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First confirmed records of *Microdon mutabilis* and *Microdon myrmicae* (Diptera: Syrphidae) for Belgium

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Abstract

Recently, the Syrphidae species *Microdon mutabilis* (LINNAEUS, 1758) has been recognized to cover a cryptic species duo, *M. mutabilis* and *M. myrmicae* SCHÖNROGGE *et al.*, 2002. Both species can only be differentiated based on larval and pupal characters and the difference in host ant species. In the framework of an update of the Belgian Syrphidae checklist, we visited the collection of the Royal Belgian Institute of Natural Sciences and discovered an adult of *M. mutabilis* s.l. that was reared from a larva collected in March 1938 at Hockai, eastern Belgium. We were able to match the collection number of the *Microdon* with that of *Formica lemani* BONDROIT, 1917 workers collected on the same locality and date by the same entomologist, and we therefore assume that the collected *Microdon* was a *M. mutabilis*. During 2009 we also could show the presence of *M. myrmicae* in Belgium at Maasmechelen, where puparia of this species were found in nests of the host ant *Myrmica scabrinodis*. For two other *M. mutabilis* s.l. populations we could not find the puparia, but we could show the presence of multiple nests of *M. scabrinodis*, suggesting these population also are *M. myrmicae*. Both species of *Microdon* can now be added to the Belgian checklist, but *M. mutabilis* may have gone extinct in Belgium.

Keywords : *Microdon*, myrmecophilous, critically threatened, *Formica lemani*, *Myrmica scabrinodis*, host-parasite co-evolution.

Introduction

Microdon MEIGEN is a peculiar genus of Syrphidae that have some superficial resemblances with soldierflies (Stratiomyidae). Some authors consider them to be a sister family of Syrphidae (SPEIGHT, 2008), but they are generally classified as a subfamily (Microdontinae) (STÅHLS *et al.*, 2003). More than 350 species of *Microdon* are known from all zoogeographic regions (DUFFIELD, 1981). In temperate zones, larval *Microdon* are found almost exclusively in the nests of ants although they live with other social insects (wasps, termites) in the tropics (AKRE *et al.*, 1973). As such, they are a widely used model system to study host-parasite interactions and co-evolution. In Europe, three species of *Microdon* were recognized until recently, but recent research has revealed that at least six species of *Microdon* can be found, several of which are cryptic ones that cannot be morphologically recognized as adult flies (e.g. DOCZKAL & SCHMID, 1999).

Microdon mutabilis is a relatively rare *Microdon* species in Europe and it is considered threatened in many of the countries where it occurs (SSYMANK & DOCZKAL, 1998, REEMER *et al.*, 2009). It was known for some time that *M. mutabilis* exhibits very strong host specificity, however, it was ELMES (1999) who first noted that its host ant species differed regionally. This observation has stimulated research by SCHÖNROGGE *et al.* (2002) that lead to the finding that specimens of *M. mutabilis* in fact belong to (at least) two cryptic species, which they named *M. mutabilis* and *M. myrmicae*. The former species is strictly associated with ant nests of *Formica lemani*, the latter is found together with *Myrmica scabrinodis*. Apparently, the use of different host ants followed by strong host-parasite co-evolution is a strong mechanism for speciation in this genus, as confirmed by the recent finding of cryptic species in other European *Microdon* (DOCZKAL & SCHMID, 1999).

Microdon mutabilis and *M. myrmicae* are cryptic species meaning that they cannot (so far) be distinguished based on external characteristics of the adult flies. SCHÖNROGGE *et al.* (2002) however discovered some discriminating features present in the puparia, that allow to distinguish *M. mutabilis* from *M. myrmicae* on the British Isles. The most obvious difference is in the anterior respiratory organs that are slightly curved and about 1.5 times longer than its diameter in *M. myrmicae*, but that are as long as wide in *M. mutabilis*. It was not well known whether these characteristics would also work for populations of *M. mutabilis* s.l. outside the U.K., but more recent research seems to confirm this (e.g. SPEIGHT, 2003, GAMMELMO & AARVIK, 2007). It remains, however, possible that other cryptic species are present in the *M. mutabilis* group, or that host preference differs regionally, as the species descriptions by SCHÖNROGGE (2002) are based on British material only. Since no puparia nor the host ant species of *M. mutabilis* s.l. were known in Belgium, we could no longer assess species identity.

Material and Methods

On 19 February 2009 we visited the Syrphidae collection at the Royal Belgian Institute of Natural Sciences in Brussels. This visit was part of ongoing efforts to update the Belgian Syrphidae fauna list, and was aimed specifically at elucidating the current Belgian status of recent taxonomic splits. While checking the material of *M. mutabilis* s.l., our attention was drawn by an individual that had apparently been pinned just after eclosion, or was peeled out of the puparium, since it had its wings not yet pumped and stretched. We controlled the identity of this individual (using VAN VEEN, 2004; SPEIGHT, 2008) and could confirm it to be a *Microdon mutabilis* s.l. According to the label, this individual was found as a larva on 15.III.1938 at Regreny Champs (approx. 600m asl), Hockai, Stavelot in the Hautes Fagnes region by A. Collaert and reared to the adult fly that eclosed on 09.IV.1938. Even more intriguing was the extra label which said that the larva was found in an ants nest under a stone ("*recoltée sous une pierre recouvrant une fourmillière*"). The locality, which is within the Belgian range of the host ant *F. lemani* points to the possibility that this specimen is in fact a *M. mutabilis* sensu SCHÖNROGGE *et al.* (2002). Lacking the puparium we however could not confirm the specific identity of this individual. Some weeks later when checking the distribution of *F. lemani* in Belgium, by coincidence we found *F. lemani* specimens collected from the same region near Hockai. After carefully studying the data we discovered that *F. lemani* workers were collected by A. Collaert on the same date and at the same locality as the *M. mutabilis* s.l. larva. In addition,

the collection number of these *F. lemani* and the *M. mutabilis* matched (11.519) indicating they belonged together. We can therefore safely say that the *M. mutabilis* larva was collected from a nest of *F. lemani*. As it is from current knowledge highly unlikely that *M. myrmicae* would occur with *F. lemani*, this also resolves the specific identity of this individual as *M. mutabilis* sensu SCHÖNROGGE.

On 20 May 2009 the first author visited the Nature Reserve Ven onder de Berg at Maasmechelen, one of the few Belgian localities where recent observations of *M. mutabilis* s.l. are known (Belgian Syrphidae database). The Ven onder de Berg is a large raised *Sphagnum* bog overgrown with sedges *Carex sp*. and *Vaccinium oxycoccos L.*. Soon three males of *M. mutabilis* s.l. were found that were slowly flying around and frequently perching on some moss hammocks in the bog. These hammocks are bowls of *Sphagnum* sp. and *Polytrichum* sp. that grow around tussocks of *Carex* sp.. Opening these hammocks revealed the presence of *M. scabrinodis* nests, the host ant of *M. myrmicae*. When further searching these nests, two pupuaria of which one had already eclosed were found that clearly belonged to a *Microdon*. The bald appearance with a fine network of reticulation on the puparia indicated that they indeed were from a *M. mutabilis* s.l. species (Fig. 1). More detailed inspection of the anterior respiratory horns showed that they were slightly curved and about 1.5 times longer than their diameter (Fig. 2). This is different from *M. mutabilis* s.s. where the anterior respiratory organs are as long as wide (DOCZKAL & SCHMID, 1999) or even shorter (SCHÖNROGGE *et al*., 2002a). In addition, the anterior respiratory organs have small papillae on the tips (Fig. 2), while the entire anterior respiratory organs of *M. mutabilis* are covered with papillae (STANKIEWICZ, 2003). We therefore with certainty could identify this *Microdon* population as *M. myrmicae*.

Fig. 1: Puparium of *Microdon myrmicae* SCHÖNROGGE *et al*. 2002. (Ven onder de Berg, Maasmechelen, prov. Limburg, Belgium. 20.v.2009).

Fig. 2: Detail of the puparium of *Microdon myrmicae* SCHÖNROGGE *et al*. 2002 showing the anterior respiratory horns (shown is the same puparium as in Fig. 1).

Discussion and conclusions

Since the publication by SCHÖNROGGE *et al*. (2002), people all over Europe have started to search for larvae and puparia in *M. mutabilis* s.l. populations to establish their specific identity. So far, *M. mutabilis* sensu SCHÖNROGGE *et al*. (2002) has been found in the U.K. only, while all other European populations were found to be *M. myrmicae* (SPEIGHT, 2003; STANKIEWICZ, 2003; BEUKER, 2004; GAMMELMO & AARVIK, 2007; SPEIGHT, 2008), which suggests that the majority of the *M. mutabilis* s.l. populations in Europe in

fact represent *M. myrmicae*. If we assume that host specificity of *M. mutabilis and M. myrmicae* is fixed within Europe, this difference may be largely explained by the difference in the distribution of the hosts ants: *F. lemani* of *M. mutabilis* is restricted to Scandinavia and some mountainous regions, whereas the host ant of *M. myrmicae* (*M. scabrinodis*) is much more widely distributed in all types of marshland areas (DEKONINCK *et al.*, 2003). In Belgium, the distribution of *F. lemani* is restricted to the highest zone of the Hautes Fagnes area, and it is likely that all *M. mutabilis* s.l. populations outside this area in fact are *M. myrmicae*. We indeed could identify the *M. mutabilis* s.l. population at Maasmechelen to be *M. myrmicae* using the pupal characteristics. At the known *M. mutabilis* s.l. population at Sankt Vith (Walleroderwald, Van de Meutter F.) and the newly discovered population at Olloy-sur-Viroin (VANTIEGHEM P. & DE GROOTE D., pers. obs.) the observers found several nests of *Myrmica* sp. (probably *scabrinodis*) indicative of *M. myrmicae*, but quick searches revealed no *Microdon* puparia. In the Netherlands, all currently known populations have been revisited and identified as *M. myrmicae* (BEUKER, 2004), which was expected due to the absence of *F. lemani* in this country (VAN LOON, 2004).

The finding of an old museum specimen of *M. mutabilis* s.s. collected in Belgium near Hockai is very interesting because it shows for the first time the presence of *M. mutabilis* s.s. in mainland Europe. During the 70 years following this record, the landscape at Hockai has changed dramatically, as has most of the Hautes Fagnes area. Huge areas have been planted with *Picea* forest, and many of the original habitats have disappeared. Such dramatic changes in the landscape may have posed insuperable challenges to the existing *M. mutabilis* populations, not the least given their restricted mobility (see further), and it remains an open question whether *M. mutabilis* s.s. still occurs in Belgium. The host ant of *M. mutabilis*, *F. lemani*, has a very restricted distribution in Belgium: it is confined to the most elevated parts of the Hautes Fagnes area in the east of Belgium (DEKONINCK *et al.*, 2006). Here, *F. lemani* locally reaches high nest densities that may be able to support *M. mutabilis* populations (DEKONINCK, W. pers. obs.). Mainly, this ant species nests in the *Sphagnum-Erica tetralix* vegetation and in the surrounding open woodland, often under stones. Of the nine populations of *M. mutabilis* s.l. that have been reported since 1980 in Belgium (Belgian Syrphidae database), only three are within the Hautes Fagnes region where *M. mutabilis* could possibly occur, but at least one of them (the population at Sankt Vith, see higher) likely is *M. myrmicae*. Repeated specific searches during 2009 aimed at finding *M. mutabilis* s.l. in this area were all unsuccessful. Unless any proof of recent populations is found, we must regard *M. mutabilis* now extinct in Belgium.

An important aspect of the ecology of *M. mutabilis* is its strong host specificity. Remarkably, survival of *M. mutabilis* s.s. eggs was strongly reduced in *F. lemani* nests with increasing distance from their original nest, which suggests subspecific adaptation to a specific ant genome (ELMES *et al.* 1999). This may explain the unusually low average dispersal distance observed for female *M. mutabilis* s.s. (two meters!). Observations of female *M. mutabilis* therefore with high certainty point to local reproduction. Also, one can often observe several male *Microdon* waiting along an ants nest for females to emerge. When females appear, they are immediately grabbed by the males for mating, sometimes even before they have had the time to harden their cuticle (VANTIEGHEM P. & VAN DE MEUTTER, F. pers. obs.). This reproductive tactic of the males indeed may be most efficient when females are almost sessile. Somewhat conflicting with these observations is the fact that three of the recent populations of *M. mutabilis* s.l. (likely all *M. myrmicae*) are located in old quarries (Han-sur-Lesse, Olloy-sur-Viroin, Sankt Vith). These anthropogenic habitats are often located some distance from natural *M. mutabilis* s.l. habitats and may provide a refuge when the original habitat deteriorates (e.g. eutrophication and forestation of the lower river valley). This indicates that *M. mutabilis* s.l. is able to move at least some hundreds of meters within a couple of decades. Still, this low dispersal capacity of *M. mutabilis* s.l. females makes them vulnerable in our rapidly changing landscapes, and protective measures for the few remaining populations are advisable if we want to retain these species for the future in Belgium.

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