Maculinea nausithous Exploits *Myrmica scabrinodis* in Transylvania: Unusual Host Ant Species of a Myrmecophilous Butterfly in an Isolated Region (Lepidoptera: Lycaenidae; Hymenoptera: Formicidae)

by

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ABSTRACT

Isolated populations of the myrmecophilous Dusky Large Blue butterfly (*Maculinea nausithous*) occur in Transylvania (Romania). The hitherto unknown host ant specificity of these populations was investigated at two sites, where *Myrmica scabrinodis* was the only potential host ant found. A total of 107 *M. scabrinodis* nests were opened in early summer to check for the presence of *M. nausithous* larvae, and two of them contained overwintered larvae. Our observations suggest that, like the habitat, the host ant of these isolated populations essentially differs from other central European *M. nausithous* populations studied, which use exclusively *Myrmica rubra*.

Keywords: host specificity, local host, *Maculinea nausithous*, myrmecophily, *Myrmica scabrinodis*, Transylvania

INTRODUCTION

Larvae of *Maculinea*[5] *nausithous* (Bergsträsser) are obligate social parasites of *Myrmica* Latreille ant nests, after developing on *Sanguisorba officinalis* L. host plant (e.g. Thomas *et al.* 1989). The identification of the local host ant species is not only crucial for the conservation of this vulnerable butterfly (Munguira & Martín 1999, Settele *et al.* 2005, IUCN 2006), but also because

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[5]Editor's note: There appears to be a difference in the usage of this name. See Pech *et al.* 2008 in which the generic name *Phenagris* is used.

it can help shed light on the evolution of this type of parasitic interaction (Elmes *et al.* 1998, Als *et al.* 2004). *M. nausithous* almost exclusively exploits *Myrmica rubra* (Linnaeus) nests in Europe (Thomas *et al.* 1989, Elmes *et al.* 1998, Korb 1998, Stankiewicz & Sielezniew 2002, Als *et al.* 2004, Tartally & Varga 2005; Fig. 1). However, *Maculinea* host ant specificity may vary between regions (e.g. Elmes *et al.* 1998), and *M. nausithous* has some rather isolated populations in Transylvania (Romania) (Rákosy & Lászlóffy 1997; Fig. 1) that differ somewhat in habitat from other *M. nausithous* sites. The aim of this study was therefore to investigate host ant use in these isolated populations.

MATERIALS AND METHODS

Only two *M. nausithous* sites are known from Transylvania (Fig. 1). Both of them are in the Câmpia Transilvaniei region, near Cluj-Napoca: one at Răscruci (N46°54', E 23°47' 485 m a.s.l.; exact localities are not given to avoid exploitation), another at Fânațele Clujului (N46°51', E23°37'; 540 m; more details of this site are given by Rákosy & Lászlóffy 1997). Both sites are

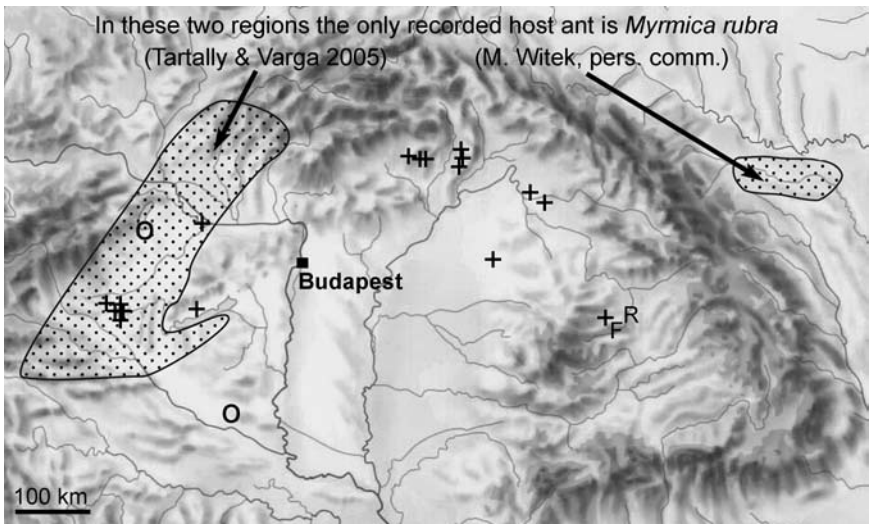

Fig. 1. The distribution and host ant use of *Maculinea nausithous* in and around the Carpathian-Basin. F: Fânațele Clujului, R: Răscruci (the sites investigated in this study), +: myrmecologically investigated (by A.T.) *Sanguisorba officinalis–Maculinea teleius* sites where *M. scabrinodis* was recorded, o: such sites where *M. scabrinodis* was not recorded (data from Bálint 1996, Wynhoff 1998, recent and unpublished data; see also Tartally & Varga 2005: Fig. 3).

semi-dry meadows with steppe character, with sporadic small boggy depressions (Fig. 2). *S. officinalis*, the host plant, occurs in a mosaic in these small depressions, creating potential metapopulation networks of *M. nausithous* subpopulations (e.g. Hanski 1999). Both known sites were investigated in this study, but it should be noted that the Câmpia Transilvaniei region is rather poorly studied, so that occurrence of other, as yet undiscovered, *M. nausithous* sites in the area is likely.

To obtain data on host specificity, *Myrmica* nests within 2 m of *S. officinalis* host plants were carefully opened (usually without full excavation, to minimize disturbance) on both sites, and the presence or absence of *M. nausithous* larvae was recorded. Nests within 2m of host plants were chosen as this is the approximate foraging zone of *Myrmica* workers, and nests further from the host plants are unlikely to adopt *Maculinea* larvae (Elmes *et al.* 1998). The investigations were from late May to early July 2002 and 2007, so that all the recorded larvae had spent the winter in their host nests, surviving one of the most critical periods for the butterfly (Elmes *et al.* 2004). Investigations were

Fig. 2: The site at Răscruci where *Maculinea nausithous* larvae were found in *Myrmica scabrinodis* nests (photo by L. Rákosy; compare with Tartally & Varga 2005: Fig. 2, where *M. nausithous* was found with *Myrmica rubra*).

completed before the pupation period in mid July, since *M. teleius* (Bergsträsser) and *M. alcon* (Denis & Schiffermüller) also develop in the boggy depressions (and *M. arion* (Linnaeus) in the adjacent drier patches at Fânațele Clujului), and pupae of *M. teleius* and *M. nausithous* are rather similar (Śliwińska *et al.* 2006) which could result in the confusion of these two syntopic species. However, the identification of *Maculinea* larvae is straightforward (Śliwińska *et al.* 2006). The number and species of *Maculinea* larvae found was noted after determination using a 20x hand lens in the field. Five to ten workers were collected from each *Myrmica* nest opened, and were preserved in 67 % ethanol for identification in the laboratory (using keys in Seifert 1988).

RESULTS

A total of 107 *Myrmica* nests were found within 2 m from the *S. officinalis* host plants at the two sites (58 at Fânațele Clujului and 49 at Răscruci), and checked for *Maculinea* larvae. All 107 nests proved to be *M. scabrinodis* Nylander. Two nests from Răscruci were infested by *M. nausithous*, both of them containing only a single *M. nausithous* larva. Larvae of *M. alcon* and *M. teleius* were also found in *M. scabrinodis* nests during our survey (A. Tartally, unpublished data), which is not surprising since *M. scabrinodis* is a common host ant of both butterflies (for a review: Elmes *et al.* 1998, Als *et al.* 2004). One of the two nests infested by *M. nausithous* also contained a *M. teleius* larva.

DISCUSSION

To our knowledge, this is the first study to provide data on the host ant use of *M. nausithous* in Transylvania. The use of *M. scabrinodis* as a host ant by *M. nausithous* is, on the one hand, not surprising, since this was the only *Myrmica* ant species found in the vicinity of the initial larval host plant, while on the other hand being highly unusual, as this butterfly is found almost exclusively in nests of *Myrmica rubra* in other parts of its range (Thomas *et al.* 1989, Elmes *et al.* 1998, Korb 1998, Stankiewicz & Sielezniew 2002, Tartally & Varga 2005 and M. Witek, pers. comm.). Although *Myrmica rubra* occurs in Transylvania, where it is connected with damp forested habitats in the eastern part of the Carpathian-Basin, this ant is not known from the sites investigated here, despite extensive surveys by local myrmecologists (B.

Markó, pers. comm.). Other *Myrmica* species (*M. hellenica* Finzi, *M. sabuleti* Meinert, *M. schencki* Viereck, and *M. specioides* Bondroit) have been recorded from the drier patches (Markó 1998, Markó & Csősz 2001; B. Markó, pers. comm.; A. Tartally, pers. observ.), but only *M. scabrinodis* is known from the boggy depressions where *M. nausithous* can lay eggs on *S. officinalis*. Thomas *et al.* (2005) provide some warnings and guidelines about recording host ant use in *Maculinea* butterflies, and although the sample of infested nests that we found was small, we believe that the comprehensive survey that we made of the *Myrmica* fauna on the investigated sites means that these records represent genuine specialization.

The rate of parasitism of *M. scabrinodis* nests that we found was low (1.9% of nests investigated overall, 4.1% of nests at Răscruci), which is an order of magnitude lower than parasitism rates previously recorded for *M. nausithous* (Stankiewicz & Sielezniew 2002, Tartally & Varga 2005, A. Tartally, unpublished data; Mean parasitism rate of other studies = 44.9%; GLM with Binomial Errors: $c^2 = 56.79$, d.f. = 3, $p < 0.0001$). If the *M. nausithous* populations one these sites persist as a local metapopulation, then high variance in parasitism rates between sub-populations might be expected, so the significance of the low parasitism rate awaits further investigation.

Our records are not the first of *M. nausithous* exploiting *M. scabrinodis*, since Munguira & Martín (1999) report this ant as a *M. nausithous* host from Spain. However, apart from this one record, this widespread *Myrmica* species has not been recorded as a host of *M. nausithous* on the other European sites studied (although *M. scabrinodis* is often common on those sites), where *M. rubra* is used exclusively (Thomas *et al.* 1989, Elmes *et al.* 1998, Korb 1998, Stankiewicz & Sielezniew 2002, Tartally & Varga 2005; see Fig. 1). Interestingly *M. nausithous* occurs only in western parts of Hungary where *M. rubra* is common on *S. officinalis* sites, but this butterfly does not occur in central and eastern parts of Hungary where *M. rubra* is rare or missing from such sites. However, *M. scabrinodis* is common in most of the Hungarian *S. officinalis* sites investigated (Fig. 1). Hence, it is an open question as to why the eastern Hungarian *S. officinalis* sites are not colonised from Transylvania by *M. scabrinodis* using *M. nausithous*. One reason could be that the high mountains of Muntii Apuseni are barriers for the isolated Transylvanian *M. nausithous* populations that inhibit spread to eastern Hungary. Another possible explana-

tion is that *M. teleius* and *M. alcon* populations are in competition with *M. nausithous* in eastern Hungary through their common use of *M. scabrinodis* as their primary host ant (Tartally & Csősz 2004, Tartally & Varga 2005; A. Tartally, unpublished data). Interestingly *M. nausithous* does not occur at Şardu (in a hilly region at the western border of the Transylvanian-Basin; N46°52', E23°24'; 480 m; the easternmost "+" on Fig. 1) where a potential *M. nausithous* site is known near to the Câmpia Transilvaniei region, with high densities of *S. officinalis* and *M. scabrinodis* (A. Tartally, unpublished data). This site is, however, used by *M. teleius* and *M. alcon* (both butterflies exploit *M. scabrinodis* and *M. vandeli* Bondroit for host ant; A. Tartally, unpublished data), and appears more similar to the central and western European *M. nausithous* sites (with bushy forest edges; see: Tartally & Varga 2005: Fig. 2) than the sites investigated in the Câmpia Transilvaniei region (which are meadows with some isolated bushes; Fig. 2). All these facts suggest that the Transylvanian *M. nausithous* populations represent a specific life form that needs further investigation and protection. The acuteness of this task is underlined by the low density of these populations. Moreover, phylogeographic studies of these populations would be of major interest, since Als *et al.* (2004) found considerable genetic diversity within European *M. nausithous* samples, suggesting potentially cryptic species.

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