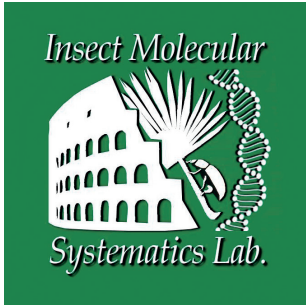




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New records of the exotic black little ant *Monomorium carbonarium* in the Iberian Peninsula and discovery of the ergatoid queen (Hymenoptera: Formicidae)Javier ARCOS GONZÁLEZ¹¹ C/Medico Vicente Reyes N°18, 5°B. 03015 Alacant, Spain - javier.arcos@e-campus.uab.cat**Abstract**

The exotic ant *Monomorium carbonarium* (Smith, 1858) is recorded for two new cities in the Iberian Peninsula. A hundred workers of this black little ant were recovered from a pitfall trap in a small urban park in the city of Alacant (SE Iberia). A visual inspection revealed a large colony with numerous nest entrances, but confined in space. Its absence in other colliding parks and green areas of the city suggests an early stage of invasion. It is also first detected in three parks in the city of Barcelona (NE Iberia). Two queen phenotypes are imaged, winged and ergatoid, the second one previously unknown. The invasive potential of the species is discussed.

Keywords: exotic species, early detection, invasive ant, wingless queen.

Introduction

Alien species have occupied nearly every environment in the world, representing a direct driver to ecosystem degradation, biodiversity loss and homogenization of natural biotas (Pysek & Richardson 2010). In this context ants are no exception; two species have been included in the 100 worst invaders in Europe (Nentwig et al. 2018) and a recent study indicates that Mediterranean climate regions are a hotspot for exotic ants, with 22 of them currently recorded in the Iberian peninsula (Schifani 2019). Here I present the first record of the exotic ant *M. carbonarium* in Alacant (SE Iberia) and the city of Barcelona (NE Iberia), and discuss its spreading potential in anthropized habitats.

The little black ant *M. carbonarium* belongs to the *minimum* species group and was originally described from Madeira, a territory that is believed to be its natural habitat together with the Azores (Wetterer et al. 2004; Wetterer et al. 2007). Outside its native range, it has been permanently introduced to several countries. According to AntMaps, recent records are from the United States (O’Keefe et al. 2000), Egypt (Mohamed et al. 2001), Irak (Abdul-Rassoul et al. 2013) and France (Galkowski 2008; Blatrix et al. 2018).

There are also several problematic records. The Caribbean samples (México, Honduras, Costa Rica, Venezuela, Cuba, Dominican Republic and the Lesser Antilles) probably belong to the similar species *Monomorium ebeninum* Forel, 1891 (Jaffe & Latke 1994; Fernández et al. 2002),

which is common in the Neotropical region. The record from Oman [Forel 1907; also mentioned in Collingwood (1985), Collingwood & Agosti (1996), and Borowiec (2014)] needs verification, since Collingwood (1985) points to a possible confusion with *Monomorium hesperium* Emery, 1895. The old records from China (Wheeler 1921) and India (Forel 1903), also mentioned in Bharti et al. (2016) are also doubtful.

In the Iberian Peninsula, *M. carbonarium* was first detected in Viana do Castelo (Portugal) (Collingwood & Prince 1998), and subsequently in San Sebastián (Gipuzkoa, North Iberia) (Espadaler & Collingwood 2001), Castelldefels and Pineda de Mar (Barcelona, North East Iberia) (Espadaler & Castillo 2014) and several localities in Girona (North East Iberia) (Miravete et al. 2013; Gómez 2015).

Material and methods

On 22 Aug 2019, as part of an ongoing survey of exotic ants in urban parks of Alacant (SE Iberia), pitfall traps were placed in different green areas all over the city. In one of these (38.21.06.600N, 0.29.06.300W), a hundred workers of *M. carbonarium* were recovered. A visual inspection revealed a large colony of black little ants foraging in columns.

The study area comprises a small park of 0.04 hectares surrounded by roads. It was completely remodeled in 2015, when soil and all plants were removed and later

replaced by other vegetal species, with the exception of a big central pine. It is divided by a pedestrian pathway into two unequal green zones, both of them irrigated and humid. The surface is mostly covered by grass and ornamental plants.

For city of Barcelona, new records come from the following urban parks:

- Plaça Catalunya (Barcelona), within a humid garden with a big font (10 Jun 2019, Arcos leg./det.). 41°23'14.2"N 2°10'09.0"E. A big nest was detected in visual inspection, and there were long trails of individual exchanging larvae and queens between entrances.
- Jardins del Doctor Pla I Armengol (Barcelona), in a recently reconstructed garden with pines (4 Jun 2020, Arcos leg./det.). 41°24'53.4"N 2°10'15.6"E. Small colony nesting in soil, probably introduced recently.
- Parc de les Rieres d'Horta (Barcelona), in a small parcel with irrigated low shrubland (17 Jun 2020, Arcos leg./det.). 41°25'52.2"N 2°09'17.2"E. Small colony nesting in soil.

Workers were identified following Bolton (1987), Dubois (1986) and comparing them with the types of the *minimum* species group in Antweb. A Nikon SMZ-U stereomicroscope was used at a magnification between 70-150x for identification and imaging. Measurements and indexes are in millimeters and follow the standards used for the genus (Bolton 1987; Sharaf et al. 2018).

Results

The individuals collected in Alacant were identified as *M. carbonarium* and compared to samples from Barcelona and Girona, with no difference found between workers. This is a monomorphic and black little ant (2mm approx.),



Fig. 1 – The red asterisk indicates the infested park, isolated by roads. White asterisks show non-infested parks suitable to be colonized. Background photo from Google Maps.

different from any other species found in the Iberian Peninsula by the combination of 3-segmented antennal club, clear mesopropodeal furrow, rounded propodeum, high petiole with rounded peak and reduced general sculpture. At first impression, it resembles the genus *Plagiolepis* due to its minimal size and also shiny black color, but it is easily discarded since the latter lacks postpetiole.

The colony was found nesting in soil inside the green areas and never directly in pavement. Several nest entrances were manually excavated, with workers and queens being taken for proper identification with an optical stereomicroscope. Other parks and suitable gardens surrounding the infested zone were inspected in order to determine the extension of the occupied zone, but no other colony was found. It was neither encountered in any other park in the city of Alacant during the study, which suggests a very recent introduction. Other ants present in the same area were *Lasius grandis* Forel, 1909 *Tetramorium* sp. (*caespitum* group), and *Solenopsis* sp.

In the samples, winged and ergatoid queens were observed. Ergatoid queens in the genera *Monomorium* have been reported for other species, mainly in the *minimum* group (Dubois, 1986) and the *salomonis* group (Bolton, 1986), but the majority produce winged queens. Coexistence of both forms is rare and has been noted for 15% of the species in the genera (Johnson & Overson, 2018). A comparative approach between queens of the group is delicate, but some comments can be made judging by the collected material, the original descriptions and photos available at Antweb.

Queen. Measurements (n=1): HL 0.73, HW 0.66, EL 0.20, EW 0.12, SL 0.65, ML 1.30, PW 0.56, PTH 0.39, PPH 0.31, PTL 0.18, PPL 0.19, PTW 0.32, PPW 0.34, CI 90, SI 98. Larger than ergatoid queen. Body color black, general aspect smooth and shiny. Wings fully developed. Head sculpture reduced to striae near the mandibular base and eyes. Masticatory margin of mandible with 4 teeth. Head capsule broader at compound eyes. Lateral profile of scutum and scutellum convex. Mesonotum lacking notal furrow. Petiole high with slightly truncated peak. Differs clearly from *M. ebeninum* by the shape of the pronotum, which is concave in the former. It most resembles *M. minimum*.

Ergatoid queen. Measurements (n=1): HL 0.73, HW 0.66, EL 0.14, EW 0.10, SL 0.51, ML 1.09, PW 0.41, PTH 0.38, PPH 0.32, PTL 0.17, PPL 0.18, PTW 0.31, PPW 0.37, CI 90, SI 77. Body color black, surface smooth and shiny. Wings absent, sternites fused. Size intermediate between worker and winged queen. Head sculpture reduced to striae near mandibular base and eyes. Masticatory margin of mandible with 4 teeth. Lateral profile of scutum and scutellum concave. Mesonotum lacking notal furrow. Petiole high with rounded peak. It most resembles *M. ebeninum*.



Fig. 2 – Worker of *M. carbonarium* in lateral view.



Fig. 3 – Queen of *M. carbonarium*.

Discussion and Conclusions

According to Pysek & Richardson (2010), early detection and rapid response is the essence of invasive species control. Unfortunately, few cases of invasive ants have been reported in an initial stage of infestation, and they come from unexpected findings rather than monitoring programs that could target them more efficiently. The introduction of *M. carbonarium* in Alacant seems very recent, since only one infested park was detected. The pathway of introduction is unknown, but it appears plausible that the ants were transported in association with imported plants. As mentioned above, the park was redesigned in 2015, and several vegetal species were then introduced. Miravete et al. (2013) suggest the port of Barcelona to be the entrance point from which it has spread to several localities in NE Iberia, and that it could have arrived in containers carrying plant material. I have not been able to find *M. carbonarium* in the port of Alacant, but the role of plant importation in the establishment of the species seems consistent. Considering the ant's small size and apparently innocuous behavior, which make its detection unlikely, it could have been overlooked in other Iberian localities, where it is probably present and spreading.

User friendly identification tips are another key in early detection, since they extend the capacity of interception to a greater number of potential observers. In the case of *M. carbonarium*, it can be easily distinguished from other species in the Iberian peninsula by its small size, black and shiny body, antennal club of three segments, deep mesopropodeal furrow and rounded propodeum. A trail of monomorphic black workers in a humid anthropized area could be a first warning of *M. carbonarium*. It should be noted that other black *Monomorium* ants in the minimum species group appear very similar to *M. carbonarium*, and that the keys for workers and queens written by Dubois (1986) are problematic and inaccurate, since some descriptions do not fit the original types in Antweb. Taking into account that the minimum species group needs urgent revision (Ward, 2005), the combination of rounded



Fig. 4 – Ergatoid queen of *M. carbonarium*.

propodeum, thick petiolar node and anterior face of petiole flat or slightly concave in the worker caste matches the characters observed in the imaged specimens of *M. carbonarium* in Antweb and the workers here studied. The propodeum profile in *M. ebeninum* is very different from the Iberian samples, and so this name can be easily excluded from the differential diagnosis, but other taxa matching the morphology of our samples exist in the minimum group, even though they have still not been recorded as exotics. I have been able to examine a small sample from France with workers showing higher and sharper propodeum, which raises the possibility of more than one species being treated as the exotic *M. carbonarium*. Overall, the identity of the black *Monomorium* ants reported as *M. carbonarium* outside its native range should be revised, together with the *minimum* species group, in order to determine the adequate name for the samples.

Little is known about the capacity of this species in becoming a problematic exotic ant. Galkowski (2008) observes a species decline in natural areas exploited by *M. carbonarium*, and I have observed them attacking alates of *Solenopsis* sp. during nuptial flights, but the mechanism by which other ant species disappear from the occupied zone should be investigated, since no aggressive behavior was seen between workers of *M. carbonarium* and other species coexisting in

the studied area. This species has been found both outdoors and indoors as a household pest (Espadaler & Castillo 2014), but no ecological or agricultural impact has been yet reported. Nevertheless, the genus *Monomorium* contains several cosmopolitan tramp species that have become major pests, like the similar-behavior species *Monomorium floricola* (Jerdon, 1851) (Wetterer 2010), which points to an also high invasive potential in the case of *M. carbonarium*. Since the eradication of an ant colony of less than 1 ha in size seemed possible in the case of Alacant, local authorities were informed of the infestation with the aim of eliminating them.

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