

On the generic status of *Limbochromis cavalliensis* (THYS VAN DEN AUDENAERDE & LOISELLE 1971) (Teleostei: Perciformes)

A. Lamboj*

Abstract

Limbochromis cavalliensis is shown to be a member of *Chromidotilapia*, diagnosed by some morphological features, for instance the number of infraorbital bones, the number of openings of the laterosensory canal in the lachrymal bone, the shape of the pelvic fin in females and the number of scales between the upper lateral line scale series to the base of the dorsal fin. In all these characteristics it is different to *Limbochromis robertsi* which is confirmed to differ from all other chromidotilapiine cichlids and retained in a now monotypic genus *Limbochromis* diagnosed by a combination of characteristics, including the number of scales surrounding the caudal peduncle, the number of infraorbital bones, the number of openings of the laterosensory canal in the lachrymal bone and a unique breeding behaviour (cave spawning, facultative larvophilous mouthbrooding). A diagnosis for *Limbochromis* is given.

Key words: *Limbochromis cavalliensis*, *Limbochromis robertsi*, *Chromidotilapia*.

Zusammenfassung

Aufgrund verschiedener Merkmale, vorrangig der Anzahl der Infraorbitalknochen, der Anzahl der Öffnungen des laterosensorischen Systems im Lacrymale, der Form der Bauchflossen beim Weibchen und der Anzahl der Schuppen zwischen der oberen Seitenlinie und der Dorsalbasis wird *Limbochromis cavalliensis* in die Gattung *Chromidotilapia* überstellt. Die Art ist in diesen Merkmalen von der zweiten Art der Gattung, *L. robertsi*, deutlich zu unterscheiden. *L. robertsi* unterscheidet sich von allen anderen Gattungen chromidotilapiiner Cichliden und der Verbleib dieser Art in der nunmehr monotypischen Gattung *Limbochromis* wird bestätigt. Als charakterisierende Merkmale dieser Art/Gattung sind hauptsächlich die folgenden hervorzuheben: Anzahl der Schuppen um den Schwanzstiel, Anzahl der Infraorbitalknochen, Anzahl der Öffnungen des laterosensorischen Systems im Lacrymale sowie ein bei Cichliden besonderes Brutpflegeverhalten als höhlenlaichender, fakultativer larvophiler Maulbrüter. Eine Diagnose für *Limbochromis* wird angegeben.

Introduction

THYS VAN DEN AUDENAERDE & LOISELLE (1971) described two new species of *Nanochromis* (sensu THYS VAN DEN AUDENAERDE 1968): *N. robertsi* THYS VAN DEN AUDENAERDE & LOISELLE (1971) and *N. cavalliensis* THYS VAN DEN AUDENAERDE & LOISELLE (1971). The integration within this genus was based mainly on the fact that both species have a reduced number of circumpeduncular scales. Differences to other *Nanochromis* species were seen in the caudal fin margin which is shaped into a pair of streamer like points. In addition the geographical distribution of both species is outside the range of all other species of *Nanochromis*. Notes about maturity, reproduction and ecology are given in the original description where both species were suggested to be mouthbreeders.

* Anton Lamboj, Institut für Zoologie der Universität Wien, Abteilung für Evolutionsbiologie, Althanstraße 14, A - 1090 Wien, Austria. e-mail: anton.lamboj@univie.ac.at

GREENWOOD (1987) published a more detailed phylogenetic review on pelmatochromine fishes with detailed anatomical and morphological observations. This author differentiated between two groups of pelmatochromine cichlids. For the second group, characterised by five synapomorphies, he created the term "chromidotilapiines", including six genera of which one is *Limbochromis*. *Limbochromis* was established for the two species *L. robertsi* and *L. cavalliensis*, formerly members of *Nanochromis*, being different to all other chromidotilapiine cichlids for example in the number of openings of the laterosensory canal in the lachrymal bone, the number of the infraorbital bones, the scales on the cheek, the number of circumpeduncular scales, separation of the upper lateral line from the dorsal fin base, shape of the pelvic fin, although Greenwood (1987) recognized differences in the first of these characteristics between both species.

Personal collecting in Cote d'Ivoire (1988) and Ghana (1991 and 1993) of *L. cavalliensis* and *L. robertsi* allowed closer observations of preserved and living specimens. It then became apparent that *L. cavalliensis* does not share some derived characteristics of *L. robertsi*, like the number of openings of the laterosensory system in the lachrymal bone, the number of circumpeduncular scales, number of scales between the upper lateral line series to the base of the dorsal fin, the degree of sexual dimorphism and of sexual dichromatism, the shape of the pelvic fin in females and in the breeding behaviour. On the other hand, *L. cavalliensis* shares all diagnostic characteristics of the genus *Chromidotilapia* BOULENGER, 1898. The only exception is a somewhat reduced number of circumpeduncular scales in some specimens of *L. cavalliensis*. It is particularly similar to *C. guntheri guntheri* (SAUVAGE, 1882); also the breeding behaviour is similar in both species, being pair-bounding male mouthbrooders.

The view that *L. cavalliensis* is without doubt a member of *Chromidotilapia* (LAMBOJ, 1993a) was accepted and transported in literature by German aquarists (LINKE & STAECK, 1993), but a correct paper giving all arguments and facts for a change of the generic status of the species was never published.

Material and methods

Meristics and morphometrics follow LEVEQUE & al. (1990) and MAMONEKENE & TEUGELS (1993), except all measurements of the head (and all parts of it), which follow KULLANDER (1980).

All measurements were taken with digital callipers with an accuracy of 0.03 mm; values in tables are rounded to tenth of mm with Microsoft Excel. All counts and measurements were made on the left side of the fish. Spines in the fins are indicated in Roman, rays in Arabic numerals.

Clearing and staining of one specimen each of *L. robertsi*, *L. cavalliensis*, *C. g. loenberghii*, and five specimens of *C. g. guntheri* follows DINGKUS & UHLER (1977) with the modifications suggested by PLÖSCH (1991).

Abbreviations used are: BMNH, British Museum (Natural History) London; MRAC, Musée Royal de l'Afrique Centrale, Tervuren; NMW, Naturhistorisches Museum Wien; SU, Stanford University Collections (California Academy of Sciences, San Francisco); SL, standard length.

Specimens examined:

Limbochromis cavalliensis: MRAC 168574 (holotype), one female, 67.0 mm SL, Cavally-River, Cote d'Ivoire; MRAC 93-119-P-0024-0025, one male, one female, 66.9 - 67.8 mm SL, Cavally-River, Cote d'Ivoire; MRAC 99-31-P-1-3, two males, one female, 57.3 - 76.7 mm SL, Cavally-River, Cote d'Ivoire (one male 76.7 mm SL cleared and stained, not measured); NMW 91426, two males, two females, 59.2 - 71.9 mm SL, Cavally-River, Cote d'Ivoire.

Limbochromis robertsi: SU 63143 (holotype), one male 76.5 mm SL, Asiakwa, Ghana; MRAC 175008 (paratype), one male, 62.1 mm SL, Asiakwa, Ghana; MRAC 74-29-P-688-689, one male and one specimen sex not determinable, 50.4 - 67.0 mm SL, Naby Abra, Ghana; MRAC 93-119-P-0026-0030, three males, two females, 39.2 - 73.9 mm SL, Krensens-Creek, Ghana; MRAC 99-31-P-4, one male, cleared and stained, 63.8 mm SL, Krensens-Creek, Ghana; NMW 91427, five males, five females, 35.7 - 73.1 mm SL, Krensens-Creek, Ghana.

C. g. guntheri: MRAC 73-05-P-268-73, three males, three females, 65.0 - 81.2 mm SL, Abono/Lake Bosumtwé, Ghana; MRAC 73-7-P-380-389, four males, one female, 65.8 - 82.9 mm SL, Ghana; MRAC 73-13-P-366 - 389, four males, three females and two specimen sex not determinable, 39.4 - 98.3 mm SL, Misahohe, Togo; MRAC 86-13-P-138-153, four males, two females and four specimen sex not determinable, 19.7 - 111.0 mm SL, Riv. Blé/Dodo, Côte d'Ivoire; MRAC 87-18-P-4782-805, three males and seven specimen sex not determinable, 24.8 - 106.0 mm SL, Mankono, Côte d'Ivoire; MRAC 87-18-P-4816-835, six males, two females and two specimen sex not determinable, 34.3 - 91.7 mm SL, Akenkro, Ghana; NMW 7740, one female, 80.3 mm SL, Bakoko, Cameroon; NMW 91428, one male, one female, 67.0 - 70.2 mm SL, Assinie, Côte d'Ivoire, NMW 914129, two males, one female, 63.5 - 102.0 mm SL, Kibi, Ghana.

C. g. loennbergii: MRAC 73-5-P-4955-979, two males, three females, 68.2 - 76.0 mm SL, Barombi-Kotto, Cameroon.

Chromidotilapia kingsleyae: BMNH 1896.5.5:36 (lectotype), one male, 84.8 mm SL, Ogoue, Gabon; BMNH 1867.5.3:1 (paratype), one male, 93.8 mm SL, Ogoue, Gabon; BMNH 1899.3.2:6 (paratype), one male, 93.0 mm SL, Ogoue, Gabon.

Additionally 3 pairs of *Limbochromis cavalliensis* and 8 pairs of *Limbochromis robertsi* were used for the observation of breeding behaviour.

Results

***Limbochromis robertsi* (THYS VAN DEN AUDENAERDE & LOISELLE, 1971)**
(counts and measurements see tab. 1)

Distribution: Ghana, Eastern Region around the village of Kibi (near Koforidua); only in small tributaries of the upper part of the Birim River.

Anatomical and morphological features are the same as described by GREENWOOD (1987), except for the first ray of the pelvic fin which is not the longest of this fin in both sexes. Such elongation of this ray can only be observed in semiadult and adult males and in a few very big females. Most females sexually active and fully grown, all semiadult females and all juvenile specimens of both sexes show a second ray of same length or longer than the first ray. Similarly this is true for females of *Paranochromis*, *Nanochromis* and, more pronounced, in *Pelvicachromis* (see GREENWOOD, 1987).

Lateral-line series with 15 - 28 scales (in few specimens, a lower number of scales in the lateral line sometimes lead to not pored scales in the upper lateral line series, making this series looking incomplete), at its highest point (8th pored scale) the upper lateral line is separated from the dorsal fin base by 2 or by 1 ½ scales; the last pored scales are separated from the fin base by 1 scale.

Tab. 1: Morphometrics and meristics of 19 specimens of *L. robertsi* (SL 35.7 - 76.5 mm, mean = 55.3 mm). SD = standard deviation

	Min.	-	Max.	Mean	SD
% of standard length					
Body depth	27.2	-	34.6	30.3	1.5
Head length	32.2	-	39.7	35.3	1.6
Length of caudal peduncle	9.5	-	18.1	14.1	1.8
Depth of caudal peduncle	10.2	-	15.1	13.7	1.0
Length of dorsal-fin base	52.0	-	59.5	56.6	2.0
Length of anal-fin base	17.7	-	21.3	19.7	1.0
Predorsal distance	30.4	-	41.1	35.0	2.6
Preanal distance	64.4	-	72.0	67.7	2.2
Prepectoral distance	33.3	-	40.6	36.2	1.6
Prepelvic distance	35.8	-	42.4	38.3	1.7
% of head length					
Head depth	55.3	-	77.8	63.3	5.6
Snout length	29.9	-	43.7	36.0	3.3
Eye diameter	21.0	-	26.3	23.9	1.6
Postorbital length	35.3	-	43.7	40.2	2.0
Interorbital distance	23.2	-	32.5	26.4	2.5
% of caudal peduncle depth					
Caudal peduncle length*	66.5	-	141.6	103.7	16.5
Meristics					
Upper lateral-line scales	16	-	20		
Lower lateral-line scales	2	-	11		
Total lateral-line scales	15	-	28		
Circumpeduncular scales	13	-	14		
Dorsal fin	XV-XVI	/	8-10		
Anal fin	III	/	6-8		
Pectoral fin	12	-	14		
Pelvic fin	I	/	5		

* The lowest (66.5 %) and the highest (141.6 %) values were found in specimens of SL 35.7 mm and SL 67.0 mm, respectively. These seem to be aberrations, all the other specimens showed a range of 87.4 - 126.8 % SL.

Chest scales smaller than those on the anteroventral aspects of the flanks.

Dorsal part of cheek with three rows of scales.

Section of the infraorbital canal of the head lateral line system with four pores on the lachrymal. Infraorbital bones series complete with lachrymal and four additional bones (fig. 1).

The neurocranial apophysis for the upper pharyngeal jaws is of the *Tilapia*-type.

13 - 14 scales around the caudal peduncle.

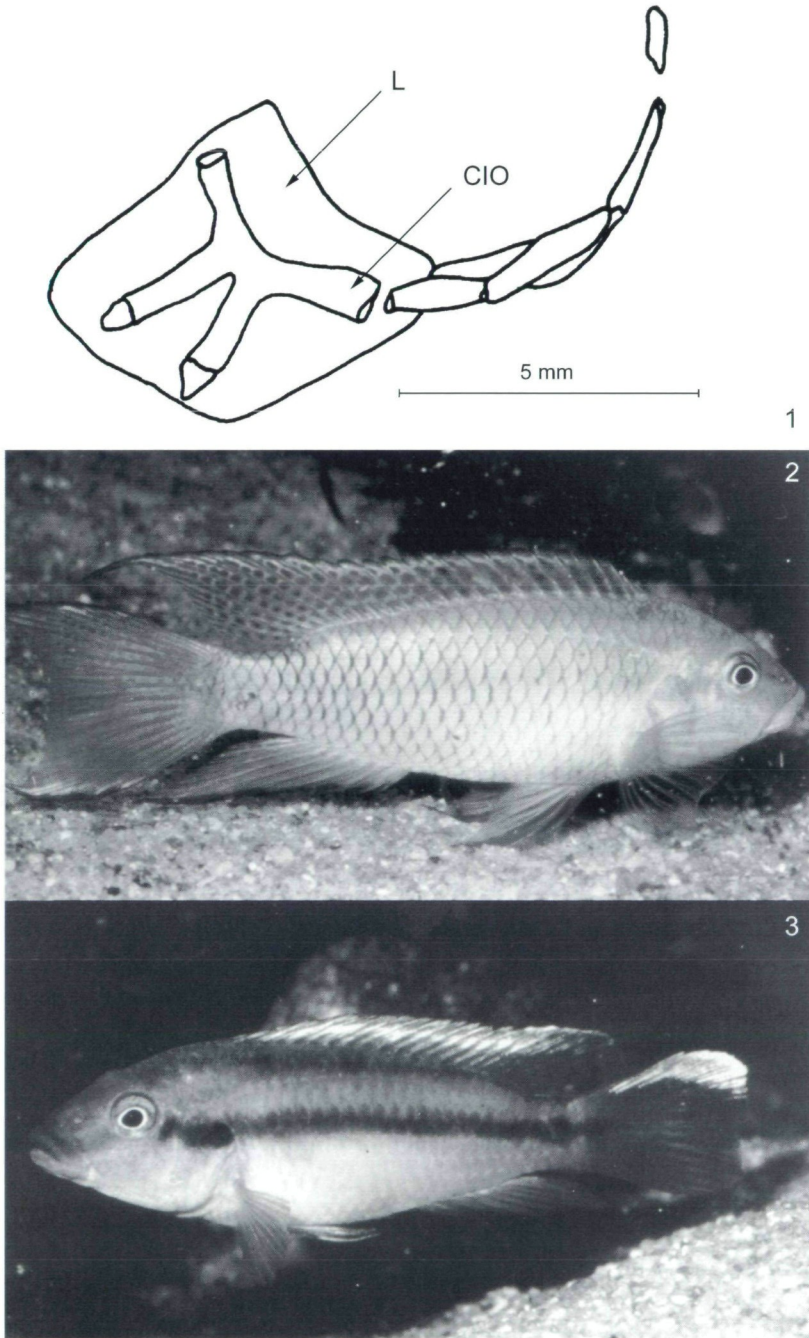


Fig. 1 - 3: *Limbochromis robertsi*: (1) Lachrymal (L) and complete series of four additional infra-orbital bones with canalis infraorbitalis (CIO), MRAC 99-31-P-4, SL = 63.8 mm; (2) adult male, Black Krensens Creek, Ghana - Eastern Region, not preserved; (3) adult female, Black Krensens Creek, Ghana, Eastern Region, not preserved.

Caudal fin in adult males with two symmetrically produced streamers (fig. 2); no or only very short projections are present in females (fig. 3).

High degree of sexual dimorphism and sexual dichromatism (fig. 2, 3): Males are usually about 1/3 bigger than females, rays of dorsal, anal and pelvic fins are more pronounced in males than in females.

Coloration of living specimens: Ground coloration brownish in both sexes, but lower part of the body usually darker in males than in females. Unpaired fins with red spots in males. Females with a clearly visible red/silver coloration in the dorsal fin. Belly of mature females with red coloration. Males with dark margins on body scales. Stressed individuals, juveniles and semiadults with two horizontal bars on the body, the upper one immediately below the dorsal fin and of similar length as this fin, the lower one in the middle of the body from the head to the beginning of the caudal fin. For additional details of coloration see THYS VAN DEN AUDENAERDE & LOISELLE (1971).

Breeding behaviour: *L. robertsi* shows a unique breeding behaviour: It is a pair-bounding and cave spawning species as known for many cichlid species and – within the Chromidotilapiines – for *Thysochromis*, *Nanochromis*, *Parananochromis* and *Pelvicachromis* (GREENWOOD 1987, KEENLEYSIDE 1991, LAMBOJ 1995, LINKE & STAECK 1993, STAECK 1982). It is unique, though, in displaying two possibilities of further hatching and broodcare: Partial larvophilic mouthbreeding in both sexes as well as typical cave-breeding behaviour with deposition of the larvae in the breeding-cave or in other hiding places similar to caves was observed. The interesting fact is that free changes between the two types of breeding behaviour were observed not only between different broods but even within the same brood (LAMBOJ 1993a, b, 1995). This behaviour was not caused by disturbances of a breeding pair. When a behavioural change was done, the new behaviour was always shown for a longer period, at the minimum for one day. Non-mouthbreeding behaviour, however, was shown more often than mouthbreeding. To my knowledge, *L. robertsi* seems to be the only cichlid species with facultative mouthbreeding behaviour.

Tendencies to polygynous reproductive pattern, as assumed by THYS VAN DEN AUDENAERDE & LOISELLE (1971) in the original description could not be observed, neither in the aquarium nor in the field.

***L. cavalliensis* (THYS VAN DEN AUDENAERDE & LOISELLE, 1971)**

(Counts and measurements see tab. 2)

Distribution: Only known from type locality: Middle part of the Cavally River in western Cote d'Ivoire, near the village of Sahibly (Region of Toulepleu).

Lateral-line series with 24 - 30 scales; at its highest point (8th pored scale) the upper lateral line is separated from the dorsal fin base by 2 ½ or by 2 large and 1 small scale; the last pored scales are separated from the fin base by 1 or 1 ½ scales.

Chest scales smaller than those on the anteroventral aspects of the flanks.

Dorsal part of cheek with three – four rows of scales.

Tab. 2: Morphometrics and meristics of 9 specimens of *C. cavalliensis* (SL 57.3 - 71.9 mm, mean = 65.8 mm). SD = standard deviation.

	Min.	-	Max.	Mean	SD
% of standard length					
Body depth	27.9	-	33.1	30.5	1.7
Head length	35.7	-	40.9	38.6	1.6
Length of caudal peduncle	11.8	-	13.4	12.5	0.6
Depth of caudal peduncle	13.7	-	14.4	14.4	0.2
Length of dorsal-fin base	52.8	-	56.6	54.8	1.5
Length of anal-fin base	15.5	-	18.3	16.5	1.0
Predorsal distance	35.8	-	45.0	40.0	3.3
Preanal distance	69.8	-	72.3	71.0	1.1
Prepectoral distance	35.4	-	41.9	38.3	2.4
Prepelvic distance	37.3	-	45.0	40.3	3.1
% of head length					
Head depth	58.8	-	74.4	63.8	5.2
Snout length	36.3	-	44.9	41.5	2.9
Eye diameter	22.3	-	26.8	24.4	1.5
Postorbital length	31.6	-	38.3	34.8	2.5
Interorbital distance	21.5	-	25.8	23.7	1.6
% of caudal peduncle depth					
Caudal peduncle length	85.1	-	96.3	89.6	3.8
Meristics					
Upper lateral-line scales	17	-	21		
Lower lateral-line scales	7	-	10		
Total lateral-line scales	24	-	30		
Circumpeduncular scales	14	-	16		
Dorsal fin	XIII-XVI	/	8-10		
Anal fin	III	/	6-7		
Pectoral fin	12	-	14		
Pelvic fin	I	/	5		

Section of the infraorbital canal of the head lateral line system with five pores on the lachrymal. Infraorbital bones series complete with lachrymal and four additional bones (fig. 4).

The neurocranial apophysis for the upper pharyngeal jaws is of the *Tilapia*-type.

14 - 16 scales around the caudal peduncle. This counts differ from GREENWOOD (1987), who counted 12 - 13 circumpeduncular scales and the original description (THYS VAN DEN AUDENAERDE & LOISELLE, 1971). In the latter 13 scales are given for the holotype and 14 for the three paratypes. Greenwood did not explain this discrepancy between his work and the description. Concerning the holotype, the difference between description of the species and my work may have it's cause in one small scale on the dorsal edge of the caudal peduncle which possibly was not counted in the description. Differences to

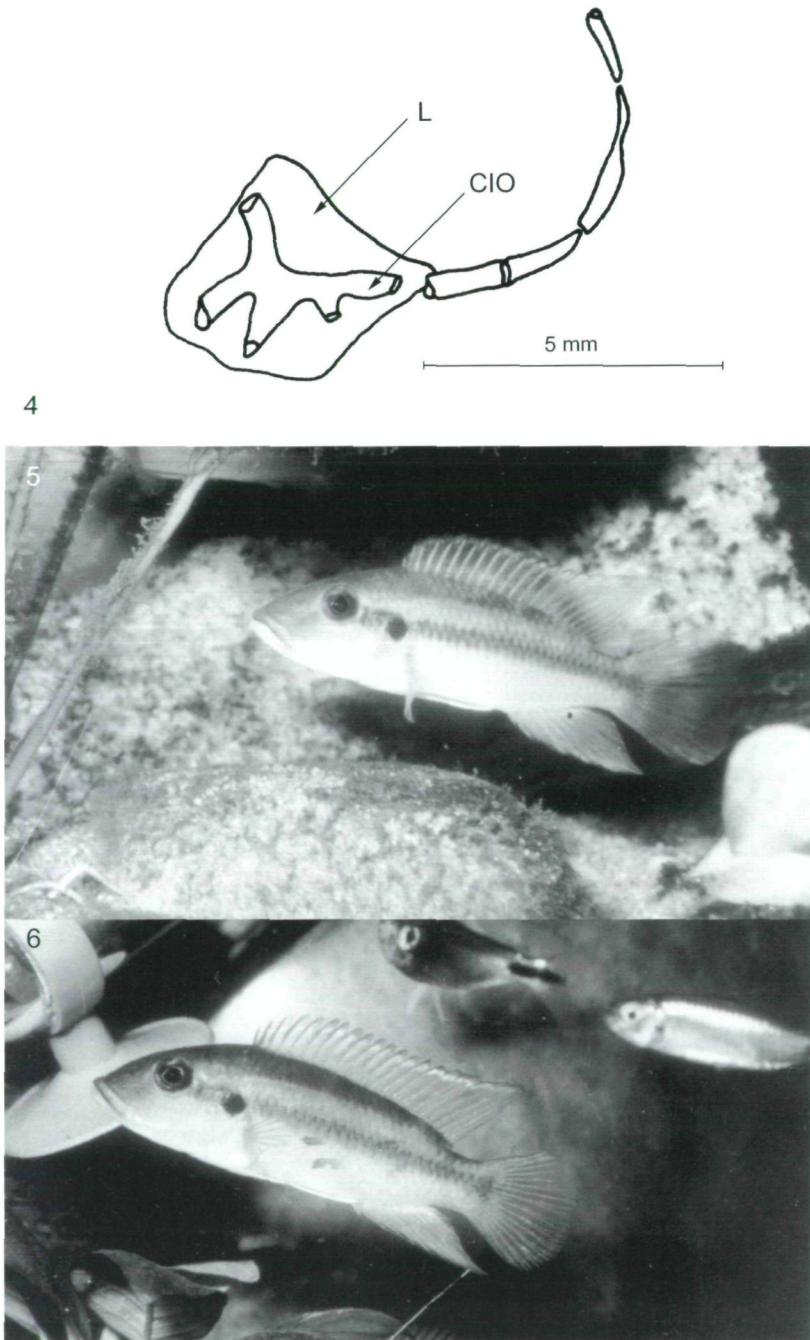


Fig. 4 - 6: *Chromidotilapia cavalliensis*: (4) Lachrymal (L) and complete series of four additional infraorbital bones with canalis infraorbitalis (CIO), MRAC 99-31-P-1-3, SL = 59.6 mm; (5) adult male, Cavally-River, Cote d'Ivoire, not preserved (6) adult female, Cavally River, Cote d'Ivoire not preserved.

Greenwood's counts cannot be clarified as he did not attribute counts to individually identifiable specimens. However, I counted 14 scales for the holotype what is confirmed by J. Snoeks (pers. comm.) who kindly proofed my observation.

Low sexual dimorphism and sexual dichromatism (fig. 5, 6). Females somewhat smaller than males. Caudal fin in some specimens of both sexes with very short, symmetrically produced streamers.

Coloration of living specimens: Ground coloration light brown in both sexes, dorsal part of body and head somewhat darker than rest of the body. Mature females with more extensive silvery coloration in the dorsal fin than males. Males only show a very small silvery band on the upper edge of the dorsal. Pelvic fins, anal fin and lower part of the caudal fin in females reddish; the same fins in males yellowish. Stressed individuals, juveniles and semiadults with one horizontal bar in the middle of the body and some short, broad vertical dark bars directly below the dorsal fin, they end approximately in the middle of the body.

The coloration shows great similarities to *C. g. guntheri*, a species which also occurs in the western region of Cote d'Ivoire, but not sympatrically with *L. cavalliensis*. The main differences between the two species are: More elongated body in *L. cavalliensis*, a somewhat higher degree of sexual dichromatism in *C. g. guntheri* (mature females of *C. g. guntheri* with more intensive coloration of the belly, especially during display behaviour). Additionally it is to mention that E. Lippitsch (Graz) kindly had a look on differences in scale morphology in some chromidotilapiine cichlids; she informed me about great similarity between *L. cavalliensis* and *C. g. guntheri* in all relevant characteristics of the scales and close relationship of both species, even when they are clearly distinguishable (pers. comm.).

After all, *L. cavalliensis* has to be transferred to *Chromidotilapia*.

Discussion

GREENWOOD (1987) established the genus *Limbochromis* as a "taxonomic defeat", mainly because of the impossibility to include this two species in any other genus of chromidotilapiine cichlids, although he clearly saw the two species did not share all genus specific characters. However, he clearly stated that the two species are members of the "group II pelmatochromine assemblage", an opinion which is to be strongly confirmed.

It is obvious that most of the characteristics of *L. cavalliensis* easily fit GREENWOOD's (1987) definition of *Chromidotilapia*. The only difference is that Greenwood strictly counted only 16 scales around the caudal peduncle in all *Chromidotilapia*-species. Own observation showed that this is a variable feature: in samples of *C. g. guntheri*, *C. g. loennbergii* (TREWAVAS, 1962) or *C. kingsleyae* BOULENGER, 1898 there are few specimens with only 15 scales around the caudal peduncle (LAMBOJ 1994, 1998b). In *L. cavalliensis* most of the observed specimens (5) show 15 scales, 3 specimens (including the holotype) had 14 scales and 2 specimens had 16 scales. Therefore the variation in scales of the caudal peduncle in this species is compatible with those found in *Chromidotilapia*. Compatibility is also observable in the pores of the infraorbital canal in the lachrymal bone, in the number of infraorbital bones and in the shape of the pelvic fin

concerning the fact that in *Chromidotilapia* the first ray of this fin is the longest in both sexes as it is in *L. cavalliensis*. Moreover, in coloration and in behaviour *L. cavalliensis* is very similar to *C. g. guntheri* (LAMBOJ, 1993a, b, 1995, 1998a) as well as in all basic patterns of squamation, while, in squamation, *L. robertsi* seems to be more related to *Parananochromis* (Lippitsch, pers. comm.). A similarity between *C. g. guntheri* and *L. cavalliensis* can also be documented by the fact that specimens of *L. cavalliensis* were at first misidentified as small and more elongated specimens of *C. g. guntheri* (DAGET & ILTIS, 1965; THYS VAN DEN AUDENAERDE & LOISELLE, 1971). Transferring *L. cavalliensis* to the genus *Chromidotilapia*, GREENWOOD's (1987) definition of the genus *Chromidotilapia* needs only to be extended in the number of circumpeduncular scales which have a range from 14 - 16 scales instead of 16 as stated by GREENWOOD (1987).

The unique character of *L. robertsi* sensu GREENWOOD (1987) is to be confirmed. Based on data of GREENWOOD and own results, a slightly altered diagnosis for *Limbochromis* is given:

1. All five synapomorphies of chromidotilapiine cichlids sensu GREENWOOD (1987).
2. The neurocranial apophysis for the upper pharyngeal jaws is of the *Tilapia*-type.
3. 13 - 14 scales around the caudal peduncle.
4. The first branched pelvic fin ray in adult males and some (very big) adult females longer than the second ray; second ray in juvenile specimens and most adult females longer or of equal length than the first ray. Dorsal fin with 15 -16 spines.
5. The upper lateral-line at its highest point (the 8th pored scale) is separated from the dorsal fin base by 2 or by 1 ½ scales; the last pored scales are separated from the fin base by 1 scale. Lateral line with 15 - 28 scales. Chest scales moderately small.
6. Vertebral column with 26 vertebrae comprising 13 or 14 abdominal and 12 or 13 caudal elements.
7. Section of the infraorbital canal of the head lateral line system with four pores on the lachrymal. Infraorbital bones series complete with lachrymal and four additional bones.
8. Sexual dimorphism and sexual dichromatism well developed.

The shape of the caudal fin with the production of streamers is not included in the definition of the genus. The production of such streamers – as mentioned by THYS VAN DEN AUDENAERDE & LOISELLE (1971) and GREENWOOD (1987) – is visible (but only slightly) in some specimens of *C. cavalliensis* too; additionally males in some populations of *C. kingsleyae* from Gabon show similar production of such streamers (LAMBOJ, 1998) and a new species (possibly a new genus too) of chromidotilapiine cichlid is documented by MAMONEKENE & TEUGELS (1993), also presenting two streamers in the caudal fin. Therefore this character seems to be useful only as a species specific in some ways, but not valuable as character typical for a genus.

A possibly better species specific is the unique breeding behaviour (facultative larvophilic mouthbreeding of this always cave-spawning species) – regarding our current knowledge of breeding behaviour in cichlids, especially in Chromidotilapiines (KEENLEYSIDE, 1991; LAMBOJ, 1993a, 1995, 1997a; STAECK, 1982).

Only one character seems proper to both species: The size of chest scales which is smaller in both species than the size of the scales on the anteroventral aspects of the flanks. I think that this character is not of high value for a genus definition in chromidotilapiine cichlids: When looking on GREENWOOD's (1987) diagnoses of the different genera it can be seen that this character occurs in every genus, even though the significance of the difference is not always the same. This is confirmed by own results. Therefore this character – in a general view – is useful as group-specific for chromidotilapiine cichlids; the variant degrees of size-differences are better seen as a homoplastic feature, not as an apomorphy.

After all, a phylogenetic relationship of *Limbochromis* to other Chromidotilapiines seems to be more logical with all substrate (cave-) spawning genera with a high degree of sexual dimorphism and dichromatism. Therefore a grouping of *Limbochromis* with *Pelvicachromis*, *Parananochromis* and *Nanochromis* – as GREENWOOD (1987) stated (see arguments there) – is to be confirmed. This conclusion is also supported when looking at molecular data (LAMBOJ, 1997a, b), and obtains yet more weight with Lippitsch's information about *L. robertsi* being close to *Parananochromis* (pers. com.).

Nevertheless – further information in this area is necessary before postulating a more definitive statement about the phylogenetic relationships in chromidotilapiine cichlids.

Acknowledgements

I would like to thank: G. G. Teugels and J. Snoeks (MRAC) for many discussions about cichlids, their help and for the loan of material; H. Kratochvil as my supervisor on the University of Vienna; the Institut d'écologie tropicale (Abidjan, Cote d'Ivoire), the Departement of Fisheries and the Institute of Aquatic Biology (both Accra, Ghana) for their help and for the permissions to collect the specimens; all numerous colleagues and friends not mentioned by name who helped during field-work to get all samples; E. Lippitsch (Graz, Austria) for her personal comments, for her comments on an earlier version of the manuscript and for her work on squamation; G. Okorn (Vienna, Austria) for her help in clearing and staining; H. Grillitsch and J. Platzer (Vienna, Austria) for their help in preparing the figures; S. Davidson (BMNH) and D. Catania (SU) for the loan of material, R. Riehl and H. Greven (Düsseldorf, BRD) and one anonymous person for a first look and comments on earlier versions of the manuscript, M. Schmucker (Vienna, Austria) for proofreading my English and two anonymous referees for their valuable comments.

References

- BAERNDT G. P., WANDERS J. B. W. & VODEGEL R., 1986: The relationship between marking patterns and motivational state in the pre-spawning behaviour of the cichlid fish *Chromidotilapia guntheri* (Sauvage). – Neth. J. Zool., 36: 88-116.
- BOULENGER G. A., 1898: A revision of the African and Syrian fishes of the family Cichlidae. Part I. – Proc. Zool. Soc. London, 1898: 132-152.
- DAGET J. & ILLIS A., 1965: Poissons de Cote d'Ivoire. – Mem. Inst. fr. Afr. noire, 74: 1-385.
- DINGERKUS G. & UHLER L. D., 1977: Enzyme clearing of alcian blue stained whole small vertebrates for demonstration of cartilage. – Stain Technol., 52: 229-232.
- GREENWOOD P. H., 1987: The genera of pelmatochromine fishes (Teleostei, Cichlidae). A phylogenetic review. – Bull. Brit. Mus. (Nat. Hist.), Zoology, 53: 139-203.
- KEENLEYSIDE M. H. A. (ed.), 1991: Cichlid Fishes. Behaviour, ecology and evolution. – Chapman & Hall, London, 378 p.

- KULLANDER S. O., 1980: A taxonomical study of the genus *Apistogramma* Regan, with a revision of Brazilian and Peruvian species (Teleostei: Percoidae: Cichlidae). – Bonn. zool. Monogr., 14, 152 pp.
- LAMBOJ A., 1993 a: Vergleichende Untersuchung zur Systematik und Verwandtschaftsproblematik ausgewählter Arten der Gattungen *Limbochromis* und *Chromidotilapia* (Teleostei, Cichlidae). – MS Thesis, Universität Wien.
- LAMBOJ A., 1993 b: *Limbochromis robertsi* (Thys van den Audenaerde & Loiselles 1971): Ein außergewöhnlicher Buntbarsch aus Ghana. – In: Buntbarsch Jahrbuch 1994. Ed. W. Staeck, Bede-Verlag, Ruhmannsfelden, pp. 38-43.
- LAMBOJ A., 1994: *Chromidotilapia bosumtwensis*, a junior synonym of *C. g. guntheri* (Osteichthyes: Cichlidae). – Ichthyol. Explor. Freshwaters, 5: 345-349.
- LAMBOJ A., 1995: Das Brutpflegeverhalten der in Gattung *Chromidotilapia* und seine systematische Bedeutung. – In: H. GREVEN & R. RIEHL (eds.): Fortpflanzungsbiologie der Aquarienfische, Schmettkamp-Verlag, Bornheim, pp. 235-242.
- LAMBOJ A., 1997a: Systematische Revision der Gattung *Chromidotilapia* (Teleostei; Cichlidae) unter vergleichender Betrachtung anderer Gattungen chromidotilapiiner Cichliden. – PhD Thesis Universität Wien.
- LAMBOJ A., 1997 b: Molekularbiologische Vergleiche mitochondrialer DNA bei chromidotilapiinen Cichliden (Teleostei, Perciformes). – Verh. Deutsche Zool. Ges., Kurzpublikationen 90.1: 178.
- LAMBOJ A., 1998 a: Übersicht über die Formen der Maulbrutpflege bei Cichliden am Beispiel der Gattung *Chromidotilapia*. – In: H. GREVEN & R. RIEHL (eds.): Verhalten von Aquarienfischen (Symposiumsband), Birgit Schmettkamp Verlag, Bornheim, pp. 165-172
- LAMBOJ A., 1998 b: Zur Cichlidenfauna des Biosphärenreservates von Dimonika (Mayombe, Kongo) mit Beschreibung zweier neuer *Chromidotilapia*-Arten (Teleostei, Perciformes). – Verh. Ges. Ichthyol, 1:139-156.
- LEVEQUE C., PAUGY D. & TEUGELS G. G., 1990 : Faune des poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest Tome 1. – ORSTOM et MRAC, 384 pp.
- LINKE H. & STAECK W., 1993: Afrikanische Cichliden I - Buntbarsche aus Westafrika. 4. komplett überarbeitete Auflage. – Tetra Verlag, Melle, 200 pp.
- MAMONEKENE V. & TEUGELS G. G., 1993: Faune des Poissons d'eaux douces de la réserve de la biosphère de Dimonika (Mayombe, Congo). – Ann. Mus. roy. Afr. Centr., 272, 126 pp.
- MYRBERG A. A., 1965: A descriptive analysis of the behaviour of the African cichlid fish *Pelmatochromis guentheri* (SAUVAGE). – Animal. Behav. 13: 312 - 329.
- PLÖSCH T., 1991: Die Alizarin-/ Alcianblau - Färbung nach Dingerkus & Uhler. – DATZ, 44: 252-254.
- STAECK W., 1982: Handbuch der Cichlidenkunde: Buntbarsche: Arten, Verhaltensbiologie, Pflege und Zucht. – Frankh'sche Verlagshandlung, Stuttgart, 200 pp.
- THYS VAN DEN AUDENAERDE D. F. E., 1968: A preliminary contribution to a systematic revision of the genus *Pelmatochromis* Hubrecht sensu lato (Pisces, Cichlidae). – Rev. Zool. Bot. afr. 77: 349 - 391.
- THYS VAN DEN AUDENAERDE D. F. E. & LOISELLE P. V., 1971: Description of two new small African cichlids. – Rev. Zool. Bot. afr. 83: 192-206.

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Annalen des Naturhistorischen Museums in Wien](#)

Jahr/Year: 2000

Band/Volume: [102B](#)

Autor(en)/Author(s): Lamboj A.

Artikel/Article: [On the generic status of *Limbochromis cavalliensis* \(THYS van den AUDENAERDE & LOISELLE, 1971\)\(Teleostei: Perciformes\). 63-74](#)