

GEA, FLORA ET FAUNA

***Cardiocondyla obscurior* Wheeler, 1929 (Hymenoptera: Formicidae) in Catalonia (NE Spain), with comments on exotic ant species**

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Rebut: 21.06.2019; Acceptat: 20.08.2019; Publicat: 30.09.2019

Abstract

The polygynous exotic ant *Cardiocondyla obscurior* Wheeler, 1929 was detected nesting in dead wood of shrubs at a public garden in urban Barcelona. Not all plant species were equally occupied by foraging workers. *Viburnum* sp. was preferentially used as foraging space. At present, fourteen exotic ant species are known from Catalonia. Only two (the Argentine ant, *Linepithema humile* Mayr, 1868 and the invasive garden ant, *Lasius neglectus* Van Loon, Boomsma & Andrásfalvy, 1990) are of major concern.

Key words: *Cardiocondyla obscurior*, exotic ants check- list, nest, *Viburnum*.

Resum

***Cardiocondyla obscurior* Wheeler, 1929 (Hymenoptera: Formicidae) a Catalunya (NE España), amb comentaris sobre les formigues exòtiques**

La formiga *Cardiocondyla obscurior* Wheeler, 1929 exòtica i poligínica, ha estat detectada en la capçada d'arbusts i nidificant en fusta morta de *Viburnum* sp. en un jardí públic de Barcelona. Fins avui, es coneixen catorze espècies de formigues exòtiques a Catalunya. Només dues, la formiga argentina, *Linepithema humile* Mayr, 1868, i la formiga de jardí invasora, *Lasius neglectus* Van Loon, Boomsma & Andrásfalvy, 1990, representen un problema a considerar.

Paraules clau: *Cardiocondyla obscurior*, llistat d'exòtiques, niu, *Viburnum*.

Introduction

Cardiocondyla ants are insects widely dispersed although rarely detected because of their minute size and unobtrusive behaviour. They are ecologically subordinate; their ecological impact is minimal and likely will never present large-scale ecological threats (Heinze *et al.*, 2006). At present, more than 70 species have been formally described.

After a random walk (30.ix.2018) the second coauthor through a Barcelona city garden with dense bushes, a single worker of a tiny ant remained on his T-shirt. A short inspection under the microscope led to identify a *Cardiocondyla* sp., unknown from Catalonia (NE Spain). This prompted a new visit to the site (12.iv.2019) in search of supplementary material for a definite identification and eventual proof of an established population. Here we confirm the presence of this exotic ant nesting outdoors and provide an updated checklist of exotic ants known from Catalonia.

Material and methods

The public garden (Gaudí square, 41°24'16.85" N, 2°09'32.84" E, elevation 32 m.a.s.l.) occupies roughly 1 ha although only a small garden section of 30 × 6 m, with 69 recently pruned bushes and a few young trees was studied. Plants were recognized using information provided by <http://www.bcnostenible.cat/es/web/punt/placa-de-gaudi>. Each bush and tree was sampled using beating trays (0.25 m²). Ants were dislodged with three vigorous hits to the bush or tree crown and the presence/absence of *Cardiocondyla* Emery, 1869 was noted. Specific identity was checked with Seifert (2003). Other ant species were also captured and identified. In addition, three baits with sugary water and tuna fish were left for two hours on the ground. Pictures were taken using a cellphone (Apple, iPhone 5). Vouchers of workers are deposited at the «Museu de Ciències Naturals de Barcelona».

Results

The species was readily identified by its prominent anterolateral corners of the postpetiolar sternite, short head (cephalic length/cephalic width (s.d.) 1.108 (0.020); $n = 5$) and all gaster tergites equally dark (Fig. 1).

Cardiocondyla obscurior Wheeler, 1929 was present on the canopies of 13 bushes (Table 1). The distribution among bushes –*Tecoma* Juss. not included– was not random (chi-square=16.3; D.F. = 6; $P = 0.012$), with *Viburnum* showing more than expected presence of *C. obscurior*. We do not assume that *Cardiocondyla* presence in a bush implies nesting in that particular plant. Neither have we accepted that the detected proportions of occupancy in April remain invariant across seasons. Flowering, eventual extrafloral nectar production or other ephemeral plant resources may perfectly vary in time, and thus influence different plant species as foraging fields for the ants. Establishing a preference for a given plant

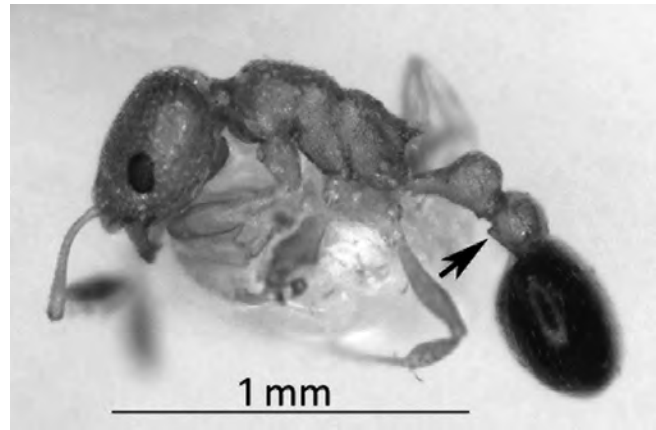


Figure 1. *Cardiocondyla obscurior* Wheeler, from Barcelona, Gaudi Square. Close-up of a worker. Remark the prominent angles from the postpetiolar sternite (arrow), the meso-propodeal depression, and the completely dark gaster.

Table 1. Presence of *Cardiocondyla obscurior* in the canopy of bushes or young trees ($n=69$), detected using beating trays, at Gaudi square, Barcelona (April, 2019).

	With <i>C. obscurior</i>	Without <i>C. obscurior</i>
<i>Viburnum</i> sp.	8	10
<i>Prunus laurocerasus</i> L.	4	8
<i>Nerium oleander</i> L.		8
<i>Pittosporum tobira</i> (Thunb.) W.T.Aiton	1	17
<i>Ligustrum japonicum</i> (Thunb.) Spach		3
<i>Arbutus</i> sp.		4
<i>Laurus nobilis</i> L.		6

species requires a focused sampling scheme along the year. In two bushes, two single queens (with no workers) were separately captured (data not included in Table 1). One society was located nesting in dead wood of *Viburnum* sp. (Fig. 2). The very small (≈ 1.5 mm length) workers were seen going up and down of the trunk. The society (12.iv.2019; N. Ortiz de Zugasti & X. Espadaler leg.) had 23 dealated queens, some 250 workers, 120 larvae and a few eggs. Kept in an artificial nest and fed twice a week with Bhatkar & Whitcomb (1970) artificial diet and freshly collected Psocoptera, after two weeks worker pupae begun to appear and workers eclosed. In addition, a single, completely yellow and smooth ergatoid male, with its sharply pointed mandibles was also trying to copulate with different queens (15.v.2019). Three male pupae were detected among the brood (28.v.2019). The ergatoid male was seen attacking a male pupa (8.vi.2019). After two months fourteen winged males and some 120 winged queens have been produced (2.vii.2019). The ergatoid male was seen trying, unsuccessfully, to copulate with several of them. No other ergatoid males have reached maturity.

Other ant species present on the sampled vegetation were: *Crematogaster scutellaris* (Olivier, 1792); *Lasius grandis* Forel, 1909; *L. neglectus* Van Loon, Boomsma & Andrásfalvy, 1990; *Plagiolepis pygmaea* (Latreille 1798) and *P. schmitzii* Forel 1895. *Tetramorium immigrans* Santschi 1927 and *Solenopsis* sp. were also detected at the baits, although no

C. obscurior workers were seen. The public garden contains an artificial pond with dense vegetation around. That habitat is heavily infested by the Argentine ant, *Linepithema humile* Mayr, 1868. Thus, *C. obscurior* is able to coexist with two notorious exotic and invasive ants (*Lasius neglectus*, *Linepithema humile*). This resistance seems to be general in the genus *Cardiocondyla* (Heinze *et al.*, 2006), although the exact mechanism by which this is accomplished is still elusive.

A long building green wall, with many, at that time, mostly leafless branches of *Tecoma capensis* (Thunb.) Lindl. (Bignoniaceae) was also checked for the presence of ants. In two *Tecoma* plants were collected a few workers and a queen *C. obscurior*. Workers were seen entering a crack in a brick of the wall.

Discussion

Three soil nesting species for this genus had been previously noted in Catalonia. *C. batesii* Forel, 1894 (Roig *et al.*, 2008), *C. elegans* Emery, 1869 (Espadaler, 1979) and *C. mauritanica* Forel, 1890 (Espadaler, 1992). Using Seifert (2003), there should be no problem to differentiate the four *Cardiocondyla* species now known from Catalonia. The pattern of colouration and petiole and postpetiole shape are diagnostic.



Figure 2. *Viburnum* sp. Workers *Cardiocondyla obscurior* Wheeler were foraging on foliage. Inset: trunk of *Viburnum* sp. where a nest of *Cardiocondyla obscurior* occupied the dead wood inside the bulge. Workers were seen going up and down the trunk. The entrance was at 23 cm from the soil surface.

Two outdoors localities for *C. obscurior*, both strictly urban, were previously known for continental Spain: 1) VALENCIA: Burjassot (Sánchez-García & Espadaler, 2015). 2) ALICANTE: Alicante (Trigos-Peral & Reyes-López, 2016). The 3rd locality, here documented (see material and methods), is also urban. In Europe, the species had been detected exclusively indoors in greenhouses from France, Deutschland (Seifert, 2003) and The Netherlands (Boer *et al.* 2018).

C. obscurior is a cosmopolitan species of Indomalayan origin (Wetterer, 2015). Nesting habits are usually noted as nesting "... in minute tree cavities (Lupo & Galil, 1985: 121; as *C. wroughtoni*), «... in plant structures above soil surface...» (Seifert, 2003: 214), or «... this species is usually arboreal.» (Deyrup, 2017: 56). Data from Barcelona fit perfectly with those descriptions. The physical contact between the canopies of many bushes precludes any possibility to indirectly estimate how many *C. obscurior* societies were there. In addition, this species seems to have a social structure approaching unicoloniality and absence of aggression in one-to-one tests would be non-informative either (Heinze *et al.*, 2006). A focused sampling and molecular genetics analyses are needed to unravel this point. We suggest it is worth doing a continued appraisal of the self-supporting capacity of this population to perpetuate itself.

With this new addition, fourteen exotic ant species are reported as present in Catalonia (Table 2). Four species nesting only indoors, four species nesting both indoors and outdoors and six species have been detected only outdoors. Only two species are of serious concern: *Linepithema humile* and *Lasius neglectus*. They are indeed invasive, with many populations, have a measurable ecological impact (Kennis & Branco, 2010) and belong in the official list of Spanish invasive species (B.O.E. 2013). Seven of the other species (Table 2) are known from a single locality (Barcelona city) and five more are reported from ≤10 localities. Thus, the majority of exotic ant species in Catalonia remain localised in occurrence and are restricted to anthropogenic areas. The exotic complement represents an 8.1 % of the 172 ant species currently known from Catalonia (unpublished data).

Table 2. Exotic ant species detected in Catalonia (up to May 2019).

Species	# loc.	nesting	1 st reference	last detection
<i>Cardiocondyla mauritanica</i> Forel 1890	9	o	Espadaler (1992)	2014
<i>Cardiocondyla obscurior</i> Wheeler 1928	1	o	This paper	2019
<i>Hypoponera punctatissima</i> (Roger 1859)	4	i	Forel (1895)	2019
<i>Lasius neglectus</i> Van Loon, Boomsma & Andrásfalvy 1990	27	o,i	Espadaler (1999)	2019
<i>Linepithema humile</i> (Mayr 1868)	>110	o,i	Goetsch (1942)	2019
<i>Monomorium carbonarium</i> (F. Smith 1858)	10	o,i	Miravete <i>et al.</i> (2013)	2018
<i>Monomorium pharaonis</i> (Linnaeus 1758)	1	i	Goetsch (1942)	2012
<i>Nylanderia jaegerskioeldi</i> (Mayr 1904)	1	o	Espadaler & Collingwood (2001)	2003
<i>Nylanderia vividula</i> (Nylander 1846)	1	o	Espadaler & Collingwood (2001)	2013
<i>Pheidole indica</i> Mayr 1879	3	o	Espadaler & Collingwood (2001)	2018
<i>Pheidole megacephala</i> (Fabricius 1793)	1	o,i	Espadaler <i>et al.</i> (2013)	2019
<i>Strumigenys membranifera</i> Emery 1869	4	o	Espadaler (1979)	2015
<i>Tapinoma melanocephalum</i> (Fabricius 1793)	1	i	Espadaler & Espejo (2002)	2017
<i>Tetramorium bicarinatum</i> (Nylander 1846)	1	i	F. García leg. (14.xi.2007, unpub.)	2019

loc: number of localities (municipalities) where the species is reported. Nesting: verified nesting in Catalonia: outdoors (o), indoors (i). 1st reference: first published reference for Catalonia. Last verified detection in Catalonia: *C. mauritanica* (Pineda de mar; 27.viii.2014; X. Espadaler leg.); *H. punctatissima* (Cosmocaixa Barcelona; 15.ii.2019; N. Ortiz de Zugasti leg.); *L. neglectus* (Sant Cugat del Vallès; 6.vi.2019; X. Espadaler leg.); *L. humile* (Sant Cugat del Vallès; 6.vi.2019; X. Espadaler leg.); *M. carbonarium* (EL Catllar de Setcases; 19.vii.2018; F. García leg.); *M. pharaonis* (Barcelona; ix.2012; A. Vaquer leg.); *N. jaegerskioeldi* (Vilanova i la Geltrú; 20.ix.2003; X. Espadaler leg.); *N. vividula* (Barcelona; v.2013; C. Pradera leg.); *P. indica* (x.2019; F. García leg.); *P. megacephala* (Barcelona; vi.2019; C. Pradera leg.); *S. membranifera* (Llampaiés; viii.2015; N. Ortiz de Zugasti leg.); *T. melanocephalum* (Barcelona; 17.x.2017; C. Pradera leg.); *T. bicarinatum* (Cosmocaixa Barcelona; 15.ii.2019; N. Ortiz de Zugasti leg.).

Acknowledgements

To Federico García, Antoni Vaquer and Carlos Pradera for their unpublished information about recent findings of several exotic species in Table 2. The authors received no funding for this work.

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