

Is *Lasius bicornis* (Förster, 1850) a very rare ant species? (Hymenoptera: Formicidae)

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Abstract

Since its description based on a single alate gyne by the German entomologist Arnold Förster, *Lasius bicornis* (Förster, 1850), previously known as *Formicina bicornis*, has been sporadically observed in the Eurasian region and consequently been characterized as very rare. Here, we present the Belgian situation and we consider some explanations for the status of this species.

Keywords: Hymenoptera, Formicidae, *Lasius bicornis*, faunistics, Belgium

Samenvatting

Vanaf de beschrijving door de Duitse entomoloog Arnold Förster, werd *Laisus bicornis* (Förster, 1850), voordien *Formicina bicornis* en beschreven op basis van een enkele gyne, slechts sporadisch waargenomen in de Euraziatische regio. De soort wordt dan meer dan 150 jaar later als 'zeer zeldzaam' genoteerd. In dit artikel geven we een overzicht van de Belgische situatie en overwegen enkele punten die de zeldzaamheid kunnen verklaren.

Résumé

Depuis sa description par l'entomologiste allemand Arnold Förster, *Lasius bicornis* (Förster, 1850), anciennement *Formicina bicornis* décrite sur base d'une seule gyne ailée, n'a été observée que sporadiquement en Eurasie, ce qui lui donne un statut de «très rare». Dans cet article, nous donnons un aperçu de sa situation en Belgique et essayons de comprendre pourquoi elle est si rare.

Introduction

After more than 150 years of observation and sampling ants, European myrmecologists still catalogue *Lasius bicornis* (Förster, 1850) as a very rare ant species. In 1998 B. SEIFERT published a red list of the ants in Germany and mentioned *L. bicornis* as extremely rare with geographical constraints (SEIFERT, 1998). In his revision of the subgenus *Chthonolasius* Ruzsky, 1912 Seifert defines the range of this species as 'continental Europe' with 57°N as the most northern locality where it was observed (SEIFERT, 1988). However recently two alate queens have been sampled in the south of Norway: Larvik, 2014, N59.2113° E10.0102° and Porsgrunn, 2012, N59.1220° E9.69799° (ØDEGAARD *et al.*, 2015). In the Mediterranean area an alate female has been found in Sardinia (in Tiana 1956 – POLDI, 1962) and some workers in central Italy (MEI, 1984). *Lasius bicornis* does not occur in Great Britain and Ireland (ELSE *et al.*, 2016) but as far east its distribution ranges to the Himalayas, Kashmir and Tibet (COLLINGWOOD, 1982). The conclusion of all these data points in one direction – *L. bicornis* is a rather rare Eurasian species, a species of which the appearance is worth mentioning. It's also

remarkable that almost every record concerns a single gyne, mostly alate or occasionally one or a few workers, but with a rare exception a nest has been found so far. In the south of the Dutch province Limburg a nest was observed in 1912 in Aalbeek and a few other records are concentrated in this province (VAN LOON, 2004). After 1950 *L. bicornis* was considered extinct in the Netherlands until 2008 when a male and two alate females were captured with a light trap in Tilburg (BOER, 2009). The ‘first’ observation in Belgium is noticed by J. Bondroit (BONDROIT, 1918), an observation that is repeatedly mentioned in later publications. However, we have good reasons to question his finding in Belgium as in a short paper Bondroit gives a list of ants found in the Hautes Fagnes and here he noticed: “*Lasius bicornis* FOERSTER. – Aix-la Chapelle (FOERSTER), Hautes Fagnes, une ♀” (BONDROIT, 1912). Here Bondroit refers to Förster and in the type description by Förster we read: “*Weibchen dieser Art würde in der Nähe von Aachen entdeckt*” (FÖRSTER, 1850). Aachen is known in French as Aix-la-Chapelle. This also means that Bondroit considered Aachen to be a city in the area of the Hautes Fagnes. In his 1918 paper Bondroit describes a record of an alate (?) female and at the end he remarks: “Province de Liège: Hautes Fagnes (1). Prusse rhéane: Aix-la-Chapelle (Förster).”. In an explanatory footnote we read: “(1) ... Cette région (les Hautes-Fagnes) est située sur la frontière belgo-prussienne, à l’est de Spa.” (BONDROIT, 1918). However that time the east border of Belgium was only a few kilometers from Spa so that the Hautes Fagnes were German territory at the time of the *L. bicornis* record. All these considerations make it unclear that Bondroit is talking of a real Belgian observation of *L. bicornis*. The capture of an alate gyne with a Malaise trap in 2003 in Sint-Pieters-Voeren is probably the first certain notice of this ant in Belgium instead of a rediscovery (DEKONINCK & GROOTAERT, 2005).

Material and methods

The data we have consulted for the evaluation of the rareness of *L. bicornis* in Belgium are listed in the database FORMIDABEL (FORMicidae DAtabase BELgium) (BROSENS *et al.*, 2013). From the 31.479 records (December 2017) we extracted 20 records related to *L. bicornis* (Table 1). In this database we compared the locations of *L. bicornis* with the records of *Lasius brunneus* (Latreille, 1798) (697 records) and *Lasius fuliginosus* (Latreille, 1798) (1.117 records) two dendrobionts. The locations in Belgium can be produced on a map on the site www.formicidae-atlas.be of The Belgian Biodiversity Platform.

Characteristics of *Lasius bicornis*

Lasius bicornis is a good recognizable ant of the genus *Lasius* Fabricius, 1804. It belongs to the subgenus *Chthonolasius* and is a temporary social parasite with a dependant colony foundation in nests of *Lasius* s. str. There seems to be a consensus that the host is the tree-ant *L. brunneus*, considered as a true canopy dwelling ant species (SEIFERT, 2008). Worker, male and gyne are characterised by an obvious very high, narrow petiole with a deep incision. The gynes are, compared with the other species of *Chthonolasius*, markedly smaller (4,5 – 5,0 mm) and not much bigger than their own workers (3,9 – 4,5) (VAN BOVEN & MABELIS, 1986). Nests can be found in old (hollow) trees (cfr *L. brunneus*) and rotten logs. Nuptial flights are observed from April until mid-September. Besides these few observations very few is known about the lifecycle of this remarkable ant. In his elaborated monography of the genus *Lasius*, E. Wilson doesn’t even dedicated a paragraph to the ecology of *L. bicornis* (WILSON, 1955). Half a century later, the situation has not changed significantly (SEIFERT, 1988; 1993).

Colony founding

Like all other ants of the subgenus *Chthonolasius*, *L. bicornis* is a temporary social parasite (KÜTTER, 1969). As a consequence, it is much less common than its hosts. Within their entire distribution range, it is therefore considered to be a very rare species. In most observations we notice only one alate or dealate gyne searching for a host colony. At such moments queens are choosing the appropriate moment to enter the hosts’ nest, kill the local queen and engage the workers for her own colony founding.



Fig. 1. Alate gyne of *L. bicornis* collected in Oudergem with the typical petiole in detail (Photograph: Camille Locatelli).

Lasius bicornis is an ant with a dependent colony founding. All the ants of the subgenus *Lasius* s. str. are independent-founding species with a system where one (haplometrosis) or two or more (pleometrosis) fertilised females intent to start a new colony. In a few studies it has been demonstrated that there are morphological differences between ant queens performing colony founding in a dependent or an independent way (KELLER & PASSERA, 1989; STILLE, 1996). It has been demonstrated that the fat content in gynes with an independent colony founding is much higher than in gynes with a dependent colony founding. Also remarkable is the development involving the fat reserves between the moment of emergence of the new gynes and the moment of the mating time. This increase may mount up to 132% for *Lasius niger* Linnaeus, 1758, and even to 455% for *Lasius flavus* Fabricius, 1782. These physiological facilities will help the queens to bridge the period between their nuptial flight and the emergence of the first workers (KELLER & PASSERA, 1989). Based on these observations STILLE (1996) showed that there is a correlation between the thorax volume (length x width x height) and the mode of nest-founding. Unfortunately we don't have analytic results for *L. bicornis*, but two other *Chthonolasius* species *Lasius umbratus* (Nylander, 1846) and *Lasius mixtus* (Nylander, 1846) have been compared with *L. niger* and *Lasius psammophilus* Seifert, 1992 (*Lasius* s. str.). In this comparison we notice an obvious difference of the thorax ratio of queen/worker between the independent species (24.08 & 31.60) and the dependent species (9.49 & 8.65). The queens of *L. bicornis* are quite small, much smaller than *L. umbratus* or *L. mixtus* and they are almost the same size as their own workers. With a probable very low thorax ratio they must have developed a successful technique to enter a host nest within a short time after their nuptial flight. There is neither morphological nor nuptial flight indication leading to the conclusion of a postponed nest acquisition.

Sampling methods and results in Belgium

Searching in the field for a hypogaecic nesting ant species is mostly like searching a needle in a haystack. Even finding an alate or dealate gyne depends of being in the right place at the right time. For almost all reports in the above-mentioned literature we are ignorant of the sampling methods, especially when it comes to old observations. Using a light trap is a good technique for collecting males and females during the nuptial flight but it's a snapshot (DEMETZ, 2010). Nevertheless there are several records of catches with this method. There are indications that collection methods that run for a long time (weeks, months) are the most promising for success of collecting hypogaecic ant species. We don't have to mention that even the best-chosen method will be useless in the wrong environment. It's most improbable to find *L. bicornis* in a sandy area without trees just like it will be nearly impossible to collect the species in a location without their host.

We performed several long-term surveys with pitfall traps, for example:

- In 2000: 18 plots with 6 pitfall traps / plot (March 2000 – March 2001) (MAES *et al.*, 2003)
- In 2001: 33 locations with 2 pitfall traps / location (April 2001 – January 2002) (LAMBRECHTS *et al.*, 2002)
- In 2003 : 7 locations with 2 pitfall traps / location (Mai 2003 – Juin 2004) (LAMBRECHTS *et al.*, 2007)



Fig. 2. New type tree-elector first used in Belgium in 2016 (Photograph: Maarten Jacobs).

Table 1: Records of *L. bicornis* in the Belgium database FORMIDABEL. Caste: AGY = alate gyne, DGY = dealate gyne, MAL = male, WOR = worker; Ref.: 1 = BONDROIT, 1918, 2 = DEKONINCK & GROOTAERT, 2005, 3 = DEKONINCK, WEGNEZ & MULS, 2009 and Leg.: D&R = A. Drumont & H. Raemdonck, DMU = David Muls, DTH = Doortje Theunissen, JBE = Jean-Pierre Beuckx, JBO = Jean Bondroit, JRE = Jos Reekmans, MJA = Maarten Jacobs, LCR = Luc Crevecoeur, WDE = Wouter Dekoninck, WBR = WalBru.

Number	Caste	Date	Municipality	UTM	Method	Microbiome	Ref.	Leg.
2	AGY	15/7/1918	les Ardennes	?	?	?	1	JBO
1	DGY	15/7/1920	les Ardennes	?	?	?		JBO
1	AGY	7/8/2003	St-Pieters-Voeren	FS9823	Malaise trap	deciduous forest	2	WDE
1	AGY	13/6/2005	Elewijt	FS0646	light trap	garden		DMU
1	AGY	4/5/2008	Awirs	FS7007	by hand	deciduous forest	3	WBR
1	AGY	13/6/2009	Elewijt	FS0646	light trap	garden	3	DMU
1	WOR	3/1/2010	Neerrepn	FS7232	alcohol trap	hollow ash		JBE
1	AGY	22/5/2010	Elewijt	FS0646	light trap	garden		DMU
1	MAL	16/8/2011	Elewijt	FS0646	light trap	garden		DMU
1	AGY	27/8/2012	Hechtel-Eksel	FS6271	light trap	pine forest		DTH
2	MAL	2/8/2013	Voeren	GS0125	light trap	deciduous forest		LCR
1	AGY	2/8/2013	Voeren	GS0125	light trap	deciduous forest		LCR
1	AGY	19/5/2014	Elewijt	FS0646	light trap	garden		DMU
1	AGY	14/5/2015	St-Truiden	FS5636	pitfall	moist grassland		LCR
1	AGY	16/9/2015	Oudergem	FS1204	pheromone trap	botanical garden		D&R
1	MAL	28/8/2016	Elewijt	FS0646	light trap	garden		DMU
1	AGY	12/5/2017	St-Truiden	FS5132	tree-elector (Fig. 2)	cherry tree		MJA
1	AGY	19/5/2017	St-Truiden	FS5132	tree-elector (Fig. 2)	cherry tree		MJA
1	DGY	12/5/2017	Borgloon (Nieuwmolen)	FS6231	window pane trap	pear tree		LCR
4	AGY	6/6/2017	Borgloon (Opleeuw)	FS6733	pitfall	hawthorn tree		JRE
3	MAL	6/6/2017	Borgloon (Opleeuw)	FS6733	pitfall	hawthorn tree		JRE
3	WOR	6/6/2017	Borgloon (Opleeuw)	FS6733	pitfall	hawthorn tree		JRE

We just mention three of several comparable investigations to come to the conclusion that in these 188 pitfalls, sampling ants during a time interval of almost a year or longer we never found a single *L. bicornis* ant. Most of the studies were performed in wet heath communities and former arable land. Sampling with pitfalls, Malaise traps, tree-electors (new method – Fig. 2) and alcohol traps in a hollow tree are preferable done in wooded environments. These methods have been used for more than two decennia especially in the province of Limburg (Belgium) in surveys for conservation studies and gave us an impression of the appearance of the rare ant species, *L. bicornis*.

Results

For Belgium we found 11 locations with different UTM grid coordinates of 1 square kilometer with the presence of this ant *L. bicornis* (Table 1). Eight of these locations are situated in Limburg. The most remarkable records of the species were done in Elewijt. During the summer of several years 2005, 2009, 2010, 2011, 2014 and 2016, David Muls collected 4 alate females and 2 males in his garden. Other ants he sampled at the same time (between 22:00 and 23:30) were sexuals of *L. fuliginosus* but also *L. flavus*, *L. mixtus*, *Tetramorium caespitum* (Linnaeus, 1758) and *Temnothorax nylanderi* (Förster, 1850). The trap was a construction of a white sheet with a Philips ML160 watt E27 lamp. Many fruit trees were situated in private gardens adjacent to deciduous forest. Searching for a nest of *L. bicornis* however remained unsuccessful, not a single nest could be found, despite nests of its host *L. brunneus* were common.

We didn't collect these specimens of *L. bicornis* in the same year (it is a list of records over 14 years) but nevertheless we may notice quite a lot of new recently collected specimens for such a modest surface. It's obvious that using the most appropriate sampling methods (it seems that light trap might be a good method) in accurately selected locations will give us a better view on the geographic distribution of this little known ant species.

Conclusion

Is *L. bicornis* a very rare ant species? Comparing the spreading of its distribution over continental Eurasia with the sporadic notifications of collected specimens we can assure that it is indeed a very rare species. Important to mention is also the fact that most observations concern sexuals after their nuptial flight and that nests are rarely discovered (as is also the case for Belgium). If we consider the difficulties for this temporary parasitic species in founding a new colony, it offers us maybe an explanation for its rarity. But other ant species such as *L. umbratus*, *L. mixtus* and *L. fuliginosus* encounter these same problems and can be noticed as common species. Is the rarity of *L. bicornis* perhaps related to the common presence of *L. fuliginosus* in the same environment? *L. fuliginosus* is a territorial ant species especially towards *Formica* species with a restriction towards *Formica fusca* Linnaeus, 1758. Ants assemblages have been studied in Poland and Finland to check the influence of the presence of colonies of *L. fuliginosus* on other ant species in the neighbourhood of their territory (CZECHOWSKI, 2000; CZECHOWSKI *et al.*, 2013). Unfortunately *L. bicornis* was missing in these observations although the species is present in Poland (RADCHENKO *et al.*, 1999; CZECHOWSKI *et al.*, 2002). As a conclusion *L. fuliginosus* seems to be tolerant to species with different food requirements but can be very competitive on others like *L. niger* and *L. psammophilus* (ŚLIPIŃSKI *et al.*, 2014). In other studies it has been shown that there can be a strong influence on the production of reproductives in a situation of interspecific competition due to the presence of high densities of nests of other ant species (PONTIN, 1961; ADAMS, 2016).

Is there some form of territorial competition between *L. fuliginosus* and *L. bicornis*? Colonies of *L. fuliginosus* can be very populous and produce a great number of reproductives. Perhaps their presence in preferable habitats can have confounding effects on nest founding by *L. bicornis*. *L. bicornis* is a temporary social parasite but so is *L. fuliginosus*. The hosts of the latter are ant species of the subgenus *Chthonolasius*. *L. umbratus* is mostly indicated as the host for *L. fuliginosus* but other species from the subgenus *Chthonolasius*, as *Lasius sabularum* (BONDROIT, 1918) and *L. mixtus* are mentioned and even *L. bicornis* (SEIFERT, 2007). The combination of the strong competitive character of *L. fuliginosus* and its possible colony founding in a nest of *L. bicornis* may have a serious negative impact on the presence of the latter in their shared environment.

More than 11 new records in a time period of 14 years might also indicate that the species is increasing its distribution. However, the use of appropriate sampling methods are more likely explaining the high number of recent records.

Maybe there are also other unknown characteristics in its lifestyle or interaction patrons with other ants leading to its rarity. The results of our own surveys in Belgium give us an indication that the application of the right sampling techniques in the right locations can offer us a better knowledge of the distribution, dispersion and probably also the biology of this ant. We don't think we can ever state that the species in question is 'locally common' but a better observation will certainly reveal additional information about its local preferences and will help to answer the many question of its ecology.

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