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SHORT NOTE

First records of the recently described ectoparasitic *Rickia lenoirii* Santam. (Ascomycota: Laboulbeniales) in the Carpathian-Basin

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ABSTRACT
Rickia lenoirii has been reported in seven localities in the Carpathian Basin, six in Hungary and one in Romania, on *Messor structor* (Hymenoptera: Formicidae) host specimens. This is the first occurrence of this fungus in two new (Pannonian and Continental) biogeographic regions. According to our findings, the northernmost (47°31'33.01"N) known occurrence of *R. lenoirii* is Ferenc-hegy (Ferenc Hill) in Budapest.

Fungi of the Laboulbeniales order are obligate ectoparasites of different arthropod taxa, mainly of Coleoptera (Santamaria, 2001; Henk et al., 2003). Six described Laboulbeniales species infect ants, but only four of these have been found in Europe (Santamaria & Espadaler, 2015): *Laboulbenia formicarum* Thaxt. is found in France, Portugal and Spain on two *Lasius* species; *Laboulbenia camponoti* S.W.T. Batra in Bulgaria and Spain on five *Camponotus* species; *Rickia wasmannii* Cavara in 15 countries on eight *Myrmica* species; and *Rickia lenoirii* Santam. in Greece on *Messor wasmanni* Krausse, 1910 and in France on *Messor structor* (Latreille, 1798). At the moment, only *R. wasmannii* and *L. camponoti* have been reported among these four Laboulbeniales species in the Carpathian Basin (Tartally et al., 2007; Csata et al., 2013; Báthori et al., 2014; Tartally & Báthori, 2015).

As *M. structor* is widely distributed in the Carpathian Basin (Schlick-Steiner et al., 2006), the potential presence of *R. lenoirii* on this host ant species in this region was plausible, especially as *R. lenoirii* is a recently described and extremely small species (Santamaria & Espadaler, 2015) that could easily escape notice. It should be noted that only *M. structor* and no other *Messor* harvester ant species are distributed in the Carpathian Basin (Schlick-Steiner et al., 2006). Thus, our aim was to investigate the presence of *R. lenoirii* within the Carpathian Basin by checking museum specimens of *M. structor* collected from several parts of this region.

In order to discover the presence of *R. lenoirii*, all the *M. structor* specimens collected in the Carpathian Basin and deposited in the Hymenoptera Collection of the Hungarian Natural History Museum were checked under an Olympus SZX9 stereomicroscope between 12.6-114x magnifications. In total, 499 *M. structor* specimens (428 workers, 28 males, and 43 queens) were examined, originating in 44 localities of the Carpathian Basin (35 sites in Hungary, 6 sites in Romania and 3 sites in Slovakia; see Supplementary File for details, available at http://periodicos.uefs.br/ojs/index.php/sociobiology/rt/suppFiles/901/0 and DOI: 10.13102/sociobiology.v62i4.901.s1077).

Pinned host specimens with *R. lenoirii* thalli we re soaked in 70% ethanol overnight. Thalli were removed with an insect pin and prepared onto slides in Heinz-PVA. Microscopy images were taken with an Olympus BD40 microscope equipped with a 100x lens and focus-stacked. Specimens were compared with the original description and diagnostic characters (Santamaria & Espadaler, 2015) and determined on the basis of thallus form, size and cell number, and shapes of antheridia and perithecium.

Rickia lenoirii specimens are deposited in the Fungi Collection of the Hungarian Natural History Museum on permanent slides (inventory numbers: 107653-107659).

Thirty specimens (6.0% of the investigated individuals) of *M structor* specimens were found to be parasitized by *R. lenoirii* (Fig 1) at six Hungarian sites (28 workers) and one Romanian one (2 workers) (see details in Appendix). Thus, *R. lenoirii* infection was recorded in 15.9% of the investigated sites in total. Fungi were recorded on the legs and antennae of the hosts. As noted in the original description of *R. lenoirii* (Santamaria & Espadaler, 2015), deterioration and reduction of antheridia to amorphous secondary appendage-like structures was observable. Brown trichogyne scars were visible on all photographed specimens. The tip of perithecia were in some cases less markedly truncated than in the original description (Fig 1). No other *Messor* species, as potential hosts, were recorded in the Carpathian Basin in the course of our research.

Our findings represent the first records of *R. lenoirii* since its recent description (Santamaria & Espadaler, 2015). This is the third ant-parasitic Laboulbeniales species recorded in the Carpathian Basin (see Section 1). The number of countries in which this fungus has been found thus has doubled, as at the time of its description it was known only from Greece and France (Santamaria & Espadaler, 2015). Now, *R. lenoirii* has been recorded in Hungary and Romania. Furthermore, Ferenc-hegy (Ferenc Hill), in Budapest, is now the northernmost (47°31'33.01"N) known occurrence of *R. lenoirii*.

The discovery of *R. lenoirii* on *M. structor* host specimens does not constitute the discovery of a new host ant species, but it should be noted that *M. structor* has cryptic species/lineages (Seifert, 2007; Schlick-Steiner et al., 2006). It would be interesting to know whether each lineage is susceptible to *R. lenoirii*. Similarly, it would be worth checking the presence of this fungus on the numerous other known (sub) species of *Messor* harvester ants (see details in Santamaria & Espadaler, 2015) and comparing different populations of the fungus. As noted in the original description, thalli from the two known host specimens seemed to be slightly different in size, and the specimens recorded in the course of our work showed some variation in perithecium shape.

Rickia lenoirii has been found in the Mediterranean biogeographic region (Santamaria & Espadaler, 2015), and it has now also been discovered in the Pannonian and the Continental regions (compare Supplementary File with EEA,

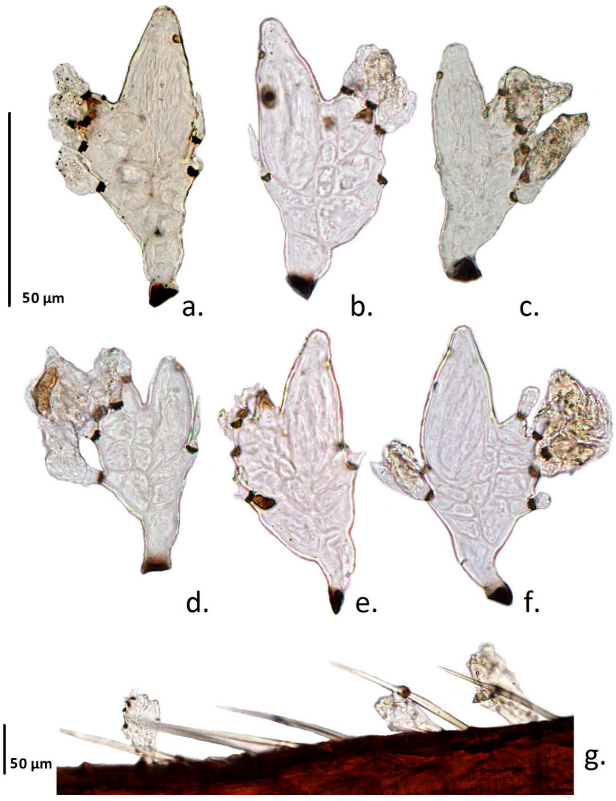

Fig 1. *Rickia lenoirii* thalli (a: Farkasrét, b: Ferenc-hegy, c: Balatonfüred, d: Badacsony, e: Révfülöp, f: Herkulesfürdő) and a part of an infected leg of a *Messor structor* host ant (g: Budapest), recorded in the Carpathian Basin (see localities and their names in the Supplementary File)

2012), where the host *Messor structor* lives in xerothermic grasslands with rich seed vegetation (Seifert, 2007). However, as discussed by Santamaria and Espadaler (2015), a relatively high level of humidity could promote *R. lenoirii* infection, as with other Laboulbeniales fungi. Our records seem to confirm this suggestion on a broad scale, as all the sites where this fungus has been found are close to big bodies of water (Lake Balaton or the Danube River; see Appendix). The Danube River could even be a corridor of *R. lenoirii*, connecting the Carpathian Basin with the Black Sea. New research focusing on this recently described parasitic fungus would probably uncover new occurrences across Europe.

Recent research has shown that ant parasitic *R. wasmannii* and *L. formicarum* have effects on their ant hosts (Csata et al., 2014; Báthori et al., 2015; Konrad et al., 2015; Pech & Heneberg, 2015). Similar experiments on *R. lenoirii* could contribute to a deeper understanding of the interactions of Laboulbeniales fungi with their hosts. However, the main aim of this inquiry is to call the attention of mycologists and myrmecologists to these small but interesting fungi and to the importance of museum collections (see Suarez and Tsutsui, 2004).

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