

Description of a new species of *Labeo* (Teleostei: Cyprinidae) from the lower Congo River

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Abstract

A new labeonine cyprinid, *Labeo fulakariensis*, is described from material recently collected in rapids on the lower Congo River near the mouth of the Foulakari River, a large north bank tributary, in the Republic of Congo, and from the Yelala rapids in the Democratic Republic of Congo. The new species is readily distinguished from other Congolese *Labeo* except *L. greenii* and *L. reidi* by the following combination of characters: plicate lips, characteristic striping of the flanks, and a dark spot on the base of the caudal peduncle. *Labeo fulakariensis* is distinguished from *L. greenii* by dorsal fin shape and snout without a deep transverse furrow or upwardly directed fleshy anterior appendage, and from *L. reidi* by the position of the eyes, the circumpeduncular scale count (16 vs 17 to 20 in *L. reidi*) and maxillary barbels hidden and smaller than in *L. reidi*.

Key words: *Labeo*, Cyprinidae, new species, Africa, lower Congo River

Introduction

Cyprinid fishes of the genus *Labeo* have been divided into two groups on the basis of the anatomy of the inner surface of their lips which are either papillate or plicate (Tshibwabwa & Teugels, 1995). In the lower Congo region (from Pool Malebo to the Atlantic Ocean, see Thieme *et al.*, 2005), the first group is represented by 3 species: *Labeo lineatus* Boulenger, 1898, *L. weeksii* Boulenger, 1909, and *L. maleboensis* Tshibwabwa, 1997, and the second group is represented by 13 species: *L. annectens* Boulenger, 1903, *L. barbatus* Boulenger, 1898, *L. chariensis* Pellegrin, 1904, *L. cyclorhynchus* Boulenger, 1899, *L. degeni* Boulenger, 1920, *L. falcipinnis* Boulenger, 1903, *L. greenii* Boulenger, 1902, *L. longipinnis* Boulenger, 1898, *L. macrostomus* Boulenger, 1898, *L. nasus* Boulenger, 1899,

L. parvus Boulenger, 1902, *L. rectipinnis* Tshibwabwa, 1997, and *L. sorex* Nichols and Griscom, 1917 (Tshibwabwa & Teugels, 1995; Tshibwabwa, 1997).

As a part of an ongoing study of the fresh water fishes of the Congo basin, several recent collections have been made in the lower Congo region by an international team including members from Brazzaville, Kinshasa, New York, and Munich. Among these collections, a new species of *Labeo* has been identified and herein we present its description as a contribution to understanding of the biodiversity of the fresh water fishes of the lower Congo region. An updated key to the *Labeo* of the lower Congo River is also provided.

Material and methods

The description of the new *Labeo* species is based on examination of the type series and comparative materials housed in the collection of American Museum of Natural History (New York), Cornell University (Ithaca), the Museum of Comparative Zoology (Cambridge) and additional type and comparative materials in the collection of Musée Royal de l'Afrique Centrale (Tervuren). Measurements, morphological observations and meristic counts follow Tshibwabwa & Teugels (1995) and Tshibwabwa (1997). Vertebral counts have been made from radiographs following Tshibwabwa & Teugels (1995). Statistical analysis has been undertaken using principal components analyses of the CSS: Statistica (StatSoft, version package 4.5). Anatomical abbreviations are: **VERT**: number of vertebrae; **NBDR**: number of branched dorsal fin rays; **SLL**: number of scales in lateral line; **SLD**: scale rows between the lateral line and the origin of the dorsal fin; **SLV**: scale rows between the lateral line and the base of the pelvic fin; **SCP**: scale rows around the caudal peduncle; **GO**: genital opening (0: near the origin of the anal fin; 1: distant from the origin of the anal fin); **PE**: position of eyes (0: lateral position; 1: supero-lateral position; 2: dorso-lateral position); **COL**: coloration of the body (0: body uniformly colored; 1: body striped; 2: body with a lateral band; 3: body with a spot on the caudal peduncle); **DORS**: shape of the upper edge of the dorsal fin (0: straight; 1: convex; 2: concave; 3: falciform); **BAR**: number and length of the barbels (0: no barbels; 1: barbels minuscule and hidden; 2: barbels small and visible; 3: barbels large and visible); **SNS**: snout shape (0: no transverse furrow and fleshy appendage at its end; 1: transverse furrow present, fleshy appendage absent; 2: transverse furrow and an upwardly directed fleshy appendage well developed); **SL**: standard length; **BD**: body depth; **CPD**: caudal peduncle depth; **CPL**: caudal peduncle length; **HL**: head length; **SL**: snout length; **IOD**: interocular distance; **E D**: eye diameter; **POL**: postocular length; **PDL**: predorsal length; **PAL**: preanal length; **PVL**: preventral length; **PPL**: prepectoral length; **DFL**: dorsal fin length; **DRL**: length of the largest ray of the dorsal fin; **PL**: pectoral fin length; **VL**: ventral fin length; **AL**: anal fin length; **ARL**: length of the largest ray of the anal fin.

Institutional abbreviations follow Leviton *et al.* (1985) and comparative materials

examined are: *L. annectens*: CU 83154; CU 86343; CU 86392. *L. barbatus*: AMNH 236562; AMNH 236563. *L. chariensis*: AMNH 236571. *L. cyclopinnis*: AMNH 6296 (Holotype); MRAC 15609. *L. cyclorhynchus*: AMNH 236564. *L. degeni*: MRAC 7111 (Lectotype); MRAC 14607. *L. falcipinnis*: MRAC 177618; MRAC 73-22-P-2781. *L. greenii*: MRAC 1190 (Holotype); BMNH 1975.6.20:504; MCZ 50286; MCZ 50450; MCZ 50522; MRAC 43991; MRAC 87376. *L. lineatus*: AMNH 236569. *L. longipinnis*: AMNH 236561; AMNH 236570. *L. maleboensis*: MRAC 2342-2344 (Holotype). *L. macrostomus*: MCZ 50466; MRAC 98148-56. *L. nasus*: AMNH 236567. *L. parvus*: AMNH 236566. *L. rectipinnis*: MRAC 98136-42 (type series); MRAC 48170-72. *L. reidi*: MRAC 87-42-P-725-729 (Holotype); MRAC 87-42-P-725-729 (Paratypes); AMNH 236559. *L. sorex*: AMNH 236565; AMNH 236568. *L. weeksii*: AMNH 236558; AMNH 236560.

Results

Labeo fulakariensis **n. sp.** shows close affinities to two species of *Labeo* which Tshibwabwa (1997) showed to be nested within a monophyletic subgroup of Congo Basin *Labeo*. Consequently, the diagnosis herein is restricted to *Labeo* of the Congo Basin. A combination of meristic, morphometric and anatomical characters discriminate the new *Labeo* species from the two morphologically most similar species of the Congo basin: *greenii* and *reidi*. These three species share the feature of plicate lips, and have a characteristic longitudinal striping of the flanks composed of a disjunct series of midscale spots aligned in longitudinal series. Additionally, they also share the presence of a dark spot at the base of the caudal peduncle. This spot is very well-developed in *L. greenii*, more-or-less developed in *L. fulakariensis*, but always very small in *L. reidi*. Two separate principal components analyses (PCA) have been undertaken, the first with morphometric data and the second with the meristics and coded morphological characters (excluding those that are invariant such as the number of branched dorsal rays).

In the first PCA, the two first principal components are characterised by positive and generally high loadings given in Table 1. A plot of the first principal component (PCI) against the second principal component (PCII) from a principal components analysis of morphometric characters supports our diagnosis of *L. fulakariensis* **n. sp.** and differentiates it from the morphologically similar Congo River species *L. greenii* and *L. reidi* (Fig. 1).

A second PCA has been undertaken with the meristic and coded morphological characters. The first principal component is characterised by high positive loadings for three characters (GO, DORS and SNS). The second principal component is characterised by high positive loadings for three characters (SCP, VERT and BAR). The factor loadings for this PCA are given in Table 2. A plot of the principal component (PCI) against the second principal component (PCII) from a principal components analysis of meristic and

morphological characters shows the *L. fulakariensis* n. sp. well separated from *L. greenii* and *L. reidi* (Fig. 2).

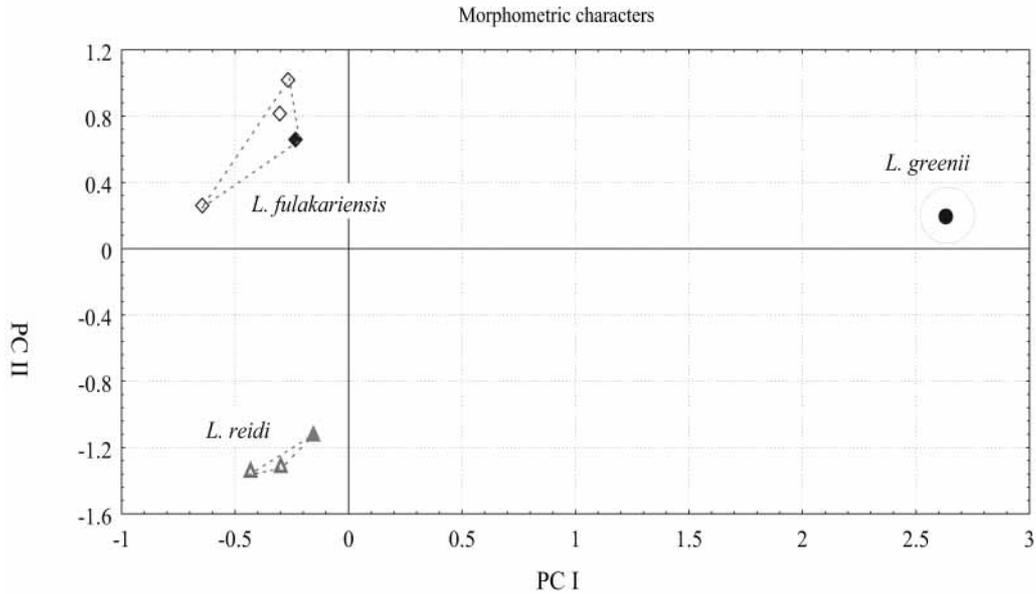


FIGURE 1. Principal component analysis using 19 morphometric measurements for *Labeo fulakariensis* n. sp., *L. greenii*, and *L. reidi*. Filled symbols refer to holotype; empty symbols refer to paratypes.

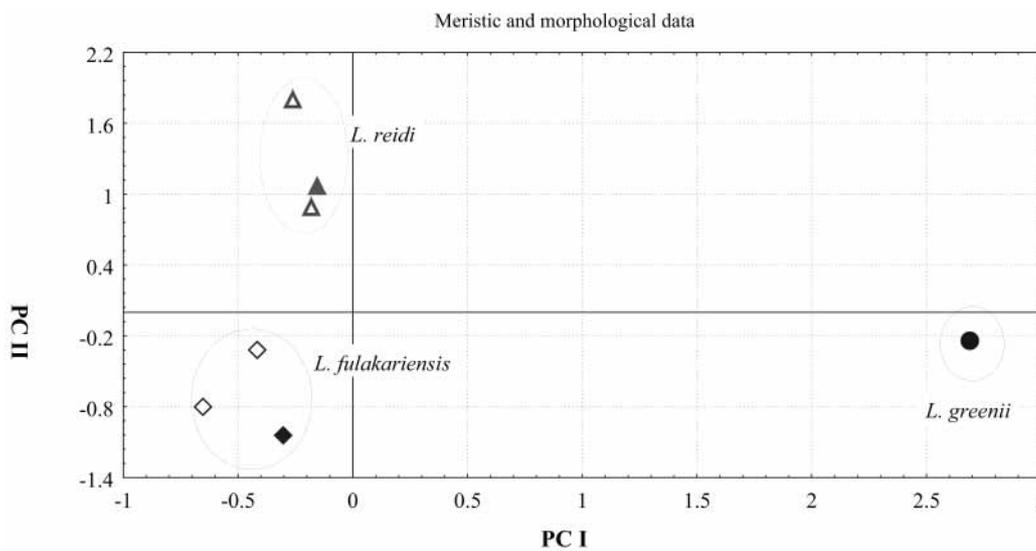


FIGURE 2. Principal component analysis using five meristic and six morphological characters for *Labeo fulakariensis* n. sp., *L. greenii*, and *L. reidi*. Filled symbols refer to holotype; empty symbols refer to paratypes.

TABLE 1. Factor loadings (after normalized varimax rotation). Analysis of three groups of *Labeo* from lower Congo River using 19 morphometric measurements in the first and the second principal component (PCI, PCII) for the principal component analysis (eigenvalues for the two axes: PCI=17.67360; PCII=0.34382; explained total variance=94.83%).

Characters	PC I	PC II
SL	.83496	.508057
BD	.78879	.574560
CPD	.78930	.572642
CPL	.84092	.408044
HL	.77191	.585755
SL	.76186	.610926
IOD	.81230	.540577
ED	.47781	.863239
POL	.53709	.820105
PDL	.77861	.588543
PAL	.80612	.551811
PVL	.81350	.536268
PPL	.77350	.594826
DFL	.80282	.552653
DRL	.79816	.560446
PL	.77498	.590256
VL	.79073	.569952
AL	.84199	.486133
ARL	.80899	.545582

TABLE 2. Factor loadings (after normalized varimax rotation). Analysis of three groups of *Labeo* from lower Congo River using five meristic characters and six morphological characters in the first and the second principal component (PCI, PCII) for the principal component analysis (eigenvalues for the two axes: PCI=5.723228; PCII=2.832211; explained total variance=77.85%).

Characters	PC I	PC II
VERT	.305306	.698508
SLL	-.754294	.100920
SLD	-.091928	.653976
SLV	-.499116	.560423
SCP	-.139072	.932973
GO	.970086	-.084383
PE	.140389	-.909940
COL	-.970086	.084383
DORS	-.970086	-.084383
BAR	-.590335	.724646
SNS	-.970086	-.084383

***Labeo fulakariensis*, new species.**

(Figures 3–5; Table 3)

Holotype: AMNH 236426: Channel in rocks, 1 km upstream of Foulakari, Congo main channel, Lower Congo River, Rotenone. Republic of Congo (4°34.71 S-14°59.74 E). 07.VIII.2004; SL: 111.6 mm.

Paratypes: AMNH 236427: Channel in rocks, 1 km upstream of Foulakari, Congo main channel, Lower Congo River, Rotenone. Republic of Congo (4°34.71 S-14°59.74 E). 07.VIII.2004; SL: 86.1 mm. AMNH 236428: Mbouono, rotenone applied to partially isolated pool of Congo main channel, downstream of Brazzaville, Lower Congo River. Republic of Congo (4°20.19 S-15°11.02 E). 20.VIII.2004; SL: 130.3 mm. ZSM 34488: Rapids near Yelala. Rotenone applied to high gradient riffle with aquatic macrophytes, flowed through holes and under cracks into several pools, fish collected at downstream constriction; Lower Congo River. Democratic Republic of Congo (5°43.51 S-13°32.50 E). 12.VII.2005; SL: 124.2 mm.

Differential diagnosis

Labeo fulakariensis is distinguished from all Congolese *Labeo* except *L. greenii* and *L. reidi* by the combination of plicate lips, characteristic striping of the flanks, and a dark spot restricted to the midbase of the caudal peduncle. *Labeo fulakariensis* is distinguished from *L. greenii* in the possession of a concave dorsal fin (vs. falciform in *greenii*), a flat dorsal profile between the eyes (vs. rounded in *greenii*), and a snout without a deep transverse furrow or upwardly directed fleshy anterior appendage (vs. snout with deep transverse furrow and upwardly directed fleshy appendage in *greenii*). *L. fulakariensis* is distinguished from *L. reidi* (a species known only from the Middle Congo) by the position of eye which is supero-lateral (vs lateral in *L. reidi*), 16 circumpeduncular scales (vs. 17 to 20 in *L. reidi*), and the maxillary barbels which are well-developed but smaller than in *L. reidi* and never visible externally (in *L. reidi*, maxillary barbels are well-developed, larger and always visible externally).

Description

Based on the holotype and three paratypes. Maximum size 179.7 mm SL. Counts and proportional measurements are presented in Table 3. Body robust, more-or-less laterally compressed, flanks with longitudinal striping, and a large black spot situated at the base of the caudal peduncle. Genital opening situated near the anal fin origin. Mouth large, rostral lobe denticulate; lips with transverse plicae on the inner surface. Maxillary barbels well-developed, hidden at the corners of the mouth; rostral barbels small and hidden beneath rostral lobe. Interorbital profile flat, snout not prominent, with few tubercles, and without a deep transverse furrow or fleshy appendage at its anterior end. Eyes in supero-lateral position and not visible from the ventral face. Dorsal fin concave with 4 unbranched and 10 branched rays. Pectoral fins in latero-ventral position, distant from pelvic fins, their tips

extending just beyond the origin of the dorsal fin; pelvic fins short, not reaching the genital opening. Anal fin not reaching the extremity of the scaly caudal fin. Caudal fin deeply notched, with pointed lobes; the upper lobe slightly more developed than the lower. Thirty-one to 32 vertebrae. Thirty-eight to 39 pored scales in lateral line, $6^{1/2}$ scale rows between dorsal fin origin and lateral line, 4–5 scales rows between lateral line and pelvic fin insertion, and 16 circumpeduncular scales.



FIGURE 3. *Labeo fulakariensis* n. sp., AMNH 236426, 111.6 mm SL.



FIGURE 4. Ventral view of mouth of *Labeo fulakariensis* n. sp., AMNH 236426, 111.6 mm SL.

Coloration

Alcohol preserved specimens are dark brown dorsally and beige-yellow ventrally; lighter from the genital opening to the inferior part of the scaly caudal fin. The scales of each longitudinal flank row bear a more-or-less well marked black spot in the midfield. The resulting patterning on the flanks resembles a series of longitudinal stripes although each “stripe” is composed of a series of unconnected black scale spots. A large black spot is present on the caudal peduncle; the caudal spot is restricted to the caudal peduncle and does not extend onto the scaly caudal fin base. A well-developed and strongly marked post

opercular spot is present just above the pectoral fin. All fins are whitish with a smoky grey overlay.

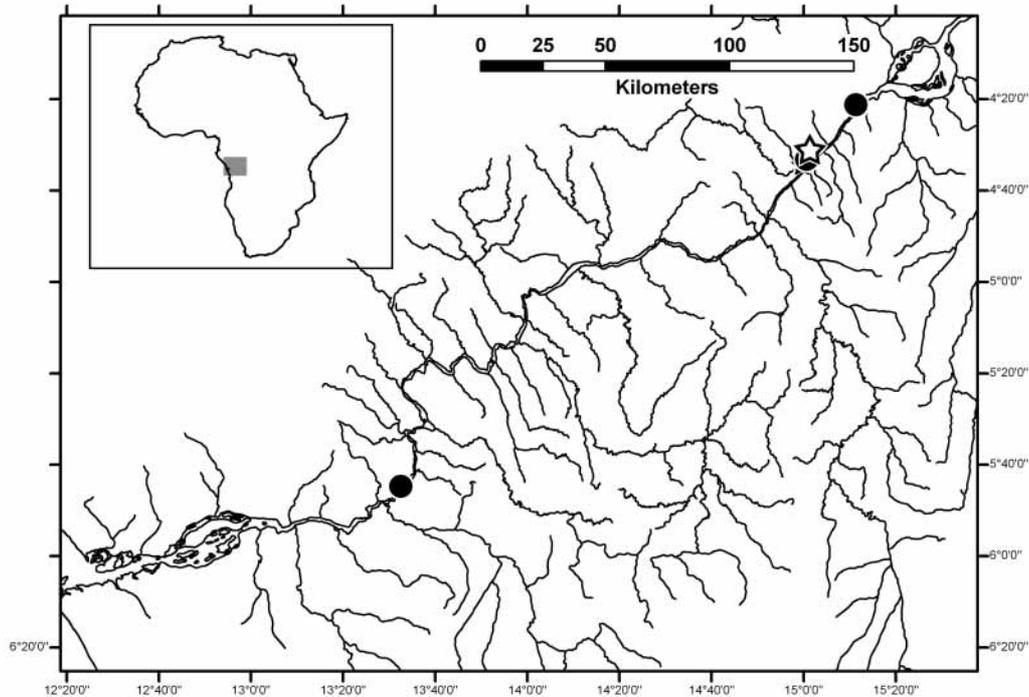


FIGURE 5. Distribution of *Labeo fulakariensis* n. sp. Holotype: open star; Paratypes: filled circles.

Reproduction

Unknown.

Distribution and habitat

Collected from the main channel of the Congo River in the lower rapids, from near Brazzaville to Yelala (See Fig. 5). Pending the results of ongoing biodiversity studies in this area, current distributional data suggest that *Labeo fulakariensis* is restricted to the Lower Congo River a region already characterized by another endemic *Labeo*, *L. rectipinnis* (Tshibwabwa, 1997) and numerous other endemic fish species (Thieme *et al.*, 2005). Specimens were captured either in protected backwaters influenced by periodic surges, or in flowing water comprised of alternating riffles and pools in rock fissures along the bank of the Congo. Smooth rock faces in these habitats bore visible tracks with the characteristic lip imprints of grazing *Labeo*.

Etymology

Named in reference to the Foulakari River, Republic of Congo, in the vicinity of which most of the type series was collected.

TABLE 3. Morphometric and meristic characters for *Labeo fulakariensis* n. sp.

Morphometric characters	Holotype	Paratypes		N	Mean
		Min	Max		
TL (mm)	161.5	121.9	179.7	4	159.0
SL (mm)	111.6	86.1	124.2	4	109.0
%SL					
BD	19.8	20.1	20.9	4	20.3
CPD	16.6	16.7	17.4	4	17.0
CPL	13.4	7.9	13.4	4	11.1
HL	30.7	25.1	31.0	4	29.2
PDL	48.9	51.0	51.4	4	50.7
PAL	86.6	86.7	88.5	4	87.5
PVL	59.4	57.5	61.3	4	59.3
PPL	29.8	28.0	29.5	4	29.1
DFL	20.5	17.9	21.2	4	20.0
DRL	31.7	26.7	32.2	4	30.2
PL	24.4	24.6	27.0	4	25.4
VL	22.8	20.8	24.0	4	22.5
AL	6.9	6.6	8.0	4	7.2
ARL	20.3	17.3	20.5	4	19.5
%HL					
SL	53.7	51.4	66.4	4	56.4
IOD	49.7	48.0	59.4	4	52.0
ED	25.2	24.7	30.3	4	26.6
POL	28.5	28.6	31.2	4	29.9
Meristics		Holotype	Paratypes		
NRDB		10	10 (3)		
VERT		31	31 (2); 32 (1)		
SLL		38	38 (2); 39 (1)		
SLD		6½	6½ (3)		
SLV		4	4 (2); 5 (1)		
SCP		16	16 (3)		

Practical key to *Labeo* species from the lower Congo River

(Note: numbers in parenthesis indicate value most commonly observed)

- 1 Papillate lips 2
 - Plicate lips 4
 2 Upper edge of the dorsal fin straight or convex 3

- Upper edge of the dorsal fin falciform (or deeply concave); 11–12 dorsal branched rays, body striped; no dark spot on caudal peduncle and scaly caudal fin; scale formula: 35–38 (37); $4^{1/2}$ – $6^{1/2}$ ($5^{1/2}$); 3–5 (4); 15–18 (16) *L. weeksii*
- 3 37 scales in lateral line; 16 scales around the caudal peduncle; upper edge of the dorsal fin straight or convex, with 9–10 branched rays; body striped; a dark spot on caudal peduncle and scaly caudal fin; barbels small and hidden; scale formula: 35–38 (37); $5^{1/2}$; 3–4 (4); 15–17(16) *L. lineatus*
- Less than 36 scales in lateral line; less than 16 scales around the caudal peduncle; upper edge of the dorsal fin always straight; body striped, a small spot at caudal peduncle; maxillary barbels large and visible; scale formula: 30–35 (34); $5^{1/2}$; 4; 12–15 (13) *L. maleboensis*
- 4 Upper edge of the dorsal fin convex or straight 5
- Upper edge of the dorsal fin concave or falciform 7
- 5 Upper edge of the dorsal fin convex 6
- Upper edge of the dorsal fin straight; 10–11 branched rays; flanks striped, scale formula: 37–39 (38); $6^{1/2}$ – $7^{1/2}$ ($7^{1/2}$); 4–5 (5); 16–19 (16) *L. rectipinnis*
- 6 Ten branched rays at the dorsal fin; flanks striped; scale formula: 35–37 (37); $5^{1/2}$ – $6^{1/2}$ ($5^{1/2}$); 3–4 (4); 16–17 (16) *L. degeni*
- 11–14 branched rays at the dorsal fin; flanks not striped; scale formula: 35–38 (37); $5^{1/2}$ – $6^{1/2}$ ($5^{1/2}$); 4–5 (5); 15–17 (16) *L. longipinnis*
- 7 Upper edge of the dorsal fin concave; flanks striped or not, dark lateral band present or absent 8
- Upper edge of the dorsal fin falciform (sometimes deeply concave); eyes always in supero-lateral position 15
- 8 Flanks striped; interorbital profile flat; snout not prominent, without a transverse furrow and a fleshy upwardly directed appendage; pectoral fins distant from the origin of the pelvic fins; anal fin not reaching the scaly caudal fin; genital opening near the origin of the anal fin; maxillary barbels well developed; scale formula: 38–39; $6^{1/2}$; 4–5; 16 *L. fulakariensis*
- Flanks not striped, dark lateral band present or absent 9
- 9 Dark lateral band present on the flanks 10
- No dark lateral band on the flanks 11
- 10 Snout with a small transverse furrow, no fleshy appendage at its end; usually small sized; scale formula: 33–36 (35); $3^{1/2}$ – $5^{1/2}$ ($4^{1/2}$); 3–4 (3); 12–16 (13) *L. parvus*
- Snout with a deep transverse furrow and a fleshy appendage at its end; usually large sized; scale formula: 37–39 (38); $4^{1/2}$ – $6^{1/2}$ ($5^{1/2}$); 3–4 (4); 13–16 (14) *L. annectens*
- 11 Usually 10 branched dorsal fin rays, maxillary barbels small and hidden 12
- Usually 12 branched dorsal fin rays, dorsal fin deeply concave; maxillary barbels large, visible at the corners of the mouth; body variegated or uniformly dark brown (sometimes vague stripes present on the flanks); snout large and rounded; scale for-

- mula: 36–38 (37); $5^{1/2}$ – $7^{1/2}$ ($6^{1/2}$); 4–5 (5); 16–21 (16) *L. cyclorhynchus*
- 12 Eyes large, in supero-lateral position; no transverse furrow or upwardly directed fleshy appendage at the end of the snout 13
- Eyes small or exceedingly small, in supero or dorso-lateral position; transverse furrow and fleshy appendage present at the end of the snout 14
- 13 Maxillary and rostral barbels very large; 19–26 scales around the caudal peduncle; snout prominent; scale formula: 38–41 (40); $6^{1/2}$ – $9^{1/2}$ ($8^{1/2}$); 5–7 (6); 19–26 (24) *L. barbatus*
- Maxillary barbels small, hidden at the corner of the mouth; rostral barbels minuscule, hidden in the rostral furrow; snout very prominent without transverse furrow or a fleshy appendage, overhanging a very large mouth; scale formula: 37–39 (38); $5^{1/2}$ – $7^{1/2}$ ($6^{1/2}$); 4–5 (5); 16–20 (18)..... *L. macrostomus*
- 14 $6^{1/2}$ to $7^{1/2}$ scale rows between the lateral line and the origin of the dorsal fin; eyes small, in dorso-lateral position; snout with a transverse furrow and a small fleshy appendage at its end; scale formula: 36–40 (38); $5^{1/2}$ – $7^{1/2}$ ($6^{1/2}$); 3–5 (4); 17–21 (19)..... *L. nasus*
- More than $7^{1/2}$ scale rows between the lateral line and the origin of the dorsal fin; eyes exceedingly small, in dorso-lateral position; snout with a very well developed transverse furrow and a very well developed and upward fleshy appendage at its end; scale formula: 40–43 (42); $7^{1/2}$ – $9^{1/2}$ ($8^{1/2}$); 5–6 (6); 20–27 (24)..... *L. sorex*
- 15 Less than 37 scales in lateral line; usually less than 16 scale rows around the caudal peduncle; scale formula: 33–36 (36); $3^{1/2}$ – $5^{1/2}$ ($4^{1/2}$); $2^{1/2}$ –4 (3); 12–16 (13) *L. chariensis*
- More than 37 scales in lateral line; 16 or more scale rows around the caudal peduncle 16
- 16 Large and oval dark spot on the caudal peduncle and on the scaly caudal fin; scale formula: 35–39 (38); $4^{1/2}$ – $6^{1/2}$ ($5^{1/2}$); 3–4 (4); 15–19 (16) *L. greenii*
- No spot on the caudal peduncle; maxillary barbels developed, rostral barbels minuscule, but both hidden; scale formula: 37–39 (38); $6^{1/2}$ – $8^{1/2}$ ($7^{1/2}$); 4–6 (5); 18–21 (19)..... *L. falcipinnis*

Acknowledgements

For partially funding fieldwork, we gratefully acknowledge the Marjorie Merriweather Post Foundation and National Geographic (grant number 7691-04). Additional funding was provided by an NSF Doctoral Dissertation Improvement Grant (DEB 0508686; RCS), an NSF Biotic Surveys and Inventories Grant (DEB 0542540; MLJS, RCS), and an Axelrod Curatorship (MLJS). For assistance with permits and logistical support in the field, we thank the Marien Ngouabi University, the University of Kinshasa, and the

German Agency for Technical Co-operation (GTZ). For assistance in the field, we thank V. Mamonekene, A. Ibala Zamba, U. Schliewen, P. Feulner, I. Harrison, D. Musibono, J. Punga, and S. Ifuta. For loaning materials, thanks to J. Friel and K. Hartel. We also gratefully acknowledge J. Snoeks (Laboratory of Ichthyology) and the staff of African Biodiversity Information Centre (ABIC) of the MRAC-Tervuren/Belgium for funding a July 2005 study visit by the senior author, and thank M. Louette, E. Vreven, M. Parrent and M. Hanssens for their assistance during that visit.

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