

Two additions to the Iberian myrmecofauna: *Crematogaster inermis* Mayr, 1862, a newly established, tree-nesting species, and *Trichomyrmex mayri* (Forel, 1902), an emerging exotic species temporarily nesting in Spain (Hymenoptera, Formicidae)

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Academic editor: F. H. García | Received 8 March 2020 | Accepted 23 June 2020 | Published 31 August 2020

<http://zoobank.org/CB85F068-8A2C-4D95-8655-64EB41AEC02E>

Citation: Casiraghi A, Espadaler X, Pérez Hidalgo N, Gómez K (2020) Two additions to the Iberian myrmecofauna: *Crematogaster inermis* Mayr, 1862, a newly established, tree-nesting species, and *Trichomyrmex mayri* (Forel, 1902), an emerging exotic species temporarily nesting in Spain (Hymenoptera, Formicidae). Journal of Hymenoptera Research 78: 57–68. <https://doi.org/10.3897/jhr.78.51858>

Abstract

Exotic ants are a growing component of urban and disturbed habitats worldwide. Sampling in two Iberian Mediterranean localities revealed several exotic species. The tree-nesting, black acrobat ant *Crematogaster inermis* Mayr, 1862, has been detected nesting outdoors on a *Robinia pseudoacacia* tree in a public garden in Valencia (Spain) and represents a new addition to the continental European fauna. Collection details, a morphological description, biometry, and the remarkable presence of short spines in smaller specimens are also given for this species. A case of an ephemeral establishment of several exotic ant species in a palm grove is also discussed. This case includes *C. inermis* and *Trichomyrmex mayri*, also a novelty for the Iberian Peninsula.

Keywords

Aphis craccivora, *Crematogaster inermis*, *Robinia pseudoacacia*, *Trichomyrmex mayri*, Spain

Introduction

Insect communities inhabiting urban and anthropized or degraded habitats are increasingly being enriched by incoming exotic species, usually with the unintentional help of human trade (Aronson et al. 2014; Rabitsch 2010; Sax and Gaines 2003). The Mediterranean regions are especially prone to the arrival of alien biota (Di Castri et al. 1990; Queiroz and Pooley 2018) and the trend seems to be never ending (Seebens et al. 2017; Gaston 2010). The ants, as a group, are among the most ecologically successful organisms and dominate many ecological communities (Wilson 1990). Correspondingly, many well established exotic ants are qualified as pests (Williams 1994; Klotz et al. 2008). Tramp ants (Passera 1994), a subset of the exotics, although, usually remain in an arrested state, never reach pest status. They may be regarded as simple, non-problematic additions to the local fauna. A recent paper by Schifani (2019) is an excellent summary of exotic ants, invasive or otherwise, in Mediterranean Europe. We document several ant species from two localities of the Iberian Mediterranean coast, and which contain exotic novelties for the Iberian myrmecofauna, one also being new for continental Europe.

Methods

Locality 1: Agost (Alicante, Spain). GPS geographical coordinates 38.4320N, 0.6639W; elevation ca. 325 m a.s.l. A small palm grove (0.1 ha) of *Phoenix dactylifera* L. was surveyed in July 2007 using a visual search for soil surface crawling ants and ants on trees by Dr. Apostolos Pekas. Ants were directly preserved in 70% ethanol, and were identified by one of the authors (KG). The grove was revisited twice (16 Jul. 2016; 26 Apr. 2017). It had been abandoned (as well as the irrigation system) and all visible ant species were collected. In addition, remains from two refuse heaps of *Pheidole* nests were also collected and analysed under the microscope for ant carcasses.

Locality 2. Valencia (Spain). The Jardín del Turia is the biggest urban park (123 ha) in Valencia city (GPS geographical coordinates 39.4823N, 0.3768W; elevation ca. 10 m a.s.l.). Founded in 1986, the vegetation is rich in species, of Mediterranean and exotic origin (Organismo Municipal Autónomo Jardines y Parques de Valencia 2019).

Samplings were carried out in a study to analyse aphid-centred trophic webs inside urban green areas of Valencia (Casiraghi 2019). There were various colonies of *Aphis craccivora* Koch, 1856 on two black locust trees (*Robinia pseudoacacia* L.) (Fabaceae), with one much bigger (DBH: diameter at breast height 39 cm) than the other (DBH 28 cm). Although the trunks were 7 m apart, the canopies of both trees were in contact and we assume all workers to belong to a single colony. The aphids were attended by an unidentified *Crematogaster* ant. The ants were initially collected in May 2019 and preserved in 100% ethanol. The trees were purposely revisited (14 October 2019) to collect more material and to get direct experience of the ant in its habitat (Fig. 1).

One of the authors (XE) identified this species as *Crematogaster inermis* Mayr, 1862. Published morphological and biometrical data on this species are very scarce, so we characterise this local population using taxonomic characters as defined in Longino (2003).



Figure 1. *Robinia pseudoacacia* tree (black locust) where *Crematogaster inermis* were nesting (Valencia, Spain). Black arrow indicates the level of nest entrance (Image X. Espadaler).

We measured the first two collected workers plus four of the smallest, four medium and four biggest workers, thus totalling 14 workers. Measurements were made at 60× with a dissecting microscope and are shown as the mean (minimum, maximum) in mm.

- HW** head width; maximum width of head in full-face view, including eyes.
HL head length; perpendicular distance from line tangent to rearmost points of vertex margin to line tangent to anterior most projections of clypeus, in full-face view.
SL scape length; length of scape from apex to basal flange.
EL maximum eye length, measured along maximum diameter.
WL (Weber's length): viewing mesosoma in lateral profile, distance from approximate inflection point, where downward sloping pronotum curves into anteriorly projecting neck, to posteroventral propodeal lobes.
ProW maximum pronotum width in dorsal view.
PW petiole width; maximum width of petiole in dorsal view.
PpW postpetiole width; maximum width of postpetiole, in same view as and perpendicular to postpetiole length.
CI cephalic index= $100 \cdot HW/HL$
SI scape index= $100 \cdot SL/HL$
OI ocular index= $100 \cdot EL/HL$

The species was identified using information from different sources: a) Partial genus revisions of Emery (1926), Santschi (1937), Salata and Borowiec (2015) and Sharaf et al. (2019); b) available keys from Antwiki (2019); c) Type and other images available in Antweb (<http://www.antweb.org> [Accessed on 10 June 2019]), and in The Ants of Egypt (http://antsafrica.org/ant_species_2012/antsofegypt/cover.htm [Accessed on 10 June 2019]), and d) by direct comparison with identified samples from Egypt kindly donated by Dr. Mostafa Sharaf from Egypt, (reference KG02023 at Antweb) and from Israel. The original description was also checked for general morphological congruence. Vouchers have been deposited in the Museum of Natural History (MNCN, Madrid) and in the Instituto de Biología Integrativa de Sistemas (I²SysBio) Centro Mixto Universidad de Valencia-CSIC of Valencia. Remaining workers are in the collection of one of the authors (XE).

Results

Locality 1. Agost (Alicante, Spain). A total of 17 species were collected by Dr. A. Pekas in 2007, six of them exotic. Three of those exotics (*C. inermis*, *T. destructor* (Jerdon, 1851), and *T. mayri* (Forel, 1902)) were previously unknown in Iberia in 2007. Images and data for *C. inermis* are available at Antweb (KG01956A-1, KG01956A-2 and KG01956A-3; data alluded to by Salata and Borowiec (2019)). *T. mayri* was also the first documented outdoors nesting presence of this species in Europe. In the second (2016) and third (2017) visits we failed to detect any of the several exotic ant species previously observed in 2007 (Table 1). Instead, a cohort of 12 local, native species was already nesting amid the very dry and partially destroyed palm leftovers (Fig. 2).

Locality 2. Valencia (Spain). Two specimens *Crematogaster inermis* were initially collected (5 May 2019; 1 worker; 1 June 2019; 1 worker; A. Casiraghi leg.). A third visit (14 October 2019) and during half-an-hour in a cloudy day with intermittent rain, 27 isolate workers were captured up- or down-coming on the trunk, 25 in one tree and two on a much younger tree. Several *Crematogaster* workers had strongly abraded mandibular dentition, an indication of wood-gnawing behaviour (Fig. 4).

Other ant species present foraging on the trunk of the bigger tree were *Formica* (*Serviformica*) sp., *Lasius grandis* Forel, 1909, and *Pheidole pallidula* (Nylander, 1849). The soil surrounding the base of trees was inspected, although only *Pheidole* and no *Crematogaster* were detected there.

Description of *C. inermis* worker

HW 1.115 (1.012, 1.200); HL 1.027 (0.962, 1.087); SL 0.836 (0.775, 0.875); EL 0.233 (0.243, 0.250), ProW 0.620 (0.550, 0.700), WL 1.138 (1.050, 1.225); PW 0.349 (0.300, 0.387); PpW 0.304 (0.262, 0.337); CI 108 (105, 110); SI 42 (39, 45); OI 22 (21, 23).

Table 1. Ant species present in different years in a date palm grove (Agost, Alicante, Spain).

Ant species	2007	2016–2017
<i>Aphaenogaster iberica</i> Emery	+	+
<i>Camponotus foreli</i> Emery		+
<i>Camponotus micans</i> (Nylander)	+	+
<i>Camponotus sylvaticus</i> (Olivier)		+
<i>Cardiocondyla batesii</i> Forel	+	+
<i>Cataglyphis iberica</i> (Emery)		+
<i>Crematogaster inermis</i> Mayr	+	
<i>Lasius lasioides</i> (Emery)	+	
<i>Messor barbarus</i> (Linnaeus)	+	+
<i>Messor bouvieri</i> Bondroit	+	+
<i>Monomorium subopacum</i> (F. Smith)	+	
<i>Nylanderia jaegerskioeldi</i> (Mayr)	+	
<i>Pheidole indica</i> Mayr	+	
<i>Pheidole pallidula</i> (Nylander)	+	+
<i>Plagiolepis schmitzii</i> Forel	+	+
<i>Solenopsis</i> sp.	+	+
<i>Tapinoma nigerrimum</i> s.l.	+	
<i>Tetramorium biskrense</i> Forel		+
<i>Tetramorium lanuginosum</i> Mayr	+	
<i>Trichomyrmex destructor</i> (Jerdon)	+	
<i>Trichomyrmex mayri</i> (Forel)	+	

2007: irrigated grove; 2016–2017: abandoned grove, without irrigation. In bold, exotic ant species in Spain.



Figure 2. Partial view (16 July 2016) of an abandoned date palm grove (Agost, Alicante, Spain) where *Crematogaster inermis*, *Trichomyrmex destructor* and *T. mayri* had been temporary nesting in July 2007 (Image X. Roig).

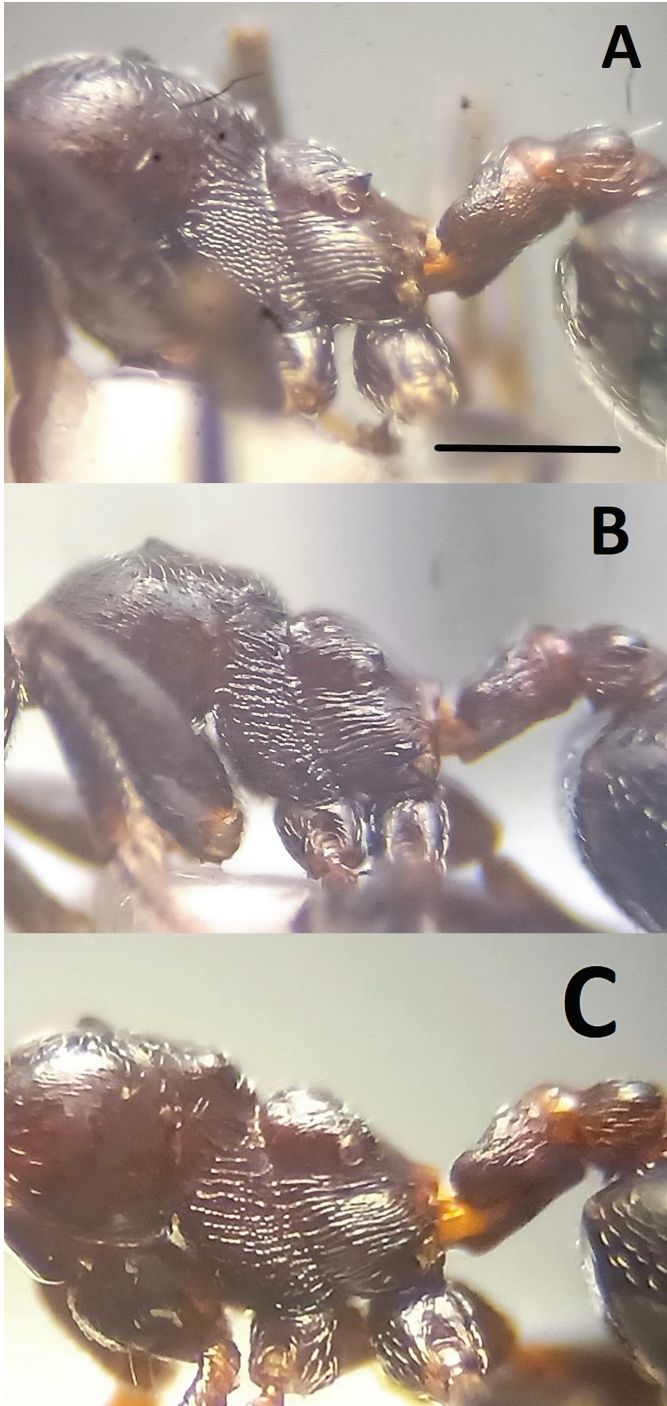


Figure 3. *Crematogaster inermis*, mesosoma lateral view. Bar 0.4 mm. **A** small specimen (HW 1.050 mm) showing small, but visible, triangular propodeal spines **B** medium sized specimen (HW 1.150 mm), with merely angulate propodeum **C** bigger specimen (HW 1.175 mm), with rounded propodeum (Images X. Espadaler).



Figure 4. *Crematogaster inermis*. Worker head in frontal view, with abraded mandible denticles. (HW 1.125 mm) (Image X. Espadaler).

Colour deep brown to black. Head slightly wider than long (CI 108), with compound eyes projecting beyond lateral margins in full face view; mandibles longitudinally striate; clypeus not emarginated anteriorly, with rugulose middle area and striated laterals; 6–8 long setae on the anterior clypeal border, directed anteriorly and 1–3 pairs of setae in the central area of clypeus; short, subdecumbent to appressed pubescence all over the cephalic surface, which is mostly glassy smooth, except for longitudinal striae at genae and semicircular striae at the base of antennal insertions; one pair of setae at the level of antennal insertion, and 0–2 pairs on the frontal area; 11 segmented antennae, with a three-segmented club; scape with short decumbent or appressed setae; distal part of scape just reaching the vertex (SI 42). Gula with 2–8 curved anteriorly setae. Occipital carina present.

Pronotum with 0–2 pairs of long humeral setae; mesonotum with a distinct central keel, and broadly angulate postero-laterally, with distinct dorsal face (see Blaimer 2012: 63, fig. 32). Metanotal groove well marked in small specimens to strongly developed in bigger specimens. Smaller specimens with areolate sculpture in the mesoepisternum; in bigger specimens longitudinal rugae are added to the areolate surface. Metapleu-

ron with 10–13 longitudinal rugae. Propodeum variable: in smaller specimens, short spines are developed (Fig. 3A), although they are produced in small angled tubercles in medium sized specimens (Fig. 3B), and absent (Fig. 3C) in bigger specimens. Femorae and tibiae with short appressed pubescence. Petiole, in dorsal view, moderately flared, without dorsoposterior denticles, and postpetiole distinctly bilobed, each of the two segments with one pair of backwards short setae; those setae may be absent but then the basal pit in postero-dorsal position is clearly visible. Gastral tergites without erect setae except for the bordering setae at the posterior border of each segment. Short appressed pubescence over all segments. First gastral sternite with 2–8 curved setae.

Discussion

Non-cited species for the Iberian Peninsula, collected in 2007, were *Trichomyrmex destructor*, *Trichomyrmex mayri* and *C. inermis*; the three species and all the other exotic ants found have now gone extinct in that locality (Agost, Alicante). Local extinctions, in this case in a man-made palm plantation, are entirely possible, especially if habitat conditions are harshly modified (viz. arrested irrigation). *T. destructor* has been recently collected in a Malaga urban public park (Reyes-López 2019).

The eventual permanence of the documented local, established nests or populations of a majority of exotic ants is only rarely reported. Interestingly, data reported here provide a neat case of a peek-a-boo, a population phenomenon already noted in ants and other organisms, where seemingly well-established populations disappear more or less suddenly for unknown or dubious reasons (Simberloff and Gibbons 2004; Cooling and Hoffmann 2015; Tartally et al. 2019).

A taxonomical revision of this ‘*inermis*’ group may involve an integrative approach (Alpha taxonomy + genetics) and is out of the scope of this paper. While several of those names are likely to be synonyms of *C. inermis*, the present paper is not taxonomic or nomenclatural in scope, and we refrain here to go any further but stating some brief notes on the different forms.

The specific name, *C. inermis*, was reached without difficulty using available keys. Absence of propodeal spines seems to be a rare character state within the genus in the Palearctic, although the clear presence of small spines in the smaller specimens may be a source of confusion if captured as isolates (Fig. 3A–C). This specific polymorphism in propodeal structure, with small spines in smaller specimens, seems to have been overlooked by myrmecologists dealing with the species. Other names in the *inermis* group are *C. fuentei* Menozzi, 1922, *C. warburgi* Menozzi, 1933, and the infraspecific *C. inermis lucida* Forel, 1890, *C. inermis armatula* Emery, 1926, and *C. inermis aphrodite* Santschi, 1937. Those forms are more or less defined based on: i) surface ornamentation and ii) the presence of propodeal angles or very small broadly triangular spines. However, the specific intranidal polymorphism in propodeal profile as shown here (propodeal spines present as a sizer-related trait) may well gauge the morphological

variability of the several above-mentioned names. It is perhaps worth noting here that the supposed Iberian endemic *C. fuentei*, was described and schematically figured (!), as with a “Mesonotum dépourvu de carène” (Menozzi 1922: 327 and fig.1). Although, available images from type material make this doubtful (CASENT0908472).

This species exhibits thermal tolerance between 11 °C and 28 °C and is active day and night in the Negev Desert, although in laboratory settings the critical upper thermal limit is 45 °C (Délye 1968). The species has been categorized as a behavioural dominant that exhibits territorial aggression in the desert of Israel (Segev and Ziv 2012). It is doubtful if this aggressive profile applies to the Spanish population since the climate and other ant species in Valencia are completely different from those in the desert. A dedicated study of ant-ant interactions in Valencia would be necessary to clarify this point. Although typically detected on trees, nests may also be underground (Ofer 2015). The same three-trophic ant-aphid-plant interaction noted in Valencia was already known from Iran (Mortazavi et al. 2015). Feeding habits include items such as scavenging insect corpses, living prey, sap of trees, and honeydew (Délye 1968). *C. inermis* is not categorized as a pest species.

To our knowledge, this is the only free-nesting, outdoors occurrence for *C. inermis* in continental Europe. Data retrieved from antmaps.org (<https://antmaps.org/?mode=species&species=Crematogaster.inermis>) indicates that *C. inermis* and its subspecies, inhabit the Maghreb (Forel 1904, Délye 1968, Cagniant 2005), Egypt (El Bokl et al. 2015), Sudan (Karavaiev 1911), Jordan (Wheeler and Mann 1911), Cyprus (Santschi 1937), Lebanon (Tohmé and Tohmé 2014), Israel (Vonshak and Ionescu-Hirsch 2009), Yemen (Collingwood and van Harten 2001) and reaches Iran (Paknia et al. 2008). The type locality is the Sinai Peninsula (Mayr, 1862). Data from Libya and Syria need verification.

A few exotic *Crematogaster* are known from routine inspection control operations at airports, ports, or quarantine facilities for some countries (USA: Suarez et al. 2005; 15 records from 12 species; 58 years-long database), although not a single *Crematogaster* was detected among the 4355 ant interception records of a 50 year-long database from New Zealand (Ward et al. 2006). Greenhouses and buildings with controlled climate may also provide opportunities to detect exotic *Crematogaster* although, obviously, they do not necessarily represent established nests or free-living, permanent populations.

The genus *Crematogaster* does not seem to provide many instances of established, outdoor-nesting, exotic species, anywhere. Among the few known examples concerning outdoors nests of exotic *Crematogaster* species are those of *C. obscurata* Emery, 1895, nesting in Florida (Deyrup 2007), and *C. scutellaris* (Olivier, 1792) in Germany (Heller 2004) and The Netherlands, where it is “... regularly imported and often established, but is never expanding.” (Boer and Vierbergen 2008). The significance and possible ecological effects of *Crematogaster inermis* from Valencia are very difficult to estimate or interpret (New 2016). We think it is safe not to expect negative consequences of their presence in the gardens of Valencia and that the species will likely remain in the established state, because of the local, climatic conditions, not reaching the spreading, invasive stage (Blackburn et al. 2011), although some occasional spreading can occur to other areas.

Acknowledgements

To Drs. Christos Georgiadis, Mostafa Sharaf and Francisco Hita-Garcia for their critical reading and comments on a first version of the manuscript. Also an unknown reviewer too, for his extensive comments that enhanced the final result positively and considerably. To Jacob Ofer (Israel) and Dr. Sharaf for providing *Crematogaster inermis* samples from Israel and Egypt, and to Apostolos Pekas (Belgium) for his initial collection of ants on the date palm grove from Agost (Alicante, Spain). Xavier Roig (Barcelona) was, as usual, an excellent companion when sampling in the field.

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