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The joint introduction of *Platyarthrus schoblii* (Isopoda: Oniscidea) and *Lasius neglectus* (Hymenoptera: Formicidae) into Hungary

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Abstract

The invasive garden ant *Lasius neglectus* VAN LOON, BOOMSMA & ANDRÁSFALVY, 1990 was found and described from Budapest, Hungary. Since then, 16 colonies of the species were located in the area. More localities could probably be detected by systematic screening throughout the country. The majority of the colonies can be found in Budapest and only a few sites are known outside the capital city (in the Botanical Garden of Debrecen and in Érd and Tahi; the latter two are situated close to Budapest).
It is known that several arthropod groups have representatives of a myrmecophilous character that are living in ant nests on a voluntary or obligatory basis (e.g., beetles, springtails, mites, crickets, and woodlice). No such phenomenon was published in relation to invertebrates accompanying *L. neglectus* before. In 2001, we detected the first commensalist isopod in a colony in Budatétény. We identified the crustacean arthropod as *Platyarthrus schoblii* BUDDE-LUND, 1885 which is a new species in Hungary. It was known only in the Mediterranean region before. After a systematic search by hand sorting, we were able to prove the presence of this isopod species in 60 % of the studied *L. neglectus* populations.
The other well-established representative of the myrmecophilous genus *Platyarthrus* in Hungary is *P. hoffmannseggii* BRANDT, 1833, which was not found to co-occur with *L. neglectus*. Similarly, *P. schoblii* has not yet been found with other ant species. Nevertheless we presume cross-adoption in each case as it happened, e.g., in Spain between the native *P. schoblii* and the introduced and invasive ant *Linepithema humile* (MAYR, 1868). The repeated co-occurrence of *P. schoblii* and *L. neglectus* could underline the hypothesis concerning the anthropogenic distribution of both species by potted ornamental plants.

Key words: *Lasius neglectus*, *Platyarthrus schoblii*, introduction, exotic species, establishment, invasive, tramp ant, Hungary

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Introduction

Since the invasive garden ant *Lasius neglectus* VAN LOON, BOOMSMA & ANDRÁSFALVY, 1990 has been described in Budapest as a polygynous and unicolonial species (VAN LOON & al. 1990), a number of new localities were found all over Europe (Fig. 1). It seems that *L. neglectus* was introduced into Hungary by human activity since it lacks nuptial flight and instead shows colony budding (VAN LOON & al. 1990, ESPADALER 1999, SEIFERT 2000, ESPADALER & REY 2001, ESPADALER & al. 2004). The transportation of horticultural products, which is performed in the area of the ant's habitat (e.g., urban parks, suburbs, botanical and nursery gardens), might be a potential vector for long distance dispersal (VAN LOON & al. 1990, TARTALLY 2000a, b, DEKONINCK & al. 2002, ESPADALER & BERNAL 2003). Introduced (so-called "exotic") species are of great importance both from an ecological and economical point of view. Introduced species can out-compete native species, alter the structure and function of ecosystems and cause considerable economic loss (e.g., ELTON 1958, MOONEY & DRAKE 1986, PIMENTEL & al. 2000). They can easily colonize heavily disturbed habitats. Urban areas are often hotspots of species introduction (MCDONNELL & PICKETT 1990, SUKOPP 1990).

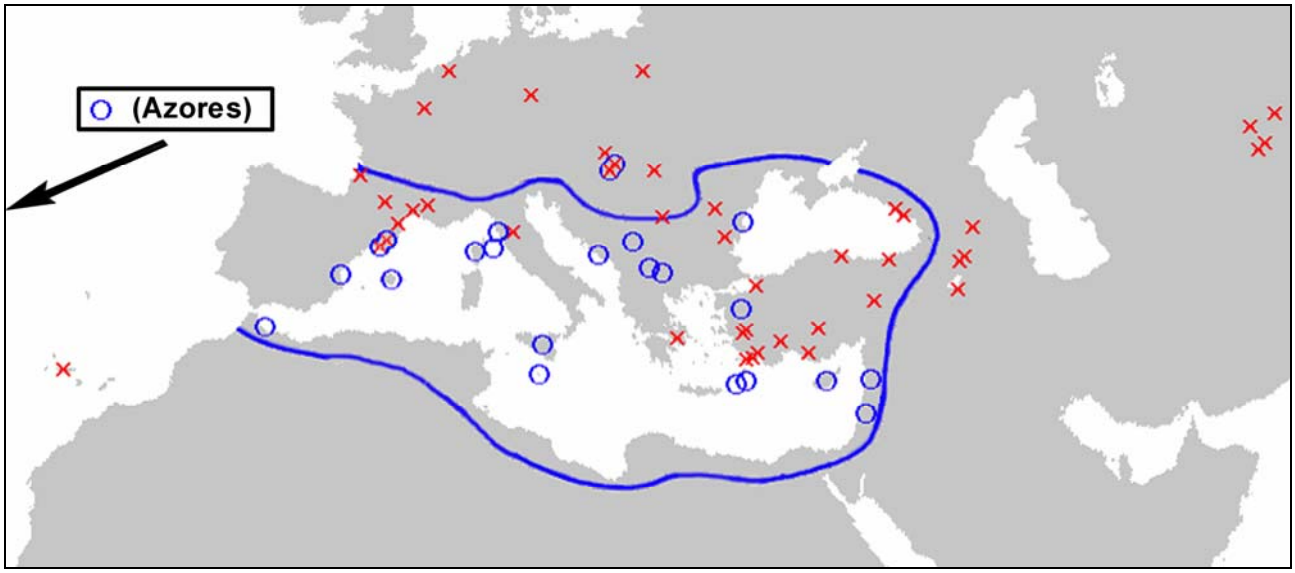

Fig. 1: Known West Palaearctic localities of *Lasius neglectus* (X) (data compiled on the basis of: VAN LOON & al. 1990, MARKÓ 1998, ESPADALER 1999, SEIFERT 2000, TARTALLY 2000a, b, ESPADALER & REY 2001, DEKONINCK & al. 2002, CZECHOWSKA & CZECHOWSKI 2003, ESPADALER & BERNAL 2003; and ESPADALER & BERNAL 2004 where the known localities of this ant species are updated) and of *Platyarthrus schoblii* species complex (O) (data collected on the basis of: STROUHAL 1939, RADU 1959, BUTUROVIĆ 1960, KARAMAN 1966, PRETZMANN 1975, SCHMALFUSS 1999, WARBURG & HORNUNG 1999, and own data); solid line: presumed native area of the isopod (modified map of SCHMALFUSS 1998).

Several authors proved or accepted the invasive and pest status of *L. neglectus* (see, e.g., BOOMSMA & al. 1990a, b, SEIFERT 2000, TARTALLY 2000a, b, ESPADALER & COLLINGWOOD 2001, DEKONINCK & al. 2002, VÖRÖS & GALLÉ 2002, CZECHOWSKA & CZECHOWSKI 2003, SCHLICK-STEINER & al. 2003, ESPADALER & al. 2004) because the species shows all the main characteristics of a tramp ant (HÖLLDOBLER & WILSON 1990: 215, PASSERA 1994). Each new data might contribute to the understanding of the life history strategy of this introduced ant.

Eastern Europe or Western Asia is thought to be the potential source area of *L. neglectus* (VAN LOON & al. 1990). SEIFERT (2000) cited a personal communication by A. Schulz who observed the species in natural steppe habitats in Asia Minor. The origin and the way of dispersal are questions of high importance concerning invasive species. However, insufficient information is available in this respect concerning *Lasius neglectus* and its accompanying fauna.

Ants usually have different, mainly commensalist guest invertebrates in their nests, for example woodlice (HÖLLDOBLER & WILSON 1990). The first myrmecophilous isopod specimens in the nest of a *L. neglectus* supercolony (= unicolonial population, see, e.g., ESPADALER & al. 2004) were found in Budatétény, in April, 2001 (leg. A. Tartally). These were identified as *Platyarthrus schoblii* BUDDE-LUND, 1885 (det. E. Hornung, rev. H. Schmalfuss and S. Taiti). This isopod is considered to be a holomediterranean species (Fig. 1) and was unknown in the Carpathian Basin before, in contrast to the native *P. hoffmannseggii* BRANDT, 1833. The latter is widespread in Hungary and in Europe (FORRÓ & FARKAS 1998, SCHMALFUSS 2003), and occurs frequently in the nests of different ant species. *Platyarthrus* spp. are presumably commensalists, scavengers that occasionally attend aphids, eat pellets expelled from infrabuccal chambers and probably feed on the faeces of the host ants, as well as on detritus, fungi and soil pieces. These white, blind and 2 to 4 mm long isopods are attracted by formic acid and humidity but they avoid light. Moreover, they pretend to be dead and/or they produce white and soggy excretion in response to the attack of ants (GRUNER 1966, HÖLLDOBLER & WILSON 1990: 473). The *Platyarthrus* species are strongly adapted to living in ant nests, although they can be kept without ants in lab populations (Hornung E., unpublished observation). There are other isopod genera besides *Platyarthrus* (e.g., *Typhloschizidium, Exalloniscus, Porcellionides* and *Nagurus*) that have myrmecophilous representatives (HÖLLDOBLER & WILSON 1990: 473).

Based on our first observations we presumed that *P. schoblii* was introduced to Budatétény together with *L. neglectus* and presumed that the isopod occurred in the nests of other *L. neglectus* supercolonies as well. A further question was whether it occurs also in the nests of native ant species in Hungary, as it does in Spain for example. Another as-

pect of the problem is whether the other well-established species, *P. hoffmannseggii*, is adopted by *L. neglectus* supercolonies in Hungary, or not.

Material and Methods

Until 2000 there were 12 published Hungarian localities where *L. neglectus* was present (VAN LOON & al. 1990, TARTALLY 2000a, b). Since then, four further sites have been added, all in Budapest: Szállás St. in 2003 (A. Andrásfalvy, pers. comm.); Pázmány P. Promenade in 2002, Dayka G. St. in 2003 (Cs. Nagy, pers. comm.) and in the Campus of Corvinus Uni, Fac. Horticultural Science in 2002 (A. Tartally, unpubl. data). We planned to survey all these known (16) Hungarian sites (Fig. 2). However, we could not find the colonies in Orom St. (where only a small *L. neglectus* colony was reported that was found in a sand box in 2000 and it disappeared until 2001) nor in Tahi (*L. neglectus* was mentioned only from one sample before). These localities were reported by TARTALLY (2000b). We checked the remaining 14 available colonies for the presence of *P. schoblii* and/or *P. hoffmannseggii* by hand sorting, turning over stones and opening nests in wood debris several times between April 2001 and April 2004. Nests of other ant species close to the entrances of *L. neglectus* supercolonies (less than 5 m) were searched at the same time for isopods. Moreover, previous collections were revised for specimens of *P. schoblii*. Since the first data, we have been checking ant nests for isopods during fieldwork both in Hungary and in Spain.

The exotic isopod species, *P. schoblii* (Fig. 3A) can easily be distinguished from the native *P. hoffmannseggii* (Fig. 3B) on the basis of its more rounded body, the longitudinal ribs on the tergits and the lobes on the head (RADU 1959, VANDEL 1962).

Results

We found *P. schoblii* populations in the nests of eight out of the 14 Hungarian *L. neglectus* supercolonies checked (Figs. 2 and 4). These are (shortcuts in brackets refer to those of Fig. 2):

Bp. (= Budapest), District I., Buda Castle (H), garden of the Historical Museum of Budapest, 9.IV. 2001, leg. A. Tartally; Buda Castle, Lovas St., 1.IV. 2004, 26.III.2004, leg. F. Vilisics.

Bp., District II., Lajos St. (E), 8.IV.2001, leg. A. Tartally; ibidem, 13.X.2001, leg. E. Hornung & A. Tartally; ibidem, 10.IX.2003, leg.: A. Tartally.

Bp., District XI., Dayka G. St. (L), 10.IX.2003, leg. A. Tartally.

Bp., District XI., Galvani St. (R), 9.IV.2001, leg. A. Tartally; ibidem, 13.X.2001, leg. E. Hornung & A. Tartally.

Bp., District XIV., Pétervárad St. (G), 13.X.2001, leg. E. Hornung & A. Tartally; ibidem, 10.IX.2003, leg. A. Tartally.

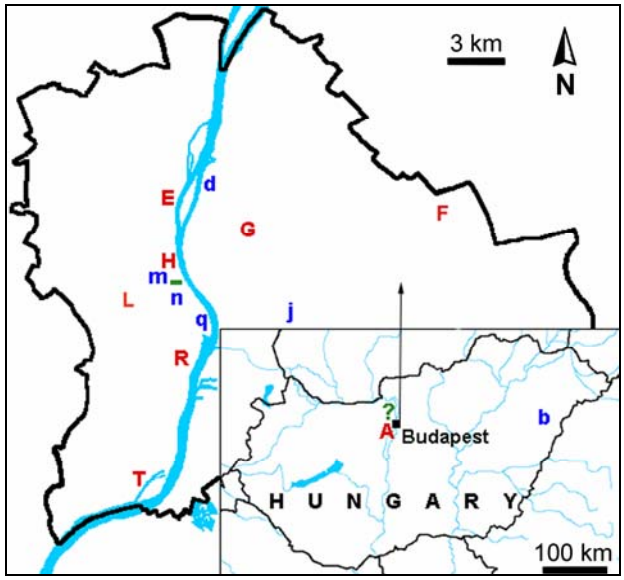

Fig. 2: The known localities of *L. neglectus* and *P. schoblii* in Hungary (letters show the checked supercolonies and capitals indicate the presence of *P. schoblii*): A: Érd: Felső St., b: Debrecen: Botanical Garden, d: Árpád-Bridge, E: Lajos St., F: Cement St., G: Pétervárad St., H: Buda Castle, j: Szállás St., m: Tigris St., L: Dayka G. St., n: Campus of Corvinus Univ., Fac. Horticultural Science, q: Pázmány P. Promenade, R: Galvani St., T: Budatétény; ?: Tahi (*L. neglectus* was reported only from one sample and the colony was not found); –: Orom St. (here *L. neglectus* disappeared by 2001).

Bp., District XVI., Cement St. (F), 13.X.2001, leg. E. Hornung & A. Tartally.

Bp., District XXII., Budatétény, Park St. (T), 2.IV. 2001, leg. A. Tartally; ibidem, 29.IV.2004, leg. F. Vilisics.

Érd, Felső St. (A), 13.X.2001, leg. E. Hornung & A. Tartally.

Despite our intensive search, we did not find *P. schoblii* outside of and no *P. hoffmannseggii* in *L. neglectus* nests, whereas *P. hoffmannseggii* can often and commonly be found together with different ant species.

Although *P. schoblii* was recorded in Spain before (see SCHMALFUSS 2003 for references), it was not described to co-occur with *L. neglectus* in this country. These isopod specimens were not morphologically different from the Hungarian *P. schoblii* specimens (revised by H. Schmalfuss and S. Taiti).

The material contained samples from colonies of different ant species that hosted the same isopod species. The list of species and localities of the known Spanish cohabitation is as follows:

Lasius neglectus VAN LOON, BOOMSMA & ANDRÁSFALVY, 1990, Matadepera (Barcelona), 3.IV. 2001, leg. X. Espadaler & S. Rey.

Lasius brunneus (LATREILLE, 1798), Sant Hilari (Girona), 23.IX.2003, leg. X. Espadaler.

Linepithema humile (MAYR, 1868), La Devesa del Saler (Valencia), 20.IV.2001, leg. X. Espadaler.

Messor structor (LATREILLE, 1798), Sant Cugat del Valles (Barcelona), 23.IV.2001, leg. X. Espadaler.

Formica gagates LATREILLE, 1798, El Muntanyá, Seva (Barcelona), 9.V.2001, leg. X. Espadaler.

Formica rufibarbis FABRICIUS, 1793, Sant Cugat del Vallés (Barcelona), 23.IV.2001, leg. X. Espadaler.

Voucher specimens are deposited in the collections of the Hungarian Natural History Museum/ Budapest, Hungary; Staatliches Museum für Naturkunde/Stuttgart, Germany (Hungarian localities); Dept. of Ecology, Faculty of Veterinary Science, Szent István University/Budapest, Hungary (Hungarian and Spanish localities), respectively.

Discussion

Our study shows that the woodlouse *P. schoblii* appears to be a recent colonizer in Hungary. It was most likely introduced together with its host ant, *L. neglectus*. Small fragments of polygynous ant colonies hosting isopod specimens can easily be spread by the transportation of horticultural products.

Isopods are especially suitable for anthropochoric distribution and jump dispersal as a fertilized female can reproduce several times without a new fertilization event (LUEKEN 1963, JOHNSON 1982). Furthermore, they carry their eggs/larvae in a brood pouch till hatching (e.g., LINSENMAIR 1989). These small-sized animals can easily be propagated in earth samples and with the exportation and importation of ornamental plants (HORNUNG & SZLAVECZ 2003).

Platyarthrus schoblii is hosted by several ant species in Spain (e.g., *Linepithema humile*, *Lasius brunneus*, *L. neglectus, Formica rufibarbis*, *F. gagates*, *Messor structor*). We found further data in scientific literature on the co-occurrence of the subspecies *P. schoblii hemicaelatus* STROUHAL with *Bothriomyrmex atlantis* FOREL, 1894 in Israel (PRETZMANN 1975). On the other hand, the widely distributed *P. hoffmannseggii* was found to be hosted by 24 ant species worldwide (GRUNER 1966, BERG & WIJNHOVEN 1997).

Platyarthrus schoblii is a holomediterranean species (SCHMALFUSS 1998). Published distribution of the species is as follows: Croatia: Dubrovnik (STROUHAL 1939); Serbia: Manastir Sv. Petka u Sičevačkoj Klisuri (BUTUROVIĆ 1960); Macedonia: Štip, Nerezi kod Skopja, Raduša (KARAMAN 1966); Israel (*P. schoblii hemicaelatus*): Aqua bella, Jerusalem, Yehiam-Galil (Bar'am, Gaash, PRETZMANN 1975), Gilboa Mts. (WARBURG & HORNUNG 1999); Greece: Karpathos Archipelago (Karpathos, Kasos, Saria, Armathia, Sokastro; SCHMALFUSS 1999); Romania (Dobrudsa): Eforia, Vasile Roaită (RADU 1959); and Azores, Balearic Islands, Morocco, Bulgaria, Turkey, Lebanon, Cyprus, N-America, Spain (references in SCHMALFUSS 2003) (Fig. 1).

Platyarthrus hoffmannseggii is an expansive isopod in Europe that co-occurs with a number of host ant species from several genera (GRUNER 1966, HÖLLDOBLER & WILSON 1990: 473). We suppose that *L. neglectus* might also adopt *P. hoffmannseggii* in a short time similarly to what happened in the case of *P. schoblii*, e.g., in Spain where it was also found together with the introduced, well established and invasive (ESPADALER & COLLINGWOOD 2001) Argentine ant, *Linepithema humile*. *Linepithema humile* is native in South America and is – similarly to *L. neglectus* – able to disperse also by colony budding (PASSERA 1994, TSUTSUI & SUAREZ 2003). The co-occurrence of the Mediterranean isopod with the Argentine ant proves the possibility of the isopod's acceptance by new host species.

In view of the above examples we presume that *P. schoblii* will also be adopted by different ant species living close to *L. neglectus* colonies in a short time.

The presence of *P. schoblii* was proved up to now in eight out of the 14 Hungarian *L. neglectus* colonies studied. The co-occurrence of the exotic isopod and *L. neglectus* confirms the theory of human introduction. This does not definitely mean a common origin as both species could meet in a later stage of their dispersal, although this possibility is quite unlikely. This problem can be solved only by genetic comparisons. The situation might even be more complicated in the case of potential multiple introductions of the ant (UGELVIG & al. 2004).

Another difficulty is that *P. schoblii* is a species complex containing 14 subspecies (SCHMÖLZER 1965) which can all probably be valid species (TAITI & FERRARA 1996). We have compared samples from Spain and Hungary. The isopods proved to be identical to subspecies *P. schoblii schoblii* on their morphological characters. More data are needed on the distribution and co-occurrence of the isopod and the ant species to clarify the overlap of their common area.

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Zusammenfassung

Die invasive Gartenameise *Lasius neglectus* VAN LOON, BOOMSMA & ANDRÁSFALVY, 1990 wurde aus

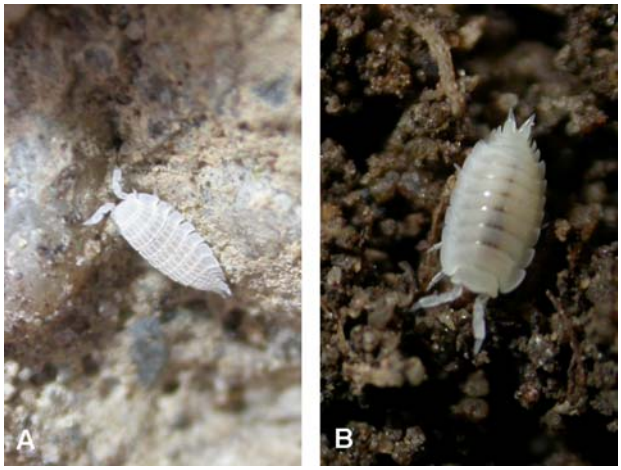

Fig. 3: The longitudinal ribs of *Platyarthrus schoblii* (A) distinguish it from *P. hoffmannseggii* (B).

Fig. 4: *Platyarthrus schoblii* in the nest of *Lasius neglectus* (all photos by E. Hornung).

Budapest, Ungarn, beschrieben. Seither wurden hier 16 Kolonien der Art gefunden. Mehr Fundorte könnten wahrscheinlich durch systematisches Suchen in ganz Ungarn gefunden werden. Ausserhalb von Budapest sind nur wenige Vorkommen bekannt (im Botanischen Garten in Debrecen sowie in Érd und Tahi; die beiden letzteren liegen nahe Budapest).

Von einer Reihe Tiergruppen sind myrmekophile Vertreter bekannt, als fakultative oder obligate Mitbewohner der Ameisen (z.B. Käfer, Springschwänze, Milben, Grillen und Asseln). Von *L. neglectus* kannte man aber bisher keine Mitbewohner. Im Jahr 2001 entdeckten wir erstmals Asseln als Kommensalen in einer Kolonie in Budatétény. Wir identifizierten sie als *Platyarthrus schoblii* BUDDE-LUND, 1885, eine aus Ungarn bisher unbekannte Art, die vorher nur aus dem mediterranen Raum bekannt gewesen war. Eine systematische Suche ergab, dass die Assel in 60 % der untersuchten *L. neglectus* Populationen vorkommt.

Die andere, aus Ungarn bekannte Art der myrmekophilen Gattung, *Platyarthrus hoffmannseggii* BRANDT, 1833, wurde nicht bei *L. neglectus* gefunden. Gleichzeitig wurde *P. schoblii* hier bisher nicht bei anderen Ameisenarten gefunden. Trotzdem vermuten wir, dass kreuzweise Adoption beider Assel-Arten stattfinden wird, wie sie z.B. in Spanien zwischen dem dort heimischen *P. schoblii* und der eingeschleppten und invasiven Ameise *Linepithema humile* (MAYR, 1868) vorkommt. Das wiederholt beobachtete gemeinsame Vorkommen von *P. schoblii* und *L. neglectus* könnte die Hypothese untermauern, dass die anthropogene Verbreitung der beiden Arten durch Zierpflanzen in Blumentöpfen erfolgt.

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