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The present distribution and nest tree characteristics of *Liometopum microcephalum* (PANZER, 1798) (Hymenoptera: Formicidae) in South Moravia

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Abstract

In 2002 - 2004 the population of the dolichoderine ant *Liometopum microcephalum* (PANZER, 1798) in South Moravia (Czech Republic), at the northwestern boundary of the species' range, was surveyed in terms of distribution, population size (number of colonies) and habitat requirements. At present the northern-most colonies in South Moravia occur at the Křivé jezero National Nature Reserve on the Dyje river and in the Skařiny Nature Reserve on the Morava River. In total, 850 colonies were recorded and the characteristics of their nest trees analysed. About one half of the nest trees were found within forest stands and 94 percent of all nest trees were oaks. Most sites with colonies are located within the active or historic floodplains. Due to the river regulation between 1970 and 1989 (including the construction of reservoirs on the Dyje) and due to present forest and park management this population has retreated to the south and is to be considered threatened despite its considerable size.

Key words: Dolichoderinae, *Liometopum microcephalum*, distribution, nest tree characteristics, conservation, South Moravia, Czech Republic.

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Introduction

The dolichoderine ant *Liometopum microcephalum* (PANZER, 1798) is the only species of this genus living in Europe. Its distribution area stretches from Italy (BARONI URBANI 1964) across the Balkans (AGOSTI & COLLINGWOOD 1987, ATANASOV & DLUSSKY 1992) and Asia Minor (AKTAC 1976) into Iran (PAKNIA & KAMI 2007) and to the southern foothills of the Caucasus (RUZSKIJ 1905); in the northwest its range reaches through Lower Austria (MAYR 1855, STITZ 1939, WIEST 1967, SCHLICK-STEINER & al. 2003) along the Morava (March) River up to the southeast of the Czech Republic, i.e., South Moravia (ZDOBNITZKY 1910, SOUDEK 1922, KRATOCHVÍL 1936, 1938, ZÁLESKÝ 1939, BRAUNE 1972, BEZDĚČKA 1993, 1995), and continues eastwards into southern Slovakia (ZÁLESKÝ 1939, BEZDĚČKA 1996b), the Carpathoukraine, Moldavia, and further along the northwestern coast of the Black Sea to the Lower Dniepr River and the Samara River, a left-hand tributary of the Dniepr, in the Ukraine (APOSTOLOV & LIKHOVIDOV 1973, MAKAREVICH 2003), and the Lower Volga River in the Russian Federation (SAVRANSKAYA 1998; GREBENNIKOV, DUBOVIKOFF, SAVRANSKAYA 2007). The population in South Moravia, reaching approximately up to 49° N (see below), is often considered the northern-most within the entire range (e.g. SEIFERT, 2007). However, the information available to us about the occurrence of *L. microcephalum* near the town of Vasilivka on the Samara River northeast of Dnepropetrovsk (RADCHENKO, 1994) and on the Volga in the environs of Volgograd (GREBENNIKOV & al. 2007) indicates that the species might be reaching the same latitude at the northeastern border of its range, i.e., about 48° 44' N on the Samara River and 48° 43' N at Krasnoslobodsk on the Volga. It is worth mentioning that these populations in the northeast of its range are reported to be very small. In general, up-to-date data on the exact distribution and size of the populations in the individual countries within the species' range are missing.

Liometopum microcephalum builds carton nests into the trunks of old trees, mainly oaks. Colonies of *L. microcephalum* are highly numerous and the workers defend their nest tree very actively and aggressively (SEIFERT 2007). They forage on trees and on the ground in the vicinity of their nest tree. Workers from individual colonies were found foraging on up to 18 trees, collecting various food items (e.g., insects, spiders, seeds) and attending aphids (WIEST 1967, J. Schlaghamerský & M. Omelková, unpubl.). In South Moravia mating has been observed from May to July during the afternoon (OMELKOVÁ & al. 2005), thus starting somewhat earlier in the year than given by SEIFERT (2007).

In the present contribution we report the results of our survey of the population in South Moravia (south-eastern Czech Republic), representing the northwestern-most population of *L. microcephalum*. We focused on the present population size (number of colonies), distribution and nest tree characteristics. The South Moravian population is remarkable as it appears to be very vital despite the fact that it lives on the margin of the species' range. However, river regulation in the past decades and current practise of forest and park management seem to pose a severe threat to this population (BEZDĚČKA 1995) and the species has been assigned the status of critically endangered in the Czech Republic (BEZDĚČKA 2005). Our objective was, therefore, to understand better the situation of the South Moravian population, its habitat requirements and limiting factors.

The first records of *L. microcephalum* in South Moravia were reported from the vicinity of the villages Stra-

chotín, Bulhary (ZDOBNITZKY 1910) and Lednice (SOUDEK 1922). In the 1930s Kratochvíl reported the species from the lower reaches of the Svratka river near Uherčice (KRATOCHVÍL 1936), from the vicinity of Hlohovec (several colonies), and in a single colony also somewhere along the road from the town of Židlochovice north to Rajhrad (KRATOCHVÍL 1938). The latter record (exact position unknown, Rajhrad is located at 49° 05' N) is the northernmost known from Central Europe and probably within the entire range of the species (see above). Further colonies were found in the vicinity of the village Pouzdřany (ZÁLESKÝ 1939) and later near Mikulov or – more probably – near Valtice (BRAUNE 1972, exact locality not given). However, all these records provide only limited information about the true distribution a frequency of this ant in South Moravia up to the major changes in the South Moravian landscape connected to massive river regulation in the 1970s and 1980s. Taking into account data up to 1996 (BEZDĚČKA 1993, 1995, 1996a), the range of *L. microcephalum* formerly covered a considerable area within the Czech Republic, stretching from the confluence of the Dyje (Thaya) and Morava (March) rivers in the south (border to Austria and Slovakia) along the Dyje and its tributary, the Svratka, almost to Rajhrad in the north. Data compiled by BEZDĚČKA (1995) showed the most important sites of occurence to be the environs of Dolní Věstonice, the Horní les Forest District near Lednice, the Kančí obora Forest District between Lednice and the town of Břeclav, the vicinity of the oxbow lake Květné jezero, the environs of the village Nové Mlýny, the environs of Lednice, Podivín and Hlohovec, the old forest stand within the Rendezvous National Nature Monument (NNM) between Valtice and Břeclav, the environs of the villages Ladná and Charvátská Nová Ves, the environs of the town of Břeclav, the Pohansko Forest District, the environs of the village Lanžhot, and the National Nature Reserves Ranšpurk and Cahnov-Soutok. Somewhat outside of this area of rather well interconnected sites there was the record of several colonies upstream on the Morava in the Skařiny Nature Reserve near Mikulčice (BEZDĚČKA 1996a). Most of the localities were situated within the active or historical floodplains of the area's major rivers Dyje and Morava and of their tributaries.

Material and methods

Study area: Our survey covered the entire area from which *L. microcephalum* had been reported and suitable habitats in its vicinity, in total about 38,000 ha. This area reached from Rajhrad in the north along the Svratka River downstream to the floodplain forests at the stream mouths of the Svratka and Jihlava Rivers on the northern banks of the second Nové Mlýny Reservoir on the Dyje River, westward along the Nové Mlýny Reservoirs to Jevišovka near Drnholec, south of the reservoirs to the Austrian border and the confluence of the Dyje and Morava, and northeastwards upstream the Morava to the town of Hodonín. It thus covered the geomorphological units Mikulov Upland (Mikulovská vrchovina) with its parts Pavlov Hills (Pavlovské vrchy) and Milovice Hills (Milovická pahorkatina), the Valtice Hills (Valtická pahorkatina) and the river valleys of the lower reaches of the Dyje (Thaya) and Morava (March), all being part of the Northpannonian Subprovince in biogeographical terms (CULEK 1996). The climate is arid to subhumid with a mean annual temperature of 9 °C and a mean annual precipitation of 524 mm (QUITT 1971). Winters are mild; more than 300 days per year have a mean temperature above freezing point; a maximum temperature of 30 °C is reached in more than 20 days per year (all data from the period 1901 - 1950). In the last decades the climate has been even warmer and drier, for instance in the period 1992 - 1996 the average monthly air temperatures during the vegetation season were 1.5 °C higher than the longterm mean, for the period 1987 - 1996 this increase was still 1.0 °C (BAGAR & KLIMÁNEK 1999); this trend has been continuing. The representation of tree species in the floodplain forests covering of the main part of the study area is the following (HRIB 2004): In the Horní les and Kančí obora segments of the Valtice Forest District along the Dyje River from Nové Mlýny to the town of Břeclav *Quercus robur* LINNAEUS, 1753 – 42.5 %, *Fraxinus angustifolia* VAHL, 1804 – 30 %, *Populus* spp. – 7.6 %, *Tilia cordata* MILLER – 5.2 %; in the Soutok Forest District (between Dyje and Morava south of Břeclav) *Q. robur* – 48.6 %, *F. angustifolia* – 29 %; in the Tvrdonice Forest District (upstream along the Morava): *Q. robur* – 46 %, *F. angustifolia* – 41 %, *Populus* spp. – 5 % (only species with percentages above 5 % presented).

Methods: We conducted the inventory of *L. microcephalum* colonies in 2002 - 2004. The starting point were published data on the distribution of this ant in South Moravia and we also drew on the experience of ornithologists, who have encountered the colonies of *L. microcephalum* while climbing trees to study large nesting birds in this area. All potential localities of the species' occurrence were toured and searched for nest trees. Each found nest tree was registered, marked by a metal label with the corresponding number, plotted in a map, and the following characteristics of the tree and its surroundings were recorded: species; trunk perimeter at breast hight (130 cm); height; vitality (estimated as percentage of tree crown bearing leaves); presence of visible cavities, areas without bark, fungal fruiting bodies, broken tip; situation (in a closed stand, on a forest edge, in a small group of trees, in an tree alley, single tree in a grassland or field, position on a waterbank); presence of surrounding understorey. Below we report only on those parameters that yielded sufficiently clear and interpretable results. To compare the composition of *L. microcephalum* nest trees with that of the entire set of trees available, we have used two very recent inventories: (1) an inventory (HAUCK & ČÍŽEK 2006) of trees with a diameter at breast height (DBH) of above 40 cm conducted on the meadows around Pohansko (northern part of the Soutok Forest District), representing a parkland situation with trees scattered as single trees and groups in an open landscape (470 trees), and (2) inventories (VRŠKA & al. 2006) of all trees of an DBH above 10 cm conducted in the National Nature Reserves Ranšpurk (4962 trees) and Cahnov-Soutok (3473 trees), representing rather dense old-growth forests with ancient trees (middle to southern part of the Soutok Forest District).

Results

Distribution and abundance of *L. microcephalum*

In the study area we found 850 colonies (numbers of colonies broken down according to Forest Districts: Mikulov – 4, Horní les – 411, Valtice – 48, Soutok – 318, and Tvrdonice – 69).

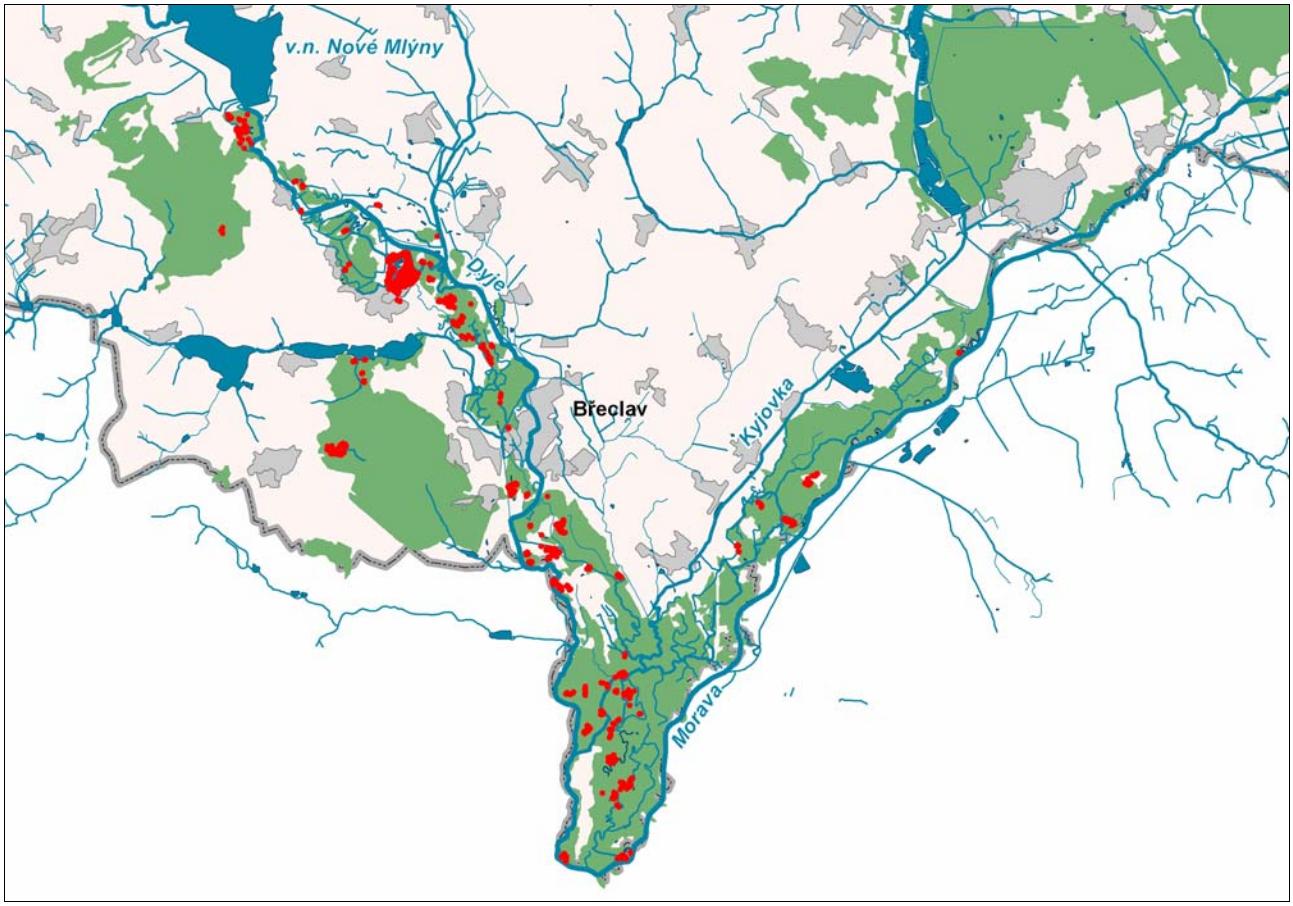

Fig. 1: The present distribution of *Liometopum microcephalum* in South Moravia.

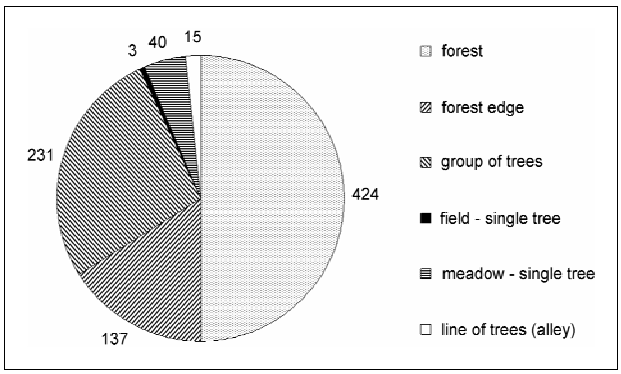

Fig. 2: Frequency distribution of *Liometopum microcephalum* nest trees across habitats.

The present distribution area in South Moravia (Fig. 1) reaches to the the northwest along the Dyje River to the Křivé jezero National Nature Reserve (48° 51' N, 16° 43' E) west of the village Nové Mlýny and adjacent to the third of the Nové Mlýny Reservoirs. This reserve contains the highest number of colonies (82) at a single site under strict legal protection. No colonies were found north or west of the reservoirs. To the south the range of *L. microcephalum* covers the floodplain forests along the Dyje River in the vicinity of the villages Bulhary and Lednice (with a particularly large population in the Lednice Park – 188 colonies), through the Niva Dyje (Dyje floodplain) Nature Park to the town of Břeclav and further to the south (Lanžhot Forest District, in total 205 colonies) to the confluence of the Dyje and Morava (border of the Czech Republic with Austria and Slovakia). In the northeast it stretches along the Morava River through the Tvrdonice Forest District up to the Skařiny Nature Reserve (48° 48' N, 17° 55' E): 69 colonies in the forest district, of those three in the reserve. Except of the numerous colonies in the floodplains of both rivers, we discovered or confirmed colonies outside the historical and actual floodplain only in the Milovice Forest (4; Mikulov Forest District), along the Lednice Fish Ponds (16) and in the Rendezvous NNM (42; the latter two sites both Valtice Forest District). Most colonies were found in mature stands that were 120 - 170 years old.

Characteristics of nest trees

Oak had a dominant position among the nest trees, hosting 94 percent of the colonies. At most sites, located in the floodplains, the oak species was *Quercus robur*; in the Rendezvous Natural Nature Monument most nest trees were *Q. cerris* LINNAEUS, 1753, whereas the few colonies found in the Milovice forest were on *Q. petraea* LINNAEUS, 1753. Further tree species hosting colonies were: elm, common maple, poplar, lime, ash, hornbeam, willow, birch, and horse chestnut. Half of the colonies were situated in forests and about a quarter in trees that were part of groups of trees in the open landscape. With 188 colonies the park at the Lednice castle was the most important locality in the latter category. Only 58 colonies were recorded on trees lining roads or standing alone in meadows or arable fields (Fig. 2). Nest tree height ranged from 5 m to 35 m, the median value

(height class) being 25 - 30 m (Fig. 3). The perimeter of the nest trees at breast height (130 cm) ranged from 100 to 750 cm (median 300 - 350 cm) (Fig. 4). Most nest trees had a vitality of 70 percent and above; very few colonies were found on trees with low vitality or dead (Fig. 5).

In the Pohansko meadows 18 *L. microcephalum* colonies were found on single trees or such standing in smaller groups (those on edges of larger stands excluded). One colony was found on an ash and one on a maple, all others on oaks. All oaks hosting colonies had a perimeter of 370 cm or above, while both other nest trees were smaller (200 cm and 330 cm, respectively). Of the 470 trees present (HAUCK & ČÍŽEK 2006), *Q. robur* had a share of 56 %, *Aesculus hippocastanum* LINNAEUS, 1753 of almost 17 %, followed by *Populus* spp. (7 %), *F. angustifolia*, and *A. campestre* LINNAEUS, 1753 (both 4.7 %). However, *Q. robur* was much more prominent among the biggest trees. In the two "virgin forest" reserves Ranšpurk and Cahnov-Soutok we found 10 and 9 nest trees of *L. microcephalum*, respectively (our inventory covered only the Cahnov part of the Cahnov-Soutok reserve as the Soutok part was unaccessible due to its island character). All were pedunculate oaks. *Quercus robur* represents only 3.7 % of all live tree individuals in the Ranšpurk reserve (*Acer campestre* – 33 %, *F. angustifolia* – 18 %, *Carpinus betulus* LINNAEUS, 1753 – 33 %) and 15 % in the Cahnov-Soutok Reserve (*Acer campestre* – 23 %, *F. angustifolia* – 25 %, *Carpinus betulus* – 21 %). Whereas oak is much too rare among the younger trees in these reserves, the few individuals still alive are very dominant and usually by far the biggest trees in these stands.

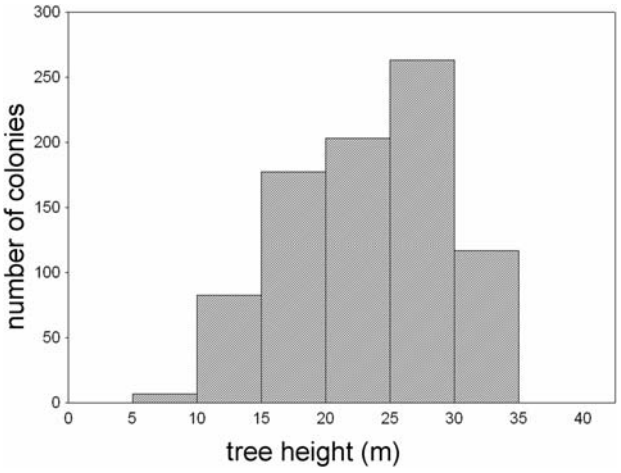

Fig. 3: Frequency distribution of *Liometopum microcephalum* nest trees across categories of tree height.

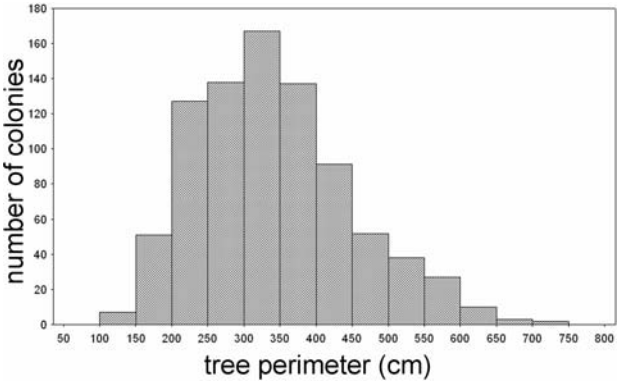

Fig. 4: Frequency distribution of *Liometopum microcephalum* nest trees across categories of perimeter at breast height.

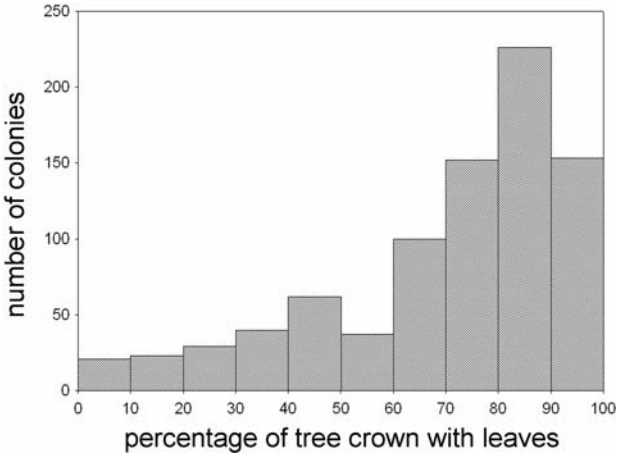

Fig. 5: Frequency distribution of *Liometopum microcephalum* nest trees across categories of tree vitality.

Discussion

Although the incomplete data on the past distribution and population size do not allow an exact quantification, we assume that there has been a severe decline in the number of *L. microcephalum* colonies in the floodplains of the Morava and Dyje Rivers and their tributaries within the past century due to the activity of man. The decrease in the size of the South Moravian distribution area of the species can be clearly shown, particularly its retreat in the northwest (c. 10 km to the south). *Liometopum microcephalum* is considered a thermophilous species and its retreat to the south is remarkable in comparison with the expansion of many other (Sub-)Mediterranean species in the recent years. The construction of the reservoirs on the Dyje upstream of Nové Mlýny between 1971 and 1989, connected with the logging and permanent inundation of about 1100 ha of floodplain forests, had a particularly severe impact. This is illustrated by the fact that we have not found any colonies north of the Nové Mlýny reservoirs (this is probably also caused by the lack of mature floodplain forest stands in this area). The regulation of the Dyje and Morava Rivers in the 1970s prevented annual flooding in most of the floodplain and caused a partial die-back of forest stands (BAGAR & KLIMÁNEK 1999). The foundation of new colonies and thus the dispersal of the species are also made difficult by the forest management in the floodplain forests, where mature stands have been intensively logged in small-area clear-cuts. In recent years, also the ancient trees in the park-like landscape of the Area of Lednice and Valtice (a UNESCO World Heritage site) have been often felled and replaced by newly planted trees for esthetic and safety reasons. As a consequence of these changes in the landscape of South Moravia and particularly in the area's floodplain forest ecosystem, the original habitat of the species has been fragmented, resulting in the insular distribution pattern that is now typical for *L. microcephalum* in South Moravia. A substantial part of the localities of *L. microcephalum* lies within areas designed as sites within the EU Natura 2000 network and one can hope that this will lead to a halt to de-

trimental management practices in the future. Despite the losses in distribution area and the existing threats the present population is still very large and viable. Assuming that not all nest trees were found during our survey, a total number of colonies of 900 or even 1000 may be a realistic estimate (although some trees without colonies that were much frequented by foraging ants might have been mistaken for nest trees). However, logging of mature forest stands has continued on a large scale since we finished our inventory. The decrease of colony numbers due to logging was reported from Austria already in the 1960s (WIEST 1967).

Except the numerous colonies in the floodplains of both rivers, some colonies were found outside of the historic as well as presently active floodplain, namely in the Milovice Forest (Bulhary Game Preserve), along the Lednice Fish Ponds (including several ones rather far to the south of their banks) and, in particular, in the Rendezvous NNM. However, the latter two localities are partially close to water, the part of the Rendezvous NNM hosting almost all of the colonies is an old forest stand (dominated by planted *Quercus cerris*) that is partially very wet, being adjacent to a pond. The reasons for the strong association of the species with hardwood floodplain forests as well as for the above-mentioned exceptions to this rule remain unclear. Some dry oak forests, as the Milovice forest, are very close to vital colonies within the floodplain and no physical barrier to the colonisation of these dry habitats is apparent. One probable reason for the lack of *L. microcephalum* in the dry forests is the lower availability of suitable nest trees, that is preferably old but still vital oaks, outside of the floodplains, where most woodlands have been traditionally managed as coppices. Besides the actual lack of large-diameter trees, the slow-growing oaks at these xerothermic sites are probably also less prone to develop tree cavities. Also air humidity requirements of *L. microcephalum* might play a role. Another factor might be competition with other behaviourally dominant ant species that have been suppressed in the floodplains by the occurrence of floods (see PETRÁKOVÁ & SCHLAGHAMERSKÝ 2007).

Based on her experience with the Austrian sites of *L. microcephalum*, WIEST (1967) claimed the species to prefer open parkland and to avoid woodland. Our results do not confirm this conclusion, at least the statement about the avoidance of forests seems too strong. WIEST (1967) did not provide the numbers of colonies investigated or known to her, but we believe this number to be substantially smaller than that of our survey in South Moravia. It is, however, true that the preferred old trees of larger diameters have been generally preserved more often in open settings, as parks, than in commercially managed forest stands.

Our results on the characteristics of nest trees generally confirm known facts on the predominant position of oak among the nest trees of *L. microcephalum* (SEIFERT 2007). The large number of other tree species that are occasionally utilised is still remarkable. It is also remarkable that the species seems to prefer mature trees but to avoid or abandon such with substantially reduced vitality. Colonies do not persist on dead trees. Our data show what type of trees are mostly colonised by the species. However, without data on the stand structure, i.e., on the many trees without *L. microcephalum* nests, ultimate conclusions on actual preferences of *L. microcephalum* are problematic. As far as afforested sites are concerned, official data from forest management plans are available but could be easily misleading in a number of respects. For instance, forest maps show the age of the principal stand present in a forest plot, but not the age of potentially present standards or reserves. However, the data on the area's forest tree composition presented above (HRIB 2004) show, that oaks are indeed preferred as nest trees. Most colonies within forests were indeed found in the oldest stands. Looking at the situation at those *Liometopum* localities, for which detailed tree inventories are available, the overrepresentation of oak as the nest tree is again very clear. Much of this preference is probably due to the abundance of suitable structures for the construction of nests, correlated with factors as tree age and trunk volume. Oaks have a much higher share in the total study area and in the given sites when old, large-diameter trees with suitable nest cavities are considered.

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Zusammenfassung

Im Zeitraum 2002 - 2004 wurde die Population der dolichoderinen Ameise *Liometopum microcephalum* (PANZER, 1798) in Südmähren (Tschechische Republik), am nordwestlichen Rand des Verbreitungsareals dieser Art, bezüglich ihrer Verbreitung, Populationsgröße (Zahl der Ameisenvölker) und Habitatansprüche untersucht. Zur Zeit befinden sich die nördlichsten Kolonien in Südmähren im Nationalen Naturschutzgebiet Křivé jezero (Krummsee) an der Thaya und im Naturschutzgebiet Skařiny an der March. Insgesamt wurden 850 Ameisenvölker erfasst und die Parameter ihrer Nestbäume analysiert. Ungefähr die Hälfte der Nestbäume lag in Waldbeständen, und 94 % der Kolonien befanden sich in Eichen. Die meisten Standorte befanden sich in aktiven oder historischen Auen. Infolge der Flussregulierung zwischen 1970 und 1989 (einschließlich der Errichtung von Stauseen an der Thaya) und aufgrund der derzeitigen Praxis bei der Bewirtschaftung hiesiger Wälder und der Pflege von Parks erlitt die Population Gebietsverluste im Norden und ist somit trotz ihrer beachtlichen Größe als bedroht anzusehen.

References

AGOSTI, D. & COLLINGWOOD, C.A. 1987: A provisional list of Balkan ants (Hymenoptera, Formicidae) and a key to the worker caste, I. Synonymic list. – Bulletin de la Société Entomologique Suisse 60: 51-62.

AKTAC, N. 1976: Studies on the myrmecofauna of Turkey I. Ants of Siirt, Bodrum and Trabzon. – Istanbul Universitesi Fen Fakultesi Mecmuasi. Seri B 41: 115-135.

APOSTOLOV, L.G. & LIKHOVIDOV, V.E. 1973: Contribution to the fauna and ecology of ants (Hymenoptera, Formicidae) from southeastern Ukraine. – Vestnik Zoologii 6: 60-66.

ATANASOV N. & DLUSSKY G. M. 1992: Hymenoptera, Formicidae. – Fauna Bulgarica 22: 1-310. (in Bulgarian)

BAGAR, R. & KLIMÁNEK, R. 1999: Main causes and effects of altered conditions in forest ecosystems in the South Moravian floodplains. – Ochrana přírody 54: 178-182. (in Czech)

BARONI URBANI, C. 1964: Formiche dell'Italia appenninica (Studi sulla mirmecofauna d'Italia III). – Memorie del Museo Civico di Storia Naturale di Verona 12: 149-172.

BEZDĚČKA, P. 1993: Inventory survey of the Ranšpurk National Nature Reserve. – Unpublished report to the Brno office of the Agency for Nature Conservation and Landscape Protection of the Czech Republic (AOPK), 8 pp. + 2 maps. (in Czech)

BEZDĚČKA, P. 1995: Hymenoptera: Formicoidea. In: ROZKOŠNÝ, R. & VAŇHARA, J. (Eds.): Terrestrial invertebrates of the Pálava Biosphere Reserve of UNESCO, II. – Folia Facultatis Scientiarium Naturalium Universitatis Masarykianae Brunensis, Biologia 93: 323-329.

BEZDĚČKA, P. 1996a: A first contribution to our knowledge of the ants of southeastern Moravia. – Sborník Přírodovědeckého klubu v Uherském Hradišti 1: 70-74. (in Czech)

BEZDĚČKA, P. 1996b: Ants of Slovakia (Hymenoptera: Formicidae). – Entomonofauna carpathica 8: 108-114. (in Czech)

BEZDĚČKA, P. 2005: Formicoidea (mravenci). In: FARKAČ, J., KRÁL, D. & ŠKORPÍK, M. (Eds.): Red list of threatened species in the Czech Republic: Invertebrates. – Agency for Nature Conservation and Landscape Protection of the Czech Republic (AOPK), Praha, pp. 384-386.

BRAUNE, M. 1972: Notizen zur Ameisenfauna der Tschechoslowakei (Hymenoptera, Formicidae). – Zprávy Československé společnosti entomologické ČSAV 8: 89-91.

CULEK, M. (Ed.) 1996: Biogeographical classification of the Czech Republic. – Enigma, Praha, 347 pp. (in Czech)

GREBENNIKOV, K.A., DUBOVIKOFF, D.A. & SAVRANSKAYA, ZH.V. 2007: The ants (Hymenoptera, Formicidae) of the lower Volga region. – <http://rove.front.ru/fm_list_eng.htm>, retrieved on 16 August 2007.

HAUCK, D. & ČÍŽEK, L. 2006: Inventory of trees suitable for the hermit beetle (Osmoderma eremita) and the cerambyx longicorn (*Cerambyx cerdo*) in the Soutok Game Preserve at Břeclav in 2006. – Unpublished report to the Agency for Nature Conservation and Landscape Protection of the Czech Republic (AOPK), Praha, 43 pp.

HRIB, M. 2004: From the history of forest management. In: HRIB, M. & KORDIOVSKÝ, E. (Eds.): The floodplain forest in the Dyje-Morava floodplain. – Moraviapress, Břeclav, pp. 209-225. (in Czech)

KRATOCHVÍL, J. 1936: The analysis of the myrmecofauna of the Pavlov hills. – Práce Moravské přírodovědecké společnosti 10: 1-30. (in Czech)

KRATOCHVÍL, J. 1938: Myrmecological notes 1-2. – Sborník Klubu přírodovědného v Brně 2: 161. (in Czech)

MAKAREVICH, O.N. 2003: *Liometopum microcephalum* (Hymenoptera, Formicidae) in the Lower Dnepr. – Vestnik zoologii 37: 51-56. (in Ukrainian)

MAYR, G.L. 1855: Formicina austriaca. Beschreibung der bisher im österreichischen Kaiserstaate aufgefundenen Ameisen, nebst Hinzufügung jener in Deutschland, in der Schweiz und in Italien vorkommenden Arten. – Verhandlungen des Zoologisch-Botanischen Vereins in Wien 5: 273-478.

OMELKOVÁ, M., CHYTIL, J. & SCHLAGHAMERSKÝ, J. 2005: Occurrence of the rare ant *Liometopum microcephalum* in the Křivé jezero National Nature Reserve (PLA Pálava). – Živa 2: 76-77. (in Czech)

PAKNIA, O. & KAMI, H.G. 2007: New and additional records for the formicid fauna (Insecta: Hymenoptera) of Iran. – Zoology in the Middle East 40: 85-90.

PETRÁKOVÁ, L. & SCHLAGHAMERSKÝ, J. 2007: Preliminary results on the interaction of *Liometopum microcephalum* (PANZER, 1798) with other ants (Hymenoptera: Formicidae). – Myrmecological News 10: 118.

QUITT, E. 1971: Climatic regions of Czechoslovakia. – Studia Geographica 16: 1-47. (in Czech)

RADCHENKO, O.G. 1994: *Liometopum microcephalum* PANZ. In: SZCZERBAK, N.N. (Ed.): Red Data Book of Ukraine. Tvarinnij svit, Ukrainskaya Encyklopedia, Kyiv, p. 233 (in Ukrainian)

RUZSKIJ, M.D. 1905: The ants of Russia. – Trudy Obshchestva Estestvojspytatelei pri Imperatorskom Kazanskom Universitete 38: 1-800. (in Russian)

SAVRANSKAYA, ZH.V. 1998: About the finding of *Liometopum microcephalum* in the territory of Kalmykia. – Poblemy zachraneni bioraznoobraziya aridnych regionov Rosii. Volgograd. Volgoradskij Gosudarstvennyj Universitet, pp. 145-146.

SCHLICK-STEINER, B.C. & STEINER, F.M. & SCHÖDL, S. 2003: Ameisen (Hymenoptera: Formicidae). Eine Rote Liste der in Niederösterreich gefährdeten Arten. – Amt der NÖ Landesregierung, Abteilung Naturschutz, St. Pölten, 75 pp.

SEIFERT, B. 2007: Die Ameisen Mittel- und Nordeuropas. – lutra Verlags- und Vertriebsgesellschaft, Tauer, 368 pp.

SOUDEK, Š. 1922: Ants, system, geografic distribution, ecology and identification key to the ants living in the territory of the Czechoslovak Republic. – Česká společnost entomologická, Praha, 98 pp. (in Czech)

STITZ, H. 1939: Hautflügler oder Hymenoptera I, Ameisen oder Formicidae. In: DAHL, F., DAHL, M. & BISCHOFF, H. (Eds.): Die Tierwelt Deutschlands und der angrenzenden Meeresteile 37. – G. Fischer Verlag, Jena, 428 pp.

VRŠKA, T., ADAM, D., HORT, L., ODEHNALOVÁ, P., HORAL, D. & KRÁL, K. 2006: Developmental dynamics of virgin forest reserves in the Czech Republic. Volume II: Floodplain forests – Cahnov-Soutok, Ranšpurk, Jiřina. – Academia, Praha, 215 pp.

WIEST, L. 1967: Zur Biologie der Ameise *Liometopum microcephalum* PANZ. – Wissenschaftliche Arbeiten aus dem Burgenland 38: 136-144.

ZÁLESKÝ, M. 1939: Prodromus of our hymenopteran insects – pars III. – Sborník entomologického odd. Národního Musea v Praze, XVII, 176: 219-220. (in Czech)

ZDOBNITZKY, W. 1910: Beitrag zur Ameisenfauna Mährens. – Mitteilungen der Kommission zur naturwissenschaftlichen Durchforschung Mährens, Zoologische Abteilung 15: 9-10.