

## ***Myrmica schencki* (Hymenoptera: Formicidae) rears *Maculinea rebeli* (Lepidoptera: Lycaenidae) in Lithuania: new evidence for geographical variation of host-ant specificity of an endangered butterfly**

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### **Abstract**

The first studies of the host-ant relationships of *Maculinea rebeli* in Lithuania were carried out. The sites are the northernmost localities of the whole known species range in Europe. Larvae, pupae and an exuvium of the butterfly were found exclusively inside *Myrmica schencki* nests. *Myrmica sabuleti*, *M. lonae*, and *M. rugulosa* were not exploited. Our results are similar to data from France and Spain but differ clearly from observations of the nearest Polish population, which strongly suggests geographical variation in host-ant specificity of *M. rebeli* in the eastern range of species distribution. The knowledge obtained is also vital for *M. rebeli* conservation in Lithuania.

**Key words:** *Maculinea rebeli*, *Myrmica schencki*, endangered species, host-ant specificity, conservation, Lithuania

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### **Introduction**

*Myrmica* LATREILLE, 1804 ants are essential in biology of *Maculinea* VAN ECKE, 1915 butterflies. Caterpillars spend their fourth (final) instar in ant colonies where they prey on host brood or beg for food like ant larvae. The latter life style occurs in *M. rebeli* (HIRSCHKE, 1904) and its sibling species *M. alcon* (DENIS & SCHIFFERMÜLLER, 1775) (e.g., THOMAS 1995). Recently, genetic and morphological studies have called into question the distinction of *M. rebeli* and *M. alcon*, but due to their different ecological requirements they should be treated as separate conservation units (see ALS & al. 2004, PECH & al. 2004, BERCZKI & al. 2005). Therefore, in this paper we follow the division existing in current literature. *Maculinea rebeli* is one of the most endangered butterflies in the Palearctic Region and is restricted to some mainly xerothermic and calcareous grassland habitats up to alpine levels (VAN SWAAY & WARREN 1999).

*Maculinea rebeli* females lay eggs on flowerheads and upper leaves of *Gentiana cruciata* L. and rarely on some other gentians as *G. germanica* WILLD., *G. asclepiadea* L. and *G. lutea* L. (JUTZELER 1988, KOLEV 2002, BERCZKI & al. 2005). Larvae after their third moult fall off from the plants. Chemical mimicry enables them to be adopted and taken to nests by *Myrmica* workers where they are fed by nurse ants with regurgitations and insects' prey (ELMES & al. 1991a, AKINO & al. 1999). They pupate and emerge after 10 - 11 or, in case of "slow-developers", after 22 - 23 months (ELMES & al. 1991b, THOMAS & al. 1998).

The relationships of *M. rebeli* with ants vary with different geographical regions. In France and Spain, *Myrmica schencki* VIERECK, 1903 is almost exclusively used as a host (THOMAS & al. 1989, ELMES & al. 1998). In Cen-

tral Europe, *M. rebeli* exploits mainly *M. sabuleti* MEINERT, 1861, but generally the host specificity is less clear-cut (STEINER & al. 2003, TARTALLY & CSÖSZ 2004, STANKIEWICZ & al. in press).

*Maculinea rebeli* was recorded from 16 European countries (VAN SWAAY & WARREN 1999) and recently has also been found at three sites in Lithuania (KAZLAUSKAS 2004 and unpubl. data). These populations (Fig. 1) constitute the northernmost localities in the whole known species range in Europe and are situated about 500 km away from the nearest populations in Poland (SIELEZNIEW & al. 2003). Here we present first data on host-ant specificity of *M. rebeli* in Lithuania obtained from the largest population of *M. rebeli* in the country and discuss it in relation to species ecology and conservation.

### **Material and Methods**

The studies were carried out at a site near Seredžius in the Jurbarkas administrative district of Lithuania, in the valley of Nemunas river (55° 05' N, 23° 24' E, 50 m a.s.l.). A xerothermic meadow with a few dozen *G. cruciata* plants overgrew the most southern facing parts of the slope and pathways (Fig. 2). In mid June 2005 we searched for *Myrmica* nests in the vicinity of *G. cruciata* within a radius of up to 2 m, which is the approximate foraging zone of workers of the *Myrmica* genus (ELMES & al. 1998). The study was conducted apparently at the beginning of the *M. rebeli* flight period, as we observed just two, very fresh looking males on the wing (Fig. 3). Nests were searched for *M. rebeli* larvae and pupae, without full excavation. According to the high conservational value of the site we did not make efforts to count all individuals if any were



Fig. 1: Distribution of *Maculinea rebeli* in Lithuania; investigated site black.

found. After examination, the ground and vegetation were restored as exactly as possible to avoid the investigation having negative impact. Uninfested nests were examined much more thoroughly to make sure that they were "empty". The density of *Myrmica* colonies was estimated by searching 20 randomly chosen 1 m squares. About 10 workers were collected from every *Myrmica* colony and all identifications were made according to CZECHOWSKI & al. (2002). Voucher samples of ants are stored in the first author's collection.

### Results and Discussion

We found and searched 17 *Myrmica* nests. Four species of this genus were present at the site: *M. sabuleti* (6 nests), *M. lonae* FINZI, 1926 (4), *M. schencki* (4) and *M. rugulosa* NYLANDER, 1849 (3). The density of *Myrmica* nests was 0.3/m<sup>2</sup>. All *M. schencki* nests were infested by *M. rebeli*. Overall we found 5 pupae (Fig. 4), one exuvium and 4 caterpillars (3 nearly full grown and one small).

The record of *M. schencki* as a host ant of *M. rebeli* is not a new finding but it is quite interesting taking into consideration the location of the study site. The highly isolated Lithuanian populations are far away from the rather strict species range that includes the Carpathians, the Alps and some adjoining regions (MUNGUIRA & MARTIN 1999). Host-ant specificity in the nearest Polish populations is completely different. There, *M. sabuleti* and *M. scabrinodis* NYLANDER, 1846 are mainly used, *M. rugulosa* was once recorded as host. *Myrmica schencki* has never been recorded rearing *M. rebeli* in Poland although it is quite common in the butterfly habitats (SIELEZNIEW & al. 2003, STEINER & al. 2003, STANKIEWICZ & al. in press, A. Stankiewicz & M. Sielezniew, unpubl. data). In other central European sites *M. sabuleti* is the most frequently recorded host but *M. rebeli* individuals were also observed in *M. schencki*, *M. speciosides* BONDROIT, 1918, *M. scabrinodis* and *M. lonae* nests, respectively (STEINER & al. 2003, TARTALLY & CSÖSZ 2004). Therefore the investigated Lithuanian population is apparently more similar to French and Spanish ones, which almost exclusively use *M. schencki* (THOMAS & al. 1989, ELMES & al. 1998). It should be taken into consideration that our sample was quite small – we



Fig. 2: *Maculinea rebeli* site at Seredžius in Lithuania.



Fig. 3: *Maculinea rebeli* male from the studied Lithuanian population.



Fig. 4: *Maculinea rebeli* pupa in a *Myrmica schencki* nest at the investigated site in Lithuania.

can not state with certainty that *M. schencki* is the only species exploited at the site. However, *M. schencki* nests were less conspicuous because of lack of small mounds and it is more likely that we missed some of them rather than colonies of other *Myrmica*. Overall, *M. rebeli* seems

to be more specific in the western and eastern parts of its European range than, e.g., in Austria or Hungary. SCHLICK-STEINER & al. (2004) found that hydrocarbon profiles of *M. rebeli* pre-adoption larvae from central Europe are more complex compared to those studied by ELMES & al. (2002) originating from populations which were parasitic on *M. schencki*. Taking into consideration field data from Lithuanian and Polish populations of *M. rebeli* we suppose that neither of them are chemically predisposed for multi-host use and two clear different geographical races exist in the east of the species range. Geographical variation in host-ant relationships was also found in the sibling *M. alcon* (ELMES & al. 1994). Some sites of this species are known from an area separating the Lithuanian and Polish populations of *M. rebeli*. Since *M. scabrinodis* is main host of *M. alcon* there (SIELEZNIOW & STANKIEWICZ 2002 and unpubl.), this suggests that there is no close relationship between *M. rebeli* in Lithuania and *M. alcon* in eastern Poland (the closest populations are about 200 km away).

Knowledge about host ants on a local scale is crucial for effective species conservation (THOMAS 1995). *Myrmica schencki* prefers short vegetation, often with patches of bare ground, and is one of the most thermophilous *Myrmica* species in grassland habitats (ELMES & al. 1998). During our studies we only found a few nests of this species, which can be explained by unfavourable microhabitat conditions caused by overgrowing.

The investigated site probably supports a rather small population of *M. rebeli*, considering the low density of *Myrmica* ant nests, as well as the low number of *G. cruciata*. At the beginning of July 2005 about 2,100 eggs were counted on plants. Therefore, based on the results of MEYER-HOZAK (2000), we can estimate population size at Seredžius at a few dozen adults. The other two Lithuanian populations (Kalviai and Dūkštos) are probably even smaller; in the same time just about 400 eggs were found at both sites. The vegetation structure at Seredžius and Dūkštos seems to be very dense, which makes germination of host plants difficult. The site Kalviai is almost completely overgrown with bushes and trees (mainly pines). To ensure the survival of those unique populations an action plan should be prepared and implemented. An ideal form of management, favouring both host plants and host ants, would probably be light grazing.

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### Zusammenfassung

Vorliegende Arbeit ist die erste Untersuchung der Beziehungen von *Maculinea rebeli* zu Wirtsameisen in Litauen. Die untersuchte Population ist die innerhalb des gesamten europäischen Verbreitungsgebiets am weitesten nördlich gelegene. Larven, Puppen und eine Exuvie des Schmetterlings wurden ausschliesslich in *Myrmica schencki*-Nes-

tern, nicht aber bei *M. sabuleti*, *M. lonae* und *M. rugulosa* gefunden. Unsere Ergebnisse ähneln Daten aus Frankreich und Spanien, unterscheiden sich aber klar von Beobachtungen an der nächstgelegenen polnischen Population. Dies deutet stark auf geographische Variation der Wirtsameisenspezifität von *M. rebeli* im östlichen Teil des Verbreitungsgebiets hin. Unsere Befunde sind auch für den Schutz von *M. rebeli* in Litauen sehr wichtig.

### References

- AKINO, T., KNAPP, J.J., THOMAS, J.A. & ELMES, G.W. 1999: Chemical mimicry and host specificity in the butterfly *Maculinea rebeli*, a social parasite of *Myrmica* ant colonies. – Proceedings of the Royal Society of London, Series B 266: 1419-1426.
- ALS, T.D., VILA, R., KANDUL, N., NASH, D.R., YEN, S.-H., HSU, Y.-F., MIGNAULT, A.A., BOOMSMA, J.J. & PIERCE, N.E. 2004: The evolution of alternative parasitic life histories in large blue butterflies. – Nature 432: 386-390.
- BERECZKI, J., PECSENYE, K., PEREGOVIĆ, L. & VARGA, Z. 2005: Pattern of genetic differentiation in the *Maculinea alcon* species group (Lepidoptera, Lycaenidae) in Central Europe. – Journal of Zoological Systematics and Evolutionary Research 43: 157-165.
- CZECHOWSKI, W., RADCHENKO, A. & CZECHOWSKA, W. 2002: The ants (Hymenoptera, Formicidae) of Poland. – MIZ PAS, Warszawa, 200 pp.
- ELMES, G.W., AKINO, T., THOMAS, J.A., CLARKE, R.T. & KNAPP, J.J. 2002: Interspecific differences in cuticular hydrocarbon profiles of *Myrmica* ants are sufficiently consistent to explain host specificity by *Maculinea* (large blue) butterflies. – Oecologia 130: 525-535.
- ELMES, G.W., THOMAS, J.A. & WARDLAW, J.C. 1991a: Larvae of *Maculinea rebeli*, a large-blue butterfly, and their *Myrmica* host ants: wild adoption and behaviour in ant-nests. – Journal of Zoology London 223: 447-460.
- ELMES, G.W., THOMAS, J.A., WARDLAW, J.C., HOCHBERG, M.E., CLARKE, R.T. & SIMCOX, D.J. 1998: The ecology of *Myrmica* ants in relation to the conservation of *Maculinea* butterflies. – Journal of Insect Conservation 2: 67-78.
- ELMES, G.W., WARDLAW, J.C. & THOMAS, J.A. 1991b: Larvae of *Maculinea rebeli*, a large-blue butterfly, and their *Myrmica* host ants: patterns of caterpillar growth and survival. – Journal of Zoology London 224: 79-92.
- ELMES, G.W., THOMAS, J.A., HAMMARSTEDT, O., MUNGUIRA, M.L., MARTIN, J. & VAN DER MADE, J.G. 1994: Differences in host-ant specificity between Spanish, Dutch and Swedish populations of the endangered butterfly *Maculinea alcon* (DENIS et SCHIFF.) (Lepidoptera). – Memorabilia Zoologica 48: 55-68.
- JUTZELER, D. 1988: Fund von *Maculinea rebeli* (HIRSCHKE, 1904) im Glarnerland (Lepidoptera, Lycaenidae). – Mitteilungen der Entomologischen Gesellschaft Basel 384: 124-125.
- KAZLAUSKAS, R. 2004: New and very rare for Lithuanian fauna Lepidoptera species collected in 1978-2004. – New and rare for Lithuania insect species 15: 47-50.
- KOLEV, Z. 2002: The species of *Maculinea* VAN ECKE, 1915 in Bulgaria: distribution, state of knowledge and conservation status (Lycaenidae). – Nota lepidopterologica 26: 177-190.
- MEYER-HOZAK, C. 2000: Population biology of *Maculinea rebeli* (Lepidoptera: Lycaenidae) on the chalk grasslands of Eastern Westphalia (Germany) and implications for conservation. – Journal of Insect Conservation 4: 63-72.
- MUNGUIRA, M.L. & MARTIN, J. 1999: Action Plan for the *Maculinea* butterflies in Europe. – Council of Europe Publishing, Strasbourg, 64 pp.

- PECH, P., FRIC, Z., KONVIČKA, M. & ZRAVÝ, J. 2004: Phylogeny of *Maculinea* blues (Lepidoptera: Lycaenidae) based on morphological and ecological characters: evolution of parasitic myrmecophily. – *Cladistics* 20: 362-375.
- SCHLICK-STEINER, B.C., STEINER, F.M., HÖTTINGER, H., NIKIFOROV, A., MISTRİK, R., SCHAFELLNER, C., BAIER, P. & CHRISTIAN, E. 2004: A butterfly's chemical key to various ant forts: intersection-odour or aggregate-odour multi-host mimicry? – *Naturwissenschaften* 91: 209-214.
- SIELEZNIEW, M. & STANKIEWICZ, A. 2002: First data on host-ant specificity of the parasitic butterfly *Maculinea alcon* (DEN. & SCHIFF.) (Lepidoptera: Lycaenidae) in Poland and eastern Europe. – *Fragmenta faunistica* 45: 123-130.
- SIELEZNIEW, M., STANKIEWICZ, A., ŁUCZAJ, Ł. & GÓRNICKI, A. 2003: Występowanie i ekologia modraszka Rebela, *Maculinea rebeli* HIRSCHKE (Lepidoptera, Lycaenidae) w Polsce [On the distribution and the ecology of Mountain Alcon Blue, *Maculinea rebeli* Hirschke (Lepidoptera, Lycaenidae) in Poland]. – *Przegląd Zoologiczny* 47: 211-220.
- STANKIEWICZ, A., SIELEZNIEW, M. & BARAŃSKI, M. in press: The first record of *Myrmica rugulosa* NYLANDER, 1849 (Hymenoptera: Formicidae) as a host-ant of *Maculinea rebeli* HIRSCHKE, 1904 (Lepidoptera: Lycaenidae). – *Polish Journal of Entomology* 74.
- STEINER, F.M., SIELEZNIEW, M., SCHLICK-STEINER, B.C., HÖTTINGER, H., STANKIEWICZ, A. & GÓRNICKI, A. 2003: Host specificity revisited: New data on *Myrmica* host ants of the lycaenid butterfly *Maculinea rebeli*. – *Journal of Insect Conservation* 7: 1-6.
- TARTALLY, A. & CSÖSZ, S. 2004: Adatok a *Maculinea* boglárkalepkék (Lepidoptera: Lycaenidae) kárpát-medencei hangyagazdairól [Data on the ant hosts of the *Maculinea* butterflies (Lepidoptera: Lycaenidae) of Hungary]. – *Természetvédelmi Közlemények* 11: 309-317.
- THOMAS, J.A. 1995: The ecology and conservation of *Maculinea arion* and other European species of large blue butterfly. In: PULLIN, A.S. (Ed.): *Ecology and Conservation of Butterflies*. – Chapman & Hall, London, pp. 180-197.
- THOMAS, J.A., ELMES, G.W., WARDLAW, J.C. & WOYCIECHOWSKI, M. 1989: Host specificity among *Maculinea* butterflies in *Myrmica* ant nests. – *Oecologia* 79: 452-457.
- THOMAS, J.A., ELMES, G.W. & WARDLAW, J.C. 1998: Polymorphic growth in larvae of the butterfly *Maculinea rebeli*, a social parasite of *Myrmica* ant colonies. – *Proceedings of the Royal Society of London, Series B* 265: 1895-1901.
- VAN SWAAY, C.A.M. & WARREN, M., 1999: *Red data book of European butterflies (Rhopalocera)*. – Council of Europe Publishing, Strasbourg, 260 pp.