

Acceptance of two native myrmecophilous species, *Platyarthrus hoffmannseggii* (Isopoda: Oniscidea) and *Cyphoderus albinus* (Collembola: Cyphoderidae) by the introduced invasive garden ant *Lasius neglectus* (Hymenoptera: Formicidae) in Belgium

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Abstract. The myrmecophilous isopod *Platyarthrus hoffmannseggii* Brandt, 1833 and the myrmecophilous springtail *Cyphoderus albinus* Nicolet, 1842 are commonly found in nests of a wide range of ant species in Belgium. Here we report the first record of both myrmecophiles in nests of the invasive garden ant *Lasius neglectus* in the Citadelpark of Ghent, Belgium. *Platyarthrus hoffmannseggii* was found in two of the *Lasius neglectus* nests studied. In one of the two *C. albinus* was also discovered. In the localities where the invasive garden ant *Lasius neglectus* was introduced, as is also the case in the Citadelpark in Ghent, it out-competes all native ant species. This ant has a dramatic effect on the local native ant fauna. However, some of the myrmecophilous species associated with the native ant-fauna are less threatened as they are accepted by this invasive garden ant.

INTRODUCTION

In 1990 the invasive garden ant *Lasius neglectus* was first discovered and described from Budapest (Boomsma et al., 1990; Loon van et al., 1990). Since then, this polygynous, supercolonial and very competitive ant has been recorded at 93 localities in 15 countries all over Europe and nearby Asia (Schulz & Seifert, 2005; Espadaler & Bernal, 2006). Recently, more has been discovered about its distribution, origin, colony structure, ecology and behaviour at the sites where it was introduced (Seifert, 2000; Espadaler & Rey, 2001; Espadaler et al., 2004; Schulz & Seifert, 2005; Espadaler & Bernal, 2006). The source of the invasive garden ant is thought to be western Asia, most probably somewhere in the area between Asia Minor and Iran (Seifert, 2000; Schlick-Steiner et al., 2003; Schulz & Seifert, 2005). This ant is mainly introduced and spread by man: the transport of horticultural products is suggested to be the main vector for long distance dispersal (Seifert, 2000; Dekoninck et al., 2002; Tarrally et al., 2004). This is certainly also the case for Belgium, where *L. neglectus* arrived before 1978 (Dekoninck et al., 2002). It has spread locally around its place of introduction: the Citadelpark in Ghent. In the microhabitats where this pest species settles, it out-competes other species of ants and produces huge nests. Also at other sites where this species was introduced in Europe, it out-competes native ant species, locally alters the structure and functioning of ecosystems and achieves pest status (Boomsma et al., 1990; Seifert, 2000; Tarrally, 2000; Espadaler & Rey, 2001; Vörös & Gallé, 2002; Czechowska & Czechowski, 2003; Schlick-Steiner et al., 2003; Espadaler et al., 2004; Tarrally et al., 2004; Schulz & Seifert, 2005; Espadaler & Bernal, 2006). The environmental factors determining the potential threat of *L. neglectus* to the native ant fauna and its spread in Belgium are the aims of the present study.

Many ant species have several guests in their nests (beetles, mites, crickets, woodlice, springtails, ...). Some of these myrmecophilous species are ignored or tolerated; others are attacked (Hölldobler & Wilson, 1990). For most of these myrmecophilous species, information on their ecology, behaviour, live cycles and dispersal is lacking because they are difficult to observe and can only be found when specifically searched for. *L. neglectus* has a different colony structure from most other *Lasius* s. str., i.e., it is polygynous and constructs huge nests, possibly experiences more diverse conditions, offers more places for other species to survive in and routes for entering the nest, and thus in general offers more refuges for myrmecophiles than the smaller nests of monogynous species. Information on the nest fauna of *L. neglectus* in its original habitat is still lacking. However, Espadaler & Bernal (2006) give some indication of other animals associated with *L. neglectus* in Spain, where this ant was also introduced (Coleoptera: *Cythra laeviscula* Ratzeburg, 1837 (Chrysomelidae) larvae in a nest at Sant Cugat and one adult of *Ampholis marginata* (Fabricius, 1781) (Nidulidae) in a nest of *L. neglectus* at Seva, Barcelona; Orthoptera: *Myrmecophilus acervorum* Panzer, 1799 in Bellaterra, Seva and Begues).

Another myrmecophilous species in nests of *L. neglectus* at the sites where it was introduced, is the isopod *Platyarthrus schoblii* Brüdde-Lund, 1885, which was recently recorded in nests of this ant in Budapest (Tarrally et al., 2004). These authors suggest that this is the result of a joint introduction of the isopod and *L. neglectus* into Hungary, as *P. schoblii* is a new species for that country and only previously known from the Mediterranean region. In their study they recorded the presence of this isopod in 60% of the *L. neglectus* populations studied (Tarrally et al., 2004). The other well-established representative of the myrmecophilous genus *Platyarthrus* in Hungary, *P. hoffmannseggii*, was not found to co-occur with *L. neglectus*. *P.*

hoffmannseggii is a widely distributed isopod in western-Europe that co-occurs with a great number of species from several genera of host ants (Vandel, 1962; Berg & Wijnhoven, 1997). Tartally et al., (2004) supposed that *L. neglectus* might also adopt *P. hoffmannseggii* in a relatively short time after introduction, as happened in the case of *P. schoblii* in Spain. There, the native *P. schoblii* was found together with the introduced and locally well established Argentine ant *Linepithema humile* (Tartally et al., 2004), which supports suggestion that this isopod is likely to be accepted by this new host species.

In western-Europe two commonly found myrmecophiles are the springtail *Cyphoderus albinus* (Gisin, 1960; Hopkin, 1997) and the terrestrial isopod *P. hoffmannseggii*. Based on Delamare Deboutville (1948) and Salmon (1964), *C. albinus* is recorded in company with *Camponotus* sp. in Hungary (Tomosvary in 1883); *Formica sanguinea*, *Lasius niger*, *Lasius flavus* and *Myrmica* sp. (Reuter in 1895), *L. flavus*, *L. niger* and *Tetramorium caespitum* (Axelson in 1905), *L. niger*, *L. flavus*, *Myrmica rubra*, *Formica fusca*, *Camponotus herculeanus* and *T. caespitum* (Linnantemi in 1907), *F. sanguinea* (Linnantemi in 1912) in Finland; *Formica* sp. and *Lasius* sp. in Sweden (Agren in 1903); *L. niger* in France (Kieffer in 1900); *L. flavus* (Evans in 1908) and *L. flavus*, *L. niger*, *Myrmica rubra* and *Formica fusca* (Bagnall in 1910) in England. There are also some additional observations of *C. albinus* with *Myrmica ruginodis* and *Lasius emarginatus* in France (Vannier, 1971), *Myrmica scabrinodis*, *M. rubra*, *Myrmica* sp. and *Lasius* sp. in Belgium (Janssens, 1995) and *Camponotus sylvaticus* in Spain (Henderickx & Vets, 2003).

In Europe, *C. albinus* is widely distributed from Ireland via Norway and Mid-Finland, to Ukraine via Italy and until North Africa in the south, and up to Lebanon (Gisin, 1960; Salmon, 1964). Records cited by Salmon (1964) from North America (USA) (= *Pseudosinella* sp. cf. Delamare Deboutville (1948)), South America (Argentina) (= dubious record cf. Mari Muri & Belfinger, 1990), West Africa (Sierra Leone) and Micronesia (Marianen) need to be validated; they concern most probably other species.

In urban sites in Belgium, and the parks of the city of Ghent especially, *P. hoffmannseggii* is a commonly found myrmecophile in ant nests. It is assumed to have a wide range of hosts in Belgium and adjacent countries (Vandel, 1960; Berg & Wijnhoven, 1997; Dekoninck et al., 2003) and probably can also be found in a wide variety of habitats.

Recently an inventory of these two ant guests was undertaken in The Netherlands and Belgium. The major aims were to (1) gather all the records, (2) collect data on the hosts, (3) obtain information on the soil properties of the known localities and (4) gather information on their abundance and behaviour in ant nests. It was during this project that *C. albinus* and *P. hoffmannseggii* were recorded for the first time in nests of the invader garden ant, *L. neglectus*, in Ghent (Belgium).

MATERIAL AND METHODS

On 24.iv.2006 five nests of *Lasius neglectus* in the Citadelpark were inspected for myrmecophilous guests. When checking the colonies for the presence of *P. hoffmannseggii* and *C. albinus*, nests were opened by turning over stones. Each time adults of the two species were carefully looked for by hand sorting and sifting of the sandy soil, plant debris and small stones.

RESULTS AND DISCUSSION

Adults of *P. hoffmannseggii* were found in two of five *L. neglectus* nests in the Citadelpark. In one of the two nests four

adults and one juvenile of the springtail *C. albinus* were also observed. Specimens are stored in the collection of the RBINS, Royal Belgian Institute of Natural Sciences and the collection of the RUCa, Rijksuniversiteit Centrum Antwerpen. The *L. neglectus* nests, where no myrmecophiles were found, were situated in less sunny conditions and perhaps this is why they lacked *P. hoffmannseggii* and *C. albinus*.

The habitat of *C. albinus* is characterised as follows: dry soil conditions, always found in the company of ants, regularly found in ant nests under stones; temperature range of soil between 6°C and 14°C; degree of moisture in the soil = 2–25% (volume); found from January to December (Bockemühl, 1956). In a soil sample taken at Spitzberg near Tübingen, *C. albinus* was found at a depth of 12 to 18 cm, when the temperature at the surface was 26°C. This species seems to be confined to a narrow temperature range (Bockemühl, 1956).

A preliminary list of the possible hosts in Belgium and The Netherlands (Berg & Dekoninck, unpubl. records) indicates a wide range of possible native hosts as already reported for elsewhere in Europe for both *C. albinus* (Delamare Deboutville, 1948; Salmon, 1964; Vannier, 1971; Janssens, 1995; Henderickx & Vets, 2003) and *P. hoffmannseggii* (Vandel, 1962; Berg & Wijnhoven, 1997). We assume that *P. hoffmannseggii* and probably also *C. albinus* are common guests in ant nests in the parks of the city of Ghent and they have no particular preference for any particular species of ant. We assume that this was also the case in the Citadelpark before the arrival of the invasive garden ant. As this invasive species has out-competed almost all other ant species, the only possible nests for both myrmecophilous species are now the supercolonies of *L. neglectus*.

How both myrmecophilous species are able to locate and colonize the nests of their new hosts (and also other host nests) is unknown. Probably they produce eggs that are "recognized" or misidentified as ant eggs or larvae and brought to the nests, as is sometimes the case for other myrmecophilous species, such as butterflies (Elmes et al., 1991; Thomas et al., 1991) and bees. This might be the case because Vannier (1971) observed *Myrmica ruginodis* workers transporting not only their larvae but also specimens of *C. albinus* deep into their nest when the nest was opened.

The suggestion that *L. neglectus* might adopt local myrmecophilous species (Tartally et al., 2004) is confirmed here. It is unknown if this is a quick process taking only several years or whether it takes much longer, because the first *L. neglectus* colony probably reached Ghent before 1978 (Dekoninck et al., 2002). The high percentage of nests with these myrmecophiles indicates it is a quick process. Donisthorpe (1927) mentions a similar case of the introduced ant (*Wasmannia auropunctata* Roger, 1863) hosting the native *C. albinus* in the hot-houses at Kew (Great Britain). The introduced pest ant species *L. neglectus* seems to be having a dramatic impact on the local ant fauna in Europe (Espadaler, 1999; Seifert, 2000; Espadaler & Rey, 2001; Dekoninck et al., 2002; Espadaler et al., 2004; Espadaler & Bernal, 2006). However, some myrmecophilous species seem to be able to adapt and colonize the nests of this introduced ant species. Probably for these species colonizing the nests of other ants is not a problem that threatens their survival.

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REFERENCES

- BERG M.P. & WUJHOVEN H. 1997: Landpissebedden. *Wer. Meded. K. Ned. Naturh. Veren.* **221**: 1–80.
- BOCKENBUHL J. 1956: Die Apteriygoten des Spitzberges bei Tübingen, eine faunistisch-ökologische Untersuchung. *Zool. Jb. (System.)* **84**(2/3): 113–194.
- BOOMSMA J.J., BROUWER A.H. & VAN LOON A.J. 1990: A new polygynous *Lasius* species (Hymenoptera: Formicidae) from central Europe. II. Allozymatic confirmation of the species status and social structure. *Insectes Soc.* **37**: 362–375.
- CZECHOWSKA W. & CZECHOWSKI W. 2003: Further records of *Lasius neglectus* van Loon, Boomsma & Andrásfalvy (Hymenoptera: Formicidae) for Warsaw, with a key to the Polish species of the subgenus *Lasius* s. str. *Fragm. Faun.* **46**: 195–202.
- DERONINCK W., DE BAERE C., MERLENS J. & MAELFAIT J.-P. 2002: On the arrival of the Asian invader ant *Lasius neglectus* in Belgium (Hymenoptera, Formicidae). *Bull. Soc. R. Belge Entomol.* **138**: 45–48.
- DERONINCK W., VANKERKHOVEN F. & MAELFAIT J.-P. 2003: *Ver-spreidingsatlas en voortropige Rode Lijst van de miereën van Vlaanderen. [Atlas of the Distribution and a Provisional Red List of the Ants of Flanders.]* Report of the Institut of Nature Conservation (Ser. B) 2003.07. Brussel, 191 pp.
- DELMARE DEBOUTTEVILLE C. 1948: Recherches sur les Collemboles Temnophiles et Myrmécophiles. *Arch. Zool. Exp. Génér.* **85**: 261–425.
- DONISTHORPE H.S.J.K. 1927: *The Guests of British Ants. Their Habits and Life Histories.* G. Routledge & Sons, London, 244 pp.
- ELMES G.W., THOMAS J.A. & WARDLAW J.C. 1991: Larvae of *Maculinea rebeli*, a large-blue butterfly, and their *Myrmica* host ants: wild adoption and behaviour in ant-nests. *J. Zool. (Lond.)* **223**: 447–460.
- ESPADALER X. 1999: *Lasius neglectus* van Loon, Boomsma & Andrásfalvy, 1990 (Hymenoptera, Formicidae), a potential pest ant in Spain. *Orysis* **14**: 43–46.
- ESPADALER X. & BERNAL V. 2006: *Lasius neglectus*, a polygynous, sometimes invasive, ant. <http://www.creafl.uab.es/xeg/Lasius/ingles/index.htm> retrieved on March 2006.
- ESPADALER X. & REV S. 2001: Biological constraints and colony founding in the polygynous invasive ant *Lasius neglectus* (Hymenoptera, Formicidae). *Insectes Soc.* **48**: 159–164.
- ESPADALER X., REV S. & BERNAL V. 2004: Queen number in a supercolony of the invasive garden ant, *Lasius neglectus*. *Insectes Soc.* **51**: 232–238.
- GISIN H. 1960: *Collemboletiflora Europaeae.* Musée d'Histoire Naturelle, Genève, 312 pp.
- HENDERICKX H. & VETS V. 2003: A new myrmecophilous Allochemes (Arachnida: Pseudoscorpiones: Chernetidae) from Catalunya, Spain. *Zootaxa* **366**: 1–10.
- HÖLDOBLER B. & WILSON E.O. 1990: *The Ants.* The Belknap Press of Harvard University Press, Harvard, 732 pp.
- HOPKIN S.P. 1997: *Biology of the Springtails (Insecta: Collembola)* Oxford University Press, 330 pp.
- JANSENS F. 1995: Een blinde asielzoeker met een voorkeur voor miereën: *Cyphoderus albinus* Nicolet, 1842 (Collembola: Cyphoderidae). *Entomo-Hifo* **6**(2): 80–84.
- LOON VAN A.J., BOOMSMA J.J. & ANDRÁSFALVY A. 1990: A new polygynous *Lasius* species (Hymenoptera: Formicidae) from Central Europe. I Description and general biology. *Insectes Soc.* **37**: 348–362.
- MARI MUTT J.A. & BELLINGER P.F. 1990: *A Catalog of the Neotropical Collembola, Flora & Fauna Handbook No. 5.* Sandhill Crane Press, Gainesville, 237 pp.
- SALMON J.T. 1964: An index to the Collembola. Part 2. *R. Soc. N. Z. Bull.* **7**: 145–644.
- SCHULCK-STEINER B.C., STEINER F.M., SCHÖDL S. & SEFFERT B. 2003: *Lasius austriacus* sp. n., a Central European ant related to the invasive species *Lasius neglectus*. *Sociobiology* **41**: 725–736.
- SCHULTZ R. & SEFFERT B. 2005: *Lasius neglectus* (Hymenoptera: Formicidae) – a widely distributed tramp species in Central Asia. *Myrmecol. Nachr.* **7**: 47–50.
- SEFFERT B. 2000: Rapid range expansion in *Lasius neglectus* (Hymenoptera Formicidae) – an Asian invader swamps Europe. *Mitt. Mus. Naturk. Berl., Dt. Entomol. Z.* **47**: 173–179.
- TARTALLY A. 2000: Notes on the coexistence of the supercolonial *Lasius neglectus* van Loon, Boomsma & Andrásfalvy, 1990 (Hymenoptera: Formicidae) with other ant species. *Tiscia* **32**: 43–46.
- TARTALLY A., HORNING E. & ESPADALER X. 2004: The joint introduction of *Platyarthrus schoblii* (Isopoda: Oniscidea) and *Lasius neglectus* (Hymenoptera: Formicidae) into Hungary. *Myrmecol. Nachr.* **6**: 61–66.
- THOMAS J.A., MUNGUIRA M.L., MARTIN J. & ELMES G.W. 1991: Basal hatching by *Maculinea* butterfly eggs: a consequence of advanced myrmecophilily? *Biol. J. Linn. Soc.* **44**: 175–184.
- VANDEL A. 1962: Isopodes terrestres (deuxième partie). *Faune de France* **66**: 417–931.
- VANNIER G. 1971: Les fourmis, prédateurs permanents de certains types de Collemboles. *Rev. Écol. Biol. Sol* **8**: 119–132.
- VÖRÖS G. & GALLÉ L. 2002: Ants (Hymenoptera: Formicidae) as primary pests in Hungary: recent observations. *Tiscia* **33**: 31–35.

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