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BRIEF COMMUNICATION

Labeo rosae (Cypriniformes: Cyprinidae) in the Congo basin: a relict distribution or a historical introduction?

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Labeo rosae, a species with a native range in Southern Africa, was discovered in the Congo basin by re-identification of two museum specimens previously identified as *Labeo mesops*. The occurrence of this species in the upper Congo implies a range extension of the species of more than 1000 km. Although the species' distribution is mirrored by that of some other Cypriniformes, its occurrence in the Congo might be due to introduction by humans.

Key words: Africa; biogeography; *Labeo altivelis*; *Labeo mesops*; reservoir lake; taxonomy.

Labeo Cuvier 1816 is, in Africa, the third most diverse cyprinid genus, after *Barbus* Barbus Cuvier & Cloquet 1816 and *Labeobarbus* Rüppell 1835 (Reid, 1985; Skelton *et al.*, 1991). Species of *Labeo* are herbivores that feed on the algal growth covering the substratum. For this, they possess special adaptations such as an inferior, sucker-like mouth with folded lips and a hardened edge (Reid, 1985; Skelton, 2001). Many species of *Labeo* were once of large commercial importance as their spawning migrations sustained important fisheries (Skelton *et al.*, 1991). Yet, in spite of this and their relatively large size the taxonomy of *Labeo* remains problematic and species identification difficult.

African *Labeo* were reviewed by Reid (1985) and, for Congo and Lower Guinea taxa, by Tshibwabwa (1997). In the Congo basin, two groups are distinguished: the plicate and the papillate (Tshibwabwa, 1997). The first, which is by far the most species rich, has rows of transverse plicae on the upper labial fold. The second lacks these plicae and has rows of globular papillae instead. The latter constitutes, at least in the

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Congo basin, a monophyletic group (Lowenstein *et al.*, 2011). Five nominal species of papillate *Labeo* are reported from the Congo basin: *Labeo altivelis* Peters 1852, *Labeo mesops* Günther 1868, *Labeo lineatus* Boulenger 1898, *Labeo weeksii* Boulenger 1909 and *Labeo maleboensis* Tshibwabwa 1997.

Prior to Reid's (1985) revision, *L. mesops* was considered endemic to the Lake Malawi basin. Reid (1985), however, extended this species' range considerably. Foremost, he placed two species from the Horn of Africa: *Labeo grammipleura* Vinciguerra 1927 and *Labeo gracilis* Boulenger 1916 into synonymy with *L. mesops*. Secondly, he listed *L. mesops* as occurring in the Tana River in Kenya. Finally, he mentioned a 'doubtful' presence of *L. mesops* in the Lufira (upper Congo). Reid (1985) referred to Goorts *et al.* (1961) as a reference hereof. Yet, no mention of *L. mesops* nor of any species of *Labeo* other than *L. cylindricus* Peters, 1852 is made in that document. Tshibwabwa (1997) contested the first range extension and revalidated *L. grammipleura* and *L. gracilis*. The second range extension was refuted by Seegers *et al.* (2003), who listed the Tana population as of uncertain taxonomical status. Tshibwabwa (1997) did, however, confirm the presence of *L. mesops* in the upper Congo.

The presence of *L. mesops* in the Congo basin was based on only two museum specimens: MRAC 182678-79 (Fig. 1), from the Lufira River, downstream of a small reservoir lake named Koni (10° 42′ S; 27° 15′ E). These specimens were collected by Magis who identified them as *Labeo* sp. (aff. *mesops*) with the local name 'Mushila'. Magis (1961) further mentioned 18 additional specimens from Lake Koni proper, but these could not be retrieved. Tshibwabwa (1997) examined the two Lufira specimens and confirmed their distinctness from all other Congolese species of *Labeo*. Following direct comparison with the holotype of *L. mesops* (BMNH 1864.1.9:64, Lake Malombe), he confirmed their identification as *L. mesops*. The holotype of *L. mesops* is a left-hand side dried skin. Hence, not all measurements and counts (*e.g.* vertebral counts) could be obtained for the latter. Moreover, Tshibwabwa (1997) did not compare the Lufira specimens with additional specimens of *L. mesops* from Lake Malawi, or with the literature. As such, it is not clear whether the differences between the Lufira specimens and the holotype of *L. mesops* (Tshibwabwa, 1997) fall within the range of what can be considered intraspecific variation.

In this study, the two Lufira specimens were compared with the holotype as well as with four additional specimens of *L. mesops* (MRAC 191845, 101298, 101302 and 99-41-P-9), all from Lake Malawi. This revealed that the two Lufira specimens differ from *L. mesops* in the number of scales around the caudal peduncle counted at the narrowest point (S_{CP}: 20 *v.* 16 in *L. mesops*), the number of scales between the dorsal and the caudal-fin (S_{DC}: 20 *v.* 14–18 in *L. mesops*) and the number of branched dorsal rays (R_{DB}: 11 + 1 *v.* 10 + 1 in *L. mesops*, where +1 denotes that the posterior-most ray was divided at its base, although it was counted as one).

Other specimens examined in this study were *L. altivelis* (45), *L. lineatus* (57), *L. weeksii* (72) and *L. maleboensis* (10) from the Congo, the Zambezi and the Rio dos Bons Sinais basins, including the complete type series of these species. All of these show 16 S_{CP}, except for one specimen of *L. altivelis*, which had 17 S_{CP}. As such, the circumpeduncular scale count of 20 also allows the two Lufira specimens to be distinguished from all known papillate species of *Labeo* from the Congo basin. Skelton (2001) mentioned 16–18 S_{CP} for *L. altivelis* and Tshibwabwa (1997) also listed some variation in this characteristic for the Congolese species. Although Skelton

FIG. 1. Specimens MRAC 182678-79: Lufira River, downstream of Koni. Although previously listed as *Labeo mesops*, these were shown to be *Labeo rosae*. Scale bar: 10 cm.

(2001) did not specify how he counted the S_{CP}, Tshibwabwa (1997) made this count starting at the first scale, posterior to the anal-fin base. As such, he followed a method different from the one used here where S_{CP} were counted at the narrowest point of the caudal peduncle.

According to Reid (1985), the only other African species of papillate *Labeo* with 20 S_{CP} are *Labeo niloticus* (Forsskål 1775), currently valid as *Labeo vulgaris* Heckel 1847 (Fricke, 2008), *Labeo horie* Heckel 1847, *Labeo ruddi* Boulenger 1907 and *Labeo rosae* Steindachner 1894. The first three species differ from the Lufira specimens in the number of branched dorsal rays ($14-16+1$ in *L. vulgaris,* $12-14+1$ in *L. horie* and $9-10+1$ in *L. ruddi v*. $11+1$ in the Lufira specimens). Using the revision of Reid (1985), the combination of S_{CP} (20), R_{DB} ($11+1$), S_{LL} ($38+2$, lateral line scales) and V (34, vertebrae, excluding the Weberian apparatus and including the pre-ural centre) indicates that the Lufira specimens are *L. rosae*. The hototype of *L. rosae* (NMW 55584) was examined in this study and the following meristics were counted: S_{CP} (20), R_{DB} ($12+1$), S_{LL} ($36+3$) and V (33). Although the values of the Lufira specimens are somewhat different from those of the holotype, they lie within the range given by Reid (1985). As such, the Lufira specimens are re-identified as *L. rosae*. Given their size (225 and 242 mm standard length, L_S), these specimens have a relatively small dorsal-fin of about the size of the head, which also separates them from similar-sized *L. altivelis* (Marshall, 2011).

Although this re-identification confirms the status of *L. mesops* as an endemic species to the Lake Malawi basin (Snoeks, 2004), it implies a considerable range extension for *L. rosae*. This species' known native range, which contains parts of the Limpopo, the Incomati and the Phongolo Rivers, lies over 1000 km south of the Lufira. Yet, the conditions in these subtropical rivers could be somewhat similar to the relatively cool rivers of the upper Congo plateaus. Two other large papillate *Labeo* also have disjunct distributions (Skelton, 2001). *Labeo altivelis* occurs in middle and lower Zambezi and in some eastward flowing rivers as well as in the Bangweulu–Mweru ecoregion. This species is, however, absent from the intermediate basins of the Kafue, the upper Zambezi and from the upper reaches of the Luangwa (Skelton, 2001). *Labeo ruddi* has an even larger distribution gap as it occurs in the warmer sections of the eastward flowing Incomati and Limpopo systems as well as in the westward draining Cunene (Skelton, 2001). These two distribution zones lie over 1000 km apart. The current distributions of these species of *Labeo* can be explained as being relicts of a once larger distribution in which local extinctions occurred. Given the severe changes in drainage patterns and climate in southern Africa (Cotterill & de Wit, 2011), local extinctions of large species of *Labeo*, which are adapted to large rivers, are not unlikely. A similar scenario was put forward for *Hydrocynus vittatus* Castelau 1861 for which the absence in the Kafue was explained as resulting from a period of local aridity (Cotterill & de Wit, 2011). Two species of *Barbus*, have similar distributions as *L. rosae*. *Barbus motebensis* Steindachner 1894 is only known from the Limpopo headwaters and from the upper Congo drainages of the Lufira and the neighbouring Luapula. *Barbus mattozi* Guimarães 1884 has a somewhat larger distribution. This species occurs in the Limpopo, the upper Congo, the Cunene and the neighbouring Curoca. Remarkably, two records are known from the upper Zambezi, where it appears to be rare (Skelton, 2001). As *B. mattozi* has habitat preferences similar to *L. rosae* (Skelton, 2001; Marshall, 2011), it cannot be excluded that the latter species remains to be discovered in parts of the upper Zambezi basin as well. Both *B. motebensis* and *B. mattozi* probably consist of several closely related species (Skelton, 2001; C. Manda, pers. comm.).

It is, however, remarkable that *L. rosae* was only collected once in the Congo basin and within and downstream of an artificial lake 10 years after it was constructed (Magis, 1961). This raises the question whether the species is native to the basin. *Labeo rosae* is a popular angling species and it was repeatedly introduced into artificial lakes north of its native range (Marshall, 2011). Due to these introductions, it could have colonized the upper Runde in Zimbabwe (Skelton, 2001; Marshall, 2011). Hence, it is possible that *L. rosae* was introduced into or near Lake Koni as well, although the whereabouts of this introduction are unknown. In the Lufira reservoirs, different attempts were made to introduce herbivorous fishes for weed control (Damas *et al.*, 1959). Besides translocations of the local ichthyofauna, this also led to the introduction of non-native species. Moreover, Lake Koni lies at less than 100 km from Kipopo (11° 34′ S; 27° 21′ E), at the time the largest aquaculture research centre in the Democratic Republic of the Congo. Here, the potential of native and alien fish species for aquaculture was tested. Some of the fishes introduced in Kipopo even originated from neighbouring Zambia. Yet, there were no reports of *L. rosae* being introduced into Zambia. The sole species of *Labeo* that was translocated in this country was *L. altivelis* (Thys van den Audenaerde, 1994). Nevertheless, *L. rosae* might have been introduced as well, either deliberately or accidentally. A similar scenario of an accidental introduction could have happened in

Lake Kivu, where *Lamprichthys tanganicanus* (Boulenger 1898) was possibly introduced together with the Lake Tanganyika sardine *Limnothrissa miodon* (Boulenger 1906) (Nshombo & Lushombo, 2010). Given that *L. rosae* is less dependent on rocky substrata than some of its congeners (Marshall, 2011), it could thrive in artificial lakes such as Lake Koni. Yet, as with all species of *Labeo*, it requires flowing water to spawn and there are no references indicating that spawning has ever occurred here.

At the time of this study, it could not be established whether *L. rosae* is native or introduced to the Congo basin. If *L. rosae* is indeed native, it is remarkable that no other specimens were ever recorded. Yet, as many of the larger rivers in the southern part of the Congo system have remained virtually unsampled, new collections could possibly provide more specimens. Moreover, species of *Labeo* are very susceptible to be affected by the construction of dams (Skelton *et al.*, 1991), so they might have become locally extinct prior to further collection efforts. Although this study showed that the two Lufira specimens correspond to the description of *L. rosae*, it cannot be excluded that they belong to an undescribed species. Yet, only two specimens were at hand and species of *Labeo* are known for their large distribution areas and large intraspecific variation (Reid, 1985). The two Lufira specimens were fixed in formalin and are thus unsuitable for genetic analysis. If additional specimens are discovered, population genetics could reveal the true origin of the Lufira population, or the possible presence of a new species. Until then, the presence *L. rosae* in the Lufira is one of the many ichthyological mysteries still present in the Congo basin.

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