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# *Trematochromis schreyeni* Poll, 1987, a junior synonym of '*Ctenochromis*' *benthicola* (Matthes, 1962) (Perciformes: Cichlidae) from Lake Tanganyika

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A detailed morphological comparison of *Trematochromis schreyeni* only known from its holotype, collected at the north-western end of Lake Tanganyika, and '*Ctenochromis*' *benthicola* described from the same region, and some additional material led to the conclusion that the two species were conspecifics. Consequently, *T. schreyeni* is considered to be a junior synonym of '*C.*' *benthicola*, an endemic species to the lake. A redescription of '*C.*' *benthicola* is also given. A statistical test comparing a single specimen and several specimens is difficult to carry out, because no variation is known in *T. schreyeni*. The present study, therefore, calculated Mahalanobis' distance between the holotype of *T. schreyeni* and specimens of '*C.*' *benthicola*, and applied the $\chi^2$ test. 

Key words: Mahalanobis' generalized distance; morphology; redescription; taxonomy.

## INTRODUCTION

Poll (1987) described *Trematochromis schreyeni* as a new genus and species based on a single specimen collected from Luhanga at the north-western end of Lake Tanganyika. He indicated that this genus shares enlarged sensory pores on the head with *Aulonocranus* Regan, 1920, *Trematocara* Boulenger, 1899 and *Telotrematocara* Poll, 1986 (junior synonym of *Trematocara* according to Takahashi, 2002*a*), but could be distinguished by the greater number of dorsal fin spines (18 *v.* 11–13 in *Aulonocranus* and 8–12 in *Trematocara*) and additional differences in scale morphology, dentition and the extent of hypertrophy of the pores on the head. At present, *Trematochromis* is still a monotypic genus, and *T. schreyeni* is known only from the holotype.

In his comparison Poll (1987) apparently overlooked the presence of enlarged sensory pores on the head of another endemic species from Lake Tanganyika,

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'*Ctenochromis*' *benthicola* (Matthes, 1962), as discussed by Matthes (1962) and Poll (1986). This study provides a comparison between the two species and the status of *T. schreyeni* is further discussed.

## MATERIALS AND METHODS

### SPECIMENS EXAMINED

This study is based on an examination of specimens taken from the north end of Lake Tanganyika (Fig. 1) and deposited in the following institutions or private collection: Institut Royal des Sciences Naturelles de Belgique, Bruxelles (IRSNB), Musée Royal de l'Afrique Centrale, Tervuren (MRAC), Laboratory of Marine Biodiversity, Graduate School of Fisheries Sciences, Hokkaido University (HUMZ) and the private collection of M. Hori, Kyoto University (Z). The following were examined: the holotype of *T. schreyeni* (IRSNB 757, male, 50·4 mm standard length, $L_S$, nord du Lac Tanganyika, côte occidentale à Luhanga, D.R. Congo, 03° 31′ S; 29° 09′ E, October 1981), and the holotype, two paratypes and 24 additional specimens of '*Ctenochromis*' *benthicola* (MRAC 130524, holotype, male, 113·5 mm $L_S$, Kalundu, D.R. Congo, 03° 26′ S; 29° 08′ E, 10–40 m depth, 28 May 1960; MRAC 130525, paratype, male, 125.4 mm $L_S$, Kalundu, D.R. Congo, 03° 26′ S; 29° 08′ E, 28 May 1960; MRAC 130526, paratype,

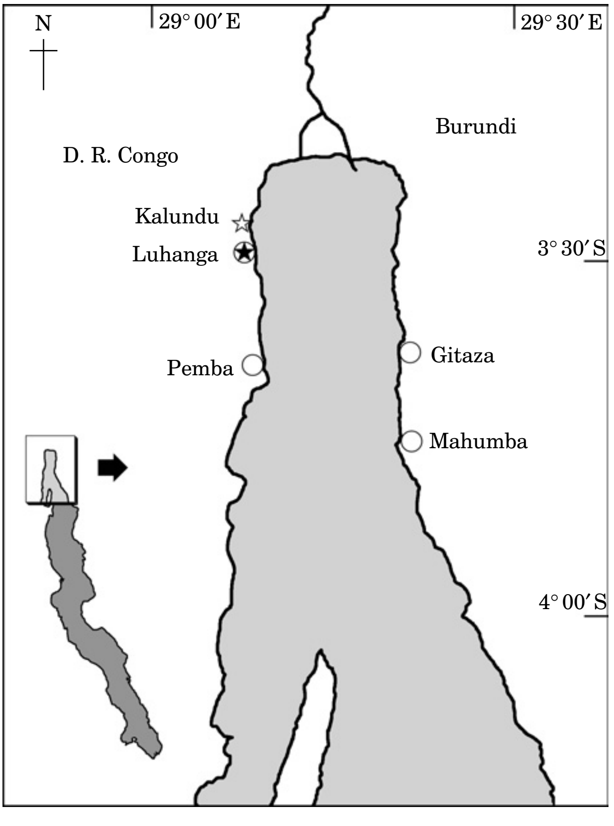


FIG. 1. Northern end of Lake Tanganyika, showing sampling localities of *Trematochromis schreyeni* (⊛, holotype) and '*Ctenochromis*' *benthicola* (☆, holotype). ○, other specimens.

male, 133·8 mm $L_S$, Luhanga, D.R. Congo, 03° 31′ S; 29° 09′ E, 5–6 May 1960; MRAC 95–098-P-0332–335, three males and one female, 103·7–119·7 mm $L_S$, Gitaza, Burundi, 03° 36′ S; 29° 20′ E, 30 m depth, 18 January 1994; MRAC 95–098-P-0336, male, 106·0 mm $L_S$, Mahumba, km 36 route Bujumbura-Nyanza lac, Burundi, 10 m depth, 19 January 1994; MRAC 96-83-P-764–767, 770–772, three males and four females, 61·0–99·4 mm $L_S$, Luhanga, 26 April 1994; HUMZ 116917, 116918, one male and one female, 74·4–103·2 mm $L_S$, Luhanga, 5–7 m depth, 18 September 1990; HUMZ 127113, male, 101·3 mm $L_S$, Gitaza, 30 m depth, 8 September 1993; HUMZ 127370, male, 80·3 mm $L_S$, Gitaza, 1–3 m depth, 18 September 1993; HUMZ 137924, female, 98·8 mm $L_S$, Luhanga, 0·5–18 m depth, 9 December 1993; HUMZ 138290, female, 74·0 mm $L_S$, Luhanga, 9 May 1994; Z 89001-a–c, 98002, three males and one female, 101·7–147·9 mm $L_S$, Pemba, 1989; Z 901012, female, 86·8 mm $L_S$, Pemba, October to December 1990; Z 901229, female, 88·0 mm $L_S$, Luhanga, October to December 1990).

The correct generic allocation of '*C.*' *benthicola* is still undecided (Takahashi, 2003*a*). The species was originally described as *Haplochromis benthicola* by Matthes (1962), and was placed in *Ctenochromis* Pfeffer, 1893 by Poll (1986). In subsequent literature, both genera have been used for this species (*Haplochromis* in Brichard, 1989 and Axelrod, 1996; *Ctenochromis* in Konings, 1988, 1998 and Takahashi, 2002*b*, 2003*a*, *b*). Takahashi (2003*a*) has noted that the generic allocation of *C. benthicola* could not be decided until a careful revision of the genus had been made with examination of the type species, *Ctenochromis pectoralis* Pfeffer, 1893. This is a complex taxonomic problem that should be addressed in another study. Until then, the convention used by Takahashi (2003*a*) was followed and the genus name *Ctenochromis* put between quotes, indicating the problems with the use of this genus name for this species.

## MORPHOLOGICAL DATA

The methods for determining 20 morphometric characters (Table I), and 12 meristic characters (number of teeth in outer series on premaxillae, and 11 characters shown in Table II; spines and soft rays in dorsal and anal fins are considered separately in this analysis) were based on Snoeks (1994, 2004), with the following exceptions. The lengths of the pectoral and pelvic fins were measured from the base to the tip of the longest ray in each fin. The number of scale rows between the upper and lower lateral lines was counted at the midpoint of the body along the lateral lines. Measurements were made to the nearest 0·1 mm using a binocular microscope and dividers.

The holotype of *T. schreyeni* has been firmly fixed with the mouth protruded [Fig. 2(a)]. Because of a substantial risk of damage, the mouth was not pushed into the normal position by force. Therefore, the standard head, snout, predorsal, preanal, prepectoral and prepelvic lengths were measured from a hypothetical point corresponding to the rostral tip of the upper jaw if the mouth would have been in a normal position.

## STATISTICAL ANALYSIS

First, the sexual dimorphism in '*C.*' *benthicola* was analysed for all morphometric and meristic characters in order to determine whether the data of both sexes could be pooled in a comparative analysis with *T. schreyeni*. The morphometric characters were $\log_{10}$-transformed and then analysed by a multivariate analysis of covariance (MANCOVA) with sex and the $\log_{10}$-transformed $L_S$ as covariates. Among the meristic characters, the number of outer teeth on the premaxillae was tested by an analysis of covariance (ANCOVA), and nine selected meristics were examined by multivariate analysis of variance (MANOVA). Each individual test (MANCOVA for the morphometrics, ANCOVA for the number of outer teeth on premaxillae and MANOVA for nine meristics) was adjusted to a significance level of $P < 0{\cdot}017$, for an experiment-wise error rate of $P < 0{\cdot}05$ (Dunn-Sidak method).

TABLE I. Morphometric characters of holotype of *Trematochromis schreyeni* and 27 specimens of '*Ctenochromis*' *benthicola*

| | *T. schreyeni* | '*C.*' *benthicola* | Regression | |
|---|---|---|---|---|
| | % of $L_S$ | % of $L_S$ | Formula[a] | $r$ |
| Standard length ($L_S$) | 50·4 mm (male) | 61·0–133·8 mm (16 males) 74·0–147·9 mm (11 females) | | |
| Body depth ($D_B$) | 32·9 | 31·8–41·1 | $\mathbf{D_B = 0 \cdot 169\ L_S^{1 \cdot 17}}$ | 0·991 |
| Head length ($L_H$) | 38·7 | 35·3–39·4 | $L_H = 0 \cdot 491\ L_S^{0 \cdot 943}$ | 0·993 |
| Head width ($W_H$) | 17·9 | 17·0–20·0 | $W_H = 0 \cdot 112\ L_S^{1 \cdot 11}$ | 0·990 |
| Interorbital width ($W_I$) | 7·9 | 7·8–10·1 | $\mathbf{W_I = 0 \cdot 0268\ L_S^{1 \cdot 26}}$ | 0·989 |
| Snout length ($L_{SN}$) | 11·5 | 11·4–13·5 | $L_{SN} = 0 \cdot 0775\ L_S^{1 \cdot 11}$ | 0·988 |
| Lower jaw length ($L_{LJ}$) | 17·7 | 16·1–19·1 | $L_{LJ} = 0 \cdot 238\ L_S^{0 \cdot 935}$ | 0·983 |
| Cheek depth ($D_{CH}$) | 8·5 | 9·0–12·6 | $\mathbf{D_{CH} = 0 \cdot 0334\ L_S^{1 \cdot 25}}$ | 0·980 |
| Eye length ($L_E$) | 12·1 | 8·1–11·0 | $\mathbf{L_E = 0 \cdot 441\ L_S^{0 \cdot 669}}$ | 0·966 |
| Lachrymal depth ($D_{LA}$) | 6·7 | 7·0–8·3 | $D_{LA} = 0 \cdot 0517\ L_S^{1 \cdot 08}$ | 0·984 |
| Dorsal fin base length ($L_D$) | 50·6 | 52·3–57·8 | $\mathbf{L_D = 0 \cdot 394\ L_S^{1 \cdot 07}}$ | 0·995 |
| Anal fin base length ($L_A$) | 17·9 | 16·4–20·8 | $L_A = 0 \cdot 126\ L_S^{1 \cdot 08}$ | 0·977 |
| Predorsal length ($L_{PD}$) | 36·1 | 35·5–40·7 | $L_{PD} = 0 \cdot 395\ L_S^{0 \cdot 994}$ | 0·992 |
| Preanal length ($L_{PA}$) | 72·0 | 68·2–74·9 | $L_{PA} = 0 \cdot 679\ L_S^{1 \cdot 01}$ | 0·993 |
| Prepectoral length ($L_{PP1}$) | 39·5 | 37·5–42·0 | $L_{PP1} = 0 \cdot 477\ L_S^{0 \cdot 960}$ | 0·988 |
| Prepelvic length ($L_{PP2}$) | 49·0 | 41·6–49·5 | $L_{PP2} = 0 \cdot 475\ L_S^{0 \cdot 986}$ | 0·974 |
| Pectoral fin length ($L_{P1}$) | 31·9 | 31·2–40·8 | $L_{P1} = 0 \cdot 261\ L_S^{1 \cdot 08}$ | 0·974 |
| Pelvic fin length ($L_{P2}$) | 32·7 | 27·7–46·1 | $L_{P2} = 0 \cdot 122\ L_S^{1 \cdot 23}$ | 0·907 |
| Caudal peduncle length ($L_{CP}$) | 14·9 | 13·2–17·0 | $L_{CP} = 0 \cdot 146\ L_S^{1 \cdot 00}$ | 0·961 |
| Caudal peduncle depth ($D_{CP}$) | 11·9 | 11·0–12·6 | $D_{CP} = 0 \cdot 103\ L_S^{1 \cdot 03}$ | 0·991 |

[a] Allometric formulae ($\log_{10}y = a \log_{10}x + b$) are transformed to $y = 10^b x^a$ for greater clarification of relative growth. Allometric formulae, which are significantly different from isometry ($\log_{10}y = \log_{10}x + b$) (*F*-test, d.f. = 1,25; significance level of $P < 0{\cdot}0027$, Dunn-Sidak method in nineteen tests), are shown in bold.

The relationships of the morphometric and meristic characters between the two nominal species were tested as follows: $H_0$, null hypothesis that the holotype of *T. schreyeni* is conspecific with '*C.*' *benthicola*; $H_1$, the holotype of *T. schreyeni* is not conspecific with '*C.*' *benthicola*. Initially the $\log_{10}$-transformed morphometrics of '*C.*' *benthicola* were analysed by a principal component analysis (PCA) using the covariance matrix. The loadings of the variables on the first principal component (PC 1) were of the same sign and of a similar magnitude (0·142–0·267), indicating that this axis can be interpreted as a proxy for general size (Bookstein *et al*., 1985). A Mahalanobis' generalized distance for morphometrics between '*C.*' *benthicola* and *T. schreyeni* $\left(D_{MO}{}^2\right)$ was calculated based on selected PCs (PC 2 to PC 7) with the following formula: $D_{MO}{}^2 = \Sigma S_i^2\ V_i{}^{-1}$, where $S_i$ is the principal component score recalculated for the holotype of *T. schreyeni* using the loadings of the variables on the *i*th PC for the '*C.*' *benthicola* specimens, and $V_i$

TABLE II. Frequency distribution of meristic characters in holotype of *Trematochromis schreyeni*, and holotype, paratypes and non-type specimens of '*Ctenochromis*' *benthicola*

| | Dorsal fin rays | | | | | Anal fin rays | | Pectoral fin rays | |
|---|---|---|---|---|---|---|---|---|---|
| | XVI,9 | XVII,9 | XVII,10 | XVIII,8 | XVIII,9 | III,7 | III,8 | 14 | 15 |
| *T. schreyeni* | – | $1^{H}$ | – | – | – | – | $1^{H}$ | $1^{H}$ | – |
| '*C.*' *benthicola* | 1 | $18^{H}$ | 4 | 3 | 1 | 6 | $21^{H}$ | $21^{H}$ | 6 |

| | Longitudinal line scales | | | Upper lateral line scales | | | | | | | Lower lateral line scales | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 32 | 33 | 34 | 9 | ... | 21 | 22 | 23 | 24 | 25 | 11 | 12 | 13 | 14 | 15 | 16 |
| *T. schreyeni* | – | $1^{H}$ | – | – | | – | – | – | $1^{H}$ | – | – | $1^{H}$ | – | – | – | – |
| '*C.*' *benthicola* | 1 | $24^{H}$ | 2 | 1 | | 1 | 5 | $10^{H}$ | 9 | 1 | 3 | 2 | $7^{H}$ | 6 | 7 | 2 |

| | Scale rows between upper and lower lateral lines | Scale rows on cheek | | | Gill rakers | | |
|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 11 | 12 | 13 |
| *T. schreyeni* | $1^{H}$ | – | $1^{H}$ | – | – | $1^{H}$ | – |
| '*C.*' *benthicola* | $27^{H}$ | 3 | 10 | $14^{H}$ | 1 | $22^{H}$ | 4 |

$^{H}$ Holotype.

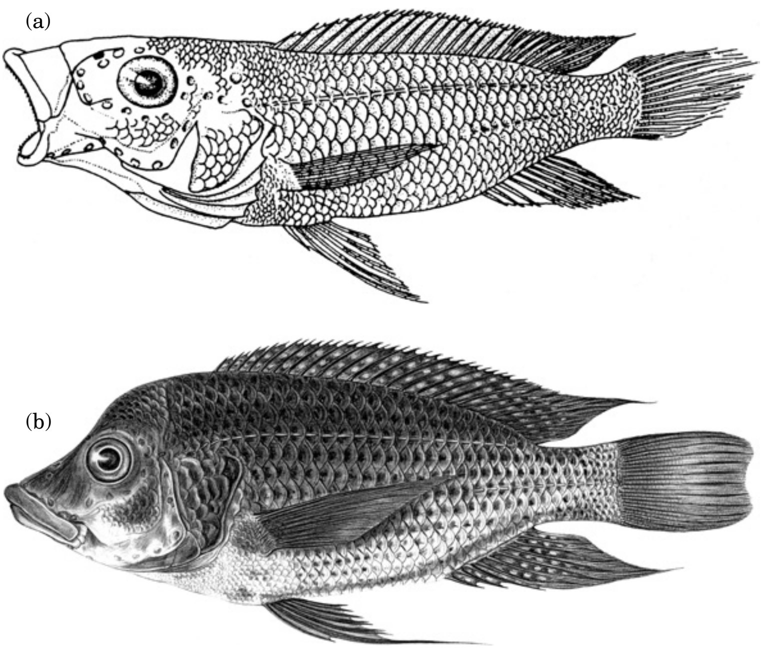

FIG. 2. Original figures of (a) *Trematochromis schreyeni* from Poll (1987), and (b) '*Ctenochromis*' *benthicola* from Matthes (1962), courtesy the Africa Museum, Tervuren.

is the variance of the scores of the '*C.*' *benthicola* specimens on the *i*th PC. Concerning the meristics, the number of outer teeth on the premaxillae were linearly related to the $L_S$. Therefore, the number were standardized using the relationship: $E_j = N_{POTj} - a\ L_{Sj}$, where $N_{POTj}$ and $L_{Sj}$ are the original values of the number of outer teeth on the premaxillae and the $L_S$ respectively in individual *j*, and *a* is the regression slope of $N_{POT}$ on $L_S$ estimated from the specimens of '*C.*' *benthicola*. A Mahalanobis' generalized distance for meristic characters $(D_{ME}{}^2)$ was calculated with the following formula: $D_{ME}{}^2 = (X_1 - x_1, \ldots, X_k - x_k, \ldots, X_{10} - x_{10})C^{-1}(X_1 - x_1, \ldots, X_k - x_k, \ldots, X_{10} - x_{10})'$, where $X_k$ is the value of meristic character *k* in the holotype of *T. schreyeni* (including $E_j$ and the raw data of the numbers of dorsal-fin spines and soft rays, anal-fin soft rays, pelvic-fin rays, scales on longitudinal line, upper lateral line and lower lateral line, scale rows on cheek, and gill rakers), $x_k$ is the average of character *k* in '*C.*' *benthicola*, and *C* is the covariance matrix among these 10 characters in '*C.*' *benthicola*. The null hypothesis (*T. schreyeni* is conspecific with '*C.*' *benthicola*) was tested by the *P*-value, where $\chi^2{}_{P[N]} = D_{MO}{}^2 + D_{ME}{}^2$ ($N = 16$: six PCs used for morphometric analysis plus 10 meristic characters used; numbers of anal fin spines and scale rows between upper and lower lateral lines were excluded from this analysis).

## RESULTS

### COMPARISON BETWEEN SEXES OF '*CTENOCHROMIS*' *BENTHICOLA*

The sexual differences in morphometric and meristic characters were tested statistically in all specimens of '*C.*' *benthicola* examined (16 males and 11 females). The interaction between sex and $L_S$ was not significant in the MANCOVA on morphometric characters, and no significant sexual dimorphism was found (Table III).

TABLE III. *P*-values of test of morphological character differences between sexes (16 males and 11 females) in '*Ctenochromis*' *benthicola*

| | Analysis | | Difference in factor | | Interaction |
|---|---|---|---|---|---|
| | Method | Covariate | Sex | Covariate | Sex × Covariate |
| Nineteen morphometrics | MANCOVA | $\log_{10}L_S$ | 0·380 | **0·000** | 0·588 |
| Number of outer teeth on premaxillae | ANCOVA | $L_S$ | 0·253 | **0·000** | 0·547 |
| Nine meristics | MANOVA | – | 0·597 | – | – |

Significant differences ($P < 0{\cdot}017$) in bold. $L_S$, standard length.

Among the meristic characters, the numbers of anal fin spines and scale rows between upper and lower lateral lines were invariable and hence were excluded from the statistical test. The number of outer teeth on the premaxillae decreased with increasing $L_S$ [Fig. 3; $F_{1,\ 24}$, $P < 0{\cdot}001$] and hence the difference between the sexes was tested by the analysis of covariance (ANCOVA) with the raw value of the $L_S$ as covariate. The interaction between sex and $L_S$ was not significant in the ANCOVA, and no significant sexual dimorphism was found (Table III).

The other nine meristics were not significantly related to the $L_S$ ($P = 0{\cdot}075$); therefore sexual dimorphism was tested by MANOVA. In this analysis, sexual dimorphism was not significant (Table III). Furthermore, no sexual dimorphism was found in any other qualitative (descriptive) characters, except for the genital papilla.

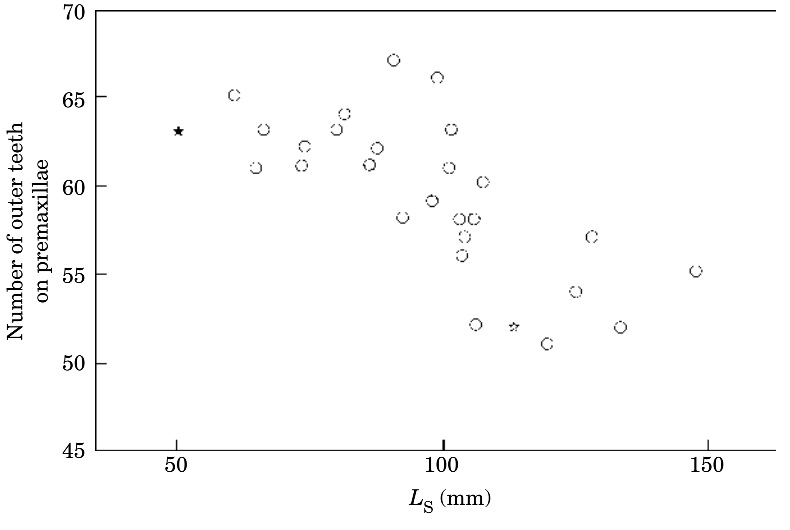


FIG. 3. Relationship between the standard length and the number of outer teeth on premaxillae in *Trematochromis schreyeni* (★) and '*Ctenochromis*' *benthicola* (☆, ○). ★ and ☆, holotypes. The curve for '*C.*' *benthicola* was fitted by: $y = -0{\cdot}138x + 72{\cdot}7$.

## COMPARISON OF *TREMATOCHROMIS SCHREYENI* WITH '*CTENOCHROMIS*' *BENTHICOLA*

Since no sexual dimorphism was observed in '*C.*' *benthicola*, the data of both sexes were pooled in the following analyses. A PCA was carried out on the $\log_{10}$-transformed morphometrics of '*C.*' *benthicola*. The proportion of PC 1, which is a proxy for multivariate size, was 96·5%. When the proportions of the remaining PC axes were recalculated against the residual 3·5%, the cumulative proportion of PC 2 to PC 7 was 83·4%. The proportions of PC 8 to PC 20 were each <4%. Therefore, PC 2 to PC 7 were concentrated on. The principal component scores (Fig. 4 and Table IV) and the raw data of the meristic characters (Fig. 3 and Table II) of the holotype of *T. schreyeni* all fell within the ranges of '*C.*' *benthicola*. The $D_{MO}{}^2$ was 9·00 and $D_{ME}{}^2$ was 4·92. These distances indicate that the morphometric and meristic characters of the holotype of *T. schreyeni* are not excluded from the multidimensional distribution of those of the '*C.*' *benthicola* specimens examined ($\chi^2$, d.f. = 16, $P = 0{\cdot}605$). As for the qualitative characters, no differences were found between the holotype of *T. schreyeni* and specimens of '*C.*' *benthicola*. Furthermore, the two nominal species shared a unique infraorbital condition: a thick sensory canal on the six infraorbitals, with large openings that were widely separated from each other, and the presence of a dermosphenotic (Fig. 5; Takahashi, 2003*b*). Although one or other of these characters are found in Tanganyikan cichlids, only in *T. schreyeni* and '*C*' *benthicola* are the thick canals with large openings found together with the dermosphenotic.

## DISCUSSION

The holotype of *T. schreyeni* is relatively small (50·4 mm $L_S$, male) compared to the specimens available for '*C.*' *benthicola* (up to 133·8 mm $L_S$ in males,

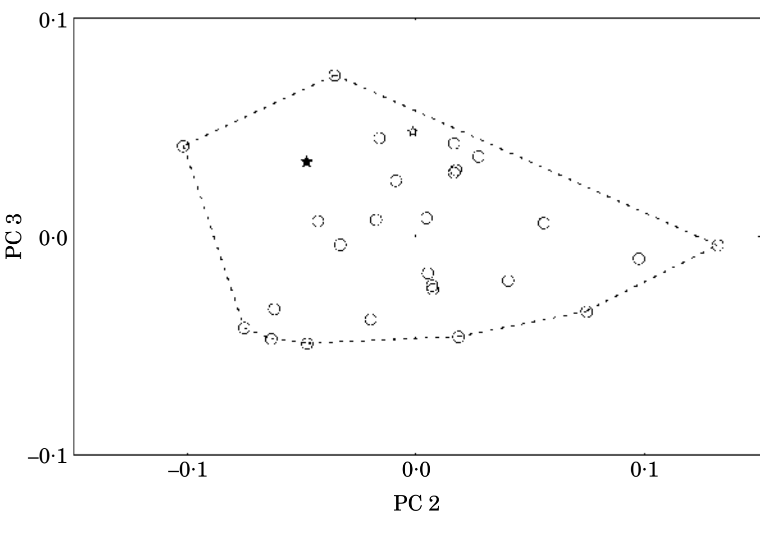


FIG. 4. Plot of the individual scores on PC 2 and PC 3 for '*Ctenochromis*' *benthicola* (☆, holotype; ○, other specimens). PC scores for the holotype of *Trematochromis schreyeni* (★) are calculated from the loadings of the variables, which are derived from the PC analysis for the specimens of '*C.*' *benthicola*.

 

TABLE IV. Scores on six principal components (PC2 to PC7) of the $\log_{10}$-transformed morphometrics. The scores of the holotype of *Trematochromis schreyeni* were estimated from loadings of the principal component analysis carried out on 27 specimens of '*Ctenochromis*' *benthicola*

| | *T. schreyeni* | '*C.*' *benthicola* |
|---|---|---|
| PC2 | −0·0477 | −0·1013–0·1318 |
| PC3 | 0·0339 | −0·0496–0·0736 |
| PC4 | 0·0647 | −0·0439–0·0844 |
| PC5 | 0·0032 | −0·0507–0·0508 |
| PC6 | −0·0280 | −0·0481–0·0389 |
| PC7 | −0·0159 | −0·0423–0·0386 |

147·9 mm $L_S$ in females). In a comparative study of the holotype of *T. schreyeni* and the holotype, two paratypes and 24 additional specimens of '*C.*' *benthicola*, no other morphometric and meristic differences between the two nominal species were found. Furthermore, the type locality of *T. schreyeni* (Luhanga) falls within the range of geographical distribution of '*C.*' *benthicola* (Fig. 1). Therefore, it can be concluded that the holotype of *T. schreyeni* is a small individual of '*C.*' *benthicola*, making *T. schreyeni* a junior synonym of '*C.*' *benthicola*.

The synonymy of *T. schreyeni* with '*C.*' *benthicola* would suggest that *Trematochromis* is a junior synonym of the genus '*Ctenochromis*', as defined by Poll (1986).

## '*CTENOCHROMIS*' *BENTHICOLA* (MATTHES, 1962) (FIG. 2)

*Haplochromis benthicola* Matthes, 1962: 46, pl. 3b (Kalundu, Luhanga); Poll, 1979: 467, photo on page 470, table on page 473 [Luanga (=Luhanga), Kalundu,

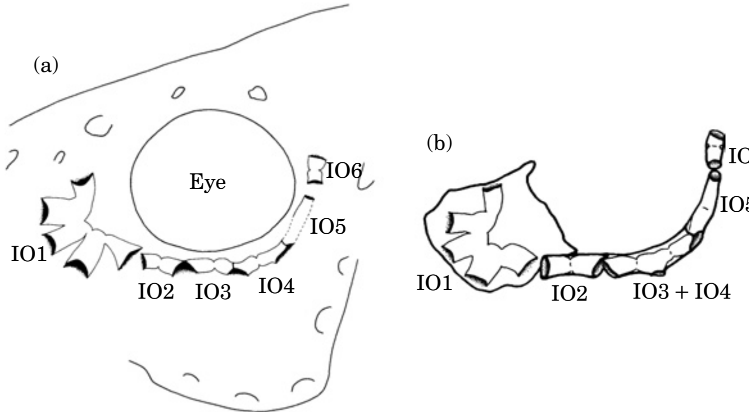


FIG. 5. Lateral view of infraorbitals (IO1–IO6) in (a) *Trematochromis schreyeni* (IRSNB 757, holotype, 50·4 mm $L_S$) and (b) '*Ctenochromis*' *benthicola* (HUMZ 127370, 80·3 mm $L_S$). IO6 is the dermosphenotic.

Bemba (=Pemba), near Rutunga]; Axelrod *et al.*, 1986: photos on pages 507, 509; Brichard, 1989: 304, photo on page 307; Axelrod, 1996: 57, photos on page 59.

*Ctenochromis benthicola*: Poll, 1986: 39 (new combination); Konings, 1988: 118, photos on page 119; Konings, 1998: 123, photos 2, 3 on page 112; Takahashi, 2002*b*: 124; Takahashi, 2003*b*: 9, Table I, Fig. 2.

*'Ctenochromis' benthicola*: Takahashi, 2003*a*: 376, 379, Fig. 12 (in Takahashi, 2003*a*), Table II (north-eastern (Burundi) and north-western (D.R. Congo) regions of Lake Tanganyika).

*Trematochromis schreyeni* Poll, 1987: 167, Figs 1, 2 (Luhanga); Konings, 1988: 250, Fig. on page 250; Axelrod, 1996: 149, Fig. on page 149; Konings, 1998: 159, Fig. on page 159.

*Diagnosis*

Presence of thick sensory canal on the six infraorbitals, with large openings that are widely separated from each other; presence of a dermosphenotic (Fig. 5); unicuspid outer and inner teeth on both jaws; and presence of two scale rows between upper and lower lateral lines.

*Description*

The description is based on the holotype of '*C.*' *benthicola* and 27 additional specimens, including the holotype of *T. schreyeni*. Morphometric and meristic values in the following description refer to the holotype of '*C.*' *benthicola*, and the ranges for other specimens are given in parentheses. Additional morphometric and meristic data are given in Tables I and II, and Fig. 3.

Body deep and moderately compressed; greatest depth at origin of dorsal fin; caudal peduncle deep, depth 91 (68–93) % of its length. Dorsal profile of head concave, with lowest point at the interorbital region; ventral profile of head gently rounded. Eye round, length 71% of snout length (negatively allometric, see also Table I; length equal to snout length in small specimens of 50·4–61·0 mm $L_S$, 63–79% in specimens >100 mm $L_S$). Mouth terminal, oblique; posterior edge of mouth not reaching vertical line through anterior margin of eye (slightly beyond anterior margin of eye in a small specimen of 61·0 mm $L_S$; the mouth condition could not be observed in the holotype of *T. schreyeni* because it is fixed with its mouth in a protruded position); lower jaw length 49 (44–49) % of head length.

Dorsal-fin spines with lappets at tips; all soft rays branched; posterior tip of dorsal fin, when depressed, reaching anterior one third of caudal fin (extending beyond caudal fin base, but never reaching posterior margin of caudal fin). Anal-fin base length 33 (31–40) % of dorsal-fin base; anal spines with lappets at tips, increasing in length posteriorly; all soft rays branched; posterior tip of anal fin, when depressed, almost reaching posterior margin of caudal fin (extending beyond caudal fin base, but not reaching posterior margin of caudal fin). Distal tip of pectoral fin acutely pointed; fifth soft ray from uppermost longest, 105 (83–109) % of head length; pectoral fin rays branched except upper two and lower one (except upper one or two and lower one or two; exceptionally in three specimens only upper two rays are unbranched and lower rays all are branched). Soft pelvic rays increasing in length laterally; outermost soft ray longest. Caudal fin truncated.

Outer and inner teeth on both jaws conical; outer teeth arranged in a single regular row; inner teeth smaller than outer teeth, arranged in five (three to six, usually four or five) irregular rows on anterior part of upper jaw. Gill rakers on first ceratobranchial moderately long, shorter anteriorly. Lower pharyngeal element sub-triangular with concave lateral margins and slightly heart-shaped caudal margin, length 12·4 mm, width 13·1 mm. Dentigerous area sub-triangular, length 7·3 mm, width 8·7 mm; teeth weakly bicuspid with a rear cusp larger than front cusp; posteriormost teeth a little larger medially.

Scales ctenoid on flanks; cheek scaled; dorsal and anal fins with scales at base; caudal fin with small scales anteriorly on fin membranes between rays; paired fins without scales. Upper lateral line high on body; lower lateral line running along body axis; two pored scales anteriorly on caudal fin (usually one or two pored scales present, but absent in three specimens).

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