

## Invasive ant species (Hymenoptera: Formicidae) of Greece and Cyprus

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**Abstract.** Fifteen invasive ant species from Greece and Cyprus are recorded. Their biology and habitat preferences in eastern Mediterranean Region are discussed. Historical and non-published records of all listed species are summarized. *Tetramorium bicarinatum* is recorded for the first time from Greece, while *Paratrechina longicornis* and *Pheidole indica* are new for Cypriot fauna. Uncertain data concerning *Anoplolepis gracilipes*, *Pheidole megacephala* and *Monomorium destructor* are discussed.

**Key words:** Invasive species, ants, Greece, Cyprus.

### Introduction

Invasive ant species of Greece and Cyprus have never been a subject of separate research. Knowledge about species composition and their distribution is based only on limited data mentioned in a few papers. Most papers were published in early 20<sup>th</sup> century and provide very few information. During our expeditions, we discovered that knowledge about the existence of invasive species in those countries is fragmentary and needs more detailed investigation. In our research, we decided to adopt an invasive species definition given in Wetterer's paper (2007). Except widely considered invasive ant species, we also decided to include in our list *Lepisiota syriaca*. This species, probably originating from the Middle East, manifests in Greece very strong affiliation to anthropogenic environments. This fact suggests human impact on its distribution for this country. Because *Monomorium monomorium* Bolton, 1987 is considered to originate from the Mediterranean Region we decided not to include this species in our investigation (despite its well documented presence in Greece). There are three species (*Anoplolepis gracilipes*, *Pheidole megacephala* and *Monomorium destructor*) whose occurrence in Eastern Mediterranean is questionable. Below we present a list of 15 invasive ant species known from Greece and Cyprus (see Table 1). If possible, we provide also short descriptions of habitat preferences in eastern Mediterranean and known distribution in Europe and the Mediterranean Basin.

### Material and Methods

We sampled ants mainly between years 2012-2016 from sites in different parts of Greece (mainland and islands) and Pafos District in Cyprus. The method applied at all sites was direct sampling (hand collecting). Ant nests and individual specimens were collected on the ground, under stones, in dead wood, and on tree trunks and twigs. No pitfall traps were used. Specimens were preserved in 75% ethanol. Material used in this research contains mostly specimens deposited in the collection at the Department of Biodiversity and Evolutionary Taxonomy of the University of Wrocław, Poland (DBET) and was supplemented by specimens loaned from the Upper Silesian Museum, Bytom, Poland (USMB), the World Museum Liverpool (Great Britain); we also examined ants deposited in the Dipartimento di Scienze Agrarie, Università di Bologna (Bologna, Italy), sampled by C. Menozzi. Moreover, during the senior author's visit in Athens (Zoological Museum of the University of Athens - ZMUA), specimens labelled by A. Legakis were examined. All sampled localities

Table 1. Consolidated catalogue of tramp/introduced ant species in Greece and Cyprus.

Species and taxonomy	Greece	Cyprus
<b>DOLICHODERINAE</b>		
<i>Linepithema humile</i> (Mayr, 1868)	X	
<b>FORMICINAE</b>		
Lasiini		
<i>Nylanderia jaegerskioeldi</i> (Mayr, 1904)	X	X
<i>Nylanderia vividula</i> (Nylander, 1846)	X	
<i>Paratrechina longicornis</i> (Latreille, 1802)	X	X
Plagiolepidini		
<i>Lepisiota syriaca</i> (André, 1881)	X	
<b>MYRMICINAE</b>		
Attini		
<i>Pheidole indica</i> Mayr, 1879	X	X
<i>Strumigenys membranifera</i> Emery, 1869	X	
Crematogastrini		
<i>Cardiocondyla mauritanica</i> Forel, 1890	X	X
<i>Tetramorium bicarinatum</i> (Nylander, 1846)	X	
Solenopsidini		
<i>Monomorium bicolor</i> Emery, 1877	X	X
<i>Monomorium pharaonis</i> (Linnaeus, 1758)	X	X
<i>Monomorium subopacum</i> (F. Smith, 1858)	X	X
<i>Solenopsis geminata</i> (Fabricius, 1804)	X	X
<b>PONERINAE</b>		
Ponerini		
<i>Hypoponera eduardi</i> (Forel, 1894)	X	X
<i>Hypoponera punctatissima</i> (Roger, 1859)	X	

are provided in a new material section for each species separately. In the literature sections, we decided to list only those publications where occurrence of the species is mentioned for the first time from a particular region or when more detailed data are provided. Therefore, publications of Legakis (2011), Borowiec (2014), Borowiec & Salata (2012) and Agosti & Collingwood (1987), which compile information mostly based on literature, are sometimes omitted in this section.

For the localities, the EL0734/ISO843 standard was used for the transliteration of the names in Greece and Cyprus. Thus, *Κρήτη* becomes Kriti instead of Crete, *Δωδεκάνησα* becomes Dodekanisa instead of Dodecanese etc. The reason for this is that it standardizes the transcription of localities (in the past you would have names as Creta, Créte, Candia, and some more minor alter spellings) and future researchers can follow the records more easily. Photos were taken using a Nikon SMZ 1500 stereomicroscope, Nikon D5200 photo camera and Helicon Focus software. Photos of some species were taken from AntWeb (Ward 2013). Maps were created using

DIVA-GIS (ver.7.5, <http://www.diva-gis.org/>).

## Results

### DOLICHODERINAE

*Linepithema humile* (Mayr, 1868) - Figs. 1, 3.

*Hypoclinea humilis* Mayr, 1868: 164.

Records in Greece:

Literature. Greece: Wetterer et al. 2009: 190. Kriti: Wetterer et al. 2009: 190.

New material. Kriti: 10 workers - Irakleio Prov, Chersonisos, 10 m, 35.31111N/25.3875E, 2014-v-23, coll. S. Salata (DBET). Attiki: 20 workers - Athens, Athens National Garden, 90 m, 37.97138N/23.7175E, 2016-vii-10, coll. S. Salata (DBET). Ionian Islands: 19 workers - Kerkyra, Acharavi, 10 m, 39.793N/19.819E, 2011-vii-05, coll. W. Żyła (USMB). Peloponnisos: 5 workers - Korinthia Pref., Loutraki, 8 m, 37.96287N/22.97172E, 2013-viii-24, coll. L. Borowiec (DBET).

Native bioregion. Neotropic.

Distribution in Europe and Mediterranean Region. Algeria; Austria; Azores; Belgium; Bulgaria; Czech Rep.; France: Corsica, mainland; Germany; Gibraltar; Ireland; Italy: mainland, Sicily; Madeira; Malta; Monaco; Morocco; Netherlands; Poland; Portugal; Serbia; Spain: Balears, Canary Is., mainland; Turkey; United Arab Emirates; Yemen.

Biology. Species associated with anthropogenic sites. In Greece occurring mostly in moist places such as parks, gardens or hydrated lawns. In Athens National Garden\* completely eliminated other species from occupied area. Especially, in humid areas overgrown by bushes or ivy. In Kriti a small population occurs on the lawn close to a hotel complex in Chersonisos. Probably because of its young stage of colonisation, it still co-occurs with native species. Its occurrence in Greece should be monitored because experience from other Mediterranean countries, such as Spain and Portugal, shows that this species can compete with local species of ants and devastate their populations in large areas.

\* The 15,5ha (today) National Garden was initially designed back in 1836 (as the Royal Garden then) by the German architect Friedrich Wilhelm von Gärtner (1791-1847). In 1839 about 15000 plants were transplanted from Genova, Milan, central Europe and northern Africa as well as from Evvoia and Sounio under the supervision of the German botanist Nikolaus Karl Fraas (1810-1875). The overall management of the Garden design was by Queen Amalia (1818-1875) (Kardamitsi-Adami and Papageorgiou-Venetis, 2009). During these transportations of plant species from Europe and Africa, it is most likely that non-indigenous ant species were transferred along with the plants and soil, as no phytosanitary protocols were in effect. A full census of the ant fauna of the National Gardens is currently in operation.

### FORMICINAE

#### Lasiini

*Nylanderia jaegerskioeldi* (Mayr, 1904) - Figs. 2, 4.

*Prenolepis jaegerskioeldi* Mayr, 1904: 8.

Records on Cyprus:

Literature. Emery 1910: 130.

New material. 1 worker - Pafos Pref., Aphrodite Baths, 51 m, 35.05N/32.33333E, 2012-v-04, coll. L. Borowiec



Figure 1. Distribution of *Linepithema humile* (Mayr, 1868) in Europe and Mediterranean Region.



Figure 2. Distribution of *Nylanderia jaegerskioeldi* (Mayr, 1904) in Europe and Mediterranean Region.



Figure 3-4. Workers, lateral view. 3-*Linepithema humile* (Mayr, 1868); 4-*Nylanderia jaegerskioeldi* (Mayr, 1904).

(DBET); 3 gynes, 2 males, 2 workers - Pafos Pref., Pafos, 56 m, 34.8N/32.4E, 2012-v-06, coll. L. Borowiec (DBET); 3 workers - Pafos Pref., Agiou Neofytou church n. Tala, 398 m, 34.8333N/32.4333E, 2012-v-07, coll. L. Borowiec (DBET); 1 worker - Pafos Pref., Pafos-Lempa, 7 m, 34.79964N/

32.39314E, 2012-v-01, coll. L. Borowiec (DBET).

Records in Greece:

Literature. *Dodekanisa*: Legakis 2011: 25 – Karpathos. *Peloponnisos*: Borowiec & Salata 2012: 258 – Korinthia Pref., Loutraki urban area, 37.96287N/22.97172E, 2013-viii-24/25, 8 m, coll. L. Borowiec; Korinthia Pref., Korinthos urban area, 37.93918N/22.94795E, 2013-ix-04/05, 36 m, coll. L. Borowiec; Borowiec & Salata 2017: 216 – 3 gynes – Messinia Pref., Kalamata, suburban area, 4 m, 37.02334N/22.13753E, 2016-vi-10, coll. L. Borowiec, 2 workers – Messinia Pref., 2 km E of Kalamata, 65 m, 37.01863N/22.15626E, 2016-vi-12, coll. L. Borowiec, 13 workers – Messinia Pref., Kalamata, Hotel Elite, 5 m, 37.02211N/22.14283E, 2016-vi-10, coll. L. Borowiec. *Ionian Islands*: Borowiec & Salata 2014: 512 – Kefalonia, Hotel Panas n. Sparta, 23 m, 38.10398 N/20.57470E, 2014-vi-23, coll. L. Borowiec.

New material. *Kriti*: 12 workers – Irakleio Pref., Irakleio city, 6 m, 35.31667N/25.1E, 2014-v-03, coll. S. Salata (DBET); 2 workers – Chania Pref., Chania, city center, 10 m, 35.5138N/24.0199E, 2017.v.26, coll. C. Georgiadis (ZMUA). *Dodekanisa*: 7 gynes, 11 males – Rodos, Kolympia, 10 m, 36.2437N/28.15649E, 2015-v-03, coll. L. Borowiec (DBET); 12 workers – Rodos, Kiotari, 12 m, 36.03333N/27.95E, 2008-vi-30, coll. L. Borowiec (DBET); 12 workers – Kos, Kardamaina, 7 m, 36.78363N/27.14107E, 2015-vii-09, coll. S. Salata (DBET); 5 workers – Kos, Pili, 78 m, 36.84185N/27.1557E, 2015-vii-07, coll. S. Salata (DBET); 2 workers – Karpathos, Karpathos city, 26 m, 35.50667N/27.21631E, 2014-v-04, coll. S. Salata (DBET); 1 worker – Karpathos, Lastos, 863 m, 35.57415N/27.15589E, 2015-v-23, coll. S. Salata (DBET). *Attiki*: 7 workers – Athens, Athens National Garden, 90 m 37.97138N/23.7175E, 2016-vii-10, coll. S. Salata (DBET); numerous workers – Attiki Pref. Athens, Areteio Hospital, 115 m 37.9796N/23.7542E, 2011-ii-17, coll. C. Georgiadis (ZMUA).

Native bioregion. Afrotropic.

Distribution in Europe and Mediterranean Region.

Egypt; Israel; Libya; Oman; Saudi Arabia; Spain: Balears, Canary Is., mainland; Turkey; United Arab Emirates; Yemen.

Biology. Synanthrope. Associated with open, arid and sunny habitats. Nests usually below big concrete slabs overgrown by grass or below flagstones. Nest entrances at the border of flagstones and lawns. Ants aggressive, eliminate all native species from occupied area. The 2 workers from Kriti (Chania) were collected around a well-established colony of *P. indica*. Active during day, especially during highest temperature period. Numerous workers were found around food remains and insect corpses. Alates were observed in May; most flights occur between 18:00 and 22:00, especially shortly before rain.

***Nylanderia vividula* (Nylander, 1846) - Figs. 5, 7.**

*Formica vividula* Nylander, 1846: 900.

Records in Greece:

Literature. *Dodekanisa*: Forel 1888: 256 – Rodos.

Native bioregion. Nearctic.

Distribution in Europe and Mediterranean Region. Croatia; Egypt; Great Britain; Iran; Ireland; Israel; Russia; Serbia; Spain: Balears, mainland; Sweden; Turkey; Ukraine; United Arab Emirates; Yemen.

Biology. Synanthrope. Nests in lawns, grass verge of the sidewalks or in stone walls of parks (Gómez & Espadaler



Figure 5. Distribution of *Nylanderia vividula* (Nylander, 1846) in Europe and Mediterranean Region.



Figure 6. Distribution of *Paratrechina longicornis* (Latreille, 1802) in Europe and Mediterranean Region.



Figure 7-8. Workers, lateral view. 7-*Nylanderia vividula* (Nylander, 1846), Photo by April Nobile, From [www.antweb.org](http://www.antweb.org). Accessed 7 August 2017; 8-*Paratrechina longicornis* (Latreille, 1802).

2006). Trager (1984) characterized it as a species related with open, usually disturbed habitats including beaches, parks, crop fields and similar habitats. The same author mentioned that all known records of *P. vividula* from Europe come from indoor localities.

**Notes.** The only known record of this species comes from 1888 (ca. 15 years before description of *N. jaegerskioeldi*). Therefore, this record can be considered as uncertain and needs verification. Moreover, authors observed only *N. jaegerskioeldi* in Rodos, which could support a thesis of incorrect determination of specimens collected by Forel.

***Paratrechina longicornis* (Latreille, 1802) - Figs. 6, 8.**

*Formica longicornis* Latreille, 1802: 11.

**Records on Cyprus:**

**New material.** 4 workers - Pafos Pref., Aphrodite Baths, 51 m, 35.05N/32.33333E, 2012-v-04, coll. L. Borowiec (DBET); 6 workers - Pafos Pref., Pafos, 56 m, 34.8N/32.4E, 2012-v-01/06, coll. L. Borowiec (DBET); 1 worker - Pafos Pref., Pafos-Lempa, 7 m, 34.79964N/32.39314E, 2012-v-01, coll. L. Borowiec (DBET).

**Records from Greece:**

**Literature.** Kugler 1988: 259.

**Native bioregion.** Indomalay.

**Distribution in Europe and Mediterranean Region.** Algeria; Azores; Egypt; France: mainland; Israel; Malta; Oman; Saudi Arabia; Spain: Balears, Canary Is., mainland; Turkey; United Arab Emirates; Yemen.

**Biology.** Ants were caught in ruderal areas, very dry, near tourist resorts and the sea coast. Active during day, especially during highest temperature period. They were not aggressive and co-occur with native species.

**Notes.** Contrary to *Nylanderia jaegerskioeldi* and *Linepithema humile*, this species does not seem threatening to native ant populations.

**Plagiolepidini**

***Lepisiota syriaca* (André, 1881) - Figs. 9, 14.**

*Acantholepis frauenfeldi* var. *syriaca* André, 1881: 61.

**Records in Greece:**

**Literature.** Kriti: Stütz 1928: 90; Borowiec & Salata 2012: 510 (as *Lepisiota dolabellae* (Forel, 1911) - misidentification) - Chania Pref., Kato Daratso n. Chania, 20-25 m, 35.5N/23.98333E, urban area, 2011-v-07, coll. L. Borowiec. Dodekanisa: Borowiec & Salata 2012: 509 (as *Lepisiota cf. syriaca* sp. 1) - Rodos, Kiotari-Asklipio rd., 59 m, 36.05N/27.93333E, 2008-vii-02, coll. L. Borowiec; Rodos, Epta Piges, W of Kolympia, 92 m, 36.25N/28.01E, 2008-vii-04, coll. L. Borowiec; Rodos, 1 km W of Kattavia, 39 m, 35.95N/27.73333E, 2008-vii-05, coll. L. Borowiec; Rodos, Apolakkia, 34 m, 36.05N/27.78E, 2008-vii-5, coll. L. Borowiec; Rodos, Rodos City, 16 m, 36.05N/27.78333E, 2008-vii-07, coll. L. Borowiec; Rodos, Mesanagros, 2008-vii-08, 257 m, 36.0N/27.81666E, coll. L. Borowiec; Rodos, Prasonisi-Kattavia rd., 29 m, 35.93333N/27.76666E, 2008-vii-11, coll. L. Borowiec.

**New material.** Dodekanisa: 3 workers - Leros, Lakki-Xirokampos, 80 m, 37.1199N/26.8656E, 2001-ix-11, coll. M. Chatzaki (DBET); 1 worker - Telendos, 14 m, 36.9979N/26.9201E, 2005-vi-10, coll. M. Chatzaki (DBET). Attiki: 2 workers - Athens, 110 m, 37.97222 N/23.72527 E, 2016-vii-10, coll. S. Salata (DBET).

**Native bioregion.** Palearctic.

**Distribution in Europe and Mediterranean Region.** Armenia; Egypt; Israel; Lebanon; Syria; Turkey.

**Biology.** In Greece, species associated with warm, dry

and sunny habitats. Nests below pavement tiles or rocks, always on sun-exposed positions. Workers manifested highest activity during warmest period of day. Never exhibited aggressive behaviour. Numerous caught close to food remains or animal corpses.

**Notes.** Species with probable origin from the Near East. In Greece, occurring only in cities or in anthropogenic sites. Such kind of distribution can suggest a human impact on its occurrence range. The influence of *L. syriaca* on the local fauna composition has never been investigated. During field work, this species always co-occurred with native species, typical for arid environments. Nevertheless, a more detailed study on the real distribution of this species and its interactions with native fauna is strongly recommended.

**MYRMICINAE**

**Attini**

***Pheidole indica* Mayr, 1879 - Figs. 10-12.**

*Pheidole indica* Mayr, 1879: 679 (s.w.q.)

**Records on Cyprus:**

**New material.** 11 workers - Pafos Pref., Pafos, 56 m, 34.8N/32.4E, 2012-v-01/06, coll. L. Borowiec (DBET); 3 workers - Pafos Pref., Agiou Neofytou church n. Tala, 398 m, 34.8333N/32.43333E, 2012-v-07, coll. L. Borowiec (DBET).

**Records in Greece:**

**Literature.** Aegean Islands: Legakis 2011: 12. Kriti: Legakis 2011: 12; Borowiec & Salata 2012: 527 - Chania Pref., Kato Daratso n. Chania, 20-25 m, 35.5N/23.98333E, 2011-v-07, coll. L. Borowiec. Kyklades: Legakis 2011: 12. Dodekanisa: Legakis 2011: 12; Borowiec & Salata 2012: 527 - Rodos, Rodos city, 16 m, 36.43N/28.22E, 2008-vii-07, coll. L. Borowiec. Ionian Islands: Legakis 2011: 12. Peloponnisos: Borowiec & Salata 2013: 364 - Korinthia Pref., Loutraki urban area, 37.96287N/22.97172E, 2013-viii-24/25, 8 m, coll. L. Borowiec; Borowiec & Salata 2017: 216 - Korinthia Pref., Korinthos, 36 m, 37.93918N/22.94795E, 2013-ix-04, coll. L. Borowiec, Messinia, Kalamata, railway park, 8 m, 37.03157N/22.11004E, 2016-vi-11, coll. L. Borowiec. Thessalia - Forel 1910: 24- Sporades.

**New material.** Kriti: 5 workers - Chania Pref., Stavros, 10 m, 35.590439N/24.079931E, 2016-iv-20, coll. G. Hebda (DBET); 3 workers - Chania Pref., Grammeno beach, 1 m, 35.23333N/23.63333E, 2014-iii-28, coll. S. Salata (DBET); 5 workers - Irakleio Pref., Irakleio city, 7 m, 35.33333N/25.11667E, 2014-iv-01, coll. S. Salata (DBET); 2 workers - Irakleio Pref., Kato Gouvas beach, 1 m, 35.33333N/25.28333E, 2014-iv-30, coll. S. Salata (DBET); 1 worker - Rethymno Pref., Plakias, 4 m, 35.18333N/24.38333E, 2013-v-05, coll. L. Borowiec (DBET); numerous workers and 4 gynes - Chania Pref., Chania, city center, 10 m, 35.5138N/24.0199E, 2017-v-26, coll. C. Georgiadis (ZMUA). Kyklades: 12 workers - Naxos, Naxos city, 1 m, 37.0938N/25.3719E, 2016-vi-29, coll. S. Salata (DBET). Dodekanisa: 6 workers - Karpathos, Karpathos city, 26 m, 35.50667N/27.21631E, 2014-v-24, coll. S. Salata (DBET); 1 worker - Kos, Kardamaina, 7 m, 36.78363N/27.14107E, 2015-vii-09, coll. S. Salata (DBET); 8 workers - Rodos, Rodos city, 16 m, 36.43333N/28.21666E, 2008-vii-07, coll. L. Borowiec (DBET).

**Native bioregion.** Indoaustralia.

**Distribution in Europe and Mediterranean Region.**



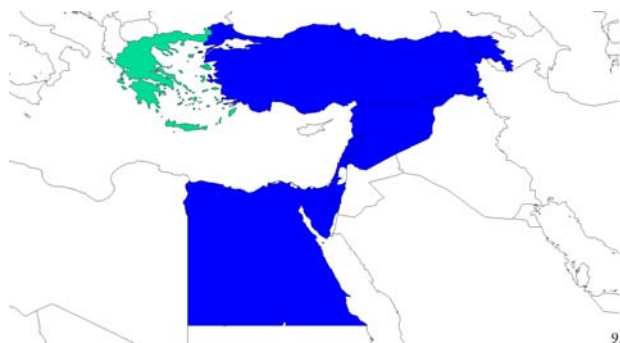


Figure 9. Distribution of *Lepisiota syriaca* (André, 1881) in Europe and Mediterranean Region.



Figure 13. Distribution of *Strumigenys membranifera* Emery, 1869 in Europe and Mediterranean Region.



Figure 10. Distribution of *Pheidole indica* Mayr, 1879 in Europe and Mediterranean Region.



Figure 14–15. Workers, lateral view. 14– *Lepisiota syriaca* (André, 1881); 15– *Strumigenys membranifera* Emery, 1869, Photo by April Nobile, from [www.antweb.org](http://www.antweb.org). Accessed 7 August 2017.



Figure 11–12. *Pheidole indica* Mayr, 1879, lateral view. 11–minor worker; 12–major worker.

Egypt; Iran; Israel; Italy: Sicily; Malta; Portugal; Saudi Arabia; Spain: Balears, Canary Is., mainland; Turkey; United Arab Emirates; Yemen.

**Biology.** Species closely related with anthropogenic habitats. Nests usually on sunny and arid places, under stones or pavement tiles. Workers were caught in parks, green areas and on sidewalks. Abundant in places rich in food remains

and animal corpses. Very often main nest chamber contained dead workers of the genus *Camponotus* and *Messor*. Colonies facultatively polygynous (Sarnat et al. 2015).

**Notes.** In all publications mentioned in the References section, this species is listed with its junior synonym *Pheidole teneriffana* Forel, 1893.

***Strumigenys membranifera* Emery, 1869** - Figs. 13, 15.

*Strumigenys (Trichoscapa) membranifera* Emery, 1869 a: 24.

**Records in Greece:**

**Literature.** Greece: Agosti & Collingwood 1987: 53 (as *Trichoscapa membranifera* Emery, 1869).

**Native bioregion.** Afrotropic.

**Distribution in Europe and Mediterranean Region.**

Egypt; France: mainland; Israel; Italy: mainland, Sardinia, Sicily; Malta; Spain: mainland; Tunisia; Turkey.

**Biology.** In Mediterranean Region found mostly in synanthropic habitats. Predatory ants, feeding mostly on Collembola. Nesting outdoors in rotting logs and soil in both moist forests and moderately dry, open cultivated fields

(Wetterer 2011, Sharaf et al. 2014).

### Crematogastrini

***Cardiocondyla mauritanica* Forel, 1890** - Figs. 16, 18.

*Cardiocondyla nuda* var. *mauritanica* Forel, 1890: 75.

Records on Cyprus:

Literature. Emery 1909: 25.

Records in Greece:

Literature. *Kriti*: Seifert 2003: 248 – Irakleio Pref., 1990-iv; Zaros, 1992-v; Chania Pref., Georgioupoli, Kavros, 1994-viii-27; Borowiec & Salata 2012: 485 – Chania Pref., Kato Daratso n. Chania, 20-25 m, 35.5N/23.98333E, 2011-iv-30, coll. L. Borowiec. *Kyklades*: Seifert 2003 – Paros, 1994-v. *Dodekanisa*: Borowiec & Salata 2012: 485 – Rodos, Kiotari, Hotel Aikaterini, 3 m, 36.03333N/27.93333E, 2008-vii-01, coll. L. Borowiec.

New material. *Kriti*: 4 workers – Lasithi Pref., Moni Kapsa, 1 m, 35.01667N/26.05E, 2014-v-03, coll. S. Salata (DBET). *Dodekanisa*: 2 workers – Kos, Kardamaina, 7m, 36.78363N/27.14107E, 2015-vii-09, coll. S. Salata (DBET).

Native bioregion. Palearctic.

Distribution in Europe and Mediterranean Region.

Egypt; Iraq; Iran; Israel; Italy: mainland, Sardinia, Sicily; Jordan; Libya; Malta; Morocco; Oman; Portugal; Spain: Canary Is., mainland; Tunisia; Turkey; Ukraine; United Arab Emirates, Yemen.

Biology. Species associated with humid habitats. Nests below flat and small stones, shallowly embedded in sandy soil. Always located close to water source, most often on sunny places. Workers were collected in close distance to a nest, maximum 50 cm from its entrance. Occasionally, workers were reported in material collected from bushes overgrowing streams or rivers banks. Ants active all day, most numerous caught at dusk. Especially, close to food remains or insect corpses. Nests always polygynous.

***Tetramorium bicarinatum* (Nylander, 1846)** - Figs. 17, 19.

*Myrmica bicarinata* Nylander, 1846: 1061.

Records in Greece:

New material. *Kriti*: 25 workers – Irakleio Pref., Irakleio City Park, 29 m, 35.34006N/25.13342E, 2014-vi-08, coll. S. Salata.

Native bioregion. Indomalaya.

Distribution in Europe and Mediterranean Region.

Algeria; Austria; Belgium; Egypt; Germany; Hungary; Israel; Netherlands; Sweden; Turkey; United Arab Emirates; United Arab Emirates; Yemen.

Biology. Synanthrope. In Europe, known mostly from greenhouses or heated buildings (Wetterer 2009a). This is the third published outdoors record of this species in Europe and the Mediterranean Region. So far, the only known records come from the public urban park in Cordoba, Spain (Reyes & Espadaler 2005) and Cilento National Park in Campania, Italy (Borowiec & Salata 2015).

In Kriti, a nest was located in a dry, partly barkless branch of mulberry tree, in a city park in Irakleio. There were a few entrances to the nest, located 1.5 m above soil level. Entrances were round, about 2 mm in diameter. Workers foraged towards the top of the tree, probably to feed on mature mulberries. It was the only ant species found on this tree; no workers were found on the soil.



Figure 16. Distribution of *Cardiocondyla mauritanica* Forel, 1890 in Europe and Mediterranean Region.



Figure 17. Distribution of *Tetramorium bicarinatum* (Nylander, 1846) in Europe and Mediterranean Region.



Figure 18-19. Workers, lateral view. 18- *Cardiocondyla mauritanica* Forel, 1890; 19- *Tetramorium bicarinatum* (Nylander, 1846).

### Solenopsidini

***Monomorium bicolor* Emery, 1877** - Figs. 20, 22.

*Monomorium bicolor* Emery, 1877: 368.

Records on Cyprus:

Literature. Salata & Borowiec 2015: 65 – Pafos Pref., 17 m, Avakas Pen., Avakas Gorge, mouth, 34.91826N/32.32978 E,





Figure 20. Distribution of *Monomorium bicolor* Emery, 1877 in Europe and Mediterranean Region.



Figure 21. Distribution of *Monomorium pharaonis* (Linnaeus, 1758) in Europe and Mediterranean Region.



Figure 22–23. Workers, lateral view. 22– *Monomorium bicolor* Emery, 1877; 19– *M. pharaonis* (Linnaeus, 1758).

2012-v-02, coll. L. Borowiec.

**New material.** 1 worker – Pafos Pref., Diarizos river n. Mamonía, 286 m, 34.75N/32.61666E, 2012-v-06, coll. L. Borowiec (DBET); 2 workers – Pafos Pref., Aphrodite Baths, 51 m, 35.05N/32.61666E, 2012-v-04, coll. L. Borowiec (DBET); 3 gynes – Pafos Pref., Diarizos river n. Nikokleia, 62

m, 34.71666N/32.58333E, 2012-v-06, coll. L. Borowiec (DBET).

**Records in Greece:**

**Literature.** Greece: Agosti & Collingwood 1987: 55 (as *Monomorium phoenicum* Santschi, 1927). Aegean Islands: Legakis 2011: 14 (as *Monomorium nitidiventre* Emery, 1893); 15 (as *Monomorium phoenicum* Santschi, 1927). Kriti: Legakis 2011: 15 (as *Monomorium phoenicum* Santschi, 1927). Kyklades: Legakis 2011: 14 (as *Monomorium nitidiventre* Emery, 1893); 15 (as *Monomorium phoenicum* Santschi, 1927). Dodekanisa: Menozzi 1928: 127 (as *Monomorium bicolor* spp. *nitidiventris*) – Karpathos; Menozzi 1936: 283 (as *Monomorium subopacum* spp. *nitidiventris*) – Rodos, Rodos city and Kallithea; Alimia Island; Karpathos, Karpathos city and Diafani; Telendos Island; Kasos Island; Kalymnos Island, between Calamandra and Noveprati; Kos Island, Kardamaina.

**New material.** Kriti: 5 workers – Irakleio Pref., Komos, 28 m, 35.0N/24.76667E, 2014-v-03, coll. S. Salata (DBET); 9 workers – Irakleio Pref., 3.8km SW of Gortinia archaeological site, 151 m, 35.05N/24.93333E, 2014-v-03, coll. S. Salata (DBET); 6 workers – Irakleio Pref., Stoli-Louves road, 197 m, 35.03333N/25.01667E, 2014-iv-22, coll. S. Salata (DBET); 3 workers – Irakleio Pref., Irakleio city, 46 m, 35.31667N/25.11667E, 2014-iv-24, coll. S. Salata (DBET); 3 gynes and 35 workers – Lasithi Pref., Pachia Ammos, 2 m, 35.1109N/25.8033E, 2014-vi-08, coll. S. Salata (DBET). Dodekanisa: 6 workers – Karpathos, Karpathos city, 26 m, 35.50667N/27.21631E, 2014-v-24, coll. S. Salata (DBET); 1 worker – Karpathos, Agnotia beach, 165 m, 35.667957/27.176429E, 2014-v-18, coll. S. Salata (DBET); 9 workers – Karpathos, Panaghia, 300 m, 35.7115N/27.17102E, 2014-v-20, coll. S. Salata (DBET); 4 workers – Karpathos, Trachanammos, 17 m, 35.45884N/27.10244E, 2014-v-22, coll. S. Salata (DBET).

**Native bioregion.** Afrotropical.

**Distribution in Europe and Mediterranean Region.**

Egypt; Iran; Israel; Libya; Oman; Saudi Arabia; United Arab Emirates.

**Biology.** Species associated with arid habitats, mostly anthropogenic, especially beaches. Nests in sand, below small, flat stones or in shells of dead snails. Always in sunny locations. Once a nest was located in the roots of a halophyte overgrowing a border of a beach. During the day entrances to the nests are covered with soil. Workers active from dusk until late at night. When active, they hunt for other insects or feed on food remains or animal corpses. Very often corpses of *Camponotus* or *Pheidole* ants were located in the main chamber. Colonies polygynous.

**Notes.** After examining specimens determined by Menozzi as *M. nitidiventre* (deposited in Bologna), we concluded that they were wrongly determined specimens of *M. bicolor*, while specimens labelled as *M. phoenicum* and *M. nitidiventre* by Legakis (deposited in Athens) and Collingwood (deposited in Liverpool) proved to be *M. subopacum*. Therefore, the real distribution of this species and its influence on the local fauna need further research.

***Monomorium pharaonis* (Linnaeus, 1758) - Figs. 21, 23.**

*Formica pharaonis* Linnaeus, 1758: 580.

**Records on Cyprus:**

**Literature.** Wetterer 2010: 120.

Records in Greece:

Literature. *Dodekanisa*: Menozzi 1928: 127 – Rodos. *Kentriki (Central) Makedonia*: Bolton 1987: 358 – Thessaloniki (as Salonika). *Kriti*: Bolton 1987: 358.

Native bioregion. Indomalay.

Distribution in Europe and Mediterranean Region. Albania; Algeria; Armenia; Austria; Belgium; Britain; Bulgaria; Croatia; Czech Rep.; Denmark; Egypt; Estonia; Finland; France: mainland; Georgia; Germany; Hungary; Iran; Ireland; Israel; Italy: mainland, Sardinia, Sicily; Latvia; Lithuania; Luxembourg; FYR Macedonia; Madeira; Moldova; Montenegro; Morocco; Netherlands; North Ireland; Poland; Portugal; Romania; Russia; Saudi Arabia; Serbia; Slovakia; Slovenia; Spain: Balears, Canary Is., mainland; Sweden; Switzerland; Turkey; Ukraine.

Biology. Synanthrope. Very common in greenhouses or heating buildings rich in food remains (zoos, botanical gardens, hospitals). Ants aggressive, usually eliminate other insects from occupied area. Because in Europe and the Mediterranean Region most records are from indoors, its influence on the native fauna is not known. Workers forage in long trails. Nests often deep in building foundations. Colonies polygynous and polydomous.

***Monomorium subopacum* (F. Smith, 1858) - Figs. 24, 26.**

*Myrmica subopaca* Smith, 1858: 127.

Records on Cyprus:

Literature. Salata & Borowiec 2015: 65 – Pafos Pref., 17 m, Avakas Pen., Avakas Gorge, mouth, 34.91826N/32.32978 E, 2012-v-02, coll. L. Borowiec (DBET).

Records in Greece:

Literature. *Greece*: Emery 1922: 178 (as *Monomorium salomonis subopaca*). *Aegean Islands*: Legakis 2011: 15. *Kyklades*: Forel 1886: clxvii – Naxos Island. *Kriti*: Forel 1910: 23 (as *Monomorium salomonis* subsp. *subopacum*); Borowiec & Salata 2012: 519 – Chania Pref., Kato Daratso n. Chania, 20-25 m, 35.5N/23.98333E, 2011-iv-30, coll. L. Borowiec. *Dodekanisa*: Borowiec & Salata 2012: 519 – Rodos, Kiotari, Hotel Aikaterini, 3 m, 36.03333N/27.93333E, 2008-vii-01, coll. L. Borowiec, Salata & Borowiec 2015: 65 – Karpathos, Trachanammos, 0 m, 35.27N/27.06E, 2014-iv-25, coll. S. Salata.

New material. *Kriti*: 7 workers – Chania Pref., Grammeno, 0 m, 35.23333N/ 23.63333E, 2014-ii-26, coll. S. Salata (DBET); 1 gyne, 5 workers – Irakleio Pref., Agia Triada, 1 m, 35.0508N/25.7542E, 2014-iv-24, coll. S. Salata (DBET); 7 gynes, 50 workers – Irakleio Pref., Tsoutsouros, 1 m, 34.9843N/25.28333E, 2014-iv-22, coll. S. Salata (DBET). *Dodekanisa*: 1 worker – Karpathos, Kato Lefkos, 32 m, 35.58606N/27.08179E, 2014-v-21, coll. S. Salata (DBET); 20 workers – Kos, Kardamaina, 7 m, 36.78363N/27.14107E, 2015-vii-09, coll. S. Salata (DBET). *Kyklades*: 7 workers – Naxos, Plaka, 6 m, 37.0532N/25.3673E, 2016-vii-02, coll. S. Salata (DBET); 5 workers – Naxos, Aliki, 15 m, 36.9799N/25.388E, 2016-vii-04, coll. S. Salata (DBET).

Distribution in Europe and Mediterranean Region. Algeria; Egypt; Georgia; Iran; Israel; Italy: mainland, Sardinia, Sicily; Lebanon; Libya; Madeira; Malta; Morocco; Oman; Portugal; Saudi Arabia; Spain: Balears, Canary Is.; Syria; Tunisia; Turkey; United Arab Emirates; Yemen.

Biology. Species very often related with anthropogenic sites but also know from natural habitats. Associated with



Figure 24. Distribution of *Monomorium subopacum* (F. Smith, 1858) in Europe and Mediterranean Region.



Figure 25. Distribution of *Solenopsis geminata* (Fabricius, 1804) in Europe and Mediterranean Region.



Figure 26–27. Workers, lateral view. 26– *Monomorium subopacum* (F. Smith, 1858); 27– *Solenopsis geminata* (Fabricius, 1804), Photo by April Nobile, from [www.antweb.org](http://www.antweb.org). Accessed 7 August 2017.

open, arid and sunny habitats. Nests below flat stones, in rock rumble or in dry litter. Workers caught on the soil or rocks surrounding a nest entrance. Large number of workers gather close to food remains or animal corpses. Active during the day, especially during highest temperature period. Colonies polygynous.



***Solenopsis geminata* (Fabricius, 1804)** - Figs. 25, 27.

*Atta geminata* Fabricius, 1804: 423.

Records on Cyprus:

Literature. Collingwood et al. 1997: 508.

Records in Greece:

Literature. *Ionian Islands*: Collingwood 1993: 193 - Zakynthos (as Zante), Agalos.

Native bioregion. Neotropic.

Distribution in Europe and Mediterranean Region. Italy: mainland; United Arab Emirates.

Biology. In Greece workers were collected foraging at midday near Agalos village (Collingwood 1993). An aggressive predator with strong negative influence on the local fauna. Nest usually in open fields or sunny glades.

**PONERINAE****Ponerini*****Hypoponera eduardi* (Forel, 1894)** - Figs. 28, 30.

*Ponera eduardi* Forel, 1894: 15.

Records on Cyprus:

Literature. Bolton & Fisher 2011: 45 - Stroumbi.

Records in Greece:

Literature. *Aegean Islands*: Forel 1888: 256 - Ikaria (as *Ponera contracta*). *Kriti*: Borowiec & Salata 2012: 497 - Chania Pref., Koutsomatados-Mili rd., 308 m, 35.383333N/23.66666E, 2011-v-02, coll. L. Borowiec. *Dodekanisa*: Legakis 2011: 3. *Ipeiros*: Borowiec & Salata 2018: 6 - 1.2 km NW of n. A. Kotsanopoulo, 170 m, 39.23467N/20.70309E, 2016-viii-30, coll. L. Borowiec, Ammoudia, 1 m, 39.2446N/20.48102E, 2016-ix-07. *Ionian Islands*: Emery 1898: 124 - Kerkyra. *Kentriki (Central) Makedonia*: Borowiec & Salata 2012: 497 - Chalkidiki, Kassandra, Siviri, 3-10 m, 40.03333N/23.35E, 2009-ix-05/06, coll. L. Borowiec. *Peloponnisos*: Forel 1886: clxvii - Morea, Nauplion (as *Ponera contracta*); Borowiec & Salata 2017: 209 - Messinia, Taygetos Mt., 0.6 km E of Ag. Triada, 600 m, 37.07255N/22.22412E, 2016-vi-17, coll. L. Borowiec, Messinia, Taygetos Mt., 0.6 km W of Artemisia, 660 m, 37.09877N/22.22287E, 2016-vi-15, coll. L. Borowiec, Messinia, Aigaleo Mt., 0.8 km SSE of Metaxada, 440 m, 37.0898N/21.74191E, 2016-vi-16 coll. L. Borowiec. *Kentriki Ellada (Central Greece)*: Forel 1888: 256 - Evvoia (as Euboea) (as *Ponera contracta*).

New material. *Aegean Islands*: 2 workers - Samos, Manolates, 37.78333N/26.81666E, 2013-vi-09, coll. H. C. Wagner (DBET); 9 workers - Samos, 1.7 km S of Agios Konstantinos, 285 m, 37.79064N/26.83246E, 2017-vi-05, coll. L. Borowiec (DBET). *Kriti*: 7 workers - Irakleio Pref., Katofigi, 560 m, 35.08333N/25.4E, 2014-iii-30, coll. S. Salata (DBET); 12 workers - Lasithi Pref., Praisos, 193 m, 35.11667N/26.06667E, 2014-iv-12, coll. S. Salata (DBET); 4 workers - Rethymno Pref., Saitoures, 305 m, 35.26666N/24.38333E, 2013-v-15, coll. L. Borowiec (DBET). *Ipeiros*: 1 gyne - Preveza Pref., Ammoudia, 1m, 39.2446N/20.48102E, 2016-ix-07, coll. L. Borowiec (DBET); 6 workers - Preveza Pref., 1.2 km NW of n. A. Kotsanopoulo, 170 m, 39.23467N/20.70309E, 2016-08-30, coll. L. Borowiec (DBET). *Peloponnisos*: 1 worker - Messinia Pref., Aigaleo Mt., 0.8 km SSE of Metaxada, 440 m, 37.0898N/21.74191E, 2016-vi-16, coll. L. Borowiec (DBET); 6 workers - Messinia Pref., Taygetos Mt., 0.6 km W of Artemisia, 660 m, 37.09877N/22.22287E, 2016-vi-15, coll. L. Borowiec (DBET); 6



Figure 28. Distribution of *Hypoponera eduardi* (Forel, 1894) in Europe and Mediterranean Region.



Figure 29. Distribution of *Hypoponera punctatissima* (Roger, 1859) in Europe and Mediterranean Region.



Figure 30-31. Workers, lateral view. 30- *Hypoponera eduardi* (Forel, 1894); 31- *Hypoponera punctatissima* (Roger, 1859), Photo by April Nobile, from www.antweb.org. Accessed 7 August 2017.

workers - Messinia Pref., Taygetos Mt., 0.6 km E of Ag. Triada, 600 m, 37.07255N/22.22412E, 2016-vi-17, coll. L. Borowiec (DBET).

Native bioregion. Palearctic.

Distribution in Europe and Mediterranean Region. Algeria; Azores; Bosnia and Herzegovina; Bulgaria; Croatia; France; Corsica, mainland; Georgia; Gibraltar; Israel; Italy;

mainland, Sardinia, Sicily; Northern Macedonia; Malta; Montenegro; Morocco; Portugal; Saudi Arabia; Serbia; Spain; Balears, Canary Is., mainland; Switzerland; Turkey; Ukraine; United Arab Emirates; Yemen.

**Biology.** Soil species, strongly associated with dark and humid, woody, natural and anthropogenic habitats. Nests always below flat stones, located close to water, in wet soil. Workers, after lifting a stone, tried to hide in soil or in litter. Never manifested aggressive behaviour. When caught mostly pretended to be dead or curled up. Nests polygynous.

***Hypoponera punctatissima* (Roger, 1859) - Figs. 29, 31.**

*Ponera punctatissima* Roger, 1859: 246.

**Records in Greece:**

**Literature.** Greece: Agosti & Collingwood 1987: 52. *Aegean Islands*: Legakis 2011: 3.

**Native bioregion.** Palearctic.

**Distribution in Europe and Mediterranean Region.** Andorra; Armenia; Austria; Azores; Belgium; Britain; Bulgaria; Czech Rep.; Denmark; Egypt; Finland; France: mainland; Germany; Hungary; Ireland; Israel; Italy: mainland, Sardinia; Libya; Luxembourg; Madeira; Malta; Morocco; Netherlands; Norway; Oman; Poland; Portugal; Romania; Saudi Arabia; Serbia; Slovakia; Spain: Balears, Canary Is., mainland; Sweden; Switzerland; Tunisia; Turkey; Ukraine; United Arab Emirates; Yemen.

**Biology.** Seifert (2013) noted that most nests investigated by him in Europe, were "outdoors in mounds or heaps of decomposing, heat-producing organic material". He also mentions a potential dispersal of this species to natural or semi-natural habitats (as a consequence of global warming). In open habitats, nests always in open and sun-exposed localities.

## Discussion

In total, 15 invasive species were noted from Greece and 9 of them occur also in Cyprus. Among them, *Paratrechina longicornis* and *Pheidole indica* are recorded for the first time from Cyprus, while *Tetramorium bicarinatum* has not been previously known from Greece. Most of these species are considered to originate from the Palearctic (5). The rest of them are native to Indomalayan (3), Afrotropic (3), Neotropic (2), Nearctic (1) and Indoaustralian (1) bioregions. *Linepithema humile*, *Nylanderia jaegerskioeldi* and *Tetramorium bicarinatum* are the only species that eliminated other ant species around their occupied area. All of these species are strongly associated with anthropogenic environments. Only four Palearctic species (*Cardiocondyla mauritanica*, *Hypoconerops eduardi*, *Hypoconerops punctatissima* and *Monomorium subopacum*) could also be found in semi-natural and natural habitats. This could be due to their wide habitat preferences or the existence, in Greece and Cyprus, of environmental factors similar to these occurring in their native range.

There are three species of uncertain presence in Greece. *Anoplolepis gracilipes* (Smith, 1857) was recorded for the first time from Kyklades by Borowiec & Salata (2012). This record was based on information given in Fauna Europea (Radchenko 2007) and is not confirmed by any available data. Be-

cause of the lack of both bibliographic sources for this record and the absence of habitats typical for this species, we acknowledge presence of this species in Greece as improbable.

The second questionable species recorded from Greece is *Pheidole megacephala*. According to Sarnat et al. (2015), records of this species from Kriti (Borowiec & Salata 2012) should be considered as misidentifications of *P. pallidula*. After re-examining specimens from Kriti we confirm this statement. Therefore, presence of this species in Greece is doubtful.

In a paper dedicated to analyse the worldwide spread of *Monomorium destructor*, we can find information of the presence of this species in Cyprus (Wetterer 2009b). Unfortunately, in a publication cited as a source of this record we could not confirm its presence there (DAFF 2001). We also studied other papers cited in Wetterer's publication that could provide such information, but the presence of this species in Cyprus seems to be unconfirmed. For this reason, we decided not to list it as a species known from this island.

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