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## A revision of the *Rutilus* complex from Mediterranean Europe with description of a new genus, *Sarmarutilus*, and a new species, *Rutilus stoumboudae* (Teleostei: Cyprinidae)

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### Abstract

By combining morphology, ecology, biology, and biogeography with the available molecular (sequence variation of the entire mitochondrial cytochrome b gene; *cyt-b*) and karyology data, the taxonomy of several species of the *Rutilus* complex inhabiting southern Europe is revised. *Rutilus stoumboudae*, new species, is described from Lake Volvi, Greece. It differs from *Rutilus rutilus* in possessing more total GR and less branched rays in both dorsal and anal fins and in its placement in the *cyt-b* based phylogeny of the genus. The resurrected genus *Leucos* Heckel, 1843 (type species *Leucos aula*, Bonaparte, 1841), which according to molecular data diverged from *Rutilus* more than 5 million years ago, during the Messinian salinity crisis, includes five species of small size, without spinous tubercles on scales and head in reproductive males, pharyngeal teeth formula 5-5, and all show a preference for still waters. *Leucos aula* is the Italian species endemic in the Padany-Venetian district; *L. basak* is widespread in Croatia, Albania, Montenegro and former Yugoslav Republic of Macedonia (FYROM); *L. albus*, recently described from Lake Skadar, Montenegro, is also found in rivers Moraca and Zeta (Montenegro). *L. albus* differs from *L. basak*, its closest relative, in having more scales on the LL and less anal-fin rays; *L. panosi* is endemic to the western-Greece district, and *L. ylikiensis* is endemic to lakes Yliki and Paralimni in eastern Greece (introduced in Lake Volvi). Among the nominal species examined, *Rutilus karamani*, *R. ohridanus*, *R. prespensis* and *R. prespensis vukovici* are all junior synonyms of *Leucos basak*. *Rutilus vegariticus* is definitively regarded as junior synonym for *R. rutilus*. *Sarmarutilus* n.gen. is a monotypic genus, with *Sarmarutilus rubilio* as the type species. According to phylogenetic data, *Sarmarutilus rubilio* is basal to a cluster of species that includes *Leucos basak*, *L. albus*, *L. aula*, *L. panosi* and *L. ylikiensis*. *Sarmarutilus* possibly evolved in pre-Messinian time, in the Lago Mare, entered the Mediterranean area during the Messinian Lago Mare phase of the Mediterranean Sea and survived only in the Tuscany-Latium district. This genus differs from *Leucos* in having large pearl organs on the central part of head and body scales in mature males and for the habitat preference, being a riverine-adapted species. It differs from *Rutilus* in pharyngeal teeth formula (5-5 in *Sarmarutilus* and 6-5 in *Rutilus*), size (small in *Sarmarutilus* and large in *Rutilus*) and for the preferential habitat (riverine vs. still water). Finally, lectotypes for *Leucos basak*, *Leucos aula*, and *Sarmarutilus rubilio* are designated.

**Key words:** Freshwater fish, Mediterranean Europe, Cyprinidae, genera *Rutilus*, *Leucos*, *Sarmarutilus* new genus, new species

### Introduction

Since the work of Kottelat (1997), which presented a general overview of the systematics of European cyprinids as well as of the many still open questions concerning their taxonomy, a wealth of molecular studies has been published on different genera to shed light on the evolution of this speciose family in the area (*Squalius*: Durand *et al.*, 1999; *Telestes* and *Scardinius*: Ketmaier *et al.*, 2004; *Barbus*: Tsigenopoulos & Berrebi, 2000, Bianco, 1998). Bianco & Taraborelli (1985) and Bogutskaya & Illiadou (2006) morphologically analyzed a number of European

## Conclusion

In this study, we updated the taxonomy of the *Rutilus* complex in southern Europe and presented an arrangement different from that proposed by Kottelat & Freyhof (2007). In our opinion, this new taxonomic scheme better mirrors the effects that the paleogeography and paleoecology of the area had on the diversification of this group of cyprinids (Fig. 1B) (Bianco, 1990; Ketmaier *et al.*, 2008). Based on phylogenetics, karyologic, morphological and ecological considerations, we resurrected the genus *Leucos* Heckel, 1854, which includes five species. Among them, the Balkanic roach (*L. basak*) shows the broadest geographical range, possibly because it took advantage of the multiple river connections in the area during the Würmian Ice Age. *L. aula* is endemic to northern Italy; *L. ylikiensis* and *L. panosi* are both endemic to Greece. *Leucos albus* is endemic to Albany, where it coexists with *L. basak*. In central Italy the monotypic genus *Sarmarutilus* is described. The only representative of the genus probably originated in the Sarmatic area in Middle Miocene, reached the Mediterranean area during the Lago Mare phase, and survived only in the Tuscany-Latium district of Italy. In the genus *Rutilus*, *R. rutilus* is of alien origin in the study area. *Rutilus pigus* is endemic to the Padano-Venetian district. *Rutilus stoumboudae* n.sp. is endemic to Lake Volvi (Greece) and is well differentiated both morphologically and molecularly from the other two species of *Rutilus*. We also emphasize that the conservation status of several species are affected by alien introductions. Today *Rutilus stoumboudae* has probably gone extinct in Lake Volvi (Greece) due to the dramatic reduction in water level that the basin has witnessed in recent years and probably also as a result of the introduction of *L. ylikiensis*. *Rutilus pigus* in Italy is currently threatened by the introduction of *R. rutilus*, which has become invasive throughout the whole peninsula. It is worth noting that the joint introduction of *R. rutilus* and *Chondrostoma nasus* is affecting also other still water species such as *Leucos aula* and *Chondrostoma soetta*, that have nearly vanished from northern Italian lakes. *Leucos basak* and *L. panosi* seem to be in a relatively good conservation status across their respective ranges. *R. ylikiensis* is affected by habitat reduction as Lake Yliki and Paralimny nearly dry up during the summer season (P.G. Bianco, pers. obs.). According to several private Italian pond owners, *L. basak* has been stocked with forage predators such as zanders and black basses (Bianco, 2014b). *Sarmarutilus rubilio*, endemic to the Tuscano-Latium district, central Italy, west of the Apennines, is locally threatened as a result of the introduction of species such as the European *Rutilus rutilus*, and *Leucos aula*, *Alburnus arborella*, *Chondrostoma genei* and *Scardinius hesperidicus*, all species introduced from the Padano-Venetian district and that are apparently more competitive and able to displace it (Bianco & Ketmaier, 2001). Unfortunately, what we just described is not an isolated case but is rather a general trend in the Italian fish fauna, which has been severely altered by introductions and translocations of species in the last hundred years, mostly for stocking purposes (Bianco & Ketmaier, 2001; 2005). Something similar is happening in Greece, where introduction of non-native *L. ylikiensis* in Lake Volvi, *L. panosi* and *Rutilus rutilus* in Lake Joannina have affected native species (Leonardos *et al.*, 2008).

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