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5 **Title:** Collapse of the invasive garden ant, *Lasius neglectus*, populations in four European countries

6
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27
28 **Abstract:** The invasive garden ant *Lasius neglectus* (Hymenoptera: Formicidae) has been spreading
29 rapidly in Europe ever since the 1990s. This ant established enormous supercolonies in many
30 European cities and poses a serious threat to the local native faunas. The spread of this species has not
31 slowed down in the last decades, but in the recent years the sizes of the known *L. neglectus*
32 populations have generally been declining or have stagnated. For 29 supercolonies checked in four
33 countries, in 10 cases *L. neglectus* individuals have not been found on the former area of their
34 occurrence. On the other hand, only two supercolonies have expanded. In this paper, we summarize
35 these monitoring data collected by the personal independent, diligent monitoring activities of
36 myrmecologists on populations of the invasive garden ant in Bulgaria, Hungary, Poland and Spain.
37 The reasons for this collapse are thought to be: (1) depletion of the local resources, (2) gradation of
38 pathogens and (social)parasites, (3) climatic factors, (4) intra-population mechanisms, (5)
39 confrontation with highly competitive native species, (6) and lack of suitable nesting microhabitats. As
40 similar phenomena were observed in the cases of supercolonies of other invasive ant species, it seems
41 that they decline more generally than has been thought.

42
43 **Keywords:** polygyny, supercolony, population dynamic, pest species, declining, disappearance

45 **Introduction**
46

47 The invasive garden ant (*Lasius neglectus* van Loon, Boomsma et Andrásfalvy, 1990; Hymenoptera:
48 Formicidae, subgenus *Lasius* s.str.) is among the 19 ant species considered the most problematic by the
49 Invasive Species Specialist Group (ISSG) of the International Union for the Conservation of Nature
50 (IUCN) (Bertelsmeier et al. 2014). This polygynous and polydomous species has been described on the
51 basis of specimens from Budapest (Hungary) (van Loon et al. 1990). Its known presence there for
52 nearly two decades as an unnamed outdoor foreign species dates back to the beginning of the 1970s
53 (van Loon et al. 1990). The species probably originated in Asia Minor (Seifert 2000) and quickly revealed
54 its expansive and invasive nature through its fast spread across Europe and part of Middle Asia
55 (Espadaler et al. 2007; Espadaler and Bernal 2016). This ant is known to be transported to new sites in
56 potted plants, soil and organic materials (van Loon et al. 1990; Tartally et al. 2004).

57
58 On the newly established bridgeheads, the species expands its range mainly by budding, since in the case
59 of *L. neglectus* the nuptial flights have been replaced by intranidal mating (van Loon et al. 1990; Seifert
60 2000; Cremer et al. 2008). Thus, the areas of the supercolonies (i.e., huge polydomous systems) can come
61 to cover areas of several square kilometres by expansion (Espadaler et al. 2007). In invaded areas, *L.*
62 *neglectus* can outnumber native ants by a factor of 100 (Tartally 2000, 2006; Nagy et al. 2009; Paris and
63 Espadaler 2012). It constitutes a serious hazard to the local myrmecofaunas, since it is highly competitive
64 towards other ant species and effects negatively or, in the case of a few species, positively the density
65 of other arthropods (Nagy et al. 2009; Boase 2014). It both occupies most available nest microhabitats
66 and monopolizes ornamental plants, mainly trees (Czechowska and Czechowski 2003; Tartally 2006;
67 Paris and Espadaler 2012). It is also reported to infest houses in large numbers and to cause damage in
68 greenhouses, parks and gardens by protecting aphids (van Loon et al. 1990; Seifert 2000; Espadaler and
69 Rey 2001). This ant is also found in a high density within electro-mechanical devices, including
70 electrical plugs, and this can cause fire hazards by creating electrical short circuits (Rey and Espadaler
71 2005).

72

73 *Lasius neglectus* has a climatic preference which makes it the most threatening among the outdoor
74 invasive ant species for the largest part of Europe. It also has found suitable places in other temperate
75 regions (Bertelsmeier et al. 2014). The present range of *L. neglectus* in Eurasia extends from 36°N to
76 54°N and from 1°E to 74°E, including about 160 known localities. In Europe, the species has been
77 observed in most countries (Espadaler and Bernal 2016), and it occurs mainly in urban and suburban
78 habitats. It is known that *L. neglectus* can survive in areas in which mean temperatures in January are
79 between –4.5 and –6 °C, and one may expect that mean January temperatures below –7 °C are critical
80 for this supposedly originally Mediterranean species (Schultz and Seifert 2005). Furthermore, the
81 proportion of climatically suitable areas for *L. neglectus* in Europe is predicted to increase with
82 climate change in the future (Bertelsmeier et al. 2014).

83

84 Until recently, most publications (for details see References) on *L. neglectus* reported its continuing
85 invasion of more and more towns and countries in Europe and the increases in the size of the
86 supercolonies. However, in recent years, it has been informally detected that at least some European
87 populations/supercolonies are going through a crisis. The present contribution examines the data
88 concerning this phenomenon with the goal of drawing the attention of myrmecologists to the
89 importance of further, more focused research.

90

91

92 **Materials and Methods**

93

94 Present states of 29 *L. neglectus* supercolonies in Bulgaria, Hungary, Poland and Spain were compared
95 with their known earlier sizes. For this purpose we searched for *L. neglectus* individuals and nests
96 meter by meter along the streets (as transects) within the latest known area of the supercolonies.
97 Private zones were usually not included in our work. This monitoring was done in summers of 2013-
98 2015 under weather circumstances favourable for activity of the species. This work practically meant
99 turning up stones, digging the soil, and checking kerbs (see Fig. 1 of Online Resource) for nests.
100 Parallel with this, ant individuals were searched for on the roadways, pavements, hedges, bushes and

101 tree trunks. By these methods we have already surveyed these supercolonies in their earlier stages (for
102 details see Online Resource) and realised that it is easy to record this ant species these ways (Tartally
103 2006; Espadaler et al. 2007). According to the registered changes of the state of the colonies, they
104 were arranged into four categories: EXPANDED, STAGNATED, DECLINED and NOT FOUND. In
105 the case of the “not found” category we searched for *L. neglectus* individuals especially intensively on
106 the former known area of the supercolonies but have recorded no specimens. We do not call this
107 category “disappeared” because both disappearance and probably unlucky samplings can be in the
108 background of such negative results (see the story of the supercolony at Orom Str. in the Online
109 Resource), especially in the case of previously huge supercolonies occupying private zones.

110

111

112 **Results**

113

114 Only two (6.9%) of the 29 investigated *L. neglectus* supercolonies fitted the category EXPANDED
115 showing invasive features. Most of them (27) belonged to the DECLINED, STAGNATED or NOT
116 FOUND categories (Table 1; for details see Online Resource). Thus, as much as 93.1% of the
117 supercolonies did not show invasive features in recent years. When the frequencies of EXPANDED +
118 STAGNATED vs. DECLINED + NOT FOUND supercolonies were compared by the chi-square test,
119 the two classes were not randomly distributed (8 vs. 21; $\chi = 5.82$, $p = 0.015$). Instead, the collapsing
120 class (DECLINED + NOT FOUND) was more frequent than expected.

121

122

123 **Discussion**

124

125 The results show that *L. neglectus* seems to have decreased or maybe even stopped its invasiveness in
126 most of the investigated supercolonies. Even some huge supercolonies seem to have declined and
127 often no *L. neglectus* have been found on their former area. Such phenomena were observed in four
128 European countries by different researchers, independently from one another.

129

130 Despite we did not have the possibility to search in private properties, the declining of all of the
131 “DECLINED” supercolonies was clear in the public areas. Furthermore, every “NOT FOUND”
132 supercolony was previously found in public areas. So, the problem about having no entrances to
133 private properties do not affect our conclusion that *L. neglectus* decreased its invasiveness at most of
134 the examined supercolonies.

135

136 The observed decline of the European populations of *L. neglectus* tallies with that of other populations
137 of invasive ant species in the World. (1) The collapse of the Argentine ant *Linepithema humile* (Mayr,
138 1868) in New Zealand was recently reported by Cooling et al. (2012). The biology of this species is
139 quite similar to that of *L. neglectus* (Seifert 2000; Espadaler et al. 2007) and may provide an excellent
140 basis for comparison. Observations of Argentine ants’ populations showed that their mean survival
141 time is about 14 years. After that, the supercolonies scatter and ultimately disappear (Cooling et al.
142 2012). (2) In Australia, seven populations of the yellow crazy ant *Anoplolepis gracilipes* (Smith, 1857)
143 declined or disappeared completely without human intervention (Cooling and Hoffmann 2015), and a
144 101-hectare supercolony of this species fragmented into 10 small isolated colonies (Gerlach 2005). (3)
145 The big-headed ant *Pheidole megacephala* (Fabricius, 1793) was known as the only ant species on the
146 island of Culebrita. However, 76 years later 16 other ant species co-occurred there, and *P.*
147 *megacephala* was restricted to a small patch in the centre of the island (Torres and Snelling 1997).
148 According to another observation, the proportion of this ant increased as of the second year of site
149 rehabilitations for a period of five years, after which it came to comprise 97% of the catch, but by year
150 13 its abundance had dropped to very low levels (Majer and de Kock 1992).

151

152 According to these data and our recent findings, it is not rare for some supercolonies of invasive ants
153 to decline more generally than was thought (a phenomenon well-known with regards to invasive
154 species of other taxa, see e.g.: Simberloff and Gibbons 2004). The reasons for such population
155 collapses may be diverse: (1) depletion of the local resources, (2) gradation of pathogens and
156 (social)parasites, (3) climatic factors, (4) intra-population mechanisms (intra-colony social

157 fragmentation, reduced genetic heterogeneity due to isolation and inbreeding, which leads to reduced
158 adaptability to changing external conditions), (5) confrontation with highly competitive native species,
159 and (6) lack of suitable nesting microhabitats (Haines and Haines 1978; Gerlach 2005; Espadaler et al.
160 2007; Cooling et al. 2012; Cooling and Hoffmann 2015). Each factor (or group of factors) may be true
161 for an individual case. Some factors may impact the others, and this makes the individual situations
162 difficult to interpret. On the other hand, in every locality, the phase of population growth, which
163 precedes the phase of decline, may proceed differently. It depends on local conditions, such as climate,
164 management, urbanization processes, etc. (Espadaler et al. 2007). Therefore it should be emphasized
165 that it is not immediately obvious how to determine even an approximate age of given ant
166 supercolonies based simply on their sizes.

167

168 Irrespective of the underlying reasons, the reported cases of collapse of the *L. neglectus* supercolonies
169 in Europe explicitly show that population growth of the introduced *L. neglectus* supercolonies is not an
170 irreversible process. The appearance of *L. neglectus* within a native ant community is not necessarily
171 followed by persistent invasion. On the contrary, we are faced with a very dynamic system. A
172 supercolony can collapse, but some its isolated refugial fragments might survive, maintaining the
173 capacity of the population to expand again under favourable circumstances. When expanding, such
174 “sister refuge fragments” meet, and they presumably can merge again into one huge supercolony,
175 because *L. neglectus* workers originated from related colonies do not recognize one another as
176 intruders and the aggression-level between them is reported to be very low (Cremer et al. 2008;
177 Ugelvig et al. 2008). The general applicability of the hypothesis of the revival of the invasive *L.*
178 *neglectus* supercolonies from small “refugial” spots is worth thorough testing.

179

180 Finally, we consider it important to stress that the outcome of this process is not predictable on the
181 basis of our data, and there is no reason to believe that the decline in the *L. neglectus* populations will
182 lead to their extinction in the European cities. On the contrary, we underline the importance of better
183 and continuous monitoring of the invasive populations, because they can be most effectively
184 controlled only if we ensure up-to-date awareness of the changes that these populations are

185 undergoing. It will be especially important to monitor the localities where *L. neglectus* individuals
186 were not found recently at the area of the former supercolonies. It would help to realise whether such
187 supercolonies can disappear or just drastically collapse (see the story of the supercolony at Orom Str.
188 in the Online Resources). Further studies of the possible factors causing the expansion, stagnation or
189 collapse based on adequate quantitative data and the ecological characteristics of this invasive species,
190 could be used in order to model the populations' dynamics in more countries.

191

192

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194

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201

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266

267

268

269 **Table 1** The direction of development of the investigated *L. neglectus* supercolonies in four European
270 countries (for details see Online Resource)

271

Country	Expanded	Stagnated	Declined	Not found	In total
Bulgaria	0	0	0	8	8
Hungary	0	5	5	1	11
Poland	1	1	2	1	5
Spain	1	0	4	0	5
In total	2	6	11	10	29

272

273

274 **Online Resource:** Tartally A*, Antonova V, Espadaler X, Csősz S, Czechowski W: Collapse of the
275 invasive garden ant, *Lasius neglectus*, populations in four European countries – *Biological Invasions*
276

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280
281 A detailed history of the investigated supercolonies of the invasive garden ant (*Lasius neglectus* van
282 Loon, Boomsma et. Andrasfalvy, 1990; Hymenoptera: Formicidae):
283
284

285 Bulgaria

286
287 Eight locations are known in Bulgaria (Espadaler et al. 2007; Cremer et al. 2008; Espadaler and Bernal
288 2016). We did not have any pieces of information from the previous authors neither about the
289 microhabitats or number and size of the populations within a locality, nor about their invasive status at
290 the time of discovery. In July 2013 and August 2014 we searched thoroughly in about 100 m radius
291 from the known geographical coordinates. Despite we have found nests of other *Lasius* s.str. species
292 [*L. niger* (Linnaeus, 1758), *L. alienus* (Foerster, 1850) and *L. brunneus* (Latreille, 1798)], we have not
293 found any colonies of *L. neglectus* at these localities:
294

- 295 1. “*Albena*” (43°12'0"N, 27°4'12"E), NOT FOUND: Discovered in 1984 (Seifert 2000).
296
- 297 2. “*Balchik 1*” (= “*Bhot*” in Espadaler and Bernal 2016, unknown name with geographical coordinates
298 in Balchik; 43°24'0"N, 28°7'48"E), NOT FOUND: Discovered in 2004 (leg. K.S. Petersen., pers.
299 comm. in Espadaler and Bernal 2016).
300
- 301 3. “*Balchik 2*” (43°24'36"N, 28°9'36"E), NOT FOUND: Discovered in 2004 (leg. K.S. Petersen., pers.
302 comm. in Espadaler and Bernal 2016).
303
- 304 4. “*Dobrich*” (= ex “*Tolbuhin*” in Espadaler and Bernal 2016; 43°33'36"N, 27°49'48"E), NOT
305 FOUND: Discovered in 2004 (leg. K.S. Petersen., pers. comm. in Espadaler and Bernal 2016).
306
- 307 5. “*Kavarna*” (43°25'48"N, 28°19'48"E), NOT FOUND: Discovered in 2004 (Cremer et al. 2008;
308 Seifert in litt. in Espadaler and Bernal 2016).
309
- 310 6. “*Kranevo*” (43°20'24"N, 28°3'0"E), NOT FOUND: Discovered in 2004 (leg. K.S. Petersen., pers.
311 comm. in Espadaler and Bernal 2016).
312
- 313 7. “*Senokos village*” (41°49'12"N, 23°13'48"E), NOT FOUND: Discovered in 2004 (leg. K.S.
314 Petersen., pers. comm. in Espadaler and Bernal 2016).
315
- 316 8. “*Varna Municipality*” (43°12'36"N, 27°54'36"E), NOT FOUND: Discovered in 2004 (leg. K.S.
317 Petersen., pers. comm. in Espadaler and Bernal 2016).
318
319

320 Hungary

321
322 In total, 21 *L. neglectus* (super)colonies are known in Hungary (see all of them in Table 1 in Tartally
323 and Báthori 2015). Some data about the earlier area were available from 11 ones:
324

- 325 1. “*Budapest, Árpád-bridge*” (47°31'57"N, 19°3'54"E), STAGNATED: A colony a few square meters
326 in size was recorded here in 1999 (Tartally 2000a). The colony was examined again in September
327 2014 (Tartally and Báthori 2015) and its area had not changed considerably, or if it had, at most it had
328 shrunk a little.

329 2. “*Budapest, Budatétény*” (47°24'17"N,
330 19°0'30"E), DECLINED: This is the type
331 locality of *L. neglectus* in which the
332 supercolony was estimated to cover an area
333 of c.a. 2 km² in 1988 (van Loon et al. 1990).
334 When the borders, published by van Loon et
335 al. (1990), were compared along six transects
336 with the borders found in August 2005, the
337 mean expansion was 89 m year⁻¹ (Espadaler
338 et al. 2007; see also Appendix 1 of Nagy et
339 al. 2009). Both in 1988 (van Loon et al.
340 1990) and in 2002 (see Nagy et al. 2009 and
341 its Appendixes), *L. neglectus* was found to be
342 the dominant ant, and within this period it
343 was often the only visible ant species in most
344 of the supercolony. It typically was visible in
345 irregularly high density (AT, pers. observ.).
346 This dominance of *L. neglectus* was evident
347 for about 20 years, from 1988 (van Loon et
348 al. 1990; Nagy et al. 2009) to c.a. 2005, as
349 AT regularly visited the supercolony from
350 1990 at least once every two or three years.
351 However, in 2009 it was shocking when no *L.*
352 *neglectus* workers or nests were visible in the
353 localities in which e.g. the type individuals
354 had been collected in 1988 (van Loon et al.
355 1990) and in which this ant had occurred in
356 high densities (Nagy et al. 2009; Fig. 1) for
357 about 20 years. During a c.a. one hour-long
358 search in 2009, only two small nests were
359 found in the area under two distinct stones,
360 c.a. 900 meters from each other. In
361 September 2014, the colony was visited again
362 (Tartally and Báthori 2015) and the situation
363 had not changed substantially. These two
364 small, refuge-like colonies and a third one
365 (see Table 1 of Tartally and Báthori 2015)
366 were found on that occasion during a c.a. one
367 hour-long search. However, it should be
368 noted that one would need to spend several
369 months within the area of the largest known
370 size (in 2005, see Appendix 1 in Nagy et al.
371 2009) of this supercolony in order to perform
372 a thorough search for this ant. Both in 2009
373 and in 2014, the typical suburban ant fauna,
374 dominated by the *Lasius* s.str. Fabricius,



Fig. 1 The entrances of polydomous *L. neglectus* nests were well visible almost continuously along the kerbs at Budatétény (Növény Str., Budapest, Hungary) in 1998. This place was about the centre of the type supercolony that time (van Loon et al. 1990) and also in 2005 (see “site 6” in Nagy et al. 2009), where AT regularly found similar nest entrance patterns between 1990 and 2005. However, we did not find any *L. neglectus* individuals or nests here neither in 2009 nor in 2014 (scanned from the 18-years-old photo taken by G. Szövényi).

1804, *Tertarium cf. caespitum* (Linnaeus, 1758) and *Serviformica* Forel, 1913 species, was clearly visible in the area (AT, pers. observ.) in which these native ant species had been being outdone by the invasive *L. neglectus* for at least 15 years (van Loon et al. 1990; Nagy et al. 2009; AT, pers. observ.).

3. “**Budapest, Castle**” (47°29'40"N, 19°2'30"E), DECLINED: Workers of *L. neglectus* were found only on and around one tree in 1988 at this locality (van Loon *et al.* 1990). The area of this supercolony was estimated as 102,450 m² in 2005, and the local average expansion rate was estimated at 10.6 m per year⁻¹ between 1988 and 2005 (Espadaler *et al.* 2007). However, the area of this supercolony appeared to be c.a. the same size in September 2014, when it was visited again (Tartally and Báthori 2015). In 2010, the observation was made (Cs. Nagy, pers. comm.) that the local ant species had appeared again and *L. neglectus* had disappeared in some parts of this supercolony that had been well colonized by *L. neglectus* earlier. This phenomenon and similar “new wholes” were also found within the supercolony in September 2014.

4. “**Budapest, Galvani Str.**” (47°27'20"N, 19°2'29"E), NOT FOUND: The colony was discovered in 1994 (Tartally 2000a) along a c.a. 250 m-long part of the street. The colony was still present in a stretch of about the same length in 2001 (Tartally *et al.* 2004), but no *L. neglectus* workers were found there in September 2014, though a thorough search was performed (Tartally and Báthori 2015). This supercolony appears now to have disappeared, but one should be careful with these kinds of statements (see the story of the following colony).

5. “**Budapest, Orom Str.**” (47°29'24"N, 19°2'29"E), STAGNATED: A colony of a few m² in size was recorded here in 2000 (Tartally 2000a). The colony was thought to have disappeared by 2004 (Tartally *et al.* 2004), but a similarly small colony was rediscovered (or a new one was discovered) less than one-hundred meters from the original locality in September 2014 (Tartally and Báthori 2015). So, it seems very likely that here are some remnants of an original invasion which have not totally disappeared.

6. “**Budapest, Pázmány P. Promenade**” (47°28'10"N, 19°3'50"E), STAGNATED: A colony of a few m² in size was recorded here in 2002 (Tartally *et al.* 2004). The colony was revisited in September 2014 (Tartally and Báthori 2015) and its area had not changed considerably, or if it had, at most it had shrunk a little.

7. “**Budapest, Pétervárad Str.**” (47°31'8"N, 19°6'30"E), DECLINED: The colony had been observed in several streets around this street in 1988 (van Loon *et al.* 1990) and was still present in more streets in 2003 (Tartally *et al.* 2004). However, *L. neglectus* workers were found only under a stone in September 2014, though a thorough search was performed (Tartally and Báthori 2015).

8. “**Budapest, Tigris Str.**” (47°29'32"N, 19°1'53"E), STAGNATED: A colony a few m² in size was recorded (A. Andrásfalvy, pers. comm.) here in 1999 (Tartally 2000a). The colony was revisited in September 2014 (Tartally and Báthori 2015) and its area had not changed considerably, or if it had, at most it had shrunk a little.

9. “**Debrecen, Botanical garden**” (47°33'28"N, 21°37'17"E), STAGNATED: The colony was discovered in 1997 (Tartally 2000a; Tartally 2000b). In 1998, its size was estimated at c.a. 0.1 km², and it expanded an average 13 m per year⁻¹ along 4 transects until 2002 (Tartally 2006, see its Fig 1 for a map showing the expansion in detail) and the level of expansion was the same until 2005 (Espadaler *et al.* 2007). However, the colony was revisited more times in 2014 (Tartally and Báthori 2015; AT, unpublished data) and its area had not changed much since 2005. The expansion level declined, e.g. while the average expansion rate was 3.125 m per year⁻¹ between 1998 and 2002, this rate was only 1.667 m per year⁻¹ between 2002 and 2014, in general in the two directions of the transect between the entrance and the observatory (see the transect in Fig 1-2 in Tartally 2006). The pattern of co-occurrence of *L. neglectus* and the native ant species here was studied several times (Tartally 2000b; Tartally 2006), and the most important competitors were *L. niger*, *L. fuliginosus* (Latreille, 1798), *Tetramorium cf. caespitum*, *Liometopum microcephalum* (Panzer, 1798) and *Serviformica* species

430 [sometimes as hosts of *Polyergus rufescens* (Latreille, 1798)]. These ant species were still present in
431 September 2014 in more places within the area of the supercolony, e.g. *L. fuliginosus* and *L.*
432 *microcephalum* are still present on the oak trees, as was the case in 1998-2002, and the supercolony is
433 still not present to the southeast of these trees (see Fig 1 in Tartally 2006).
434

435 10. “*Debrecen, Csap Str.*” (47°31'50"N, 21°36'49"E), DECLINED: The colony was discovered in
436 2007 along a stretch of the street roughly 70 m long and in the yard of a detached house (AT,
437 unpublished data). However, in September 2014 *L. neglectus* workers were only found under a stone
438 in the yard, though a thorough search was performed along the street and in the yard (Tartally and
439 Báthori 2015).
440

441 11. “*Érd, Felső Str.*” (47°22'13"N, 18°55'23"E), DECLINED: The colony was discovered in 1998
442 (Tartally 2000a) in front of a detached house and in its yard. The colony was still widely present in
443 front of the house (the yard was not checked on that occasion) in 2001 (Tartally et al. 2004). However,
444 in September 2014 *L. neglectus* workers were only found on a tree in front of the house, though a
445 thorough search was performed in the yard and in front of the house (Tartally and Báthori 2015).
446

447 In the case of the other 10 Hungarian supercolonies (see Tartally and Báthori 2015), no useful data
448 about this topic were recorded in the earlier research, as the borders of these supercolonies have not
449 been established yet. However, they can all be treated as supercolonies because they were more than
450 twenty square meters in size when the first investigations were made and also in September 2014 (see
451 Tartally and Báthori 2015).
452

453

454

Poland

455
456 In Poland, *L. neglectus* is known only from Warsaw, where it was formally reported in 1999
457 (Czechowska and Czechowski 1999), but in all likelihood it appeared there no later than the beginning
458 of the 1990s, as suggested by an observation made by the late Prof. Bohdan Pisarski (pers. comm. to
459 W. Czechowski) concerning “*the strange small L. niger*” which occurred in masses close to his
460 dwelling place. In total, five polydomous systems of the species were found, all situated in a central
461 part of the city within a radius of 3 km (Czechowska and Czechowski 2003). A later search for *L.*
462 *neglectus* done in 2009–2010 in other areas of the urban and suburban greenery of Warsaw, which run
463 the highest risk of being infested by foreign ant species, such as parks, two botanical gardens
464 (including greenhouses) and the zoo (including pavilions), did not yield any results (H. Babik, pers.
465 comm.).
466

467 In summer 2015, the five known *L. neglectus* colonies were examined, 13–16 years after having been
468 discovered. Consecutively as in Czechowska and Czechowski (2003), the states of the colonies were
469 as follows:
470

471 1. “*Solec Str.*” (52°14'09"N, 21°02'10"E), NOT FOUND: The colony was discovered in 1999. Since
472 then, the street has been partly redeveloped, including new houses, paved stretches and reorganized
473 (reduced) greenery. No trace of *L. neglectus* was found, neither in the sites in which it had previously
474 been observed nor in the vicinity.
475

476 2. “*Furmańska Str.*” (52°14'39"N, 21°01'93"E), EXPANDED: The colony most probably was
477 accidentally discovered by B. Pisarski a quarter of a century ago (see above) and then formally
478 reported in 1990. At present, it is still in very good condition, apparently even better than previously,
479 both in respect of its range and individual colony-sizes. The ant workers are noticeably bigger than
480 those from other *L. neglectus* colonies in Warsaw (W. Czechowska, pers. comm.).
481

482 3. “*The Marshal Edward Rydz-Śmigły Park*” (52°13'42"N, 21°01'48"E), DECLINED: The colony
483 was discovered in 2002. Originally (in the early 2000s), it was the biggest known *L. neglectus* colony
484 in Warsaw; material taken from it represented the Warsaw population of the species in comparative

485 population studies on *L. neglectus* (Cremer et al. 2008; Ugelvig et al. 2008). Now, the former
486 supercolony occurs in a vestigial form. Some single colonies survived on or near a few trees with
487 incomparably weaker activity on the trunks, and the ants seem visibly smaller than in a prosperous
488 period in their life. Originally, there was also a big *L. neglectus* nest density around the fountain in the
489 park on the area paved with a granite sett. Now, there are only a few nests of the native *L. niger*
490 instead of crowds of *L. neglectus* (W. Czechowska, pers. comm.).

491
492 4. “**Emilii Plater Str.**” (52°13'35"N, 21°00'23"E), DECLINED: The colony was discovered in 2002.
493 At the time, it “*stretched for about 300 m along the street where the ants visited canopies of several*
494 *trees [...]. The main [individual] colony there seemed to be that at the foot of the old maple. This tree,*
495 *invaded by ants in masses, was situated at the crossing of E. Plater St and Nowogrodzka St at a very*
496 *small patch of dense ornamental shrubby and herb vegetation, completely encircled by concrete or*
497 *asphalt surface*” (Czechowska and Czechowski 2003). At present, this main single colony seems to
498 have died out completely. Even under weather conditions especially favorable for *L. neglectus*, not a
499 single ant can be seen. And the whole linear polydomous system is now limited to nests at the base of
500 only a few trees (with no ants visible on tree stems). The rest of the trees of the former *L. neglectus*
501 system are, most probably, occupied by the native dendrophilic *L. brunneus* – only external signs of
502 nests typical of *L. brunneus* presence (brown sawdust) were visible.

503
504 5. “**Opaczewska Str.**” (52°12'34"N, 20°58'12"E), STAGNATED: The colony was discovered in 2002.
505 Originally, the following description was given: “*the polydomous system of L. neglectus stretched for*
506 *about 1 km in the green belt along the street*” (Czechowska and Czechowski 2003). Now it seems to
507 retain its previous state, more or less.

508
509 At the same time (in 2015), some new *L. neglectus* nests were found in Warsaw (G. Trigós Peral,
510 pers. comm.). Two of them (ca. 200 m from each other) were located in the same city quarter as the
511 colony no. 5 (ca 1 km to the south). A few nests were in the Ujazdowski Park, at a distance ca. 600 m
512 (to the southwest) from the supercolony no. 3 (which has now deteriorated). The latter place was
513 searched in 2009 with no results, though close attention was paid to possible occurrence of *L.*
514 *neglectus* (H. Babik, pers. comm.). It seems, therefore, that when old supercolonies in Warsaw tend to
515 collapse, new ones can successfully come into being in other place. Alternatively, these small colonies
516 can be remnants of some earlier collapsed supercolonies (see above the stories of the supercolonies at
517 Budatétény and Orom Str.). Besides, a single *L. neglectus* worker was found in one of the pitfall traps
518 set in the Pole Mokotowskie (G. Trigós Peral, pers. comm.) – a park where the search for this species
519 were not been carried out earlier.

520
521

522 Spain

523
524 In Spain area mappings for the changes that have taken place to five supercolonies were done from
525 2002 to 2009. The change between 2002 and 2009 was expressed as a percentage, in %, as the
526 difference between the estimates in both years divided by the estimate in 2002.

527
528 The physical structure of the habitat (freely accessible, private properties, public gardens, streets) and
529 exact microhabitats where the ants were detected (walls, trees, nests under stones or in concrete cracks
530 or crevices) allowed and required different procedures in order to arrive at estimates. For two
531 populations (Bellaterra, Sant Cugat), the number of trees with ant trails was the unit used to estimate
532 colony presence. For the populations from Seva, Taradell and Matadepera, the area occupied was
533 estimated using the perimeter of the polygons limiting ant colonies. Four of these supercolonies were
534 observed as being in decline, while one of them showed an expansion of the infested area:

535
536 1. “**Bellaterra**” (41°30'8"N, 2°6'15"E), DECLINED about 24 %, see the [map](#) of Espadaler and Bernal
537 (2016) for details.

538

- 539 2. “*Matadepera*” (41°36'36"N, 2°18'0"E), DECLINED about 7 %, see the [map](#) of Espadaler and
540 Bernal (2016) for details.
541
542 3. “*Sant Cugat*” (41°30'0"N, 2°6'0"E), DECLINED about 18%, see the [map](#) of Espadaler and Bernal
543 (2016) for details.
544
545 4. “*Taradell*” (41°52'48"N, 2°18'0"E), DECLINED about 18 %, see the [map](#) of Espadaler and Bernal
546 (2016) for details.
547
548 5. “*Seva*” (41°48'0"N, 2°15'36"E), EXPANDED about 14%, see the [map](#) of Espadaler and Bernal
549 (2016) for details.
550

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