

# Revision of the *Pelvicachromis taeniatus*-group (Perciformes), with revalidation of the taxon *Pelvicachromis kribensis* (Boulenger, 1911) and description of a new species

by

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**Abstract.** – Sixty-six specimens of seven populations of the *Pelvicachromis taeniatus*-group are compared and examined, using molecular and anatomical-morphological methods as well as coloration patterns. Accordingly, the taxon *P. taeniatus* is restricted to populations from Benin and Nigeria. For most populations from Cameroon the old taxon *P. kribensis* is revalidated and specimens from the Wouri River are described as a new species, *P. drachenfelsi* sp. nov. Species diagnosis is based on molecular characters and coloration patterns – mainly in the coloration of the male caudal fin. *Pelvicachromis drachenfelsi* sp. nov. shares a black margin and white to pale bluish submargin in the lower half of the male caudal fin with *P. taeniatus*, a coloration pattern absent in *P. kribensis*, but it differs from *P. taeniatus* by a white margin and a black submargin in the dorsal half of this fin (*vs* a pattern of dots in *P. taeniatus*). Additionally, female of *P. taeniatus* differ from those of *P. drachenfelsi* sp. nov. and *P. kribensis* by two or three horizontal dark bars in the caudal fin (*vs* none in *P. drachenfelsi* sp. nov. and one in most populations of *P. kribensis*). The populations of *P. kribensis* from the Moliwe River system and the Nyong River system potentially represent a new species, but a definitive decision requires additional material and study. The molecular phylogeny points to the possibility that *Pelvicachromis* is not monophyletic.

**Résumé.** – Révision du groupe de *Pelvicachromis taeniatus* (Perciformes), avec revalidation du taxon *Pelvicachromis kribensis* (Boulenger, 1911) et description d'une nouvelle espèce.

## Key words

Cichlidae  
*Pelvicachromis taeniatus*  
Cameroon  
Nigeria  
Chromidotilapiines  
Taxonomy

Soixante-six spécimens de sept populations du groupe de *Pelvicachromis taeniatus* sont examinés et comparés par des méthodes moléculaires et anatomico-morphologiques ainsi que les motifs de leur coloration. Il en résulte que le taxon *P. taeniatus* est limité aux populations du Bénin et du Nigeria. Pour la plupart des populations du Cameroun, le taxon ancien *P. kribensis* est revalidé tandis que les spécimens provenant de la rivière Wouri appartiennent à une nouvelle espèce, *P. drachenfelsi* sp. nov. La diagnose des espèces est fondée sur les caractères moléculaires et les robes – essentiellement la coloration de la nageoire caudale des mâles. *Pelvicachromis drachenfelsi* sp. nov. et *P. taeniatus* présentent un motif commun absent chez *P. kribensis* : une bande marginale noire et une submarginale blanche ou bleuâtre pâle dans la moitié inférieure de la nageoire caudale des mâles. En revanche, *Pelvicachromis drachenfelsi* sp. nov. diffère de *P. taeniatus* par une bande marginale blanche et une submarginale noire à la partie dorsale de cette même nageoire (c'est un motif ponctué chez *P. taeniatus*). En outre, les femelles de *P. taeniatus* diffèrent de celles de *P. drachenfelsi* sp. nov. et de *P. kribensis* par deux ou trois barres noires horizontales à la nageoire caudale (aucune chez *P. drachenfelsi* sp. nov. et une dans la plupart des populations de *P. kribensis*). La possibilité de reconnaître une nouvelle espèce pour les populations de *P. kribensis* des systèmes des rivières Moliwe et Nyong nécessite du matériel et des études supplémentaires. Les résultats de phylogénie moléculaire ne permettent pas d'établir la monophylie de *Pelvicachromis*.

In 1968, Thys van den Audenaerde published a revision of the genus *Pelmatochromis* in which, on the one hand, he created the basis for recognizing several genera by erecting subgenera of *Pelmatochromis*, but on the other hand he also stated synonymy for some taxa. One of the new genera erected as subgenus by Thys van den Audenaerde, but subsequently established as a genus by Trewavas (1974), was the genus *Pelvicachromis*. In that revision, he synonymised *Pelvicachromis (Pelmatochromis) kribensis* (Boulenger, 1911) and *P. kribensis calliptera* (Pellegrin, 1929), both described from southern Cameroon, with *P. taeniatus* (Boulenger, 1901), described from Nigeria. Unfortunately, Thys van den Audenaerde did not give clear reasons for this synonymy, but merely referred to certain coloration patterns of the male

caudal fins (number of ocelli) and to the poor coloration in the types of *P. taeniatus*; no detailed arguments for the synonymization were given.

In 1987, Greenwood published a more detailed analysis of the phylogeny and anatomy of pelmatochromine cichlids. He coined the term “chromidotilapiines” for all members of the group without microbranchiospines (what includes the genus *Pelvicachromis*) and erected several new genera within the chromidotilapiines, but presented no discussion or exploration of the single species or their populations within most genera. Thus, Thys van den Audenaerde species name and description of *P. taeniatus* remained largely untouched.

Subsequently, in all scientific publications after Thys van den Audenaerde (1968), *P. kribensis* had been accepted as a

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synonym of *P. taeniatus*. This was mainly based on the fact that anatomical or morphological differences between populations of the species are not or very poorly recognisable – which is a well-known condition for several species within the genus (e.g. Lamboj and Stiassny, 2007).

In contrast, several aquaristic articles questioned the validity of Thys van den Audenaerde synonymization mainly based on coloration of live specimens from Nigeria and Cameroon (e.g. Paulo, 1977; Loiselle and Castro, 1980). Some of these aquaristic papers presented a few morphological and anatomical data, but none did so based on material deposited in scientific collections or type material. Moreover, none of these papers were published in reviewed journals, nor did they reach clear conclusions. Accordingly, none of these can be recognized or accepted as a valid revision.

Over the years, numerous geographical colour morphs of *P. taeniatus* had been discovered by the ornamental fish trade and by aquarists collecting cichlids in Cameroon. It became evident that at least three main groups occur within the species and that some coloration variation exists within most of these groups (Lamboj, 2004b): a group from the Niger River system with visible coloration differences, compared with two groups from the river systems in Cameroon. The first Cameroonian group is represented by two more similar clusters of populations from regions around Mount Cameroon and from localities south of the Nyong River. The second Cameroonian group consists of one form known only from the Wouri River system. This so-called “Wouri form” was discovered by Austrian aquarists (O. Gartner and colleagues, pers. comm.) in the late 1980s and shows no variation of coloration patterns, contrary to the other Cameroonian forms where coloration pattern variation is evident (e.g. number of black dots in male caudal fin, absence or presence of one black horizontal band in female caudal fin; A.L., pers. obs.).

The main differences both within and between the groups are most conspicuous in male-specific coloration, less in female coloration.

A molecular investigation of several specimens, based on field samples collected by one of the authors (A.L.) as well as on imported specimens from trade (identified by A.L.), strongly supports a grouping as visible in coloration patterns. This paper presents these molecular results in combination with descriptions of the coloration differences between the groups. It also describes the “Wouri-form” as a new species, redescribes *P. kribensis* and provides a revised diagnosis and description of *P. taeniatus*.

## MATERIAL AND METHODS

### Morphological examination and behavioural observation

External counts and measurements follow Barel *et al.*

(1977). All measurements were taken on the left side with digital callipers. The clearing and staining protocol to examine bones and cartilage followed Dingerkus and Uhler (1977). In addition, live specimens collected by one of the authors (A.L.) and additional ones imported for the ornamental fish trade were used for colour comparison, description of live specimens, and behavioural observations, the latter were not included in morphological examinations or type series or other collections, also Lamboj (2004b) has been used as reference too. For distribution, Daget (1991) and Lamboj and Stiassny (2007) have been used as additional reference. Abbreviations used throughout the text are: SL: standard length; HL: head length. Institutional abbreviations: AMNH, American Museum of Natural History, New York; BMNH, British Museum (Natural History), London; MRAC, Muséum Royal de l’Afrique Centrale, Tervuren; NMW, Naturhistorisches Museum Wien; ZSM, Zoologische Staatssammlung München.

### Sampling

In addition to the type specimens of *P. taeniatus* and *P. kribensis* specimens from BMNH, samples for anatomical and morphological as well as for molecular comparisons were collected by one of the authors (A.L.) in Cameroon and Benin. Specimens of *P. taeniatus* from Nigeria, of *Limbochromis robertsi* Thys van den Audenaerde & Loiselle, 1971 from Ghana and of *P. humilis* (Boulenger, 1916) came from the ornamental fish trade; additional specimens of other genera used for the study were also collected by A.L. In the molecular analyses, 20 individuals of the *Pelvicachromis taeniatus*-group from the Niger (2), Lobe (9), Nyong (2), Wouri (3) and Moliwe (4) river systems were included. Additionally, 5 specimens of *Pelvicachromis humilis*, 1 specimen of *Benitochromis batesii* (Boulenger, 1901), *B. conjunctus* (Lamboj, 2001), *B. finleyi* (Trewavas, 1974), *B. nigrodorsalis* (Lamboj, 2001), *B. riomuniensis* (Linke & Staeck, 1981), *B. ufermanni* (Lamboj, 2001), *Chromidotilapia g. guntheri*, Boulenger, 1998, *C. linkei* Staeck, 1980, *L. robertsi* and *Thysochromis ansorgii* (Boulenger, 1901) were included. A.L. identified all cichlids.

### Molecular analyses

A total of 7 molecular markers (partial or complete sequence) were used in the present study. These genes were represented by: i) the nuclear recombination activation gene-1 (RAG1), ii) the mitochondrial 12S rRNA gene, iii) the mitochondrial protein-coding genes (PCGs) NADH dehydrogenase subunit 2 (ND2) and cytochrome *b* (CytB), iv) the Threonine (tRNAThr) and Proline (tRNAPro) mitochondrial transfer RNA genes and v) the mitochondrial “d-loop” region. Fin clips removed from the bodies of several specimens were sent to LGC Genomics GmbH (Berlin, Germany) to perform DNA extraction, gene amplification and all

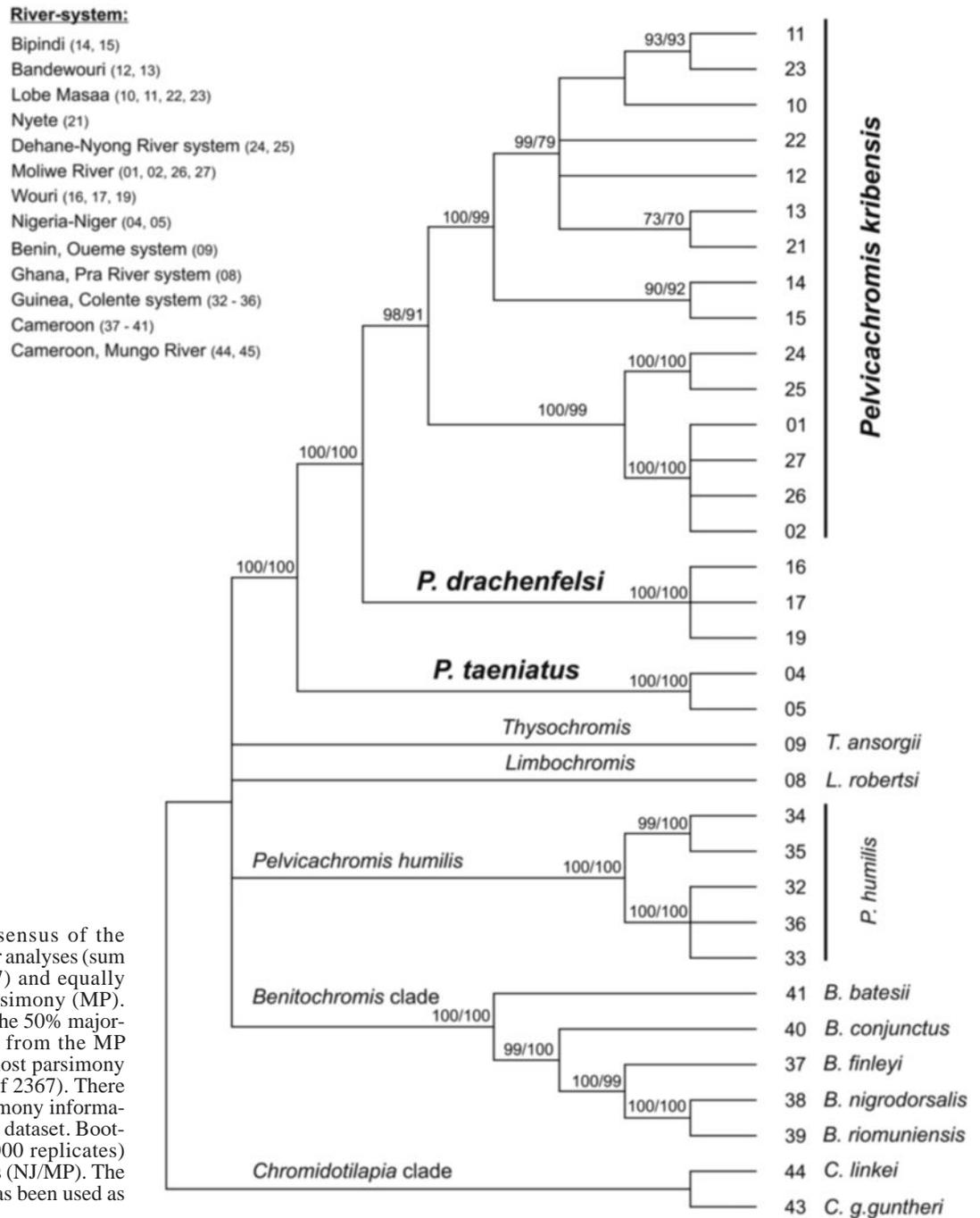


Figure 1. - Strict consensus of the neighbour-joining cluster analyses (sum of branch length = 0.47) and equally weighted maximum parsimony (MP). For the strict consensus the 50% majority rule consensus tree from the MP search was used (nine most parsimony trees with a tree length of 2367). There were a total of 491 parsimony informative positions in the final dataset. Bootstrap values > 50% (2,000 replicates) are indicated at the nodes (NJ/MP). The *Chromidotilapia* clade has been used as outgroup.

related sequencing reactions. The sequences of the oligonucleotides required to amplify of each marker were obtained from the literature (Kocher *et al.*, 1995; Tang *et al.*, 1999; López *et al.*, 2004; Schliewen and Klee, 2004). All electropherograms were edited, trimmed, cleaned and assembled into the final consensus sequences using the program BioEdit v5.0.9 (Hall, 1999). The same program was used to check for frame shifts and stop codons in all protein-coding gene sequences (CytB, ND2, RAG1).

All sequences are deposited in GenBank under the accession numbers listed in table I. Each gene was aligned separately. 12S rRNA and d-loop region were aligned using the program MUSCLE (Edgar, 2004) as implemented in MEGA v5.05 (Tamura *et al.*, 2011). All protein-coding genes and tRNA sequences were manually aligned in BioEdit. The same program was used to concatenate all alignments into the final matrix.

To check for levels of intra- and interspecific variation, a

Table I. - Specimens investigated and marker sequences determined in the present study (and GenBank accession numbers).

No	Species	Population	12S rRNA	ND2	RAG1	CytB	tRNA Thr	tRNA Pro	d-loop region
1	<i>Pelvicachromis kribensis</i>	Moliwe River	KF359818	KF359851	KF359784	KM103527	–	–	–
2	<i>Pelvicachromis kribensis</i>	Moliwe River	KF359819	KF359852	KF359785	KM103528	–	–	–
4	<i>Pelvicachromis taeniatus</i>	Nigeria-Niger	KF359820	KF359853	KF359786	KM103529	KM103561	KM103589	KM103617
5	<i>Pelvicachromis taeniatus</i>	Nigeria-Niger	KF359821	KF359854	KF359787	KM103530	KM103562	KM103590	KM103618
8	<i>Limbochromis robertsi</i>		KF359822	KF359855	KF359788	KM103531	–	–	–
9	<i>Thysochromis ansorgii</i>		KF359823	KF359856	KF359789	KM103532	KM103563	KM103591	KM103619
10	<i>Pelvicachromis kribensis</i>	Lobe Masaa	KF359824	KF359857	KF359790	KM103533	KM103564	KM103592	KM103620
11	<i>Pelvicachromis kribensis</i>	Lobe Masaa	KF359825	KF359858	KF359791	KM103534	KM103565	KM103593	KM103621
12	<i>Pelvicachromis kribensis</i>	Bandewouri o.oc.	KF359826	KF359859	KF359792	KM103535	KM103566	KM103594	KM103622
13	<i>Pelvicachromis kribensis</i>	Bandewouri o.oc.	KF359827	KF359860	KF359793	KM103536	KM103567	KM103595	KM103623
14	<i>Pelvicachromis kribensis</i>	Bipindi	KF359828	KF359861	KF359794	KM103537	KM103568	KM103596	KM103624
15	<i>Pelvicachromis kribensis</i>	Bipindi	KF359829	KF359862	KF359795	KM103538	–	–	–
16	<i>Pelvicachromis drachenfelsi</i>	Wouri	KF359830	KF359863	KF359796	KM103539	KM103569	KM103597	KM103625
17	<i>Pelvicachromis drachenfelsi</i>	Wouri	KF359831	KF359864	KF359797	KM103540	KM103570	KM103598	KM103626
19	<i>Pelvicachromis drachenfelsi</i>	Wouri	KF359832	KF359865	KF359798	KM103541	KM103571	KM103599	KM103627
21	<i>Pelvicachromis kribensis</i>	Nyete	KF359833	KF359866	KF359799	KM103542	KM103572	KM103600	KM103628
22	<i>Pelvicachromis kribensis</i>	Lobe Masaa	KF359834	KF359867	KF359800	KM103543	KM103573	KM103601	KM103629

distance matrix was calculated using the LogDet (e.g. Lockhart *et al.*, 1994) model as implemented in MEGA v5.05. The same distance model was applied to reconstruct the neighbour-joining (Saitou and Nei, 1987) topology.

*C. g. guntheri* and *C. linkei* were used as outgroup to root the final trees.

The focus of this paper is on testing whether the proposed morphological species delimitation is congruent with the distribution of molecular variability in a more restricted set of populations. Accordingly, all three codon positions of each PCG were included in the analysis. In order to obtain corroborate our results, additional analyses were performed using a reduced 4 gene matrix (rRNA 12S, CytB, ND2, and RAG1), which gave congruent results (data not shown). The final trees were reconstructed using both, neighbour-joining cluster analyses (NJ) and equally weighted maximum parsimony (MP) as implemented in MEGA. Ambiguous posi-

tions and gaps were removed from each sequence pair in NJ analyses; partial deletion (Site Coverage Cutoff value: 80%) of ambiguous positions and gaps was applied in MP inferences. Nodal support was evaluated in all reconstructed topologies using nonparametric bootstrapping based on 2000 replicates.

#### Molecular variance and species delimitation in the *P. taeniatus*-group

The final dataset (7 molecular markers) was indented to test whether molecular diversity reflects the distribution of morphological diversity in the *P. taeniatus*-group. Both tree reconstruction methods (NJ and MP) provided similar results; a strict consensus of both analyses is presented in figure 1. Three main clusters with significant differentiations can be identified within the *P. taeniatus*-group: (i) specimens from the Niger-River system, (ii) specimens from the Wouri

Table I. - Continued.

No	Species	Population	12S rRNA	ND2	RAG1	CytB	tRNA Thr	tRNA Pro	d-loop region
23	<i>Pelvicachromis kribensis</i>	Lobe Masaa	KF359835	KF359868	KF359801	KM103544	KM103574	KM103602	KM103630
24	<i>Pelvicachromis kribensis</i>	Dehane-Nyong River system	KF359836	KF359869	KF359802	KM103545	–	–	–
25	<i>Pelvicachromis kribensis</i>	Dehane-Nyong River system	KF359837	KF359870	KF359803	KM103546	–	–	–
26	<i>Pelvicachromis kribensis</i>	Moliwe River	KF359838	KF359871	KF359804	KM103547	KM103575	KM103603	KM103631
27	<i>Pelvicachromis kribensis</i>	Moliwe River	KF359839	KF359872	KF359805	KM103548	KM103576	KM103604	KM103632
32	<i>Pelvicachromis humilis</i>		KF359840	KF359873	KF359806	KM103549	KM103577	KM103605	KM103633
33	<i>Pelvicachromis humilis</i>		KF359841	KF359874	KF359807	KM103550	KM103578	KM103606	KM103634
34	<i>Pelvicachromis humilis</i>		KF359842	KF359875	KF359808	KM103551	KM103579	KM103607	KM103635
35	<i>Pelvicachromis humilis</i>		KF359843	KF359876	KF359809	KM103552	KM103580	KM103608	KM103636
36	<i>Pelvicachromis humilis</i>		KF359844	KF359877	KF359810	KM103553	KM103581	KM103609	KM103637
37	<i>Benitochromis finleyi</i>		KF359845	KF359878	KF359811	KM103554	KM103582	KM103610	KM103638
38	<i>Benitochromis nigrodorsalis</i>		KF359846	KF359879	KF359812	KM103555	KM103583	KM103611	KM103639
39	<i>Benitochromis riomuniensis</i>		KF359847	KF359880	KF359813	KM103556	KM103584	KM103612	KM103640
40	<i>Benitochromis conjunctus</i>		KF359848	KF359881	KF359814	KM103557	KM103585	KM103613	KM103641
41	<i>Benitochromis batesii</i>		KF359849	KF359882	KF359815	KM103558	KM103586	KM103614	KM103642
43	<i>Chromidotilapia g. guntheri</i>		KF359850	KF359883	KF359816	KM103559	KM103587	KM103615	KM103643
44	<i>Chromidotilapia linkei</i>			KF359884	KF359817	KM103560	KM103588	KM103616	KM103644

River system, and (iii) all remaining specimens from populations of the Moliwe, Nyong and Lobe river systems. In this latter group, specimens from Moliwe and Nyong cluster together, while all remaining clusters do not reflect distribution patterns of the populations from the most southern parts of Cameroon. We refrain from discussing a potential species status of the populations from the Nyong River system for several reasons: (i) the small amount of material from the Nyong River system, (ii) some difficulties to differentiate the Nyong specimens from the south Cameroon populations by coloration patterns and (iii) the fact that more populations of the third cluster of the *P. taeniatus*-group occur in the Moliwe/Edea area in Cameroon, which were not available for the present study. A more detailed account will be given once more material has become available.

In contrast, populations from Benin/Nigeria and from the Wouri River system are easily diagnosable by basic coloration patterns, and are clearly differentiated from the remain-

ing Cameroonian populations. Morphologically little or no differences are visible, but this is a common feature within the genus (Lamboj and Stiassny, 2007) and cannot to be seen as an argument against species recognition. Although our goal was not to draw conclusions on relationships among analysed taxa, remarkably, *P. humilis* never clustered with the *P. taeniatus*-group, questioning the monophyly of *Pelvicachromis*.

Note that molecular results are mainly driven by the fast-evolving mitochondrial gene. The sole nuclear marker used in this study does not allow clear separation of the proposed 3 species of the *P. taeniatus*-group due to insufficient variation among sequences.

In summary, we define *P. taeniatus* as a taxon restricted to Benin and Nigeria and give a revised diagnosis for this species, we formally describe one new species from the Wouri River system, and we redescribe *P. kribensis*.

## SYSTEMATICS

## Comparative material

*Pelvicachromis humilis*. – BMNH 1915.4.13:44, holotype, Sierra Leone: North Sherbo District. MRAC 154802, Sierra Leone: Kasewe Forest. MRAC 154803, Sierra Leone: Kasewe Forest. MRAC 164505, Sierra Leone: Kasewe Forest. MRAC 183575-576, Sierra Leone: Kasewe Forest. MRAC 183577-578, Sierra Leone: Kasewe Forest. MRAC 73-10-P-663-685, Liberia: Bombo-Jet. MRAC 73-10-P-6427-482, Sierra Leone: Pujehun, riv. Waanje et marigot. MRAC 73-10-P-6483-528, Sierra Leone: Bayama, marigots de la riv. Waanje. MRAC 73-10-P-6600-620, Sierra Leone: Majihun, marigots d'un ruisseau trib. de la riv. Moa. MRAC 73-10-P-6529-568, Sierra Leone: Tangahun, marigot à +/- 12 km SO de Kenema, trib. sup. de la riv. Waanje. MRAC 73-10-P-6569-599, Sierra Leone: Tangahun, marigot à +/- 12 km SO de Kenema, trib. sup. de la riv. Waanje. MRAC 73-10-6636-643, Liberia: Gwene-Town, marigots près de la riv. Loffa. MRAC 73-10-P-7802-861, Sierra Leone: Towahun-Tangahun. MRAC 92-59-P-2644-2652, Guinea: Kambo River, affl. Bofou (basin Forecariah) en gué de Franciga, 09°32'N, 13°01'W. AMNH 12317, Liberia: near Kaleata. AMNH 97493, Sierra Leone: Bandujuma, Waanje River. AMNH 97494, Liberia: Gbanga, in small creek tributary to St. Paul's River. AMNH 97495, Sierra Leone: Tiwai Island. AMNH 97496, Sierra Leone. AMNH 97497, Sierra Leone: Tiwai Island. AMNH 97498, Sierra Leone: Gola North Forest Reserve, large pool by village 5 miles from Lalehun along Joru Road. AMNH 97499, Sierra Leone: small stream behind village ca. 2 km east of Kambama Village. AMNH 97500, Sierra Leone: small stream behind Kambama Village. AMNH 97501, Sierra Leone: Gola North Forest Reserve, large pool near village 5 miles from Lalehun along Joru Road. AMNH 97502, Sierra Leone: small stream behind Kambama Village. AMNH 97503, Sierra Leone: River Moa. AMNH 97405, Sierra Leone: River Moa. AMNH 97505, Sierra Leone: River Moa.

*Pelvicachromis pulcher*. – All from Nigeria, Niger River system. BMNH 1901.1.28.13-20, syntypes, 5 males, 3 females, 55.7-90.0 mm SL, Mouth of Ethiop River, Sapele station, W.J. Ansorge coll. BMNH 1902.11.10.221-228, 4 males, 4 females, 31.7-45.7 mm SL, Assay, coll. W.J. Ansorge. BMNH 1902.11.10.229-230, 1 male, 1 female, 29.2-32.7 mm SL, Agbera, W.J. Ansorge coll. BMNH 1912.2.2.9, male, 50.1 mm SL, Wari, lower Niger, J.P. Arnold coll. BMNH 1984.7.27.1048-1053, 1 male, 4 specimens, 20.6-34.2 mm SL, Akio, Aye River, 06°44'30"N, 03°45'0"E, D.H.J. Sidenham coll. MRAC 154804-807, 2 males, 2 females, 46.9-68.2 mm SL, Lagos, 06°27'N, 03°23'E, F. Gagelmann coll., Mar. 1951. MRAC 154809-810, 2 males, 66.1-70.6 mm SL, Sapele, 05°55'N, 05°42'E, F. Gagelmann coll., Jan. 1951. MRAC P 154821, female, 53.3 mm SL, Lagos, 06°27'N, 03°23'E, F. Gagelmann coll., Jun. 1951. MRAC 84-20-P-262, female, 56.8 mm SL, New Calabar River, 04°55'N, 06°52'E, L. Risch coll., Mar. 1984. MRAC 84-51-P-17, male, 48.2 mm SL, 2 km SW of Aking (Awaswamba, Cross River State, 05°04'N, 08°30'E, J.C. Reid coll., Oct. 1980. MRAC 84-51-P-68-69, 2 males, 38.2-41.1 mm SL,

Ayip Eku Palm Oil Estate, Cross River State, 05°24'N, 08°42'E, J.C. Reid coll., Sep. 1980. MRAC 86-08-P33, male, 65.3 mm SL, Umuayara village, Mba Etche Kelga, Rivers State, 05°12'N, 07°06'E, P.J. Akirir coll., Oct. 1983. MRAC 86-08-P-34, male, 71.5 mm SL, Sombreiro River, P.J. Akiri coll., Aug. 1985. MRAC 86-10-P-101, male, 66.4 mm SL, Nun River, 05°07'N, 06°21'E, P.J. Akiri coll., Nov. 1985. MRAC 88-35-P 434-435, 2 males, 75.6-77.1 mm SL, New Calabar River, 04°55'N, 06°49'E, C.B. Powell coll., Jan. 1986. MRAC 88-35-P-436-438, 2 males, 1 female, 57.869.4 mm SL, 3 km south of Isiokpo, New Calabar, C.B. Powell coll., Jan. 1988. MRAC 88-43-P-439-442, 2 males, 1 female, 40.7-52.2 mm SL, Taylor Creek at Joinkrama, 05°11'N, 06°30'E, C.B. Powell coll., Feb. 1988. MRAC 90-019-P-0463-0489, 16 males, 11 females, 31.564.2 mm SL, New Calabar River, 3 km south of Isiokpo, 04°57'N, 06°53'E, C.B. Powell coll., May 1988. MRAC 91-01-P-411-414, 4 males, 35.8-54.7 mm SL, Taylor Creek, 05°14'N, 06°32'E, C.B. Powell coll., Dec. 1990. MRAC 91-067-P-0549, female, 43.4 mm SL, Okoso Creek, 05°08'N, 06°23'E, C.B. Powell coll., Jul. 1991. MRAC 91-055-P-0602-0603, 1 male, 1 female, 50.9-56.8 mm SL, Orashi River, 05°01'N, 06°27'E, C.B. Powell coll., Jun. 1991. MRAC 91-010-P-0653, male, 48.4 mm SL, Orashi River, 05°01'N, 06°27'E, C.B. Powell coll., Jan. 1988. MRAC 92-014-P-0125, male, 53.7 mm SL, Orashi River at Odieke, 05°01'N, 06°27'E, C.B. Powell coll., Nov. 1991. MRAC 93-039-P0147-0148, 2 males, 44.5-54.1 mm SL, Kwa Ibo River, 04°44'N, 08°02'E, R.P. King coll., Jul. 1992.

*Pelvicachromis roloffii*. – All from Sierra Leone, Kwabolake, Sherbo District; Griffin-Cadenot: MRAC 73399, holotype. MRAC 733400, allotype. MRAC 73401-402, paratypes.

*Pelvicachromis rubrolabiatus*. – All Guinea: Kolente basin, Badi River; S. Sidibe coll. NMW 94835, holotype, male, 59.5 mm SL. NMW 94836, paratype, 1 female, 35.7 mm SL. MRAC A2-011-P-19-20, paratypes, 1 male, 1 female 65.2-48.1 mm SL.

*Pelvicachromis sacrimontis*. – All from Nigeria. MRAC 86-10-P-102, neotype, male, 66.4 mm SL, Nigeria: Chokoche, Imo River, Rivers State, 04°59'N, 07°59'E, P.J. Akiri coll., Aug. 1985. MRAC 138748-138755, paraneotypes, 8 males, 68.5-77.8 mm SL, d'Aba, E.R. Smykala & van de Weyer coll., 1967. MRAC 154410-154412, paraneotypes, 2 males, 1 female, 57.4-77.6 mm SL, d'Aba, 05°07'N, 07°22'E, E.R. Smykala coll., Jan. 1965. MRAC 154513-154514, paraneotype, 1 male, 1 ex., 56.2-57.9 mm SL, d'Aba, 05°07'N, 07°22'E, E.R. Smykala coll., Jan. 1967. MRAC 154520-154530, paraneotypes, 3 females, 2 ex., 34.1-49.2 mm SL, d'Aba, 05°07'N, 07°22'E, E.R. Smykala coll., Jan. 1967. MRAC 86-08-P-33, paraneotype, male, 65.3 mm SL, Umuayara Village, Mba Etche, Kelga Rivers State, P.J. Akiri coll., Oct. 1983. MRAC 86-08-P-34, paraneotype, male, 71.5 mm SL, Odiemudie, Sombreiro River, Rivers State, P.J. Akiri coll., Oct. 1983. MRAC 86-10-P-101, paraneotype, male, 66.4 mm SL, Okosos, Nun River, Rivers State, P.J. Akiri coll., Nov. 1985. MRAC 86-10-P-103, paraneotype, male, 66.0 mm SL, same collection data as neotype. MRAC 88-37-P-138-142, paraneotypes, 1 male, 2 females, 2 ex., 32.8-90.6 mm SL, River Umuayara at Umuede about 25 km NNW of Port Harcourt,

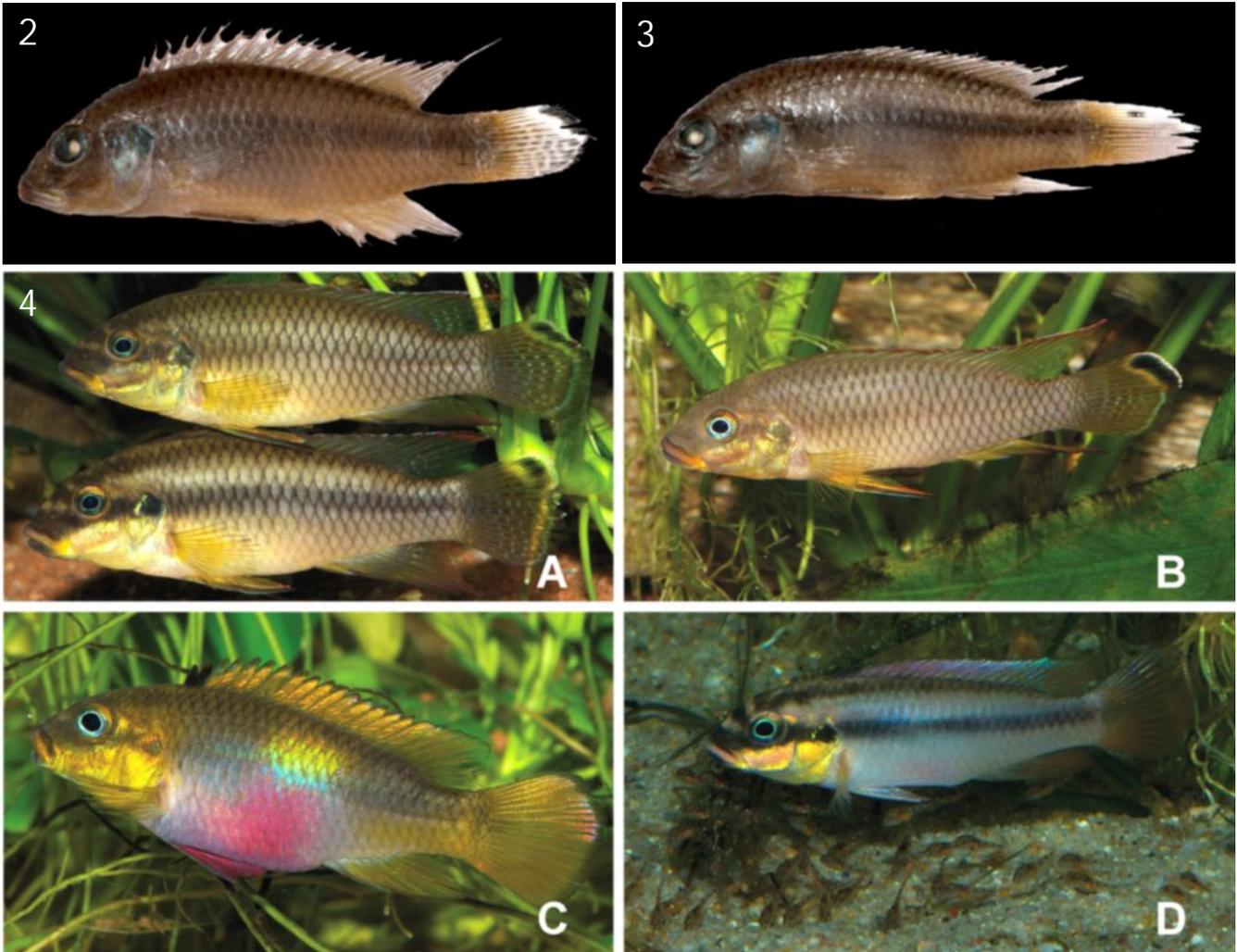


Figure 2. - Holotype of *Pelvicachromis drachenfelsi* sp. nov., NMW 95237, male, 60.3 mm SL, Cameroon, Wouri River system, Region of Yabassi, tributary of Wouri River on Road Douala-Yabassi, 04°18.250' N, 10°02.971' E.

Figure 3. - One of the paratypes of *Pelvicachromis drachenfelsi* sp. nov., out of NMW 95238, female, 43.6 mm SL, Cameroon, Wouri River system, Region of Yabassi, tributary of Wouri River on Road Douala-Yabassi, 04°18.250' N, 10°02.971' E.

Figure 4. - Live specimens of *P. drachenfelsi* sp. nov. in aquaria, collected at type locality by A.L., not measured, not preserved. **A:** Two males, specimen below submissive with horizontal black band; **B:** Male in dominant coloration; **C:** Female in display; **D:** Female guarding fry.

T. Roberts coll., Jun. 1987. MRAC 93-039-P-0149-0150, paraneotypes, 2 males, 65.8-65.9 mm SL, Abak, Kwa Ibo River, 04°59'N, 07°47'E, R.P. King coll., Feb. 1992.

*Pelvicachromis signatus*. – All from Guinea: Kolente basin, Bandi River, route Kangasili-Sougeta, 10°11'N, 12°28'W, J. Van Orshoven, Dec. 1966-Jan. 1967 and Dec. 1968. ZMA 109.959, holotype, male, 72.3 mm SL; ZMA 109.960, paratype, 1 female, 52.2 mm SL. ZMA 114.995, paratypes, 5 males, 58.0-79.0 mm SL.-ZMA 114.996, paratypes, 2 females, 38.1-51.9 mm SL. MRAC 77-10-P-2-5, paratypes, 2 males, 2 females, 52.1-71.5 mm SL.

*Pelvicachromis silviae*. – NMW 95243, holotype, male, 47.8 mm SL; Nigeria, Niger River system, river Uwerum, near village of Ughelli, app. 5°30'N, 5°59'E, Delta State, E. Ajih coll., Feb. 2009. NMW 95244, paratypes, 2 males, 3 females, 35.7-41.5 mm

SL, same as holotype. MRAC 91-067-P-0549, paratype, female, 43.9 mm SL, Nigeria: Niger River system, Okoso Creek, 5°08'N, 6°23'E, C.B. Powell coll., Jul. 1991. MRAC B2-22-P-1-2, paratypes, 1 male, 1 female, 33.3+43.9 mm SL, same as holotype.

*Pelvicachromis subocellatus*. – All from Gabon: BMNH 1872.1.27.14-15, syntypes, 40.8-45.9 mm SL. 6 spms out of MRAC 144619-144630, Moanda, 34.0-53.4 mm SL.

***Pelvicachromis drachenfelsi*, n. sp.**  
(Figs 2-4)

*Holotype*. – NMW 95237, male, 60.3 mm SL, Cameroon, Wouri River system, Region of Yabassi, tributary of Wouri

River on Road Douala-Yabassi, 04°18.250'N, 10°02.971'E, Cyrille Dening coll., Mar. 2011.

*Paratypes*. – NMW 95238, 4 males, 6 females, 34.1–46.9 mm SL, same as holotype. NMW 95239, 13 males, 1 female, 2 juveniles, 21.1–42.0 mm SL, same locality data as holotype but collected by A. Lamboj, Feb. 2009. MRAC B2-19-P-1-4, 2 males, 2 females, 33.8–47.9 mm SL, same collecting data as NMW 95239. AMNH 255627, 2 males, 2

females, 32.9–48.6 mm SL, same collecting data as NMW 95239. ZSM 41742, 2 males, 2 females 28.8–39.7 mm SL, same collecting data as NMW 95239.

### Diagnosis

A moderately gracile species, with rounded head and well-developed sexual dimorphism and dichromatism. Differs from all congeners with the exception of *P. taeniatus* by a black margin with a white to pale bluish submargin in the lower half of the male caudal fin (*vs* no margin/submargin in the other species), differs from all congeners in a white margin and a black submargin in the dorsal half of the male caudal fin (*vs* not present). Differs in female coloration from *P. taeniatus* and *P. kribensis* in showing a dusky blackish margin and absence of horizontal dark bars in the caudal fin (*vs* no margin in populations of *P. kribensis* of the Lobe River system or one horizontal dark bar in some populations of *P. kribensis* north of the Sanaga River system and one to three horizontal dark bars in populations of *P. taeniatus*). Differs from *P. taeniatus* and *P. kribensis* in a caudal peduncle usually longer than deep (*vs* shorter than deep to as long as deep). Differs from *P. humilis*, *P. rubrolabiatus* and *P. signatus* in the absence of seven-eight dark, vertical bars on body, and in three tubular infraorbital bones *vs* two. Differs from *P. silviae* Lamboj, 2013 in lesser body depth (28.7–35.1% SL *vs* 37.4–43.0%, mean 32.3 *vs* 39.2%), longer caudal peduncle (caudal peduncle length 93.9–124.6% of caudal peduncle depth *vs* 73.2–85.3, mean 106.0 *vs* 78.1%), more spines in dorsal fin (17–18 *vs* 14–16). Differs from *P. subocellatus* (Günther, 1871) in males by absence of a lappet-like elongation of some rays of caudal fin. Differs from *P. roloffii* (Thys van den Audenaerde, 1968) in greater caudal peduncle length (12.4–18.2% SL *vs* 9.4–12.2, mean 15.4 *vs* 10.7%) and higher number of pored scales of lateral line (27–29 *vs* 24–26). Differs from *P. sacrimontis* Paulo, 1977 in shorter interorbital distance (16.3–27.4% HL *vs* 29.4–45.3%, mean 24.2 *vs* 36.0%). Differs from *P. pulcher* (Boulenger, 1901) in rows of dots in the central field of the male caudal fin (*vs* absence).

### Description

Measurements and meristic counts for the holotype and 38 paratypes are given in table II. Small cichlid species with body moderately gracile, dorsal head profile rounded and short

Table II. – Morphometrics and meristics of the holotype and 38 paratypes of *Pelvicachromis drachenfelsi* sp. nov.

	Holotype	Mean	SD	Range (all)	
Standard length (mm)	60.3	37.6		21.1	60.3
% SL					
Body depth	33.2	32.3	1.6	28.7	– 35.1
Head length	32.9	32.9	1.1	30.9	– 35.9
Caudal peduncle length	15.2	15.4	1.1	12.4	– 18.2
Caudal peduncle depth	14.4	14.7	0.7	12.3	– 16.1
Dorsal–fin base	60.2	57.0	2.3	52.5	– 61.0
Anal–fin base	16.2	18.9	1.4	15.7	– 21.4
Predorsal distance	28.9	29.1	1.2	25.9	– 31.6
Preanal distance	66.0	66.7	2.2	62.0	– 71.6
Prepectoral distance	33.7	34.3	1.1	32.4	– 36.5
Prepelvic distance	37.2	36.5	1.3	33.4	– 39.5
Longest dorsal fin ray	28.2	19.3	2.4	15.6	– 28.2
Longest anal fin ray	30.0	20.8	3.1	16.0	– 30.6
Longest pectoral fin ray	24.5	24.5	1.2	22.2	– 28.0
Longest pelvic fin ray	35.3	25.3	3.5	19.0	– 39.3
% HL					
Head depth	65.8	61.9	2.4	57.5	– 66.5
Snout length	27.0	25.7	3.7	19.9	– 38.8
Eye diameter	28.6	29.6	2.3	22.6	– 32.5
Postorbital distance	44.4	44.7	1.9	38.7	– 47.6
Interorbital distance	24.7	24.2	2.0	16.3	– 27.4
Cheek depth	34.8	31.0	2.5	23.8	– 35.4
Lower jaw length	41.7	38.7	2.6	30.9	– 42.9
Preorbital distance	22.1	20.2	2.1	12.8	– 23.2
% of caudal peduncle depth					
Caudal peduncle length	106.0	105.3	6.7	93.9	– 124.6
Meristics		median			
Upper lateral–line scales	18	19		16	– 20
Lower lateral–line scales	7	7		6	– 9
Total lateral–line scales	28	28		27	– 29
Circumpeduncular scales	16			16	
Dorsal fin spines	17	17		17	– 18
Dorsal fin rays	8	9		8	– 9
Anal fin spines	3			3	
Anal fin rays	7	7		7	– 8
Pectoral fin rays	12	12		11	– 13
Gill rakers (lower limb of first arch)	10	10		8	– 12
Total gill rakers	18	16		14	– 18

snout. Ventral body wall gently rounded to caudal peduncle, more rounded in ripe and gravid females. Caudal fin rounded. Caudal peduncle usually longer than deep, but deeper than long in few specimens (six specimens of type series, all females or juveniles). Sexual dimorphism well developed, with males usually 10-15% larger in SL than females, with soft dorsal, anal and pelvic fins more elongated. First ray of pelvic fin always longest in males; in females second ray always longest of this fin. In males, tip of pelvic fin can reach or overlap origin of anal fin.

**Osteology and dentition.** – Infraorbital bone series with lachrymal and three additional tubular bones and a gap between 2<sup>nd</sup> and 3<sup>rd</sup> tubular infraorbital, lachrymal with four openings of laterosensory system. Premaxilla usually with 1, rarely 2 rows of teeth (if 2 rows, second toothband with just few teeth), dentary usually with 2 rows, in few smaller specimens rarely with 1 row of regularly set unicuspid teeth. Anteriorly in the lower jaw a few teeth orientated posteriorly, not buccally. Lower pharyngeal bone triangular, with unicuspid to weakly bicuspid teeth on lateral parts of this bone, and asymmetric bicuspid teeth in the central field.

Gill rakers on first gill arch. Nine to ten tuberculate gill rakers on ceratobranchials, 4-8 pointed gill rakers on epi-branchials. Well-developed hanging pad on roof of pharynx.

**Scales.** – Cycloid, 2 or 3 rows of scales on cheek; 4 horizontal rows on opercle. Dark spot on outer edge of opercle unscaled. Chest-scales smaller than body scales, 3 or 4 scales between pectoral and pelvic fins. Upper lateral-line separated from dorsal-fin base anteriorly by two and a half to three and a half scales, at the 8th pored scale by one or one and a half scales, and at last pored scale by a half or one scale. End of upper lateral-line never overlapping lower lateral-line, usually separated from beginning of lower lateral-line by 1-4 rows of scales (one specimen with 8 rows, possibly an individual aberration). About 1/5 to 1/4 of caudal fin covered with scales, all other fins unscaled.

### Coloration

Live specimens of both sexes (Fig. 4): Head and body pale brown to greyish brown. Dorsum somewhat darker than ventral parts of body. Dark scale-less spot on the outer edge of opercle, with a pale iridescent blue margin on anterior and posterior edge. Upper lip brownish to orange-brown, lower lip greyish to brown. Throat and ventral parts of branchiostegal membranes pale yellow, more prominent in dominant specimens. Dark longitudinal stripe sometimes visible on sides (in stressed, submissive or breeding individuals and those guarding fry), at about height of lower lateral-line, from posterior edge of eye to end of caudal peduncle, but not extending onto caudal fin. Dark stripe dorsal of upper lip, proceeding from angle of mouth to anterior edge of eye. Upper edge of eye golden-yellow. Dark yellow to pale reddish horizontal stripe from angle of the mouth to anterior

edge of preopercular, bordered pale bluish to turquoise dorsally and ventrally. Pectoral fin clear to pale yellow.

**Male-specific coloration.** Dorsal fin pale yellow to brownish, with red margin, tips of spines and rays in posterior two thirds of this fin bluish-white. Most caudal parts of this fin with some pale bluish maculae. Upper half of caudal fin with white margin, followed by a dark submargin and a white to bluish second submargin after this. Black submargin of upper half passes over to a black margin in lower half of the fin, second white to bluish submargin of upper half of this fin passes over to a white to pale bluish submargin in lower half. Central field of this fin reddish and with 4-7 rows of blue maculae, more prominent in lower parts. Anal fin with dark margin, base and central parts of this fin yellowish, remainder of this fin reddish to violet with bluish maculae in posteriormost parts. Leading edge of pelvic fins bluish, first soft ray dark grey to black, other parts of this fin reddish to pale violet. Body scales with dark margins. Ventralmost parts of opercle, subopercle, interopercle and chest pale yellow.

**Female-specific coloration.** Dorsal fin iridescent yellow, with thin black margin, followed by some thin, bluish submargin in some specimens. First two spines of this fin and lappet between these spines black. One or two black dots in soft ray part of this fin in some individuals. Caudal fin yellow, with dark grey to blackish, transparent margin, upper half of this fin with iridescent bluish to pale violet hue, one or two black dots on upper half of this fin in some individuals. Anal fin yellow with pale bluish base and dark grey to blackish margin. Anterior edge of pelvic fins black, other parts of this fin red to dark violet. Lower parts of opercle, subopercle and interopercle yellow, chest whitish. Flanks and belly region, up to about middle of the body, wine red. Yellow blotch in middle of body, from about lower lateral to dorsal fin-base or somewhat below, usually separated from



Figure 5. - Distribution map for *Pelvicachromis drachenfelsi* sp. nov. (black area), *P. kribensis* (dotted area) and *P. taeniatus* (hachured area).

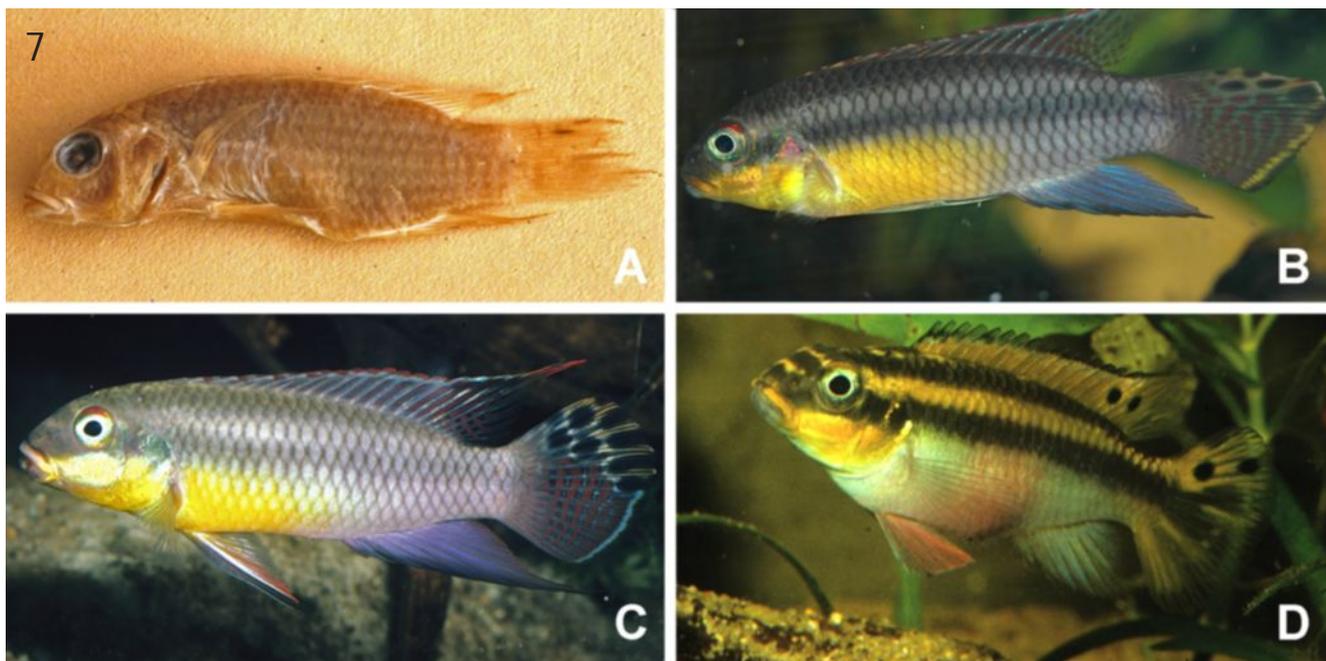


Figure 6. - Type locality of *Pelvicachromis drachenfelsi* sp. nov.; Cameroon, Wouri River system, Region of Yabassi, tributary of Wouri River on Road Douala-Yabassi, 04°18.250' N, 10°02.971' E, dry season, Feb. 2009.

Figure 7. - *Pelvicachromis taeniatus*. **A:** Holotype, BMNH 1901.1.28.21, male, 60.3 mm SL, Nigeria, mouth of Ethiop River, Niger Delta (Sapele Station); **B:** Male from Benin, Iguidi River, Niger River system, collection 2003 by A.L.; **C:** Male from Nigeria, Niger River system, collection of Otto Gartner; **D:** Female from Nigeria, Niger River system, from trade; live specimens not measured, not preserved.

red belly by one or two bluish scale rows. When courting, caudal and anterior dorsal body parts dark to blackish.

Juveniles of both sexes (before attaining adult coloration) exhibit a pattern of 2 or (rarely) 3 rows of irregular dark spots on brown coloration, up to about 10-12 mm SL. With increasing size, sex-specific coloration is seen.

Preserved specimen coloration. General coloration of

both sexes: Head and body brown, darker dorsally. Cheek, throat, prepelvic and prepectoral regions of flanks and chest light brown. Dark spot on outer edge of opercle. Dark longitudinal stripe visible in some individuals, reaching from posterior edge of eye to end of caudal peduncle, not extending into the caudal fin. Dark bar from anterior edge of eye to upper lip.

Male-specific coloration. The general preserved coloration of adult males is shown in the holotype (Fig. 2). Anterior portion of dorsal fin brownish. Posterior portion of dorsal fin and central parts of caudal fin with numerous dark spots. Upper parts of caudal fin with very thin white margin, black submargin and white 2<sup>nd</sup> submargin; lower half with thin black margin and white submargin. Anal fin brownish. Pelvic fins reddish brown to dark brown with dark anterior edge, pectoral fins clear.

Female-specific coloration. One paratype shown in Figure 3. Belly dark brown to reddish brown. Anterior portion of dorsal fin darker brown than posterior portion with no up to two black dots. Caudal fin brownish in central parts, more pale to whitish in outer parts, no up to two black dots in upper half. Anal fin base dark brown, outer parts of fin pale brown to clear. Pelvic fins reddish brown to brown, with dark anterior edge, pectoral fins clear.

Breeding behaviour. In aquaria, the species is a monogamous, pair bonding, cave spawner. Eggs and larvae are guarded mainly by the female, very rarely by the male too. Hatching occurs after three days post-spawn. Larvae are usually deposited on the bottom of the cave, rarely in other caves near the original cave. Juveniles are free swimming 8 or 9 days post-hatching and are guarded by both parents for about 5 to 6 weeks. Breeding and guarding females regularly exhibit a very prominent black midlateral band during the first 2 to 4 weeks when guarding fry, which is a typical coloration for breeding females within the genus; rarely the male also shows such coloration.

### Distribution

This species is endemic in the Wouri River system in southwestern parts of Cameroon (Fig. 5). It is restricted to pure freshwater of low conductivity and pH; during a field trip of one of the authors (A.L.) in February 2009 to the type locality (Fig. 6), a water temperature of 27.0°C, conductivity of 24.6µS, pH 7.3 and air temp. 29.0°C was measured. The type locality is a river about 4-8 m wide, and during the dry season 40-130 cm deep with water visibility ~1.2-1.5 m. The river bottom consists of fine sand with layers of leaves from surrounding trees, detritus and mud. Some bigger rocks and fallen/sunken trees were also been observed. On some places, vegetation beds of *Crinum natans* and *Bolbitis heudelotii* occurred, on the river bank big accumulations of *Anubias barteri* had been grown. Some parts of the river were shaded by dense rain forest. Syn-

topic species collected included *Chromaphyosemion riggenbachi* (Ahl, 1924), *Epiplatys infrafasciatus* (Günther, 1866), *Procatopus* sp., *Barbus camptacanthus* (Bleeker, 1863) and *Brycinus* cf. *longipinnis* (Günther, 1864).

### Etymology

The species name is dedicated to Ernst-Otto von Drachenfels, Germany – aquarist, friend and promoter of our research.

Table III. - Morphometrics and meristics of the holotype and holotype + three additional specimens of *Pelvicachromis taeniatus*.

	Holotype	Mean	SD	Range (all)	
Standard length (mm)	56.0	47.2		36.3	– 58.3
% SL					
Body depth		34.6	3.1	29.9	– 36.4
Head length		31.4	2.3	28.4	– 33.8
Caudal peduncle length		13.2	0.8	12.4	– 14.1
Caudal peduncle depth		15.9	0.3	15.6	– 16.3
Dorsal-fin base	57.5	60.5	1.8	59.0	– 62.2
Anal-fin base	18.1	20.3	1.0	19.0	– 21.1
Predorsal distance	39.2	27.5	1.4	25.7	– 29.2
Preanal distance	75.7	65.6	1.9	62.8	– 66.7
Prepectoral distance	44.5	33.4	1.4	31.5	– 34.7
Prepelvic distance	47.4	36.9	0.7	36.0	– 37.5
Longest dorsal fin ray	28.3	21.4	1.5	20.0	– 23.3
Longest anal fin ray	25.4	28.2	9.2	19.9	– 40.8
Longest pectoral fin ray	31.1	23.7	2.5	20.2	– 25.8
Longest pelvic fin ray	32.6	29.3	4.8	25.9	– 36.3
% HL					
Head depth	96.0	64.2	0.5	63.6	– 64.8
Snout length	42.2	26.2	3.4	22.9	– 30.2
Eye diameter	19.2	33.3	2.0	31.1	– 35.7
Postorbital distance	38.6	40.5	1.8	38.7	– 42.9
Interorbital distance	31.5	23.7	2.3	21.4	– 26.8
Cheek depth	32.2	30.5	2.8	27.6	– 34.0
Lower jaw length	32.7	37.2	1.8	34.7	– 38.9
Preorbital distance	25.9	20.2	1.1	18.6	– 21.1
% of caudal peduncle depth					
Caudal peduncle length		82.9	3.5	78.4	– 86.8
Meristics		median			
Upper lateral-line scales	18	19		18	– 19
Lower lateral-line scales	8	8		7	– 8
Total lateral-line scales	26	28		26	– 28
Circumpeduncular scales	16			16	
Dorsal fin spines	18	17		17	– 18
Dorsal fin rays	7	8		7	– 9
Anal fin spines	3	3		3	
Anal fin rays	7	7		7	– 8
Pectoral fin rays	12	12		11	– 12
Gill rakers (lower limb of first arch)	9	10		9	– 10
Total gill rakers	13	15		13	– 16

***Pelvicachromis taeniatus* (Boulenger, 1901)**

(Fig. 7)

*Holotype*. – BMNH 1901.1.28.21, male, 60.3 mm SL, Nigeria, mouth of Ethiop River, Niger Delta (Sapele Station), W.J. Ansorge coll.

*Additional specimens*. – AMNH 97565, 1 male, 2 females, 36.3–58.3 mm SL, Nigeria, Niger River system.

**Diagnosis**

A moderately gracile species, with rounded head and well-developed sexual dimorphism and dichromatism. Differs from all congeners by a coloration in male caudal fin with a white to yellow upper half of this fin, having a number of black dots in the dorsal half, without any margin, and a black margin with a white to pale bluish submargin in the lower half of this fin (*vs* no margin/submargin in lower half of this fin in all congeners with exception of *P. drachenfelsi* sp. nov. and a white margin and black submargin in upper half of caudal fin in *P. drachenfelsi* sp. nov.). Females differ from females of *P. drachenfelsi* sp. nov. and *P. kribensis* in having two or three horizontal dark bars in the caudal fin (*vs* none in *P. drachenfelsi* sp. nov. and one in some populations of *P. kribensis*). Differs from *P. drachenfelsi* sp. nov. in a caudal peduncle shorter than deep (*vs* usually longer than deep). Differs from *P. humilis*, *P. rubrolabiatus* and *P. signatus* in absence of seven–eight dark, vertical bars on body and in three tubular infraorbital bones *vs* two. Differs from *P. sylviae* in lesser body depth (29.9–36.4% SL *vs* 37.4–43.0%, mean 34.6 *vs* 39.2%), shorter pre-anal distance (62.8–66.7% SL *vs* 66.2–69.8%, mean 65.6 *vs* 68.3%), shorter prepelvic distance (36.0–37.5% SL *vs* 37.9–44.3%, mean 36.9 *vs* 39.8%), and more spines in dorsal fin (17–18 *vs* 14–16). Differs from *P. subocellatus* in lesser body depth in males in lappet-like elongation of some rays of caudal fin (*vs* no such elongation). Differs from *P. roloffii* (Thys van den Audenaerde, 1968) in greater caudal peduncle length (12.4–14.1% SL *vs* 9.4–12.2, mean 13.2 *vs* 10.7%) and more pored scales of lateral-line (26–28 *vs* 24–26). Differs from *P. sacrimontis* Paulo, 1977 in shorter interorbital distance (21.4–26.8% HL *vs* 29.4–45.3%, mean 23.7 *vs* 36.0%). Differs from *P. pulcher* (Boulenger, 1901) in shorter preorbital distance (18.6–21.2% HL *vs* 21.0–33.8%, mean 20.2 *vs* 24.9%), and in rows of dots in the central field and lower part of the male caudal fin (*vs* absence).

**Description**

Measurements and meristic counts for holotype and 3 additional specimens are presented in table III. Small cichlid species with body moderately gracile, dorsal head profile rounded and short snout. Ventral body wall gently rounded toward caudal peduncle, more rounded in ripe and gravid females. Caudal fin rounded. Caudal peduncle shorter than

deep. Sexual dimorphism well developed, with males usually 10–15% larger in SL than females and with soft dorsal, anal and pelvic fins more elongated. First ray of pelvic fin always longest in males, in females second ray of this fin always longest. In males, tip of pelvic fin can reach or overlap origin of anal fin.

*Osteology and dentition*. – Infraorbital bone series with lachrymal and three additional tubular bones and a gap between 2<sup>nd</sup> and 3<sup>rd</sup> tubular infraorbital; lachrymal with four openings of laterosensory system.

Premaxilla with 1 or more often 2 rows, dentary with 2 rows of regularly set unicuspid teeth. Anteriorly in the lower jaw a few teeth orientated posteriorly, not buccally. Lower pharyngeal bone triangular, with unicuspid to weakly bicuspid teeth on lateral parts of this bone, and asymmetric bicuspid teeth in the central field.

Gill rakers on first gill arch. Nine to 10 tuberculate gill rakers on ceratobranchials, 5 or 6 pointed gill rakers on epi-branchials. Well-developed hanging pad on roof of pharynx.

*Scales*. – Cycloid, 2 or 3 rows of scales on cheek; 4 horizontal rows on opercle. Dark spot on outer edge of opercle unscaled. Chest-scales smaller than body scales, 3 or 4 scales between pectoral and pelvic fins. Upper lateral-line separated from dorsal-fin base anteriorly by two and a half to three and a half scales, at the 8<sup>th</sup> pored scale by one or one and a half scales, and at last pored scale by a half or one scale. End of upper lateral-line never overlapping lower lateral-line, usually separated from beginning of lower lateral-line by no to two rows of scales. About 1/5 to 1/4 of caudal fin covered with scales, all other fins unscaled.

**Coloration**

Live specimens of both sexes (Fig. 7): Head and body pale brown to greyish brown. Dorsum somewhat darker than ventrum. Dark scaleless spot on the outer edge of opercle, with a pale iridescent blue margin on anterior and posterior edge. Upper lip yellow to orange-brown, lower lip greyish to yellow. Throat and ventral parts of branchiostegal membranes pale yellow, more prominent in dominant specimens. Dark longitudinal stripe sometimes visible on sides (in stressed, submissive or breeding individuals and those guarding fry), at about height of lower lateral-line, from posterior edge of eye to end of caudal peduncle, but not extending onto caudal fin in males, extending onto caudal fin in females. Dark stripe over upper lip, proceeding to a dark stripe from posterior end of upper lip to anterior edge of eye. Eye silver to golden-yellow, with a red coloration on most upper parts in adult specimens. Dark yellow to red horizontal stripe from angle of the mouth to anterior edge of preopercular, bordered dorsally by a thin pale bluish to turquoise line in some specimens. Pectoral fin clear to pale yellow.

Male-specific coloration. Dorsal fin with red margin, followed by a white to yellow submargin in most specimens.

Table IV. - Morphometrics and meristics of 13 syntypes and 13 syntypes + 11 additional specimens of *Pelvicachromis kribensis*.

	Syntypes + additional specimens				
	Syntypes range	Mean	SD	Range	
Standard length (mm)	28.5-52.4	40.0		28.5	– 57.8
% SL					
Body depth	30.4-36.2	33.2	1.9	30.4	– 37.3
Head length	29.5-34.5	31.7	1.6	29.4	– 35.3
Caudal peduncle length	12.1-15.4	13.6	1.0	12.1	– 15.4
Caudal peduncle depth	14.6-17.0	15.8	0.9	13.6	– 17.0
Dorsal-fin base	58.4-63.8	60.5	2.4	55.9	– 64.8
Anal-fin base	16.5-21.8	18.7	1.7	15.8	– 22.6
Predorsal distance	25.8-30.5	27.9	1.5	25.0	– 30.8
Preanal distance	64.8-74.1	68.9	2.5	64.8	– 74.1
Prepectoral distance	30.1-35.5	33.1	1.4	30.1	– 35.5
Prepelvic distance	32.5-37.5	35.1	1.5	32.5	– 37.7
Longest dorsal fin ray	13.5-20.4	20.3	4.0	13.5	– 31.8
Longest anal fin ray	17.0-26.5	23.3	2.2	17.0	– 42.0
Longest pectoral fin ray	17.9-24.3	23.0	2.2	17.9	– 26.6
Longest pelvic fin ray	20.3-32.0	27.8	3.7	20.3	– 38.2
% HL					
Head depth	57.4-68.3	61.2	2.5	57.4	– 68.3
Snout length	19.8-32.2	25.7	3.3	19.8	– 32.2
Eye diameter	26.5-34.2	31.0	2.1	26.5	– 34.2
Postorbital distance	40.3-46.0	43.4	1.9	40.3	– 46.7
Interorbital distance	22.0-26.3	23.7	1.8	20.7	– 29.3
Cheek depth	28.5-33.8	29.5	2.0	25.5	– 33.8
Lower jaw length	29.4-38.3	36.0	3.6	27.8	– 41.1
Preorbital distance	17.8-22.3	19.1	1.2	17.0	– 22.3
% of caudal peduncle depth					
Caudal peduncle length	72.5-93.6	86.6	7.7	72.5	– 100.0
Meristics		median			
Upper lateral-line scales	16-19	19		16	– 20
Lower lateral-line scales	5-7	6		5	– 9
Total lateral-line scales	26-29	28		26	– 29
Circumpeduncular scales	16			16	
Dorsal fin spines	16-17	17		16	– 18
Dorsal fin rays	8-9	8		7	– 9
Anal fin spines	3	3		3	
Anal fin rays	6-7	7		6	– 7
Pectoral fin rays	11-12	12		11	– 13
Gill rakers (lower limb of 1 <sup>st</sup> arch)	8-10	10		8	– 11
Total gill rakers	12-15	15		12	– 17

Spines light blue, interspinous membranes red, membrane of soft dorsal fin red with numerous light blue maculae. Most caudal parts of this fin with some pale bluish maculae. Upper half of caudal fin white to yellow, with 3-12 dark dots (individual variation). Lower half of this fin with black margin and white to yellow submargin. Central field of this fin reddish with 4-8 rows of blue maculae. Anal fin red to bluish-

violet, with dark margin, and some pale bluish maculae in most posteriormost parts. Leading edge of pelvic fins black to dark blue, followed by a thin blue line, and red coloration over 1 or 2 rays, posteriormost part of this fin greyish. Body scales with dark margins. Most ventral parts of opercle, subopercle, interopercle and chest pale greenish to bright yellow, in some specimens lower caudal body parts with some reddish coloration.

Female-specific coloration. Dorsal fin iridescent yellow, with black margin and whitish to bluish submargin in most parts. Black margin broadest on first 1 or 2 spines, reaching from tip down to base of dorsal fin, continuously narrowing toward posterior parts and absent on last 2 or 3 rays. One or two black dots in soft ray part of this fin in some individuals. Caudal fin yellow, with dark grey to blackish margin and 1-3 horizontal dark bars, most prominent one these in middle of fin, extending from dark midlateral band. Upper half of this fin with 1-3 black dots in some individuals. Anal fin whitish to pale yellow or pale blue, with blackish margin on outer edge. Anterior edge of pelvic fins dark blue to black, other parts of this fin red to dark violet. Lower parts of opercle, subopercle and interopercle whitish to yellow, chest whitish. Flanks and belly region, up to about middle of the body but usually not touching midlateral band, wine red. Parts between dark midlateral band and dark dorsum whitish to pale yellow. Caudal and anterior dorsal body parts pale blue, as are parts between red belly and midlateral band.

For additional photographs of adult specimens of both sexes from different localities see Lamboj (2004b): 187-188.

Juveniles of both sexes (before attaining adult coloration) exhibit a pattern of 2 or 3 rows of irregular dark spots on brown coloration, up to about 10-12 mm SL. With increasing size, sex-specific coloration is seen.

Preserved specimen coloration. Head and body brown, darker dorsally. Cheek, throat, prepelvic and prepectoral

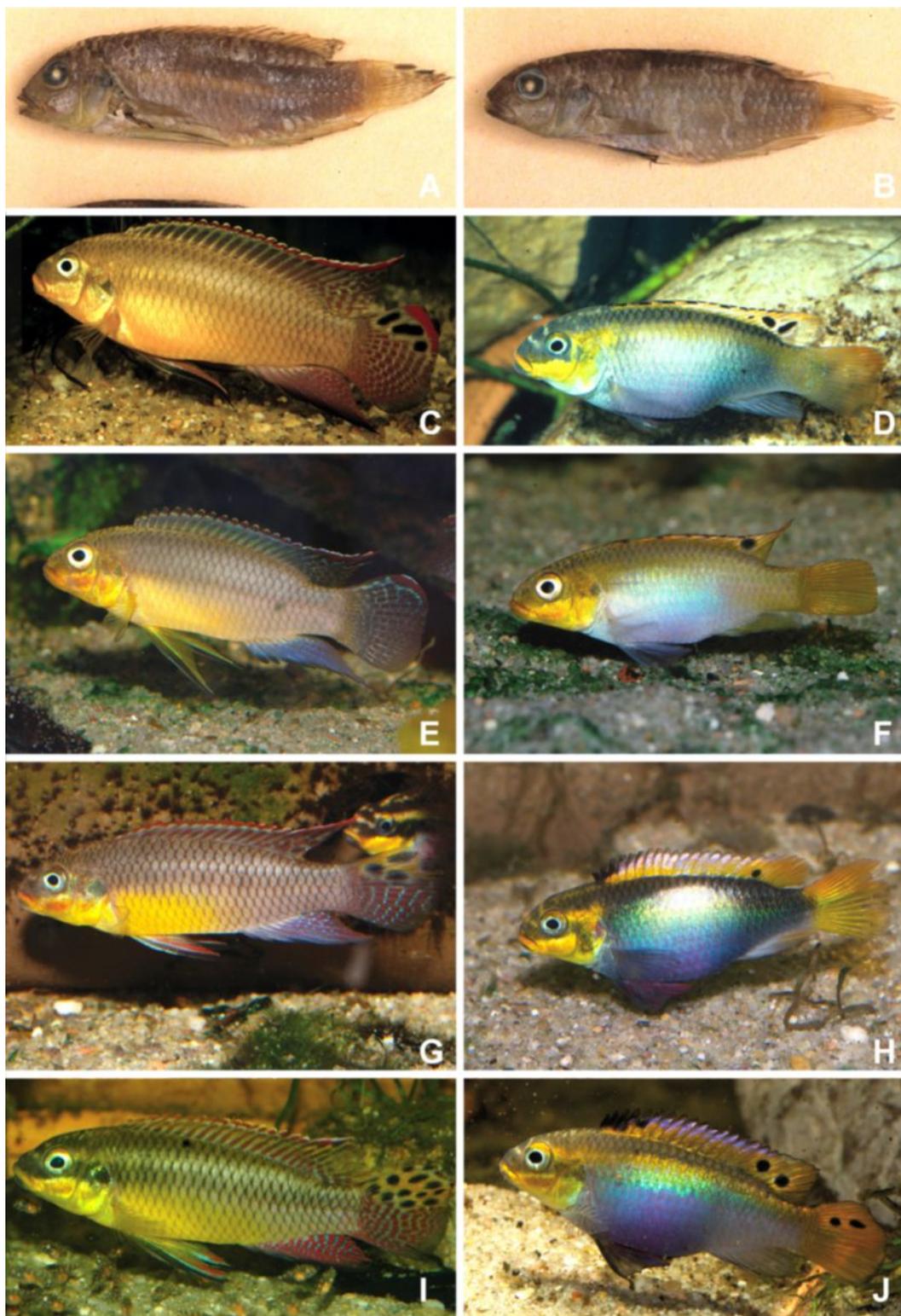


Figure 8. - *Pelycachromis kribensis*. **A, B**: Two syntypes out of BMNH 1902.11.12.164-165 and BMNH 1912.6.29.19-28; **A**: Male, SL 51.2 mm, **B**: Female SL 40.8 mm, Cameroon, Kribi River at Kribi, South Cameroon; **C**: Male; **D**: Female from Kienke River system (Kribi), not preserved, not measured; **E**: Male; **F**: Female from Lobe River system (Lobe Masaa, SL 42.0 + 35.8 mm SL, preserved after photographing as NMW 95242); **G**: Male; **H**: female from Nyong River system (Dehane, male not measured, not preserved, female 36.2 mm SL, preserved after photographing as NMW 95240); **I**: Male; **J**: Female from Moliwe River (Moliwe village, 57.8+33.7 mm SL, preserved after photographing as NMW 95241).

regions of flanks and chest pale light brown. Lips greyish-brown. Dark spot on outer edge of opercle (visible in AMNH specimens). The holotype shows some black dots in the upper half of the caudal fin; in AMNH specimens a black margin, followed by a pale submargin is visible in the lower half of this fin.

Breeding behaviour. In aquaria, the species is a monogamous, pair bonding, cave spawner. Eggs and larvae are guarded mainly by the female, very rarely by the male too. Hatching occurs after three days post-spawn. Larvae are usually deposited on the bottom of the cave, rarely in other caves near the original cave. Juveniles are free swimming 8 or 9 days post-hatching and are guarded by both parents for about 5 to 6 weeks. Breeding and guarding females regularly exhibit a very prominent black midlateral band during the first 2 to 4 weeks when guarding fry, a typical coloration for breeding females within the genus; rarely the male also shows such coloration.

### Distribution

From East Benin (Iguidi River) to Nigeria (Niger system), restricted to freshwater parts of regions near the coast, up to app. 50 km inland (Fig. 5).

### *Pelvicachromis kribensis* (Boulenger, 1911) (Fig. 8)

*Syntypes*. – BMNH 1902.11.12.164-165 and BMNH 1912.6.29.19-28, 7 males, 5 females, 1 ex., 28.5-52.4 mm SL, Cameroon, Kribi River at Kribi, southern Cameroon.

*Additional material*. – NMW 95240, 3 females, 31.7-36.2 mm SL, Cameroon, Nyong River system, small creek at region of Dehane, 03°29.087'N, 10°06.311'E, A. Lamboj coll., Feb. 2009. NMW 95241, 1 male, 1 female, 42.3+45.7 mm SL, Cameroon, Moliwe River at village of Moliwe, 04°03.997'N, 09°15.288'E, A. Lamboj coll., Feb. 2009. NMW 95242, 3 males, 3 females, 39.3-51.0 mm SL, Cameroon, Lobe River system, small creek near village of Massa'a, 02°52.384'N, 09° 54.096'E, A. Lamboj coll., Feb. 2009.

### Diagnosis

A moderately gracile species, with rounded head and well-developed sexual dimorphism and dichromatism. Differs from *P. drachenfelsi* sp. nov. and *P. taeniatus*, by a male caudal fin coloration without black or white margins/submargins (vs white margin and black submargin in upper half of fin in *P. drachenfelsi* sp. nov. and black margin with white to yellow submargin in lower half of fin in *P. drachenfelsi* sp. nov. and *P. taeniatus*). Differs from *P. drachenfelsi* sp. nov. in caudal peduncle being shorter than deep to as long as

deep (vs usually longer than deep). Differs from *P. humilis*, *P. rubrolabiatus* and *P. signatus* in absence of seven or eight dark, vertical bars on body, and in three tubular infraorbital bones vs two. Differs from *P. silviae* in lesser body depth 30.4-37.3% SL vs 37.4-43.0%, mean 33.2 vs 39.2%), shorter prepelvic distance (32.5-37.7% SL vs 37.9-44.3%, mean 35.1 vs 39.8%), greater preorbital distance (17.0-22.3% HL vs 16.3-17.3%, mean 19.1 vs 16.9%), and more spines in dorsal fin (17-18 vs 14-16). Differs from *P. subocellatus* in males by absence of a lappet-like elongation of some rays in upper half of caudal fin). Differs from *P. roloffii* (Thys van den Audenaerde, 1968) in greater caudal peduncle length (12.1-15.4% SL vs 9.4-12.2, mean 13.6 vs 10.7%) and higher number of pored scales of lateral line (26-29 vs 24-26). Differs from *P. sacrimontis* Paulo, 1977 in shorter interorbital distance (20.7-29.3% HL vs 29.4-45.3%, mean 23.7 vs 36.0%). Differs from *P. pulcher* (Boulenger, 1901) in rows of dots in the central field and lower part of the male caudal fin (vs absence).

### Description

Measurements and meristic counts for syntypes and 11 additional specimens are presented in table IV. Small cichlid species with body moderately gracile body, rounded dorsal head profile and short snout. Ventral body wall gently rounded toward caudal peduncle, more rounded in ripe and gravid females. Caudal fin rounded. Caudal peduncle usually deeper than long to as deep as long. Sexual dimorphism well developed, with males usually 10-15% larger in SL than females, with soft dorsal, anal and pelvic fins being more elongated. First ray of pelvic fin always longest in males, in females second ray always longest. In males, tip of pelvic fin can reach or overlap origin of anal fin.

*Osteology and dentition*. – Infraorbital bone series with lachrymal and three additional tubular bones and a gap between 2nd and 3rd tubular infraorbital, lachrymal with four openings of laterosensory system.

Premaxilla usually with 1-2 rows, dentary usually with 2 rows (one small syntype with SL 36.6 mm with 1 row) of regularly set unicuspid teeth. Anteriorly in the lower jaw a few teeth orientated posteriorly, not buccally. Lower pharyngeal bone triangular, with unicuspid to weakly bicuspid teeth on lateral parts of this bone, and asymmetric bicuspid teeth in the central field.

Gill rakers on first gill arch. Eight to 10 tuberculate gill rakers on ceratobranchials, 4-7 pointed gill rakers on epi-branchials. Well-developed hanging pad on roof of pharynx.

*Scales*. – Cycloid, 2 or 3 rows of scales on cheek; 4 horizontal rows on opercle. Dark spot on outer edge of opercle unscaled. Chest-scales smaller than body scales, 3-5 scales between pectoral and pelvic fins. Upper lateral-line separated from dorsal-fin base anteriorly by two and a half to three scales, at the 8<sup>th</sup> pored scale by one or one and a half scales,

and at last pored scale by a half or one scale. End of upper lateral-line never overlapping lower lateral-line, usually separated from beginning of lower lateral-line by no to five rows of scales. About 1/5 to 1/4 of caudal fin covered with scales, all other fins unscaled.

### Coloration

Live specimens of both sexes (Fig. 8): Head and body pale brown to greyish brown. Dorsum somewhat darker than ventrum. Dark scaleless spot on outer edge of opercle, with a pale iridescent blue margin on anterior and posterior edge. Upper lip brownish to orange-brown, lower lip greyish to brown. Throat and ventral parts of branchiostegal membranes pale to intense yellow, more prominent in dominant specimens. Dark midlateral band sometimes visible (in stressed, submissive or breeding individuals and those guarding fry), at about height of lower lateral-line, from posterior edge of eye to end of caudal peduncle, but not extending onto caudal fin in most populations. Dark stripe dorsal of upper lip proceeding from angle of mouth to anterior edge of eye. Upper edge of eye golden-yellow to red. Dark yellow to reddish horizontal stripe from angle of the mouth to anterior edge of preopercular in some populations, bordered pale bluish to turquoise dorsally and ventrally in some specimens. Pectoral fin clear to pale yellow.

Male-specific coloration. Variable with numerous colour forms known. Dorsal fin with very thin white margin in most specimens, followed by a red submargin and a white to pale yellow second submargin in anterior parts. Spines light blue, interspinous membranes red, membrane of soft dorsal red with numerous light blue maculae. Upper half of caudal fin with no or more often with red margin, followed by a white to bluish submargin in populations from the Lobe River system. Lower edge of this fin dusky black to greenish. Two to eight black dots on white to yellow field in upper half of caudal fin in most populations, absent in all populations from Lobe River system. Central field of this fin reddish with 4-7 rows of blue maculae, more prominent in lower parts. Anal fin with dark outer margin, rest of fin red to violet with many rows of small blue maculae in posterior parts. Anterior edge of pelvic fins black to dark blue, followed by a thin blue line, and red coloration over 1 or 2 rays, posteriormost part of this fin greyish. Body scales with dark margins. Ventralmost parts of opercle, subopercle, interopercle and chest pale yellow.

Female-specific coloration. Dorsal fin iridescent whitish to yellow, with thin black margin, followed by thin, bluish submargin in some specimens. Black margin broadest on first spines, continuously narrowing toward posterior parts and absent on last 4-6 rays. One to three black dots in soft ray part of this fin in some individuals. Caudal fin yellow, with dark indistinct margin, upper half of this fin with one to few black dots in some individuals. Anal fin yellowish with

pale base and dark grey to blackish margin. Anterior edge of pelvic fins black, other parts of this fin red to dark violet. Lower parts of opercle, subopercle and interopercle yellow to whitish, chest whitish. Flanks and belly region, up to about middle of the body, wine red, flanked by whitish to bluish coloration in upper parts. When courting, caudal and anterior dorsal body parts dark to blackish.

For additional photographs of adult specimens of both sexes from different localities, see Lamboj (2004b): 189-193.

Juveniles of both sexes (before attaining adult coloration) exhibit a pattern of 2 or 3 rows of irregular dark spots on brown coloration, up to about 10-12 mm SL. With increasing size, sex-specific coloration is seen.

Preserved specimen coloration. Head and body brown, darker dorsally. Cheek, throat, prepelvic and prepectoral regions of flanks and chest pale light brown. Lips brown. Dark spot on outer edge of opercle. Males with black dots in the upper half of the caudal fin and numerous dark dots in central parts of this fin and soft dorsal fin parts; females with no or up to two black dots in soft dorsal fin parts, rest of this fin and caudal fin clear.

Breeding behaviour. In aquaria, the species is a monogamous, pair bonding, cave spawner. Eggs and larvae are guarded mainly by the female, very rarely by the male too. Hatching occurs after three days post-spawn. Larvae are usually deposited on the bottom of the cave, rarely in other caves near the original cave. Juveniles are free swimming 8 or 9 days post-hatching and are guarded by both parents for about 5 to 6 weeks. Breeding and guarding females regularly exhibit a very prominent black midlateral band during the first 2 to 4 weeks when guarding fry, a typical coloration for breeding females within the genus; rarely the male also show such coloration. No between-population differences in breeding have been determined.

### Distribution

Cameroon, occurring in coastal freshwater areas around Moliwe, Muyuka and in the southern tributaries of the Nyong River system, also in the Kienke and Lobe systems and Rio Muni (Fig. 5). Specimens from Bioko (northeast of the island, Olsina and Basupu rivers) have not been examined here, but based on a photograph in Álvarez (1994) these clearly belong to *P. kribensis*.

### CONCLUDING REMARKS

The distinction of species based on anatomical and morphological data and features within most genera of chromidotilapiine cichlids is often problematic and not possible. This process becomes easier when considering coloration patterns and markings (e.g., Lamboj 2001, 2004a, 2004b,

2013; Lamboj and Stiassny, 2007). The problematic anatomical and morphological differentiation possibly led Thys van den Audenaerde to synonymise *P. kribensis* with *P. taeniatus* in 1968, as most of the coloration patterns and markings are unrecognizable in the type specimen due to the preservation status. Greenwood's (1987) more detailed examinations of chromidotilapiine cichlids also failed to uncover any new aspects of the species status because this work was based mainly on preserved material rather than comparison of live specimens (merely mentioning the existence of several colour forms in *Pelvicachromis* species).

We confirm the similarities in anatomical and morphological characters, as typical for most *Pelvicachromis* species. Nevertheless, coloration differences present a solid basis for differentiation and correspond with molecular data. Within the *P. taeniatus*-group, three main clades are recognized: 1) the *P. taeniatus*-clade for specimens from Benin and Nigeria, separated from all other forms by basic coloration patterns within the whole distribution area; 2) the clade for specimens from the Wouri River system, which is described in this paper as *P. drachenfelsi* sp. nov., because its characteristic and unique coloration distinguish it from all other members of the *P. taeniatus* group; 3) the *P. kribensis*-clade for populations from all other parts of Cameroon.

Within the *P. kribensis* a closer grouping of specimens from the Moliwe River region and from the Nyong River system (so-called Dehane form, Lamboj, 2004b) is recognizable. This subgroup may represent a species of its own, but this is not discussed herein because of difficulties in distinguishing coloration patterns of both sexes from other populations of *P. kribensis* and a lack of more detailed samples for molecular work from populations of different locations within Moliwe and Nyong River systems, whose occurrence is documented by literature (e.g., Muyuka and Ndonga forms; Lamboj, 2004b). More samples and additional works will be necessary to satisfactorily clarify this. All remaining *P. kribensis* populations build a clade in which no stronger distinctions are possible either by discrete coloration patterns or by molecular results. For this clade, together with the forms from the Moliwe- and Nyong systems, the old taxon *P. kribensis* is revalidated. Nonetheless, as stated above, we cannot exclude that, after more detailed examinations, the populations from Moliwe and Dehane systems represent a species of its own.

Our hypothesis about the distribution history of these three closely related species, based on the molecular data, is that the origin of the group was in the Niger River system. From there, the group spread south via coastal connections of the different river systems. *Pelvicachromis drachenfelsi* seems to be a somewhat isolated species in the tributaries of the Wouri River system, without visible coloration differences of populations. Isolation could occur because brackish

water is present high up in the mouth of the Wouri River, forming a good barrier for *Pelvicachromis* species.

Populations south of the Nyong River may have some contact to each other, at least during the rainy season, when middle and upper parts of creeks and rivers are joining by flooded areas (A.L., pers. obs.).

An interesting additional result of this work is the separate position of *P. humilis* from other *Pelvicachromis*. This indicates that the genus under its current definition is possibly not monophyletic, supporting other results (Lamboj and Kratochvil, 1997; Lamboj, 2004b, Schwarzer *et al.*, 2014). Intrageneric relationships of *Pelvicachromis* remain to be clarified. A paper giving more comprehensive informations on the differences between the *P. humilis* group and all remaining *Pelvicachromis*, is in preparation.

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