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Checklist and distribution of ciliates from the family Euplotidae Ehrenberg, 1838 (Protista: Ciliophora: Spirotrichea) in Slovakia, Central Europe

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Abstract

A checklist of ciliates from the family Euplotidae recorded in the territory of Slovakia, Central Europe was assembled. Altogether, 11 species belonging to three genera of the family Euplotidae have been reported there: *Euplotes alatus*, *Euplotes charon*, *Euplotes moebiusi*, *Euplotoides aediculatus*, *Euplotoides eurystomus*, *Euplotoides patella*, *Euplotoides woodruffi*, *Euplotopsis affinis*, *Euplotopsis finki*, *Euplotopsis muscicola*, and *Euplotopsis novemcarinata*. However, records of the marine species *E. alatus* and *E. charon* are doubtful and very likely represent misidentifications of *E. moebiusi*. Since the euryhaline species *E. woodruffi* was found for the first time in Slovakia, its morphology is described. Based on the literature data and our own observations, the present checklist is also accompanied with distribution data on the 11 aforementioned species. As concerns ecology, Slovak euplotids typically occurred in freshwater bodies having higher trophic levels. Only two species, *E. finki* and *E. muscicola*, were isolated from terrestrial habitats, especially, from mosses, leaf-litter, and decaying wood mass.

Key words: *Euplotes*, *Euplotoides*, *Euplotopsis*, freshwater, soil and moss ciliates, species diversity

Introduction

The ciliate family Euplotidae Ehrenberg, 1838 belongs to the order Euplotida Small & Lynn, 1985 of the class Spirotrichea Bütschli, 1889. Among spirotricheans, euplotids are morphologically easily recognizable due to the prominent adoral zone of membranelles, loss of right marginal cirri, reduced number of left marginal cirri to fewer than tree, and ventrally located caudal cirri. The cell of euplotids is rigid, ovoid and ventrally flattened. Its dorsal side carries several meridional kineties whose bristles are associated with small vesicles (Lynn 2008). Euplotids are widely distributed and can be found in almost all types of aquatic and terrestrial environments, but prefer estuarine and marine habitats. They are omnivores feeding on bacteria, algae and other small protists (for review, see Foissner *et al.* 1991 and Song & Warren 2009).

The name-bearing genus *Euplotes* Ehrenberg in Hemprich & Ehrenberg, 1831 was established almost 200 years ago. According to the morphological and ecological features, Borror & Hill (1995) recognized three further genera within this old species-rich genus: *Euplotoides* Borror & Hill, 1995; *Euplotopsis* Borror & Hill, 1995; and *Moneuplotes* Jankowski, 1978. Many authors have, however, not followed their classification because euplotid genera turned out to be polyphyletic in molecular analyses (e.g., Petroni *et al.* 2002; Miao *et al.* 2007; Schwarz *et al.* 2007; Achilles-Day *et al.* 2008; Yi *et al.* 2009; Di Guiseppe *et al.* 2014). Nevertheless, any systematic conclusions are preliminary at the present state of knowledge, as only a small portion of the euplotid diversity has been investigated with molecular methods.

To date, more than 150 euplotid taxa were described (Online Catalogue of Ciliate Names: 1. Hypotrichs; <http://www.protozoology.com>; Berger 2006), but only about 70 of them were considered as valid species (e.g., Curds 1975; Foissner 1982; Carey 1992; Borror & Hill 1995; Petz *et al.* 1995; Wilbert 1995; Coppelotti & Cisotto 1996; Valbonesi *et al.* 1997; Tuffrau *et al.* 2000; Foissner *et al.* 2002; Lobban *et al.* 2005; Song & Warren 2009; Dai *et al.* 2013). However, the discovery of new euplotid species, especially, from marine and estuarine environments still continues (e.g., Jiang *et al.* 2010a, b; Pan *et al.* 2012; Chen *et al.* 2013).

Only two euplotids were isolated from terrestrial habitats of Slovakia: *Euplotopsis finki* and *Euplotopsis muscicola*. The former is a rare taxon, which is documented also only by a few reports from the territory of Slovakia (Bartošová & Tirjaková 2008; present study). On the other hand, *E. muscicola* belongs to one of the most common terrestrial ciliate species (Foissner 1998). This is also corroborated by many reports of *E. muscicola* from the territory of Slovakia (Tirjaková & Matis 1987; Tirjaková 1992b, 2005; Andelová & Tirjaková 2000; Chrenková & Tirjaková 2000; Tirjaková & Vďačný 2004; Holecová *et al.* 2005; Bartošová & Tirjaková 2008). However, this species was found also in aquatic habitats of Slovakia (Matis 1961; Matis & Straková-Striešková 1991; Tirjaková 1992a, 1997a, b; Szentivány & Tirjaková 1994; Matis & Tirjaková 1995; Tirjaková & Stloukal 2004; Tirjaková & Vďačný 2005). Occurrence of *E. muscicola* in limnetic environments was confirmed also by, for instance, Rawlinson & Gates (1985). In spite of this, records of *E. muscicola* from freshwaters are rare and typically come from sediments. In Foissner's (1998) checklist of soil ciliates, there are mentioned three further euplotids living in terrestrial habitats: *E. corsica*, *E. labiatus*, and *E. terricola*. Since the two latter species were reported from the Holoarctis, their occurrence at the territory of Slovakia is likely.

Up to date, 11 euplotid species have been reported from Slovakia, but occurrence of two of them is questionable (Matis *et al.* 1996; present study). This is very likely only a top of the iceberg, since over 150 euplotids have been described worldwide. Although the majority of euplotids are marine, we believe that investigation of rainwater pools, swamps, tree holes and peat bogs might extend our knowledge on biodiversity of these common ciliates in Slovakia, a Central European country representing the transition zone for the West and East Carpathian as well as the Pannonian biota (Buchar 1983; Holecová & Franc 2001; Astaloš *et al.* 2003).

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