

LABOULBENIA FORMICARUM (ASCOMYCOTA, LABOULBENIALES), AN EXOTIC PARASITIC FUNGUS, ON AN EXOTIC ANT IN FRANCE

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EXOTIC
LABOULBENIALES
LABOULBENIA FORMICARUM
LASIUS NEGLECTUS

ABSTRACT. – The exotic ectoparasitic fungus *Laboulbenia formicarum* (Ascomycota, Laboulbeniales) is reported from three localities in France, two of which are coastal (one Mediterranean, another Atlantic) infesting an exotic, invasive ant, *Lasius neglectus*. From 42 studied populations in Europe, four were infested and 38 were uninfested. It is a rare event for two organisms originating from different biogeographic regions – a fungus from North America and an ant from Asia Minor – to meet.

INTRODUCTION

The recent focus on the loss of biodiversity hints specially at the characteristics of both invasive organisms and invaded communities (Mack *et al.* 2000, Davis 2009). One of the most striking drivers of that loss is the presence of exotic species that, once they have arrived and become established, may become invasive (Williamson 1996, Kolar & Lodge 2001). Their effect on the biota is remarkable, mostly in a negative way (Davis 2009). A very recent work reports on exotic fungi in France (Desprez-Loustau *et al.* 2010). This inventory did not include any species in Laboulbeniales. Laboulbeniales are an order of ascomycetous fungi consisting of over 2000 species that have obligate ectoparasitic association with arthropods, mostly insects, especially Coleoptera and Diptera, and on a few ant species, mites and millipedes (Tavares 1985). As a group it is well known in France because of the extensive work by Balazuc (1973, 1974). Although they live as parasites their effect on the host seems to be negligible or nil (Santamaria 2001).

Here we provide three distant locations in France for an exotic species of Laboulbeniales, *Laboulbenia formicarum* Thaxter (Fig. 1), apparently originating from North America. In this last region the fungus has been known since its description by Thaxter (1908). Presently known data show that the fungus is noted on five genera in North America (*Formica*, *Lasius* (+ *Acanthomyops*), *Myrmecocystus*, *Polyergus* and *Prenolepis*) and 17 species of ants, all belonging to the subfamily Formicinae, tribes Formicini and Lasiini (Bequaert 1920, Cole 1935, 1949, Benjamin & Shanor 1950, Judd & Benjamin 1958, Nuhn & Van Dyke 1979, Smith 1917, 1928, 1946, 1961, Wheeler 1910). Its distribution is widespread in North America (Fig. 2). After Nuhn & Van Dyke (1979) the species remained elusive until it was detected at São Vicente (Madeira, Portugal) growing on *Lasius grandis*



Fig. 1. – Thalli of *Laboulbenia formicarum* on a *Lasius* leg. Inset: mature specimen (Image: S Santamaria, with permission).

Forel, a native species (Wetterer *et al.* 2006) nesting in a parking lot a few yards from the sea (Espadaler & Santamaria 2003). In continental Europe, the fungus is known exclusively on *Lasius neglectus* VanLoon, Boomsma & Andrásfalvy. This is an invasive ant species (Seifert 2000) forming huge supercolonies that may occupy sev-

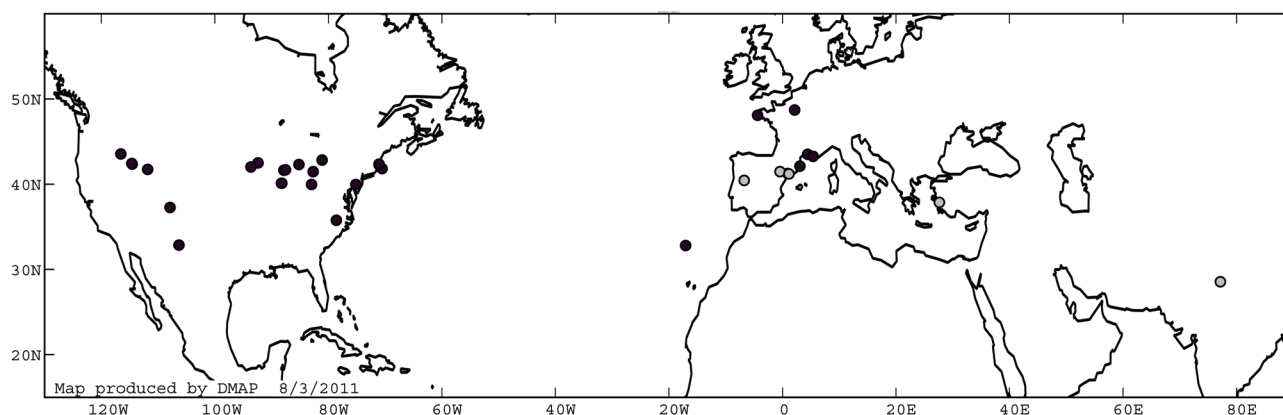


Fig. 2. – Distribution of *Laboulbenia camponoti* Batra (India, Spain, Turkey; grey dots) and *L. formicarum* Thaxter (France, USA, Portugal (Madeira), Spain; black dots). Host species for *L. camponoti*. India: *Camponotus* (unspecified). Spain: *C. aethiops* (Latreille), *C. pilicornis* (Roger), *C. sylvaticus* (Olivier). Turkey: *C. baldaccii* Emery. Host species for *L. formicarum*. France: *Lasius neglectus*. USA: *Formica aserva* Forel, *F. curiosa* Creighton, *F. montana* Wheeler, *F. neogagates* Viereck, *F. nitidiventris* Emery, *F. pallidefulva* Latreille, *F. schaufussi* Mayr, *F. subpolita* Mayr, *F. subsericea* Say, *F. vinculans* Wheeler, *Lasius murphyi* Forel, *L. neoniger* Emery, *L. pallitarsis* (Provancher), *Myrmecocystus mimicus* Wheeler, *Polyergus breviceps* Emery, *P. lucidus* Mayr, *Prenolepis imparis* (Say). Portugal: *Lasius grandis*, Spain: *L. neglectus*. Note: nomenclature follows the most recent version of Bolton's Catalogue and Synopsis, in <http://gap.entclub.org/> version: 1 July 2010, last accessed 4 January 2011.

eral hectares (Espadaler *et al.* 2007, Cremer *et al.* 2008). The host is known from > 130 localities and 19 countries in Eurasia (Espadaler & Bernal 2010). The native range of this ant, which is exotic in Europe, is Asia Minor (Seifert 2000). Its global distribution ranges from 32°N to 48°N. In continental Europe, a single report of *Laboulbenia formicarum* on *Lasius neglectus* is known from L'Escala, Spain (42°07'02"N; 3°08'14"E). In this location, ants occupy most of the tamarisks (*Tamarix gallica* L.) located along the promenade that borders the sea. Ants are seen descending tree trunks, and disappearing through the cracks in the soil at their bases. Infestation was first recorded in September 2006. Out of 739 ant workers, 599 (81 %) were infested. The infestation still existed in September 2009 and July 2010 (M. Stock leg.). Ten other species of ants found in the same locality (762 specimens studied) were free of the fungus (Herraiz & Espadaler 2007).

Here we report on a partial survey of European *Lasius neglectus* populations for the presence of *Laboulbenia formicarum*. Since the survey was not systematic, the present note is meant 1) as a plea for the attention of European myrmecologists to be drawn towards a peculiar group of unusual but not so uncommon fungi: Laboulbeniales, and 2) as a first step in mapping the distribution of an exotic entomopathogenic fungus. For myrmecologists, and to complete the information on ant parasitic Laboulbeniales in Europe, we note that two other species are currently known in Europe: *Laboulbenia camponoti* Batra (Fig. 2) detected on various species of *Camponotus* (tribe Camponotini) (Espadaler & Lodos 1983, Espadaler & Blasco 1991) and *Rickia wasmannii* Cavara, much more common and widespread geographically, on different species of *Myrmica* (Tartally *et al.* 2007).

MATERIAL AND METHODS

Fungi were detected during routine entomological studies with ants. We have directly searched for the fungus on samples from 42 of the 133 confirmed populations of *Lasius neglectus* belonging to seven of the 19 countries where it is known (Espadaler & Bernal 2010; a list is available on request from the first author) although the positive results presented here are not intended as a systematic assessment of the current distribution of the exotic species. Thalli are easily seen under a binocular microscope, as at first sight they look like whitish dirt, but with a distinct pattern of size and form (Fig. 1). A microscope slide preparation of a few thalli scratched from dry ant specimens is an easy way to confirm structure on that "dirt". Thalli may be present all over the body or only on specific parts such as the head or legs.

RESULTS

Among the 42 studied *Lasius neglectus* populations (L'Escala, Spain included) only three, all located in France, were infested by *Laboulbenia formicarum*. Details follow.

1) Saintes-Maries-de-la-Mer, France (43°27'48"N; 4°26'00"E). Rice fields, swamps and a stud farm, 6.vi.2009, C Lebas leg. Fifteen ants out of 52 (28.8 %) were infested. The ants were collected in the middle of a sandy road in the Camargue. The landscape comprises three types of environment: a floodplain wetland permitting the development of paddy fields or dense grass five to six feet tall when the field is not cultivated; abandoned wetland covered with seaweed and lined with tamarisk trees; a meadow area with bulls and horses breeding. The

nest entrance was in the ground. Other ant species on the slopes near the tall grasses were *Aphaenogaster senilis* (Mayr), *Formica cunicularia* Latreille and *Lasius myops* Forel. In floodplain *Gonomma hispanicum* (André), *Messor capitatus* (Latreille), *Tapinoma madeirense* Forel and *Tetramorium* sp. None of these species were parasitized by the fungus. Vouchers of parasitized ants are deposited in the Entomology Laboratory of the Muséum National d'Histoire Naturelle (Paris).

2) Douarnenez, France (48°05'55"N; 4°21'32"W). In a garden, 27.x.2007, J Wagenknecht leg. A further sampling (2010, S Tragust leg.) allowed a quantitative assessment of infection. Here the situation was somewhat different. Out of 50 ants, 22 (44 %) had the dark spots indicative of spore attachment, immediately evident because of their size and because they were sometimes also elevated from the cuticle. Only 11 out of the whole 50 had 1-3 thalli (only one more than 10 thalli) and only 3 out of 50 had both thalli and dark spots. The remaining 14 had no evident infection.

3) Gif-sur-Yvette, France (48°42'18.01''N; 2°07'55.60''E). Near trees in an avenue, June 2010, S Tragust leg. Workers and queens bear more than 1-3 thalli on their bodies. Out of 50 ants 44 were infested (88 %).

DISCUSSION

A first question is about the exotic status of *Laboulbenia formicarum* in Europe: could it be that its presence had been overlooked until recently? If we consider that: 1) its description dates from 1908 and is known in more than twenty locations in North America on five genera and more than twenty species of ants; 2) Europe is the myrmecologically best known region in the world and 3) European myrmecologists have been aware of the possibility of finding similar fungi on insects, because another species in Laboulbeniales on ants (*Rickia wasmannii* Cavara) has been known there since 1899 (Cavara 1899), then we think it is highly likely that the fungus would have been detected much earlier if it had been present. We therefore assume that our observations correspond to new locations of an introduced species. Only three new locations were found out of the more than 40 populations studied and considering the presently known locations (Madeira, Spain, France) this might suggest an Eastern expansion.

A second question is in order. Why is *L. formicarum* on this side of the Atlantic only found on *Lasius*, while in the American continent it is noted on at least five genera all within the subfamily Formicinae? The genera *Formica* and *Lasius*, the most frequent hosts in America, are the richest in species in continental Europe (Czechowski *et al.* 2002, Seifert 2007). If the arrival of *L. formicarum* is recent, as proposed above, it might not have had time to move to other host species. Experimental cross-inoculations would be worth attempting. This directly suggests

another possibility, that *L. formicarum* in America is a complex of cryptic species, each one parasitizing a different genus. Of course, this is only a hypothesis and this should be tested with molecular techniques, as described in Weir & Blackwell (2001).

Finally, how did the junction of two exotic species occur, with each one coming from different biogeographic areas? This "new interaction" (Parker & Gilbert 2004) of two introduced species coming from different continents is a rare event (Torchin *et al.* 2003, Desprez-Loustau *et al.* 2007, their Table II). The possibility of the interaction is straightforward as *L. formicarum* is known on at least five other species of *Lasius* (*L. alienus*, *L. neoniger*, *L. pallitarsis*, *L. murphy* in North America; *L. grandis* in Madeira), although the route of dispersal of both organisms is unknown. Given the coastal location of three of the known localities, and under the hypothesis of a more favourable climate for fungal infections it will be interesting to check whether the fungus parasitizes *Lasius neglectus* in the many populations known from other coastal regions in Europe (Espadaler & Bernal 2010), that is, populations found on the Bulgarian coast of the Caspian Sea, the Netherlands North Sea, the Greek Aegean Sea, and in Corsica. Of course, as the infested population of Gif-sur-Yvette shows, more directed surveys are also needed to check for the fungus on the inland populations of the ant and whether it is able to infect ants other than *Lasius neglectus*, either native or exotic, in the four European areas known to date. It can be noted that the probable origin of *L. formicarum* in North America is also the case for the majority (40 %) of species of exotic fungi in France (Desprez-Loustau *et al.* 2010). Although *L. formicarum* can be described as an exotic (synonym = alien) species in Europe, its consideration as an invasive species is questionable since its host species is invasive in Europe and biological invasions usually refers to detrimental effects on native biodiversity (http://www.issg.org/is_what_are_they.htm; accessed on 10 January, 2011).

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