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# Ants (Hymenoptera: Formicidae) of the Madeiran Archipelago

by

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## ABSTRACT

The subtropical Atlantic archipelago of Madeira is part of the Macaronesian biogeographic subregion. Absence of important mainland competitors and predators on Macaronesian islands has allowed the survival of many relicts of the subtropical biota that once inhabited the Mediterranean area. In the 19th century, however, two highly destructive exotic ant species, the big-headed ant (*Pheidole megacephala*) and the Argentine ant (*Linepithema humile*), invaded Madeira. Many authors have assumed that these invaders exterminated most or all native ants of Madeira, despite no research actually documenting such impact. In the present study, we compiled records and evaluated the native versus exotic status of all ant species collected in Madeira.

We examined specimens of 27 ant species from Madeira: *Cardiocondyla emeryi*, *Cardiocondyla mauritanica*, *Hypoconerops eduardi*, *Hypoconerops punctatissima*, *Hypoconerops* sp. 1, *Lasius grandis*, *Linepithema humile*, *Messor structor*, *Monomorium carbonarium*, *Monomorium pharaonis*, *Monomorium subopacum*, *Myrmecina graminicola*, *Paratrechina jaegerskioeldi*, *Paratrechina longicornis*, *Pheidole megacephala*, *Pheidole pallidula*, *Plagiolepis schmitzii*, *Pyramica membranifera*, *Solenopsis* sp. 1, *Solenopsis* sp. 2, *Strumigenys silvestrii*, *Tapinoma madeirense* (new status), *Technomyrmex pallipes*, *Temnothorax unifasciatus*, *Temnothorax wollastoni*, *Tetramorium bicarinatum*, and *Tetramorium caldarium*. One previously reported species, *Camponotus sylvaticus*, we could not verify with specimens, but accept it was correctly identified, at least to genus. We determined that one ant taxon reported from Madeira is a junior synonym of another taxon present: *Plagiolepis schmitzii madeirensis*

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(= *P. schmitzii*, new synonymy). In addition, published records of eight ant taxa reported from Madeira appear to be misidentifications of other species present.

Based on their known distribution and ecology, ten ant species (including the seven most common species) appear to be native to Madeira. Only one native ant species, *T. wollastoni*, has not been collected recently (1995 or later) in Madeira. Although exotic ants may have exterminated *T. wollastoni*, it seems likely that this species still survives.

**Key Words: Please provide**

## INTRODUCTION

The subtropical Atlantic archipelago of Madeira, off the coast of North Africa, was originally settled by the Portuguese in the early 1400s, and is now an autonomous region of Portugal. Only the two largest islands, Madeira (737 km<sup>2</sup>) and Porto Santo (41 km<sup>2</sup>), are currently inhabited. In addition, there are more than 50 smaller, uninhabited islands (17 km<sup>2</sup> total), including two island clusters to the south, the Desertas and Selvagens.

Madeira is part of the Macaronesian biogeographic subregion, which also includes the Azores, Canary Islands, Cape Verde Islands, and part of the northwest African coast. The islands of Macaronesia have acted as a biological conservatory, preserving a large number of species found nowhere else in the world. Absence of many important mainland competitors and predators and the islands' mild climates have allowed the survival of many relicts of the subtropical biota that inhabited the Mediterranean area before the end of the Tertiary Period, 2 million years ago. In addition, many groups of endemic plants, animals, and fungi have diversified tremendously in Macaronesia (Wollaston 1854; Enghoff 1992; Hobohm 2000). For example, Madeira has 216 species of land snails, twice as many as all of Britain (Cook 1996).

With the Portuguese settlement, Madeira quickly became an important center for commerce, particularly between Europe and the New World. With human commerce came many animal and plant invaders, including new competitors, predators, and parasites. Organisms on isolated islands are especially susceptible to new invaders due to the low level of past evolutionary pressures, and the depredations of exotic species have been deemed responsible for a large portion of the extinctions of island endemics (Wilson

1992). Worldwide, 90% of documented mammal and bird extinctions in the past 500 years have occurred on islands (MacPhee & Flemming 1997, Manne *et al.* 1999). All historical extinctions of land snails have occurred on islands, and almost twice as many endemic land snails of Madeira have gone extinct since human colonization than in the previous 300,000 years (Goodfriend *et al.* 1994; Cook 1996).

The earliest exotic records for two notorious invasive ants, the big-headed ant (*Pheidole megacephala*) and the Argentine ant (*Linepithema humile*), both come from Madeira, where these two species underwent population explosions in the 1850s and 1890s, respectively. Researchers have long assumed that these invaders spread across all of Madeira and exterminated most or all native ants, despite no research actually documenting such impact (Wetterer 2006). In a companion study, Wetterer *et al.* (2006) concluded that *P. megacephala* and *L. humile* probably never spread beyond coastal lowland areas, which make up <10% of Madeira's land area. In 2002, Wetterer *et al.* (2006) found that native ants dominated most of Madeira; *P. megacephala* and *L. humile* were restricted to ~0.3% and ~6% of Madeira's land area, respectively.

In the present study, we provide a checklist of the ants in the Madeiran Archipelago, with a list of known site records, and evaluate the native versus exotic status of each species.

## METHODS

### Museum specimens

We examined specimens from the two major ant collections made during the 19th century on Madeira, by Thomas Wollaston and Ernst Schmitz.

Wollaston sold a collection of his ant specimens from Madeira to the Oxford University Natural History Museum (ONHM). XE examined this entire collection, which had remained intact in its original drawer. All these specimens, collected sometime between 1847 and 1855, were undated and labeled with taxonomic determinations by Forel (as mentioned by Saunders 1903). XE also examined a Wollaston syntype of *Temnothorax wollastoni* deposited at the British Natural History Museum (BMNH). JKW examined Wollaston's *L. humile* and *P. megacephala* specimens at the BMNH that were identified by Barry Bolton.

Schmitz sent ant specimens from Madeira to Auguste Forel who deposited them at the Musée d'Histoire Naturelle in Geneva (MHNG). XE examined Schmitz' Madeira specimens representing all species listed by Schmitz (1896, 1897) and Forel (1895, 1904) that we did not find occurring in Madeira in 2002. All these specimens, collected between 1894 and 1904, were undated and labeled with Forel's taxonomic determinations. We looked for these specimens that Schmitz (1896) deposited in the Seminary Museum in Funchal, but could not find them. Curators at the Natural History Museum in Boa Vista, Madeira where the Seminary collection now resides, told us that most of the collection had been destroyed in a fire.

We also searched for Madeiran ant specimens in the collections at the Smithsonian Institute's National Museum of Natural History (SI) in Washington D.C., and the Museum of Comparative Zoology (MCZ) at Harvard University.

### **New collections**

Between 1989 and 2002, AMFA and other several researchers at the Laboratório Agrícola da Madeira (most notably J. Jesus and J. Andrade) collected ants opportunistically, primarily from agricultural sites. In May and October 2002, DAP and two undergraduates at the University of Madeira (Élvio Nunes and Iola Martins) collected 196 ant samples from plant beatings at six sites: Abrigo, Curral, Poiso, Ribeiro Frio, Ribeiro Serrão, and Urzal. In June 2002, undergraduates at the University of Madeira collected ants from their homes. In 2003 a student Nelio Freitas (NF) collected material in Deserta Grande.

Between 5 June - 28 July 2002, JKW and ALW collected ants through hand-collecting and sifting soil and litter in a wide variety of habitats. We sampled most intensively in disturbed areas searching for *L. humile* for a genetic and behavioral study (Wetterer & Wetterer 2006). On Madeira, JKW and ALW sampled 93 sites (elevation included for sites >500m asl): 1 = Achada da Madeira. 2 = Arco de São Jorge, by Boaventura tunnel. 3 = Boca da Encumeada, lookout, 1000m. 4 = Cabo Girão, lookout, 580m. 5 = Calheta, vineyard. 6-7 = Camacha (6 = roof of Laboratório Agrícola building, 700m; 7 = central park, 730m). 8-9 = Câmara de Lobos (8 = waterfront; 9 = Pico da Torre lookout). 10 = Cancela, overlook west of town, garden. 11 = Canhas,

town. 12-14 = Caniçal (12 = outside café; 13 = industrial complex; 14 = waterfront). 15 = Caniço de Baixo, Rocamar Hotel garden. 16 = Carvalho, above town on ER 209, pine forest, 650m. 17-18 = Chão da Ribeira (17 = forest trail; 18 = by road). 19-20 = Curral das Freiras (19 = near tunnel S of town, 960m; 20 = chestnut forest 1 km N of town, 550m). 21 = Curral Falso, Laurisilva forest, under rocks, 900m. 22 = Eira do Serrado, pine forest, 1090m. 23 = Fonte da Pedra, grassy area surrounded by forest. 24-45 = Funchal (24 = waterfront; 25 = Univ. of Madeira campus; 26 = planter & traffic circle by Oudinot Center; 27 = Conde Carvalho Park; 28 = Parque de Santa Catarina; 29 = English bookstore; 30 = Parque São Francisco; 31 = main pier; 32 = Municipal Museum herb garden; 33 = Quinta das Cruzes garden; 34 = Quinta Magnolia garden; 35 = marine biology station; 36 = Reid Hotel garden; 37 = one block N of Alto Lido Hotel, apartment garden; 38 = Ponta da Cruz; 39 = Praça da Autonomia; 40 = Mercado dos Lavradores; 41 = Boa Vista, alleyway; 42 = Boa Vista, Botanical Garden; 43 = Boa Vista, Loiro Park; 44 = Boa Vista, Quinta da Boavista garden; 45 = Boa Vista, overlook park). 46 = Livramento, overlook. 47 = Machico, beachfront. 48-49 = Monte (48 = Tropical Garden; 49 = public garden). 50 = Palheiro Ferreiro, Blandy's Gardens. 51-53 = Parque Ecológico de Funchal (51 = bottom, by entrance, 1150m; 52 = middle, pine/pasture, 1420m; 53 = top, 1500m). 54-57 = Paúl da Serra (54 = intersection of EN 110 & ER 208, heathland, 1500m; 55 = Estanquinhos on ER 208, pine forest, 1580m; 56 = Cristo Rei statue on EN 209, heathland, 1330m; 57 = 0.4 km E of Ponto, under rocks, 1200m). 58 = Paúl do Mar, town. 59 = Pico Alto, E side by road, 1120m. 60-61 = Pico do Arieiro (60 = peak lookout, 1810m; 61 = 1 km E of peak, 1600m). 62-63 = Pico Ruivo (62 = near parking area, 1590m; 63 = peak, 1860m). 64 = Poiso, campground 1.5 km SSE of town, 1150m. 65-75 = Ponta de São Lourenço (65 = Ponta do Rosto, lookout; 66 = Ponta das Gaivotas, planted trees; 67 = Ponta das Gaivotas, hotel; 68 = Ponta do Buraco, by start of trail; 69 = Ponta do Buraco, planted palm trees; 70 = 1 km N of Ponta Buraco, 1st north shore lookout; 71 = 1.1 km N of Ponta Buraco, vegetated area; 72 = 1.5 km N of Ponta Buraco, 2nd north shore lookout; 73 = E side of Estreito; 74 = Ponta do Furado; 75 = Ranger station by Ponta do Furado). 76 = Ponta do Garajau, by Christ statue. 77-78 = Porto da Cruz (77 = park by church; 78 = waterfront). 79 = Porto Moniz, town. 80 = Pousada dos Vinháticos,

under rocks, 630m. 81-82 = Rabaçal (81 = near house, 1060m; 82 = along hiking trail, 1050m). 83 = Ribeira Brava, town. 84 = Ribeiro Frio, 1 km E out levada trail, 880m. 85 = Santa Catarina, airport parking lot. 86-88 = Santana (86 = town; 87 = on trail to coast; 88 = pine & *Eucalyptus* forest 2 km SW of town, under rocks, 700m). 89 = São Martinho, Centro de Fruticultura. 90 = São Roque, above town. 91-92 = São Vicente (91 = garden by cave entrance; 92 = town center). 93 = Seixal, urban.

From 21 June - 2 July 2002, XE collected ants on Madeira (23 sites): 13 sites also sampled by JKW & ALW (Sites 2, 15, 20, 22, 25, 27, 56, 60, 64, 70, 71, 82, & 89) and 10 other sites: 94 = Boaventura, roadside. 95 = Câmara de Lobos, Park San Francisco. 96 = Estrada Monumental, km 194; 2 km E of Câmara de Lobos. 97 = Fajã da Nogueira. 98 = Lombo do Urzal. 99 = Parque Ecológico do Funchal; 1260 m; pine forest. 100 = Ponta de São Lourenço; *Pinus halepensis*, road. 101 = Pousada dos Vinháticos, road to Encumeada. 102 = Ribeira Brava; garden Câmara Municipal. 103 = São Vicente, weeds next to parking lot.

JKW and ALW collected ants on Porto Santo (20 sites): 104 = Airport terminal, on outside wall. 105 = Cabeça da Ponta, 106 = Camacha, playground. 107 = Camacha, along road by houses. 108 = Fonte da Areia lookout. 109 = Miradouro das Flores lookout. 110 = Morenos, garden. 111 = Pico do Castelo lookout. 112 = Pico do Castelo, near trail head. 113 = Ponta da Calheta. 114 = Ponta da Galé. 115 = Ponto da Conveira lookout. 116 = Serra de Dentro, roadside near reservoir. 117 = Serra de Fora, on house. 118 = Vila Baleira, town center park. 119 = Vila Baleira, vineyard west side of town. 120 = Vila Baleira, west side park. 121 = Vila Baleira, along storefronts on Ave. Castro, 122 = Vila Baleira, doorstep of Columbus house. 123 = Ilhéu de Baixo, East side under plants near shore.

XE and DAP collected ants on Porto Santo (4 sites): one the same as JKW and ALW (Site 113) and three others: 124 = Pico do Castelo. 125 = Ponta. 126 = Vila Baleira; town.

We deposited voucher specimens at the Entomological collection of the University of Madeira, and the Insect Collection of the Laboratório Agrícola da Madeira (ICLAM).

## Native versus exotic

Ant species found in relatively undisturbed natural areas and not widely distributed beyond Macaronesia (the Azores, Madeira, the Canary Islands, and Cape Verde) and the Mediterranean, we considered native to Madeira (i.e., predating human arrival). Species distributed around the world through human commerce, we considered exotic.

## RESULTS

We examined specimens representing 27 ant species from the Madeiran Archipelago (see Table 1 and species accounts below). Of these species, 17 have previously published records from Madeira (Heer 1852, 1856; Wollaston 1854; Smith 1858; Mayr 1876; Emery 1882, 1893, 1921; Forel 1895, 1904; Schmitz 1896, 1897; Saunders 1903; Wheeler 1927; Stitz 1940; Donisthorpe 1940; Wellenius 1949, 1955; Bolton 1977, 1980, 1982, 1987; Espadaler & Báez 1993, Seifert 1992, 2003a, Arechavaleta *et al.* 2000): *Cardiocondyla emeryi*, *Hypoponera eduardi*, *Hypoponera punctatissima*, *Lasius grandis*, *Linepithema humile*, *Messor structor*, *Monomorium carbonarium*, *Monomorium subopacum*, *Myrmecina graminicola*, *Paratrechina longicornis*, *Pheidole megacephala*, *Plagiolepis schmitzii*, *Tapinoma madeirense*, *Temnothorax unifasciatus*, *Temnothorax wollastoni*, *Tetramorium bicarinatum*, and *Tetramorium caldarium*. In addition, we examined specimens of ten ant species not previously reported from Madeira: *Cardiocondyla mauritanica*, *Hypoponera* sp. 1, *Monomorium pharaonis*, *Paratrechina jaegerskioeldi*, *Pheidole pallidula*, *Pyramica membranifera*, *Solenopsis (Diplorhoptrum)* sp. 1, *Solenopsis (Diplorhoptrum)* sp. 2, *Strumigenys silvestrii*, and *Techomyrmex pallipes*. One previously reported species, *Camponotus sylvaticus* (in Mayr 1865), we could not verify with specimens, but accept it was correctly identified, at least to genus.

One taxon reported from Madeira we determined to be a junior synonym of another taxon present: *Plagiolepis schmitzii madeirensis* (= *P. schmitzii*, new synonymy). Eight reported ant taxa we consider misidentifications: *Ponera coarctata* = (*H. eduardi* and *H. punctatissima*), *Formica fusca* (= *L. grandis*), *Lasius niger* (= *L. grandis*), *Monomorium monomorium* (= *M. carbonarium*), *Monomorium salomonis* (= *M. subopacum*), *Plagiolepis pygmaea* (= *P. schmitzii*), *Tapinoma erraticum* (= *T. madeirense*), and *Tetramorium simillimum* (= *T. caldarium*). We raise *Tapinoma erraticum* var. *madeirense*



to a full species, and designate *Tapinoma ambiguum* as a junior synonym of *Tapinoma madeirense*.

In 2002, we collected 22 ant species, and we examined specimens collected in 1995 and 1999 for two others. The remaining four species (*C. sylvaticus*, *M. structor*, *T. wollastoni*, and *T. bicarinatum*) have no records from Madeira in more than 100 years.

### Species accounts and site records

+ = new record for Madeira (not including presentation of the present records, without site data, in Wetterer *et al.* 2006). Collectors: A = A.M.F. Aguiar; E = X. Espadaler; F = Nelio Freitas; J = J. Jesus; M = I. Martins & É. Nunes; P = D. Aguin Pombo; W = J.K. Wetterer & A.L. Wetterer. For the three most common species collected in 1989-2002 by Aguiar *et al.* (*L. grandis*, *M. carbonarium*, and *P. schmitzii*), we only list the number of Madeira island site records. When available and relevant, published records below include (in order) collection date, collector, and source references; specimen records include collection date, collector, museum repository, and additional label information.

#### 1. *Cardiocondyla emeryi* Forel 1881

**Published records. Madeira:** No site data (1933; Seifert 2003a). Funchal (E Schmitz; Forel 1904 & Seifert 2003a). Funchal (1960; Seifert 2003a). Funchal (N Krauss; Bolton 1982). Funchal (Stitz 1940). Furado (E Schmitz; Forel 1904 & Seifert 2003a). Paul do Mar (2001; Seifert 2003a).

**Specimens examined. Madeira:** Boca da Encumeada, lookout (2002; W). Câmara de Lobos (1995; A & J). Caniçal, waterfront (2002; W). Funchal, 11 sites: 24, 25, 27, 28, 30, 32, 33, 34, 35, 37, & 45 (2002; W). Funchal, Conde Carvalhal Park (2002; E). Paúl do Mar, town (2002; W). São Martinho, Centro de Fruticultura (2002; W). **Porto Santo:** Cabeça da Ponta (2002; W). Morenos, garden (2002; W). Ponta da Calheta (2002; E). Vila Baleira, 3 sites: 118, 119, & 120 (2002; W). **Desertas:** Deserta Grande (2003; F).

Although Schmitz (1896, 1897) did not report *C. emeryi*, Forel (1904) wrote that Schmitz collected this species in a variety of locales on Madeira, listing two sites (see above). Stitz (1940), Bolton (1982), and Seifert (2003a) reported several additional *C. emeryi* specimens from Madeira. We found *C.*

*emeryi* was widespread but uncommon on Madeira and Porto Santo, restricted to highly disturbed sites, primarily urban gardens. Because this species is very small and forages in small numbers, it is probably often overlooked. *Cardiocondyla emeryi*, native to Africa, is a well-known tramp species distributed worldwide by human commerce (e.g., see many sites in Bolton 1982 and Seifert 2003a). It is probably exotic to Madeira.

## +2. *Cardiocondyla mauritanica* Forel 1890

**Published records.** None

**Specimens examined. Madeira:** Caniçal, waterfront (2002; W). Funchal, Univ. of Madeira campus garden (2002; W & E). Funchal; Quinta das Cruzes garden (2002; W).

*Cardiocondyla mauritanica* has not been previously reported from Madeira. We found this Mediterranean native only at three urban sites in southeastern Madeira. This species has been recorded in numerous sites around the world, including the Canary Islands (Seifert 2003a) and Ascension Island (Ashmole & Ashmole 1997). In the New World, it has usually been recorded as its junior synonym, *Cardiocondyla ectopia* Snelling. Espadaler & Bernal (2003) considered this species native to the Canary Islands. Based on its limited urban distribution in Madeira, however, it appears to be an exotic, possibly a recent introduction.

## 3. *Hypoponera eduardi* (Forel 1894)

**Published records. Madeira:** No site data (as *Ponera contracta*; Wollaston; Saunders 1903). Funchal (E Schmitz; Forel 1904). Furado (E Schmitz; Forel 1904). Nossa Senhora da Victoria (E Schmitz; Schmitz 1897). Palheira (E Schmitz; Forel 1904).

**Specimens examined. Madeira:** No site data (Wollaston; ONHM, labeled *Ponera contracta*). Chão da Ribeira, forest trail & by road (2002; W). Fajã da Nogueira (2002; E). Fonte da Pedra, grassy area surrounded by forest (2002; W). Funchal; 3 sites: 33, 42, & 45 (2002; W). Livramento, overlook (2002; W). Lombo do Urzal (2002; E). Palheiro Ferreiro, Blandy's Gardens (2002; W). Parque Ecológico de Funchal, middle & top sites (2002; W). Poiso, campground 1.5 km SSE of town (2002; E). São Vicente, garden by cave entrance (2002; W). São Vicente, weeds next to parking lot (2002; E).

**Desertas:** No site data (2003; F). Deserta Grande (Wollaston; ONHM, labeled *Ponera contracta*). Ilhéu Chão (Wollaston; ONHM, labeled *Ponera contracta*).

Smith (1858) recorded specimens of *Ponera contracta* (= *Ponera coarctata*) from Madeira in the BMNH (presumably collected by Wollaston). Saunders (1903) recorded Wollaston's specimens in the ONHM (above), identified as *Ponera coarctata*. XE found that Wollaston's ONHM specimens were a mix of *H. eduardi* and *H. punctatissima*. Stitz (1940) reported *Ponera coarctata* specimens, collected by O. Lundblad in Rabaçal, but we expect that these were misidentifications of *H. eduardi* and/or *H. punctatissima* as well. Schmitz (1897) and Forel (1904) reported *Hypoponera eduardi* specimens from Madeira. We found *H. eduardi* at many different sites, both disturbed and relatively undisturbed, all over Madeira. It was extremely common at some sites. For example, in native forest at Chão da Ribeira, we found this ant under about one of every four rocks. This species occurs throughout the Mediterranean area, as well as all four archipelagos of Macaronesia (Wellenius 1955; Collingwood & van Harten 1993; Wetterer *et al.* 2004). Exotic populations have been reported only in Oman, Saudi Arabia, and New Zealand (Cumber 1959; Collingwood 1985). It is probably native to Madeira.

#### 4. *Hypoponera punctatissima* (Roger 1859)

**Published records. Madeira:** No site data (Emery 1893). **Selvagens:** Selvagem Grande (Emery 1882). No site data (as *Ponera contracta*; Wollaston; Saunders 1903).

**Specimens examined. Madeira:** No site data (Wollaston; ONHM, labeled *Ponera contracta*). Funchal, 5 sites: 27, 32, 33, 43, 45 (2002; W). Porto da Cruz, church garden (2002; W). **Desertas:** Deserta Grande (2003; F).

Emery (1882, 1893) listed *H. punctatissima* specimens from Selvagem Grande and Madeira. Saunders (1903) recorded Wollaston's specimens in the ONHM (above) as *Ponera contracta* (= *H. coarctata*). We found *Hypoponera punctatissima* on Madeira in urban gardens. This African native is a well-known tramp species widely distributed throughout the tropics and subtropics. It is probably exotic to Madeira.

### +5. *Hypoponera* sp. 1

**Published records.** None

**Specimens examined. Madeira:** Cancela, overlook west of town, garden (2002; W). Funchal, 5 sites: 32, 33, 34, 43, & 45 (2002; W). Ponta de São Lourenço, 3 sites: 68, 71, 73 (2002; W). Ponta de São Lourenço, site 71 (2002; E). Porto da Cruz, waterfront (2002; W). São Vicente, town center (2002; W). **Porto Santo:** Cabeça da Ponta (2002; W). Morenos, garden (2002; W). Vila Baleira, west side park (2002; W).

We are uncertain of the species identity of this ant, which has not been previously reported from Madeira. It is very similar to *Hypoponera bondroiti* (Forel), an apparently New World species described from Belgium, which has also been introduced to Japan (e.g., Yamauchi *et al.* 1996, but see Seifert 2003b). Like *H. bondroiti* (Yamauchi *et al.* 1996), this species has ergatoid males. XE distinguished workers of this species from *Hypoponera punctatissima* as follows:

- Frontal line absent. Petiole with medium long hairs. Mesopleurae not smooth and shiny. Mesopleural suture present but difficult to see. Ommatidium whitish, larger (0.026 mm) ..... *Hypoponera* sp. 1
- Frontal line present. Petiole with long hairs. Mesopleurae smooth and shiny. Mesopleural suture absent. Ommatidium smaller (0.013 mm) .....  
..... *Hypoponera punctatissima*

This species was common in dry habitats of eastern Madeira and Porto Santo, and less common in urban parks. Wetterer *et al.* (in prep.) found this same species from St. Helena. It seems likely, but not certain, that this species is exotic to Madeira.

### 6. *Lasius grandis* Forel 1909

**Published records** (all as *Lasius niger*) . **Madeira:** No site data (Smith 1858, Mayr 1865, Emery 1882, Saunders 1903, Wellenius 1955, Seifert 1992). Cural Pequeno (Schmitz 1896). Poiso (Schmitz 1896), Santa Cruz (Schmitz 1896). Quinta dos Reis (Schmitz 1896). Rabaçal (Stitz 1940, Wellenius 1949). Ribeiro Frio (Wellenius 1949).

**Specimens examined. Madeira:** No site data (TV Wollaston; ONHM, labeled *Lasius niger*). No site data (Schmitz; MHNG). Rabaçal (1962; NLH Krauss; SI). Ribeiro Frio (1962 & 1967; NLH Krauss; SI). Santo da Serra (1962; NLH Krauss; SI). 78 sites (1989-2002; A *et al.*). All 6 sampled sites, plant beating (2002; M). (64 sites: 1, 2, 3, 7, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 37, 41, 42, 43, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 76, 77, 78, 80, 81, 82, 83, 84, 86, 87, 88, 89, 90, 91, & 93 (2002; W). 14 sites: 2, 15, 56, 60, 64, 82, 89, 94, 95, 97, 99, 101, 102, & 103 (2002; E). **Desertas:** Deserta Grande (2003; F).

*Lasius grandis* has been previously reported from Madeira only by Seifert (1992), who identified all *Lasius* specimens from Madeira as this species. XE also assigned all *Lasius* he examined from Madeira to *Lasius grandis*, including those of Wollaston and Schmitz. We therefore assume that all earlier reports of *Lasius niger* specimens from Madeira (Smith 1858, Saunders 1903, Stitz 1940, Wellenius 1949, 1955) resulted from misidentifications of *L. grandis*. In addition, we believe records of *Formica fusca*, reported from Madeira by Heer (1852, 1856), Smith (1858), and Mayr (1865), were also misidentified *L. grandis*. Wheeler (1927) omitted *F. fusca* from his list of Madeiran ants, despite citing Heer (1852), which included mention of this species in Madeira. Wheeler (1927) noted that an early record of *Formica fusca* from the Canary Islands was probably *L. niger*, and he apparently assumed the same for *F. fusca* reported from Madeira. We found that *L. grandis* is by far the most common ant on Madeira, occurring from sea level to the highest peaks. The few places we did not find this species were the driest habitats in the eastern tip of the island, and in a few urban areas dominated by *P. megacephala* or *L. humile*. *Lasius grandis* is also known from the Canary Islands and the western Mediterranean (Seifert 1992). It seems very likely that this species is native to Madeira.

### 7. *Linepithema humile* (Mayr 1868)

**Published records. Madeira:** Funchal and its outskirts, south, east, and north coast (Schmitz 1896). Funchal (Stitz 1940), Funchal (Wellenius 1949). Monte (Wellenius 1949), Porto Novo (Wellenius 1949). Ribeira Brava (Wellenius 1949).

**Specimens examined. Madeira:** No site data (Wollaston; BMNH). Arco de São Jorge, by Boaventura tunnel, under rocks (2002; W & E). Cabo Girão (2002; A & J). Calheta, vineyard (2002; W). Camacha, Ribeirinha (2001; A & J). Camacha, roof of Laboratório Agrícola building (2002; W). Câmara de Lobos, waterfront (2002; W). Caniço, Mãe de Deus (1990; A). Curral das Freiras (2002; A & J). Funchal (1924; de Noronha; SI). Funchal, 10 sites: 25, 26, 27, 30, 33, 34, 36, 38, 44, & 45 (2002; W). Funchal, Beco do Amparo (1996; A & J). Funchal, Bom Sucesso (1992; A). Funchal, Cabrestante (1995; A & J). Funchal, Conde Carvalhal Park (2002; E). Funchal, Lazareto (1996; A & J). Funchal, Lombo da Boa Vista (1991; A). Jardim do Mar, Igreja (1995; A & J). Lugar de Baixo (1991 & 2001; A). Machico, beachfront (2002; W). Paúl do Mar, town (2002; W). Pilar, Ribeiro Choco (1992; A). Ponta de São Lourenço, 4 sites: 68, 69, 66, & 67 (2002; W). Pousada dos Vinháticos, road to Encumeada (2002; E). Santa Catarina, airport parking lot (2002; W). Santana, on trail to coast (2002; W). São Martinho (1989; A). São Vicente, town center (2002; W). Tabúa, Zimbreiros (1996; A & J). **Porto Santo:** Airport terminal, on outside wall (2002; W). Cabeça da Ponta (2002; W). Camacha, playground & along road by houses (2002; W). Campo de Baixo (1992; A). Pico do Castelo (2002; E & P). Pico do Castelo, near trail head (2002; W). Ponta (2002; E & P). Ponto da Conveira lookout (2002; W). Serra de Dentro, roadside near reservoir (2002; W). Serra de Fora, on house (2002; W). Vereda da Terra Chã (2001; A). Vila Baleira; town (2002; E & P). **Desertas:** Deserta Grande (2003; F). Ilhéu Chão (2003; F).

Forel (1895) and Schmitz (1896) published the first reports of *Linepithema humile* from Madeira. Stitz (1940) and Wellenius (1949, 1955) also noted specimens of *L. humile* from Madeira. The pre-1855 Wollaston specimen we found at the BMNH (see above) predates all published records, including this species' original description by Mayr (1868). On Madeira, *L. humile* is fairly uncommon except on the dry eastern tip of the island. On Porto Santo, *L. humile* is very common. But outside these very dry areas, this species is largely restricted to highly disturbed urban and agricultural areas. We found no evidence of any great impact of this ant on the native species of Madeira. Even where it was most common, in the driest parts of Madeira, we found it in close association with native ant species, including *M. carbonarium*, *M. subopacum*, and *P. schmitzii*. It seems likely that this species was formerly more

common in Madeira and has declined in recent years. *Linepithema humile*, the Argentine ant, is native to the Neotropics but has been spread around the world through human commerce.

### 8. *Messor structor* (Latreille 1798)

**Published record. Madeira:** Funchal, Parque São Francisco (Schmitz 1896).

**Specimen examined. Madeira:** Funchal, Parque São Francisco (Schmitz; MHNG).

*Messor structor* specimens collected by Schmitz in Forel's collection are indistinguishable from European *M. structor*. Schmitz (1896) wrote of this species in Madeira: "As I did not find this species except in the municipal garden in this city, I am inclined to consider it introduced and not indigenous; in much the same way it is very common in the south of the Europe." We thoroughly searched the same municipal garden where Schmitz (1896) found this species, and did not find it. Instead, this garden is largely dominated by *P. megacephala*. We agree with Schmitz (1896) that this European species is probably exotic to Madeira, and we believe that this species may be extinct in Madeira.

### 9. *Monomorium carbonarium* (F. Smith 1858)

**Published records. Madeira:** No site data (Smith 1858, Saunders 1903, Forel 1904). Caniçal (Schmitz 1896). Ribeiro Gonçalo Ayres (Schmitz 1896). Rabaçal (Stitz 1940, Wellenius 1949). Feireira (Stitz 1940). Porto Novo (Wellenius 1949).

**Specimens examined. Madeira:** No site data (Wollaston; ONHM). 29 sites (1989-2002; A *et al.*). Arco de São Jorge, by Boaventura tunnel (2002; E). Boaventura, roadside (2002; E). Cabo Girão, lookout (2002; W). Câmara de Lobos, Park San Francisco (2002; E). Câmara de Lobos, Pico da Torre lookout (2002; W). Cancela, overlook west of town, garden (2002; W). Canhas, town (2002; W). Caniçal, industrial complex, under rocks (2002; W). Caniçal, waterfront (2002; W). Caniço de Baixo (2002; E). Chão da Ribeira, by road, under rocks (2002; W). Curral das Freiras, near tunnel S of town (2002; W). Eira do Serrado, pine forest (2002; W). Funchal, 6 sites: 28,

37, 38, 41, 42, & 45 (2002; W). Livramento, overlook (2002; W). Machico, beachfront (2002; W). Monte (1962; NLH Krauss; SI). Palheiro Ferreiro, Blandy's Gardens (2002; W). Paúl do Mar, town (2002; W). Ponta de São Lourenço, 4 sites: 65, 68, 69, & 75 (2002; W). Ponta de São Lourenço, site 70 (2002; E). Ponta do Garajau, by Christ statue (2002; W). Porto da Cruz, park by church (2002; W). Porto da Cruz, waterfront (2002; W). Porto Moniz, town (2002; W). Pousada dos Vinháticos, road to Encumeada (2002; E). Pousada dos Vinháticos, under rocks (2002; W). Rabaçal, near house (2002; W). Ribeira Brava; garden Câmara Municipal (2002; E). Santana, on trail to coast (2002; W). São Martinho, Centro de Fruticultura (2002; W & E). São Vicente, garden by cave entrance (2002; W). São Vicente, weeds next to parking lot (2002; E). Seixal, urban (2002; W). **Porto Santo:** Camacha, along road by houses (2002; W). Pico do Castelo (2002; E & P). Pico do Castelo, near trail head (2002; W). Vila Baleira, town (2001; A). Vila Baleira, town (2002; E & P). Vila Baleira, town center park (2002; W).

Smith (1858) described *Myrmica carbonaria* (= *Monomorium carbonarium*) based on specimens that Wollaston collected in Madeira. Schmitz (1896), Forel (1904), Stitz (1940), and Wellenius (1949) reported this species from Madeira. Mayr (1865) reported *Monomorium minutum* (= *Monomorium monomorium*) from Madeira, but we expect that this was a misidentification of the closely related *M. carbonarium*. We found *M. carbonarium* was extremely common on both Madeira and Porto Santo, particularly in urban sites, though not very conspicuous due to its small size. Wheeler (1927) considered this ant to be a Neotropical tramp, but at the time it was considered conspecific with *Monomorium ebeninum*. Yarrow (1967) considered *M. carbonarium* to be a Macaronesian endemic found only in the Azores and Madeira. Collingwood (1985) listed *M. carbonarium* from Oman, but noted that his specimens had antennae resembling those of *M. hesperium*. This species appears to be native to Madeira.

### +10. *Monomorium pharaonis* (Linnaeus 1758)

**Published records.** None

**Specimens examined. Madeira:** Santo Antonio, Madalena, in apartment kitchen (1995; A).



*Monomorium pharaonis* has not been previously reported from Madeira. We found it only once, indoors. This species is a common tramp ant, well known around the world as an indoor pest. It is certainly an exotic in Madeira.

### 11. *Monomorium subopacum* (F. Smith 1858)

**Published records. Madeira:** No site data (Wollaston; Smith 1858, Saunders 1903, Bolton 1987). **Porto Santo:** No site data (as *M. salomonis*; Forel 1904), No site data (Krauss; Bolton 1987), No site data (Lindberg; Bolton 1987). **Selvagens:** No site data (as *M. salomonis*; Schmitz 1896, Forel 1904), Selvagem Grande (Emery 1882), Selvagem Grande (as *M. salomonis*; Arechavaleta *et al.* 2000), Selvagem Pequena: No site data (as *M. salomonis*; Arechavaleta *et al.* 2000).

**Specimens examined. Madeira:** No site data (E Schmitz; labeled *M. salomonis*; MHNG). Caniçal, industrial complex, under rocks (2002; W). Caniçal, waterfront (2002; W). Ponta de São Lourenço, 2 sites: 70 & *Pinus halepensis*, road (2002; E). Ponta de São Lourenço, 65, 66, 68, 70, 72, 73, 74, 75 (2002; W). Ponta do Garajau, by Christ statue (2002; W). **Porto Santo:** No site data (Wollaston; ONHM). Fonte da Areia lookout (2002; W). Miradouro das Flores lookout (2002; W). Morenos, garden (2002; W). Pico do Castelo lookout (2002; W). Pico do Castelo, near trail head (2002; W). Pico do Castelo. (2002; E & P). Ponta da Calheta (2002; W, E, & P). Ponta da Galé (2002; W). Vila Baleira, 2 sites: 118 & 119 (2002; W). **Desertas:** Deserta Grande (2003; F). **Selvagens:** Selvagem Grande (E Schmitz; MHNG), Selvagem Grande (1999; M Arechavaleta), Selvagem Pequena (1999; M Arechavaleta).

Smith (1858) described *Myrmica subopaca* (= *Monomorium subopacum*) based on specimens that Wollaston collected in Madeira (also listed by Saunders 1903 and Bolton 1987). Bolton (1987) also listed *M. subopacum* specimens from Porto Santo. Schmitz (1896) and Forel (1904) listed *Monomorium salomonis* from Madeira, Porto Santo, and Selvagem Grande based on specimens obtained by Schmitz, but XE examined some of Schmitz' specimens and determined them all to be *M. subopacum*. Arechavaleta *et al.* (2000) listed *M. salomonis* from Selvagem Pequena and Selvagem Grande, but XE examined these specimens and determined that they were also *M. subopacum*. We found that *Monomorium subopacum* was the most common

ant in relatively undisturbed dry habitats on Madeira and Porto Santo, and co-dominant with *L. humile* at disturbed dry sites. Bolton (1987) wrote that “This species is widely distributed in Africa north of the Sahara, ranging from Morocco to Egypt and in drier parts of the northern and eastern shores of the Mediterranean. Previous notes on distribution of this species in sub-Saharan Africa given in Wheeler (1922) and elsewhere should be treated with great caution as misidentifications were rife in the *salomonis*-group.” Bolton (1987) reported exotic records from Madagascar, Niger, Ascension Island, Senegal, South Africa, and Sri Lanka. This species may be native to Madeira.

## 12. *Myrmecina graminicola* (Latreille 1802)

**Published record. Madeira:** Portela (Espadaler & Báez 1993).

**Specimens examined. Madeira:** Arco de São Jorge, by Boaventura tunnel, under rocks (2002; W). Caniço de Baixo (2002; E). Cural das Freiras, chestnut forest 1 km N of town (2002; W & E). Funchal, 3 sites: 27, 42, & 43 (2002; W). Monte, public garden (2002; W). Palheiro Ferreiro, Blandy’s Gardens (2002; W). Parque Ecológico do Funchal; 1260 m; pine forest (2002; E). Poiso, campground 1.5 km SSE of town (2002; W & E). Portela, field near laurel forest (1989; M Báez; two males, see Espadaler & Báez 1993 above), Ribeiro Serrão, plant beating (2002; M). Santana, pine & Eucalytus forest 2 km SW of town, under rocks (2002; W).

Espadaler & Báez (1993) reported two males of *Myrmecina graminicola* collected in Madeira by Báez in 1989. We collected this species at several sites around the island, in both disturbed and relatively undisturbed habitats. This European ant is not known as a tramp species and could be native to Madeira. Madeira is the southernmost record for *Myrmecina graminicola*; of the ten ant species we designate as native, this species appears the most likely to be actually exotic.

## +13. *Paratrechina jaegerskioeldi* (Mayr 1904)

**Published records.** None

**Specimens examined. Madeira:** Funchal, Conde Carvalhal Park (2002; W & E). Funchal, Municipal Museum herb garden (2002; W). Funchal, Quinta Magnolia garden (2002; W). Funchal, Quintinha de São João (2001; A).

*Paratrechina jaegerskioeldi* has not been previously reported from Madeira. We found this species only in urban gardens in Funchal. This species is abundant in the Middle East (Kugler 1988) where it has become a household pest in the Arabian Peninsula (Collingwood & Agosti 1996). It has recently been found in the Canary Islands (Espadaler & Bernal 2003) and Spain (Espadaler & Collingwood 2000). Because we found this species only in Funchal, we feel that this species is probably a recently arrived exotic in Madeira.

#### 14. *Paratrechina longicornis* (Latreille 1802)

**Published records. Madeira:** No site data (Smith 1858, Mayr 1876).

**Specimens examined. Madeira:** Câmara de Lobos, Park San Francisco (2002; E). Câmara de Lobos, Pico da Torre lookout (2002; W). Câmara de Lobos, waterfront (2002; W). Canhas, town (2002; W). Caniçal, waterfront (2002; W). Caniço de Baixo (2002; E). Caniço de Baixo, Rocamar Hotel garden (2002; W). Funchal (1994; A). Funchal, 8 sites: 24, 28, 30, 31, 32, 37, 38, & 42 (2002; W). Funchal, marina (1990; A). Funchal, Quebradas (2001; A). Funchal, Rua Bela de Santiago (2002; A & J). Funchal, Rua Dr Pita (2001; A). Lugarinho (2001; A & J). Machico, beachfront (2002; W). Paul do Mar (2001; J Andrade). Paúl do Mar, town (2002; W). Ponta de São Lourenço; *Pinus halepensis*, road (2002; E). Porto Moniz, town (2002; W). Ribeira Brava; garden Câmara Municipal (2002; E). São Martinho, Centro de Fruticultura (2002; W & E). **Porto Santo:** Pico do Facho (2001; A). Vila Baleira, town (2000 & 2001; A). Vila Baleira, town (2002; E & P). Vila Baleira, 5 sites: 118, 120, 121, 122, & 123 (2002; W).

Smith (1858) listed *Tapinoma gracilescens* (= *Paratrechina longicornis*) collected in Madeira by Wollaston. Mayr (1876) listed *P. longicornis* specimens from Madeira in the Godeffroy Museum. We collected *P. longicornis* only in highly disturbed habitats, primarily in urban areas and occasionally in agricultural areas. *Paratrechina longicornis* is an important exotic pest ant spread throughout the tropic and subtropics by human commerce.

#### 15. *Pheidole megacephala* (Fabricius 1793)

**Published records. Madeira:** No site data (Wollaston; Saunders 1903), Funchal (Heer 1852), S. Gonçalves (Schmitz 1896), Curral Pequeno (Schmitz 1896), Serra (Schmitz 1896).

**Specimens examined. Madeira:** No site data (Wollaston; ONHM). Estrada Monumental, km 194; 2 km E of Câmara de Lobos (2002; E). Funchal, marine biology station on waterfront (2002; W). Funchal, Mercado dos Lavradores (2002; W). Funchal, Nazaré (2001; A & J). Funchal, Parque Santa Catarina (2002; W). Funchal, Parque São Francisco (2002; W). Funchal, planter in front of Oudinot Mall (2002; W). Funchal, Praça da Autonomia (2002; W). Funchal, town center beach (2002; W). Funchal, traffic island next to Oudinot (2002; W). Funchal, waterfront café, in planter (2002; W). **Porto Santo:** No site data (Wollaston; ONHM). Pico do Castelo (1959; Lindberg; BMNH).

Heer (1852, 1856) found his apartment in the capital city of Funchal and the surrounding area swarming with ants that he described as *Oecophthora pusilla* (= *P. megacephala*). Wollaston (1854) mentioned that the Madeiran beetle *Cossyphodes wollastonii* was found in *Pheidole pusilla* (= *P. megacephala*) nests. Smith (1858) listed *Pheidole pusilla* (= *P. megacephala*) from Madeira. Forel (1895) and Schmitz (1896) reported that this species was no longer in Funchal and its suburbs, but recorded it from several other sites on Madeira (São Gonçalo, Curral Pequeno, Serra). We found this species was very common in central Funchal near the waterfront. We also found this species in a few other places in Funchal and at one site near the town of Câmara de Lobos, just to the east of Funchal. It seems likely that *P. megacephala* populations on Madeira are lower now than when Heer visited Madeira in 1850-1851. We did not find *P. megacephala* on Porto Santo, where it may be extinct. *Pheidole megacephala*, the big-headed ant, is an important pest ant spread throughout the tropic and subtropics by human commerce.

### +16. *Pheidole pallidula* (Nylander 1849)

**Published records.** None

**Specimens examined. Selvagens:** Selvagem Grande (1999; M Archavaleta).

*Pheidole pallidula* has not been previously reported from Madeira. Archavaleta *et al.* (2000) inadvertently omitted this record. This is the only species recorded from the Madeira Archipelago that has not been reported from the island of Madeira. We are tentatively calling this Mediterranean species a native in Madeira.

### 17. *Plagiolepis schmitzii* Forel 1895

(= *Plagiolepis schmitzii* var. *madeirensis* Emery 1921 [one worker syntype examined], syn. nov.)

**Published records. Madeira:** No site data (as *P. pygmaea*; Wollaston; Saunders 1903). Funchal (as var. *madeirensis*; Emery 1921). Funchal (Emery 1921). Monte (Schmitz 1896). Poiso (as *P. pygmaea*; Schmitz 1896). Poiso (Schmitz 1896). **Porto Santo:** no site data (as *P. pygmaea*; Schmitz 1896). São Gonçalo (as *P. pygmaea*; Schmitz 1896). Serra d'Água (Schmitz 1896).

**Type material examined.** From the Forel Collection at Musée d'Histoire Naturelle in Geneva (MHNG): One pin with one queen and two labels: Typus [red label]; *Pl. pygmaea* Latr. var. *schmitzii* For., Madeira (Schmitz) [handwritten], here designated LECTOTYPE [lectotype label added]. One pin with two males and three labels: Typus [red label]; *Pl. pygmaea* Latr. var. *schmitzii* For., Madeira, 1400 m (Schmitz) [handwritten]. One pin with three workers and three labels: Typus (red label); *Pl. pygmaea* Latr. var. *schmitzii* For., Garajan, Madeira, Schmitz, 3, 5-9 [handwritten]. One pin with three workers and three labels: Typus [red label]; *Pl. pygmaea* Latr. var. *schmitzii* For., Palheiro, Madeira (Schmitz) [handwritten]. Two pins with three workers and two labels each: Cotypus; *Pl. pygmaea* Latr. var. *schmitzii* Forel, Serra d'Água, Madeira). One pin with three workers and two labels: Cotypus; *Pl. pygmaea* Latr. var. *schmitzii* For., Garajan, Madeira, Schmitz, 3, 5-9 [handwritten]. From the Emery Collection at the Museo Civico di Storia Naturale in Genova, Italy (MCSN): One pin with one worker and three labels: *Pl. barbara* var. *madeirensis* Em [handwritten]; Coll. C. Emery Museo Genova; SYNTYPUS *Plagiolepis barbara* var. *madeirensis* Emery, 1921 [red label, handwritten; present].

**Other specimens examined. Madeira:** No site data (Wollaston, labeled *P. pygmaea*; ONHM). No site data (Schmitz; eight workers labeled *P. pygmaea*; MHNG). 32 sites (1989-2002; A *et al.*). Achada da Madeira, under rocks (2002; W). Arco de São Jorge, by Boaventura tunnel (2002; E). Boaventura, roadside (2002; E). Câmara de Lobos, Park San Francisco (2002; E). Cancela, overlook west of town, garden (2002; W). Caniçal, industrial complex, under rocks (2002; W). Caniço de Baixo (2002; E). Carvalhal, above town on ER 209, pine forest (2002; W). Cural das Freiras, chestnut forest 1 km N of

town (2002; W). Cural das Freiras, near tunnel S of town (2002; W). Cural das Freiras, plant beating (2002; M). Eira do Serrado, pine forest (2002; W & E). Funchal, 15 sites: 25, 27, 28, 31, 32, 33, 34, 36, 37, 38, 41, 42, 43, 44, & 45 (2002; W). Funchal, site 27 (2002; E). Livramento, overlook (2002; W). Palheiro Ferreiro, Blandy's Gardens (2002; W). Paúl da Serra, 0.4 km E of Ponto, under rocks (2002; W). Paúl do Mar, town (2002; W). Pico Ruivo, near parking area (2002; W). Poiso, campground 1.5 km SSE of town (2002; W & E). Poiso, plant beating (2002; M). Ponta de São Lourenço, 5 sites: 65, 68, 69, 71, & 72 (2002; W). Ponta de São Lourenço, site 71 (2002; E). Ponta de São Lourenço; *Pinus halepensis*, road (2002; E). Ponta do Garajau, by Christ statue (2002; W). Porto da Cruz, park by church (2002; W). Porto da Cruz, waterfront (2002; W). Pousada dos Vinháticos, road to Encumeada (2002; E). Pousada dos Vinháticos, under rocks (2002; W). Rabaçal, along hiking trail (2002; W & E). Ribeira Brava, town (2002; W). Santana, on trail to coast (2002; W). Santana, town (2002; W). São Martinho, Centro de Fruticultura (2002; W & E). **Porto Santo:** No site data (Wollaston; labeled *P. pygmaea*; ONHM). Ilhéu de Baixo (2002; W). Morenos, garden (2002; W). Pico do Castelo (2002; E & P). Ponto da Conveira lookout (2002; W). Vereda da Terra Chã (2001; A). Vila Baleira, 3 sites: 118, 120, & 122 (2002; W). Vila Baleira; town (2002; E & P). **Desertas:** Ilheu Chão (Wollaston; labeled *P. pygmaea*; ONHM), Deserta Grande, Doca (2000; A & J), Deserta Grande (2003; F).

Smith (1858) listed *Tapinoma pygmaea* (now *Plagiolepis pygmaea*) from Madeira. Forel (1895) listed *Plagiolepis pygmaea* and described *Plagiolepis pygmaea* var. *schmitzii* (now *Plagiolepis schmitzii*) from the specimens Schmitz sent from Madeira. Emery (1921) described a new subspecies, *Plagiolepis schmitzii madeirensis* Emery as distinct from *Plagiolepis schmitzii* Forel, based on specimens collected by Baron Jules de Guerne in Funchal, Madeira (no date recorded). XE examined types of *P. pygmaea* var. *schmitzii*, specimens from the Wollaston Collection, identified in 1903 by Forel as *P. pygmaea*, and one worker syntype of *Plagiolepis schmitzii* var. *madeirensis* as indicated above. In addition, XE examined many workers, queens and males collected in Madeira in 2002. In all cases, males were nearly as large as queens, and workers had very dense gaster pubescence, features highly characteristic of this species. Comparison of gaster pubescence and antennal structure on type material of

*P. schmitzii* and *P. schmitzii* var. *madeirensis*, show that they belong in the same species and the var. *madeirensis* is here designated as synonym of *P. schmitzii*. In addition, all specimens XE examined from Madeira that were previously identified as *Plagiolepis pygmaea* (Latr.), were also *P. schmitzii*. We found that *P. schmitzii* is one of the most common ants in Madeira, rivaling *Lasius grandis* in its ubiquity and abundance. *Plagiolepis schmitzii* is also known from the western Mediterranean (Portugal, Spain, France, Sicily, Corsica, Morocco, Algeria, Tunisia). It is almost certainly native to Madeira.

### +18. *Pyramica membranifera* (Emery 1869)

**Published records.** None

**Specimens examined. Madeira:** Cancela, overlook garden (2002; W). Porto da Cruz, church garden (2002; W).

*Pyramica membranifera* has not been previously reported from Madeira. We found it only in two gardens, one on the north side and one on the south side of Madeira. It is a well-known tramp species spread throughout the tropics and subtropics by human commerce and certainly exotic to Madeira.

### +19. *Solenopsis (Diplorhoptrum)* sp. 1

**Published records.** None

**Specimens examined. Madeira:** Cancela, overlook west of town, garden (2002; W). Funchal, 7 sites: 27, 32, 33, 34, 43, 44, & 45 (2002; W). São Martinho, Centro de Fruticultura, inside dried avocado (2002; W). **Porto Santo:** Vila Baleira, town center park (2002; W).

We are uncertain of the species identity of this ant, which has not been previously reported from Madeira. Workers are yellow, monomorphic, and usually have two clypeal teeth, though rare individuals have two additional poorly developed lateral teeth. Both long and short hairs are abundant all over the body. The eyes are black and well developed, with 3-5 ommatidia. Measures (in mm): head length (hl) 0.41-0.46; head width (hw) 0.30-0.34; scape length (sl) 0.25-0.30; cephalic index (hw x 100)/hl 74-80; scape index (sl X 100)/hl 61-66. Queens are brown to dark brown, hl 0.54-0.61 mm; hw (eyes included) 0.56-0.58; sl 0.38-0.41; ci 95-102; si 67-70. The ocelli are large and the central ocellus is separated from the lateral ocelli by a distance

a bit larger than its diameter. The scutum hides the pronotum in dorsal view. Weber's length is 1.05-1.17. Systematic work on thief ants is direly needed.

Our records of this small yellow-orange thief ant are the first for Madeira. We found this species only at highly disturbed sites in Funchal and its suburbs and in Vila Baleira on Porto Santo, almost exclusively in soil sift samples. This species is indistinguishable from a common *Solenopsis* we collected in the Azores (Wetterer *et al.* 2004), but quite distinct from *Solenopsis* from the Canary Islands. We found this species only in disturbed sites, and therefore it is probably exotic to Madeira.

### +20. *Solenopsis (Diplorhoptrum) sp. 2*

**Published records.** None

**Specimens examined. Madeira:** Funchal, Conde Carvalhal Park (2002; E).

We are uncertain of the species identity of this ant, which has not been previously reported from Madeira. We collected a single very small queen in an urban park that is markedly different from queens of *Solenopsis* sp. 1. The color is brown (rather than yellow) and the pilosity much less abundant than in *Solenopsis* sp. 1 queens. The head is more elongate: hl 0.53; hw 0.49; sl 0.70; ci 92; si 65. The ocelli are smaller: the distance between central ocellus and lateral ocelli is more than twice its diameter. The scutum is less developed, the pronotum is widely visible in dorsal view. Weber's length is 0.70. We found this species only at one disturbed site, and therefore it is probably exotic to Madeira.

### +21. *Strumigenys silvestrii* Emery 1906

**Published records.** None

**Specimens examined. Madeira:** Funchal, Boa Vista overlook, garden (2002; W). São Martinho, Centro de Fruticultura, in pan trap (2001; A).

*Strumigenys silvestrii*, a South American native, has not been previously reported from Madeira. Exotic populations have been reported from the Bahamas, Cuba, Dominican Republic, Florida, Louisiana, and California (Bolton 2000). It is certainly an exotic in Madeira.



## 22. *Tapinoma madeirense* Forel 1895 (stat. rev.)

(= *Tapinoma ambiguum* Emery 1925 [two males, four workers syntypes examined], syn. nov.)

**Published records. Madeira:** No site data (Wollaston; as *Tapinoma erraticum*; Saunders 1903). Caramujo (as *T. erraticum*; Stitz 1940). Monte (Wellenius 1949). Palmeira (as *T. a erraticum*; Schmitz 1896). Poiso (Schmitz 1896). Quinta dos Reis (as *T. a erraticum*; Schmitz 1896). Rabaçal (as *T. a erraticum*; Stitz 1940). Rabaçal (Wellenius 1949). Ribeira Brava (Schmitz 1896), Nazareth (Schmitz 1896). Ribeiro Frio (Wellenius 1949). São Gonçalo (Schmitz 1896).

**Type material examined:** From the Forel Collection at Musée d'Histoire Naturelle in Geneva (MHNG): One pin with three queens (one beheaded) and four labels: Typus [red label]; *Tapinoma erraticum* Latr. var. *madeirense* Forel, Ribeira Brava, Madeira [handwritten]; Coll. A. Forel; (now *Tapinoma erraticum madeirense*, typewritten, present). The topmost queen is here designated LECTOTYPE [lectotype label added]. One pin with three workers and four labels: Typus [red label]; *Tapinoma erraticum* Latr. var. *madeirense* Forel, Madeira ([handwritten]; Coll. A. Forel; var. *madeirense* Forel [handwritten]). One pin with three workers and four labels: Typus [red label]; *Tapinoma erraticum* Ltr. var. *madeirense* Forel, Curral (Schmitz), Madeira 1; Coll. A. Forel; 1° Curral [handwritten]. One pin with three queens and two labels: Cotypus; *Tapinoma erraticum* Latr. var. *madeirense* Forel, Ribeira Brava, Madeira [handwritten]. One pin with three workers and two labels: Cotypus; *Tapinoma erraticum* Latr. var. *madeirense* Forel, Madeira (Schmitz) [handwritten]. One pin with three workers and two labels: Cotypus; *Tapinoma erraticum* Latr. var. *madeirense* Forel, Madeira. From the Emery Collection at the Museo Civico di Storia Naturale in Genova, Italy: One pin with one male and three labels: Syntypus, *Tapinoma erraticum* subsp. *ambiguum* Emery, 1925 [red label]; *Tapinoma erraticum ambiguum* Emery [handwritten]; Drôme, France, Forel [handwritten]. One pin with one male (without gaster) and on the same card as the male, illegible, Forel, 23.VI.13 [handwritten]; Syntypus, *Tapinoma erraticum* subsp. *ambiguum* Emery, 1925 [red label]. One pin with three workers and three labels: Syntypus, *Tapinoma erraticum* subsp. *ambiguum* Emery, 1925 [red label]; 1 cotypus, 26.X.50 illegible [handwritten];

Prag, Wasmann [handwritten]. One pin with one worker and three labels: Syntypus, *Tapinoma erraticum* subsp. *ambiguum* Emery, 1925 [red label]; Museo Civico di Genova [printed]; Prag, Wasmann [handwritten].

**Other specimens examined. Madeira:** No site data (Wollaston, labeled *T. erraticum*; ONHM). No site data (E Schmitz; seven workers and five queens labeled *T. erraticum*; MHNG). Abrigo, plant beating (2002; M). Achadas da Cruz (1989; A). Arieiro, Poço da Neve (2002; A & J). Boca da Corrida (1999 & 2001; A & J). Boca da Encumeada, lookout (2002; W). Caniço de Baixo (2002; E). Cural das Freiras, chestnut forest 1 km N of town (2002; E). Cural Falso, Laurisilva forest, under rocks (2002; W). Eira do Serrado, pine forest (2002; W). Fajã da Nogueira (2002; E). Funchal, Boa Vista overlook park (2002; W). Parque Ecológico de Funchal, 3 sites: 51, 52, & 53 (2002; W). Parque Ecológico do Funchal; 1260 m; pine forest (2002; E). Paúl da Serra, 4 sites: 54, 55, 56, & 57 (2002; W). Paúl da Serra, 56 (2002; E). Pico do Arieiro, 1 km E of peak (2002; W). Pico do Arieiro, peak lookout (2002; E). Pico Ruivo, near parking area (2002; W). Poiso, campground 1.5 km SSE of town (2002; W & E). Poiso, plant beating (2002; M). Ponta de São Lourenço, site 71 (2002; E). Pousada dos Vinháticos, road to Encumeada (2002; E). Rabaçal, along hiking trail (2002; W & E). Ribeiro Frio (1967; Krauss; SI). Ribeiro Frio, plant beating (2002; M). Ribeiro Serrão, plant beating (2002; M). Santana, near church (1991; A). São Jorge, Ribeira Funda (2001; J Andrade). **Porto Santo:** No site data (Wollaston, labeled *T. erraticum*; ONHM). **Desertas:** Deserta Grande (Wollaston; labeled *T. erraticum*; ONHM).

Forel (1895) described *Tapinoma erraticum* var. *madeirense* from Madeira, distinguishing it from *T. erraticum* (also see Emery 1925, Seifert 1984). Female castes differ in the degree of clypeal incision, which is deeper in *T. erraticum*. Males *T. erraticum* have subgenital plate with strong broad lobes, truncated terminally while in *T. madeirense* the lobes are elongated, somewhat directed externally and thinner. XE examined type specimens of *T. erraticum* var. *madeirense* and specimens from the Wollaston Collection, identified in 1903 by Forel as *T. erraticum* as indicated above. In addition, XE examined many workers, queens, and males collected in Madeira in 2002. Comparison of the subgenital plate in males, and clypeal morphology in queens and workers of material from Madeira and from diverse places in Europe, previously identi-

fied as *Tapinoma ambiguum* Emery, including type specimens (see above) showed that all these specimens were conspecific. Therefore *T. ambiguum* is here designated as a junior synonym of *T. madeirense* Forel that is revised to full specific status. Schmitz (1896) and Wellenius (1949) also reported *T. madeirense* from Madeira. Smith (1858) and Schmitz (1896) listed *T. erraticum* from Madeira, but we consider records of *T. erraticum* from Madeira as misidentifications of *T. madeirense*. *Tapinoma madeirense* was very common ant in Madeira at sites above 600 m elevation, particularly relatively undisturbed sites. This species is almost certainly native to Madeira.

### +23. *Technomyrmex pallipes* (F. Smith 1876)

(=*Technomyrmex albipes*; Wetterer *et al.* 2006; misidentification)

**Published records.** None

**Specimens examined. Madeira:** Funchal, one block N of Alto Lido Hotel, house and garden (2002; N Silva & W).

*Technomyrmex pallipes* (= *Tapinoma pallipes*; B. Bolton, in prep.) has not been previously reported from Madeira. Natasha Silva, a student at the University of Madeira, found this species in her home in Funchal. We subsequently collected it in gardens near her home. According to Bolton (pers. comm.), who re-identified our specimens, “the species is very common in the Afrotropical region and invades houses. It is widespread in parks and gardens in Madagascar and also occurs on many islands in the Indian Ocean. In Europe I have samples from some hothouses and it has also been found infesting a house in Milano, Italy.” This species is no doubt exotic to Madeira.

### 24. *Temnothorax unifasciatus* (Latreille 1798)

**Published record. Madeira:** No site data (Wollaston; Saunders 1903, Donisthorpe 1940).

**Specimens examined. Madeira:** No site data (Wollaston; ONHM). Curral, plant beating (2002; M). Parque Ecológico do Funchal; 1260 m; pine wood (2002; E). Ribeiro Serrão, plant beating (2002; M).

Saunders (1903) and Donisthorpe (1940) reported *Temnothorax unifasciatus* specimens collected by Wollaston in Madeira. We found this species in only three relatively undisturbed, medium to high elevation locales in Madeira. Wetterer *et al.* (2004) found *T. unifasciatus* more commonly in

the Azores, where it appears to nest exclusively in rock crevices. It is found throughout Southern and Central Europe, from Portugal to the Caucasus and from southern Italy to northern Germany and Poland. *Temnothorax unifasciatus* is probably native to Madeira.

### 25. *Temnothorax wollastoni* (Donisthorpe 1940)

**Published record. Madeira:** No site data (Wollaston; Donisthorpe 1940).

**Specimen examined. Madeira:** No site data (Wollaston, BMNH, one syntype).

Donisthorpe (1940) described *Temnothorax wollastoni* from Madeira based on two worker specimens collected by Wollaston. The sexual forms remain unknown. XE determined that the species is valid. Its general morphology is much like *Temnothorax gaetulus* Santschi from Morocco. The absence of spines and lack of a clear mesopropodeal depression in *T. wollastoni* allow the separation of the two species. This species is endemic to Madeira. Unfortunately, we did not collect any specimens of this species.

### 26. *Tetramorium bicarinatum* (Nylander 1846)

**Published record. Madeira:** No site data (as *Tetramorium guineense*; Schmitz 1897). No site data (Wollaston; Bolton 1977).

**Specimens examined. Madeira:** No site data (Wollaston; BMNH). Machico (E Schmitz; five workers and one queen labeled *T. guineense*; MHNG).

Schmitz (1897) reported these specimens as *Tetramorium guineense* (= *T. bicarinatum*). Bolton (1977) reported *Tetramorium bicarinatum* from Madeira collected by Wollaston. This widespread tramp ant is almost certainly exotic to Madeira, though perhaps it is no longer present.

### 27. *Tetramorium caldarium* Roger 1857

**Published records. Madeira:** No site data (Wollaston; as *Tetramorium simillimum*; Saunders 1903). No site data (as *Tetramorium simillimum*; Schmitz; Forel 1904). No site data (Bolton 1980). Caniçal (Lindberg; Bolton 1980). **Desertas:** Deserta Grande (Lindberg; Bolton 1980).

**Specimens examined. Madeira:** Achada do Gramacho (1989; A). Câmara de Lobos, Park San Francisco (2002; E). Cancela, overlook west of town, garden (2002; W). Caniçal, waterfront (2002; W). Caniço de Baixo (2002; E). Funchal, 16 sites: 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 36, 37, 41, 42, 44, & 45 (2002; W). Funchal, Quebradas (2001; A). Funchal, site 27 (2002; E). Machico, Banda d'Além (1993; A). Machico, beachfront (2002; W). Palheiro Ferreiro, Blandy's Gardens (2002; W). Paúl do Mar, town (2002; W). Ponta de São Lourenço, 4 sites: 68, 70, 73, & 74 (2002; W). Ponta de São Lourenço, site 71 (2002; E). Porto da Cruz, park by church (2002; W). Porto da Cruz, waterfront (2002; W). Porto Moniz, town (2002; W). Ribeira Brava, town (2002; W). Ribeira Brava; garden Câmara Municipal (2002; E). São Martinho, Centro de Fruticultura (2002; W & E). São Vicente, town center (2002; W). **Porto Santo:** Miradouro das Flores lookout (2002; W). Morenos, garden (2002; W). Pico do Castelo lookout (2002; W). Ponta da Calheta (2002; E & P). Vila Baleira, 3 sites: 118, 120, & 122 (2002; W). Vila Baleira; town (2002; E & P). **Desertas:** Bugio (Wollaston; labeled *T. simillimum*; ONHM). Deserta Grande (Wollaston; labeled *T. simillimum*; ONHM). Deserta Grande (1959; Lindberg; MCZ). Deserta Grande, Doca (2000; A & J), Deserta Grande (2003; F).

Bolton (1980) first reported *Tetramorium caldarium* from Madeira. Specimens from Madeira previously identified as *Tetramorium simillimum* by Forel that we examined were actually *T. caldarium*. We expect that the *T. simillimum* collected by Schmitz on Madeira listed by Forel (1904) was misidentified *T. caldarium*. This widespread tramp ant is almost certainly exotic to Madeira.

Unconfirmed record (no specimens examined)

## 28. *Camponotus sylvaticus* (Olivier 1792)

**Published record. Madeira:** No site data (Mayr 1865).

We did not examine any specimens of this species from Madeira, leaving open the possibility that this record is actually some other *Camponotus* species. *Camponotus sylvaticus* is a European species. This species was probably an exotic that temporarily infested lumber from Europe.

Table 1. Ants of the Madeiran Archipelago (ranked according to number of collection sites in 1989-2002 or date last recorded; see Wetterer *et al.* 2006).

| Native species                      | Atlantic Island Range |      |      | Status |
|-------------------------------------|-----------------------|------|------|--------|
|                                     | bz                    | mpds | cvah |        |
| <i>Lasius grandis</i>               | _z                    | m_d_ | c__  | M      |
| <i>Plagiolepis schmitzii</i>        | _z                    | mpd_ | c__  | M      |
| <i>Monomorium carbonarium</i>       | _z                    | mp__ | ____ | E      |
| <i>Tapinoma madeirense</i>          | __                    | mpd_ | ____ | M      |
| <i>Monomorium subopacum</i>         | __                    | mpds | cva_ | M      |
| <i>Hypoponera eduardi</i>           | _z                    | m_d_ | cv__ | M      |
| <i>Myrmecina graminicola</i>        | __                    | m__  | ____ | P      |
| <i>Temnothorax unifasciatus</i>     | _z                    | m__  | ____ | M      |
| + <i>Pheidole pallidula</i>         | __                    | __s  | c__  | M      |
| <i>Temnothorax wollastoni</i>       | __                    | m__  | ____ | E      |
| Exotic species                      |                       |      |      |        |
| <i>Linepithema humile</i>           | bz                    | mpd_ | c_h  | N T    |
| <i>Tetramorium caldarium</i>        | bz                    | mpd_ | cv_h | P T    |
| <i>Paratrechina longicornis</i>     | bz                    | mp__ | cvah | O T    |
| <i>Cardiocondyla emeryi</i>         | b_                    | mpd_ | cvah | A T    |
| <i>Pheidole megacephala</i>         | bz                    | mp__ | cvah | A T    |
| + <i>Hypoponera</i> sp. 1           | __                    | mp__ | __h  | ?      |
| + <i>Solenopsis</i> sp. 1           | _z                    | mp__ | ____ | ?      |
| <i>Hypoponera punctatissima</i>     | bz                    | m_ds | cv_h | M T    |
| + <i>Paratrechina jaegerskioldi</i> | __                    | m__  | c__  | M T    |
| + <i>Cardiocondyla mauritanica</i>  | __                    | m__  | c_a  | M T    |
| + <i>Pyramica membranifera</i>      | __                    | m__  | _v   | A T    |
| + <i>Strumigenys silvestrii</i>     | __                    | m__  | ____ | N      |
| + <i>Technomyrmex pallipes</i>      | __                    | m__  | _v   | O T    |
| + <i>Solenopsis</i> sp. 2           | __                    | m__  | ____ | ?      |
| + <i>Monomorium pharaonis</i>       | __                    | m__  | c__  | O T    |
| <i>Tetramorium bicarinatum</i>      | _z                    | m__  | cv__ | A T    |
| <i>Messor structor</i>              | __                    | m__  | ____ | M      |
| <i>Camponotus sylvaticus</i>        | __                    | m__  | ____ | M      |

+ = new record for the Madeiran Archipelago. Atlantic Island Range: b = Bermuda, z = Azores, m = Madeira, p = Porto Santo, d = Desertas, s = Selvagens, c = Canary Islands, v = Cape Verde, a = Ascension, h = Saint Helena. Status: A = African, E = Macaronesian endemic, M = Mediterranean, N = New World, O = Asian, P = Palearctic, T = known tramp.

## DISCUSSION

Of the total 28 ant species we report from Madeira, 10 appear to be native and 18 exotic (Table 1). The dominant ants throughout much of Madeira, in both highly disturbed and relatively undisturbed habitats, are three native species: *Lasius grandis*, *Plagiolepis schmitzii*, and *Monomorium carbonarium*. At sites above 600 m elevation, *Tapinoma madeirense* is often the most common ant. Because most of Madeira is over 600 m, this ant is certainly among the four most common ants in Madeira (Wetterer *et al.* 2006). Three other native ant species are moderately common: *Monomorium subopacum*, *Hypoponera eduardi*, and *Myrmecina graminicola*. Two natives, *Temnothorax unifasciatus* and *Pheidole pallidula*, appear to be rare. We did not collect the one endemic Madeiran ant, *Temnothorax wollastoni*. Because we concentrated our surveys in highly disturbed environments, exotic ants are over-represented in our samples. Weighting our collection records according to the actual proportions of different habitats in Madeira, the seven most common species currently in Madeira are all native (see Wetterer *et al.* 2006).

All exotic ants, except *L. humile*, were restricted to the lowlands, and almost exclusively to urban areas and, to a lesser extent, agricultural lands (Wetterer *et al.* 2006). We found *L. humile* common in some lowland areas, primarily in the dry eastern tip of Madeira (where *L. grandis* is absent), and in some urban and agricultural areas. Because we did not find any exotic ants over most of Madeira, including all areas with intact native vegetation, we suspect that the one native ant we did not collect, *T. wollastoni*, still survives and will be found in the future.

## ACKNOWLEDGMENTS

We thank M. Wetterer for comments on this manuscript; J. Jesus, J. Andrade, V. Pereira, A. Fernandes, and J.P. de Carvalho at the Laboratório Agrícola da Madeira for use of their specimen records; S. Wetterer, É. Nunes, I. Martins, N. Freitas, and students of the University of Madeira for collecting ant specimens; the staff of the Natural Park of Madeira for field assistance; B. Bolton of the BMNH for loan of *Temnothorax wollastoni* type, permission to work in the BMNH collection, and for identifying *Technomyrmex pallipes*; J. Hogan of the ONHM for loan of Wollaston's specimens; B. Merz of the MHNG and R. Poggi from the Museo Civico di Storia Naturale (Genova) for specimen loans;

the National Geographic Society, Florida Atlantic University, and Centro de Ciência e Tecnologia da Madeira (CITMA) for financial support.

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