-fin origin range between 369–420 and 399–439, respectively.

**Head.**—Head length, 350–376. The eye is large (horizontal eye diameter, 294–337 thousandths of HL). The lateral line tubules of the infraorbital bones are enlarged, and the bones of that



Fig. 2. Cleithrum (frontal view) of *Cyrtocara macrocleithrum*, USNM 268478.

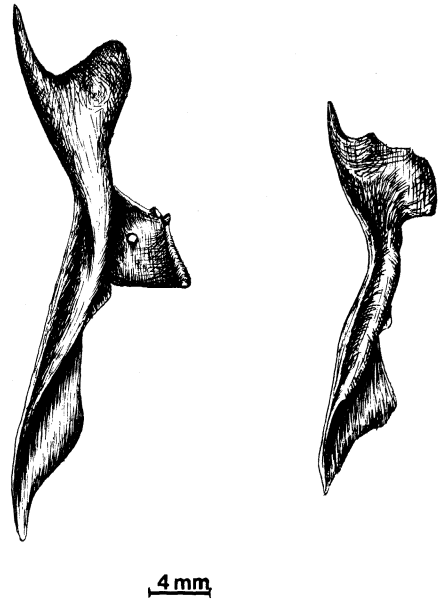


Fig. 3. Left cleithra of *Cyrtocara macrocleithrum* (left) and *Trematocranus microstoma* (right), in lateral view, USNM 268478; 268479.

series are deepened, so that there are only two scale rows on the cheek.

The lower jaw is prognathus and the mouth "beak-like." Lower jaw length, 429–471 thousandths of HL. There is a small ventral protuberance present at the symphysis of the dentaries (Fig. 1).

Teeth on the lower jaw are in two rows while those in the premaxillae are in one row. Most teeth are unicuspid and slightly recurved. Occasionally a tooth will be weakly bicuspid (Barel et al., 1977:fig. 52). The holotype has 18 teeth in the outer row of the left lower jaw. Tooth position on the lower jaw is typical of *Cyrtocara* in that posteriorly the outer row does not curve behind the inner one as described for *Lethrinops* (Trewavas, 1931).

*Fins*.—Dorsal-fin base length, 516 (494–533). Pectoral fin is most often comprised of 16 segmented rays. Anal fin is comprised of three spines and eight or nine segmented rays. The caudal fin is emarginate.

*Skeleton*.—As stated previously, the body form is characterized by a distinct ventral protuberance of the cleithrum. The cleithral tips are bound together by connective tissue. The

cleithrum of *C. macrocleithrum* (SL = 123.4 mm, HL = 46.5 mm USNM 268478) is compared to one from *Trematocranus microstoma* Trewavas (SL = 115.9 mm, HL = 39.6 mm USNM 268479) (Fig. 3). The ratio of cleithrum length/head length of *C. macrocleithrum* is 0.318 while that of *T. microstoma* is 0.223.

The lower pharyngeal bones (USNM 268478) dissected from two specimens (Table 2) are triangular in outline with two tooth forms (Fig. 4). Teeth in the posterior rows range in number between 21–22, those in the median rows between 10–11, and in the oblique rows, 5–6.

Radiographs were taken of the holotype (USNM 268475) and three paratypes (USNM 268476). Three specimens (including the holotype) had 12 abdominal vertebrae, and one had 11. Three specimens (including the holotype) had 18 caudal vertebrae and one, 16.

*Squamation*.—Scales are ctenoid, with 30–32 pored lateral line scales. There are two scale rows on the cheek.

*Gill rakers*.—There are 11–13 gillrakers on the ceratobranchial of the first arch. The anterior four gillrakers on the ceratobranchial of the holotype are single filaments, while the poste-

TABLE 1. PRINCIPAL MORPHOMETRIC AND MERISTIC CHARACTERISTICS OF *Cyrtocara macroleithrum* (N = 12 AND INCLUDES HOLOTYPE).

	Holotype	Mean	SD	Range
Standard length, mm	122.0	117.7	8.0	100.0–127.4
Head length, mm	44.0	43.0	3.2	35.8–47.2
Thousandths of HL				
Horizontal eye diameter	320	310.5	14.4	294–337
Vertical eye diameter	305	295	15.1	274–313
Snout length	395	376	16.8	346–396
Postorbital head length	330	352	15.5	320–378
Preorbital depth	243	251	10.3	235–276
Premaxillary pedicel	309	286	18.1	264–316
Lower jaw length	461	456	13.1	429–471
Interorbital width	166	181	8.6	166–195
Cheek depth	261	275	18.7	235–304
Head depth	1,039	1,040	22.4	1,000–1,073
Thousandths of SL				
Head length	361	365	7.3	350–376
Snout to dorsal	411	408	14.1	369–420
Snout to pelvic	425	426	10.1	399–439
Body depth	390	389	10.9	367–404
Least caudal peduncle length	157	181	11.7	157–201
Least caudal peduncle depth	129	121	5.5	111–129
Pectoral-fin length	359	347	22.9	303–379
Pelvic-fin length	279	257	23.7	217–292
Dorsal-fin base length	526	516	11.9	494–533
Lateral line scales	31	31.2	—	30–32
Scale rows on cheek	2	2	—	2
Pectoral-fin rays	15	15.8	—	15–16
Anal-fin spines	3	3	—	3
Anal-fin rays	8	8.2	—	8–9
Gill rakers on ceratobranchial	12	12	—	11–13

rior four are trifold. Those in the middle are either bifid or trifold.

*Coloration.*—Freshly collected specimens are white ventrally and brown dorsally. Laterally, there are six to seven vertical bars which occur under the dorsal-fin base and extend to the ventral body outline. Light from the lateral side is refracted so as to form silver/blue highlights over a brown ground coloration. Median fins are for the most part clear. Pectoral fins are pale yellow. Both anal and pelvic fins are clear, with black micromelanophores interspersed throughout the anterior membranes. There does not appear to be any sexual dichromatism of the pelvic fins; however, the micromelanophores are intensified in the anal fins of the males. Head is brown dorsally fading to white ventrally.

## DISCUSSION

*C. macroleithrum* appears to be common in the Monkey Bay region of southern Lake Malawi. Because this species lives in deep water, it is difficult to collect information relative to its trophic relationships. Specimens trawled from 70 m have completely everted stomachs when they reach the surface. However, certain characteristics may be inferred from *C. macroleithrum*'s anatomy. Based on the number of gill-rakers and weak tooth development, we suggest that this species feeds on small benthic macroinvertebrates and perhaps small fishes. Its short gut and deep water existence suggest that it does not feed on algae or phytoplankton. It further lacks the strong jaws, large mouth and dentition typical of haplochromine piscivores.

Since all of the known Lake Malawi haplo-

TABLE 2. PRINCIPAL MORPHOMETRIC AND MERISTIC CHARACTERISTICS OF LOWER PHARYNGEAL BONE FROM TWO SPECIMENS OF *Cyrtocara macrocleithrum*.

Standard length	123.4*	124.0
Head length	46.5	47.3
Length of pharyngeal bone	11.3	11.4
Length of dentigerous surface	12.0	10.8
Breadth of pharyngeal bone	6.4	6.6
Breadth of dentigerous surface	7.4	7.8
Number of teeth in right/left posterior row	21/21	21/22
Number of teeth in right/left median row	10/10	11/11
Number of teeth in right/left oblique row	5/5	5/6

\*Fig. 4.

chromine cichlids are mouth-brooders, *C. macrocleithrum* is presumed to fit this reproductive pattern. Females collected in Aug. 1983, contained ripe ovaries. The right and left ovaries of one female (123.4 mm) contained 79 and 83 eggs, respectively. The diameter of 10 eggs ranged between 3.1–3.4 mm, which is typical for mouth-brooders. Substratum brooders would be expected to have smaller eggs (McKaye, 1984).

#### DIAGNOSIS

*C. macrocleithrum* appears to be unique among other haplochromine fishes of southern Lake Malawi in the ventral protuberance caused by the cleithrum. It is probably most closely related to a series of undescribed deep water forms, tentatively placed in the genus *Trematocranus* (Trewavas, 1935), with which it shares the moderately enlarged lateral line cavities of the infraorbital bones. Further analyses, including out-group comparisons, of many of the deep water forms are needed to determine if the enlarged infraorbital lateral line cavities of *C. macrocleithrum*, *Trematocranus* sp. and *Aulonocara* sp. are synapomorphic at a generic or higher taxonomic level, or due to convergence. It should be noted that enlargement of these cavities is also found in *Aulonocranus* and *Trematocara* of Lake Tanganyika (Trewavas, 1935).

Greenwood (1979) altered Malawian cichlid nomenclature when he restricted the name *Haplochromis* to a monophyletic group of five species from lakes Victoria, Kivu, Edward and

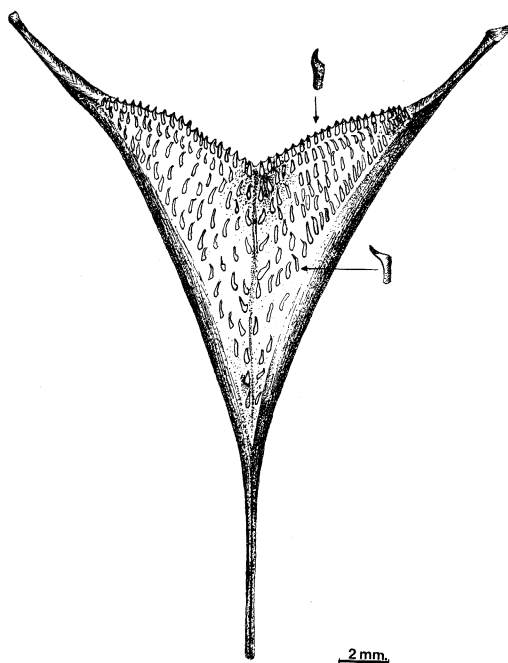


Fig. 4. Lower pharyngeal bone of *Cyrtocara macrocleithrum*, USNM 268478.

George. He further recommended that *Cyrtocara* Boulenger be employed temporarily as a replacement name for the Malawian species previously placed in the genus *Haplochromis*. Greenwood (1979) acknowledged the fact that the Malawian haplochromine fishes represent a polyphyletic group and stated that "any generic placement at the present time must be considered merely a formal nomenclatural action unrelated to the phyletic affinities of the species" (Greenwood, 1979:317). In placing this previously undescribed species in *Cyrtocara*, we follow Greenwood's suggestion and deviate from the former policy of moving some of the more distinctive species to separate small genera (Regan, 1921, Trewavas, 1935). The current uneasy nomenclatural situation emphasizes the need for alpha taxonomic work on the Malawi cichlid flock, which must precede detailed phylogenetic analyses.

#### ETYMOLOGY

The name was chosen to reflect the large and distinctive nature of the cleithrum.

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## LITERATURE CITED

- AXELROD, H. R., AND W. E. BURGESS. 1981. African cichlids of lakes Malawi and Tanganyika. T. F. H. Publ., Neptune, New Jersey.
- BAREL, C. D. N., M. J. P. VAN OIJEN, F. WITTE AND E. L. M. WITTE-MASS. 1977. An introduction to the taxonomy and morphology of the haplochromine cichlidae from Lake Victoria. *Neth. J. Zool.* 27:381-389.
- ECCLES, D. H., AND D. S. C. LEWIS. 1976. A revision of the genus *Docimodus* Boulenger (Pisces: Cichlidae), a group of fishes with unusual feeding habits from Lake Malawi. *Zool. J. Linn. Soc.* 59:165-172.
- , AND ———. 1977. A taxonomic study of the genus *Lethrinops* Regan (Pisces: Cichlidae) from Lake Malawi. Part 1. Rhodes University. J. L. B. Smith Institute, Ichth. Bull. 36:1-12.
- , AND ———. 1978. A taxonomic study of the genus *Lethrinops* Regan (Pisces: Cichlidae) from Lake Malawi. Part 2. Rhodes University. J. L. B. Smith Institute, Ichth. Bull. 37:1-12.
- , AND ———. 1979. A taxonomic study of the genus *Lethrinops* Regan (Pisces: Cichlidae) from Lake Malawi. Part 3. Rhodes University. J. L. B. Smith Institute, Ichth. Bull. 38:1-12.
- GREENWOOD, P. H. 1979. Towards a phyletic classification of the "genus" *Haplochromis* (Pisces, Cichlidae) and related taxa. Part 1. *Bull. Brit. Mus. Nat. Hist. (Zool.)* 35:265-322.
- LEWIS, D. S. C. 1982. A revision of the genus *Labi-dochromis* (Teleostei: Cichlidae) from Lake Malawi. *Zool. J. Linn. Soc.* 75:189-265.
- MARSH, A. C. 1983. A taxonomic study of the fish genus *Petrotilapia* (Pisces: Cichlidae) from Lake Malawi. J. L. B. Smith Institute. Ichthy. Bull. 48:1-14.
- MCKAYE, K. R. 1984. Behavioural aspects of cichlid reproductive strategies: Patterns of territoriality and broad defense in Central American substratum spawners versus African mouth brooders, p. 245-273. *In: Fish reproduction: Strategies and tactics.* R. J. Wootton and G. W. Potts (eds.). Academic Press, London.
- REGAN, C. T. 1921. The cichlid fishes of Lake Nyasa. *Proc. Zool. Soc. Lond.* 1921:675-727.
- RIBBINK, A. J., B. A. MARSH, A. C. RIBBINK AND B. J. SHARP. 1983. A preliminary survey of the cichlids of rocky habitats in Lake Malawi. *South African J. Zool.* 18:1-310.
- TREWAVAS, E. 1931. A revision of the cichlid fishes of the genus *Lethrinops* Regan. *Ann. Mag. Nat. Hist.* 10:133-152.
- . 1935. A synopsis of the cichlid fishes of Lake Nyasa. *Ann. Mag. Nat. Hist.* 10:65-118.
- SCHOOL OF FOREST RESOURCES, THE PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PENNSYLVANIA 16802; AND APPALACHIAN ENVIRONMENTAL LABORATORY, CENTER FOR ENVIRONMENTAL AND ESTUARINE STUDIES, UNIVERSITY OF MARYLAND, FROSTBURG, MARYLAND 21532. Accepted 18 Dec. 1984.