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## ANTS (HYMENOPTERA: FORMICIDAE) OF BERMUDA

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## ABSTRACT

For more than 50 years, two exotic ant species, *Lasius alienus* (Mayr) and *Pheidole megacephala* (F.) have been battling for ecological supremacy in Bermuda. Here we summarize known ant records from Bermuda, provide an update on the conflict between the dominant ant species, and evaluate the possible impact of the dominant species on the other ants in Bermuda. We examined ant specimens from Bermuda representing 20 species: *Brachymyrmex heeri* Furel, *B. obscurus* Furel, *Crematogaster pennsylvanicus* De Geer, *Cardiocrabius emeryi* Furel, *C. obscurus* Wheeler, *C. amblygnathus* sp., *Hypomyzomex opaciceps* Mayr, *H. punctatissima* Roger, *L. alienus*, *Monomyrmex mormonorum* Bolton, *Oxytrichus rugosus* Smith, *Paratrechina longicornis* Latreille, *P. ruginoda* Nylander, *P. megacephala*, *Plagiognathus ellipsoides* Furel, *Solenopsis (Diplocheiliceras)* sp., *Tetramorium caespitium* Roger, *T. simillimum* (Smith), *Wasmannia auropunctata* (Roger), and an undetermined Dacnini. Records for all but three (*H. punctatissima*, *P. ruginoda*, *W. auropunctata*) include specimens from 1987 or later. We found no specimens to confirm records of several other ant species, including *Monomyrmex phoenicis* (L.) and *Tetramorium caespitium* (L.). Curiously, *L. alienus* dominates most of Bermuda, while *P. megacephala* appears to be at its lowest population levels recorded. Though inconspicuous, *B. obscurus* is common and coexists with both dominant species. *Paratrechina longicornis* has conspicuous populations in two urban areas. Three other ant species are well established, but inconspicuous due to small size (8.4 mm). *Solenopsis* sp. or subterranean habits (*S. opaciceps*). All other ant species appear to be rare, including at least one, *O. rugosus*, which was apparently more common in the past.

**Key Words:** Atlantic islands, biodiversity, exotic ants, *Pheidole megacephala*, *Lasius alienus*, transport

## RESUMEN

Durante más de 50 años, dos especies exóticas de hormiga, *Lasius alienus* (Mayr) y *Pheidole megacephala* (F.) han estado combatiendo la supremacía ecológica en Bermuda. Aquí resumimos los registros conocidos de hormiga en Bermuda, ponemos al día el estado de la cuestión en el conflicto entre la especie dominante de hormiga, y evaluamos el impacto posible de la especie dominante en las otras hormigas en Bermuda. Examinamos especímenes de hormiga de Bermuda que representan 20 especies: *Brachymyrmex heeri* Furel, *B. obscurus* Furel, *Crematogaster pennsylvanicus* De Geer, *Cardiocrabius emeryi* Furel, *C. obscurus* Wheeler, *C. amblygnathus* sp., *Hypomyzomex opaciceps* Mayr, *H. punctatissima* Roger, *L. alienus*, *Monomyrmex mormonorum* Bolton, *Oxytrichus rugosus* Smith, *Paratrechina longicornis* Latreille, *P. ruginoda* Nylander, *P. megacephala*, *Plagiognathus ellipsoides* Furel, *Solenopsis (Diplocheiliceras)* sp., *Tetramorium caespitium* Roger, *T. simillimum* (Smith), *Wasmannia auropunctata* (Roger), y un Dacnini indeterminado. Los registros para todo excepto tres (*H. punctatissima*, *P. ruginoda*, *W. auropunctata*) incluyen los especímenes de 1987 o más tarde. No encontramos ningún espécimen para confirmar los registros de varias otras especies de hormiga, incluyendo *Monomyrmex phoenicis* (L.) y *Tetramorium caespitium* (L.). Curiosamente, *L. alienus* domina la mayor parte de Bermuda, mientras *P. megacephala* parece estar en su nivel de población más bajo que se haya registrado. Aunque poco abundante, *B. obscurus* es común y coexiste con ambas especies dominantes. *Paratrechina longicornis* tiene poblaciones visibles en dos áreas urbanas. Otras tres especies de hormiga se han establecido bien, aunque no llaman la atención debido al tamaño pequeño (*S. opaciceps* sp. o hábitos subterráneos (*S. opaciceps*). Todas las otras especies de hormiga parecen ser raras, incluyendo por lo menos una, *O. rugosus*, que era más común en el pasado.

Translation provided by the authors.

A battle for territorial supremacy has been raging on the Atlantic islands of Bermuda for more than 50 years. The combatants are two species of exotic ants, one Old World (the big-headed ant,

*Pheidole megacephala* (F.) and one New World (the Argentine ant, *Lasius alienus* (Mayr). As documented in studies conducted 1927-1986 (Haskins 1939; Haskins & Haskins 1965, 1968;

Crowell 1968; Lieberburg et al. 1975). *P. megacephala* was the dominant ant in Bermuda when *L. kamohi* arrived in the 1940s. This new invader quickly overran much territory, excluding *P. megacephala*. *Pheidole megacephala*, however, persisted, and ever since, these two species have been contesting ever shifting battlefields between mutually exclusive territories. Largely ignored in this drama, however, are the other ant species in Bermuda.

Both *P. megacephala* and *L. kamohi* are well-known for killing off native invertebrates, particularly native ants (Erickson 1971; Human & Gardin 1996; Holway 1999; Vanderwoude et al. 2000; Wetterer et al. 2000, 2001; Wetterer 2002). This paper presents combined published, unpublished, and new ant records from Bermuda, provides an update on the conflict between the two dominant ant species, and examines the possible impact of the dominant ants on the other ant species that persist in Bermuda.

#### Published Ant Records from Bermuda

Many early accounts describe enormous ant plagues in Bermuda in the 17th and 18th centuries (Jones 1659; LeFroy 1882; Hurdie 1897; Kevan 1981), but no specimens of these ants are known and the species involved have never been identified. Wheeler (1906) proposed that the plague ants might have been *Solenopsis geminata* (F.) or *Monomorium destructor* (Jordan).

In the first identification of an ant species from Bermuda, Kirby (1884) of the British Museum identified one ant species collected by the HMS Challenger expedition in April 1873 as *Formica nigra* L. (= *Lasius niger* (L.)). Kirby (1884) noted that this species was "probably introduced" and that "the specimens do not appear to differ from the ordinary European species."

Dahl (1892) identified two species of ants from Bermuda, collected in 1889 by the Humboldt-Stiftung Expedition, as *Pheidole pallida* Heer (= *P. megacephala*) and as *Odontomachus* species, "probably" *Odontomachus insularis* Guérin-Méneville.

Verrill (1902) reported that on expeditions to Bermuda in 1898-1901 "ants of several" undetermined species were collected by us which have not yet been fully studied by a specialist. Nonetheless, Verrill (1902) recognized specimens of the "small House-ant" *Monomorium minutum* (Buckley) (= *Monomorium monomorium*; Bolton) and the "Garden-ant or Pavement-ant" *Tetramorium caespitum* (L.), and wrote: "probably these were early introduced from England." In addition, Verrill (1902) received from V. Hayward specimens of *P. megacephala* collected on St. David's Island, and received from L. Mowbray "a few Hymenoptera, including males, females, and very small workers of one or two species of the genus *Pheidole*, as determined by Mr. Th. Pergande. These are common, as House-ants, and destruc-

tive." Verrill (1902) also mentioned "a few ants," found in guts of the endemic Bermuda lizard *Eumeces longirostris* Cope. Finally, Verrill (1902, cited Kirby's (1884) record of the "European Black ant" *L. niger*, and Dahl's (1892) records of *P. megacephala* and *Odontomachus* sp. near *insularis*.

Wheeler (1906) made a comprehensive list of Bermuda ants, based on the three past accounts (Kirby 1884; Dahl 1892; Verrill 1902) and on new specimens supplied by T. Kincaid and J. H. Comstock. Of the 11 taxa on his list, Wheeler (1906) examined specimens of eight: *Hypomyzomex opaciceps* (Mayr), *Odontomachus haematodes insularis* (quadrans) Smith (= *O. ruginodis*), *Cardiscondyla caryi* (Furn.), *P. megacephala*, *Brachymyrmex heeri* Forel, *Brachymyrmex heeri obscurior* Forel (= *B. obscurior*), *Prenolepis kirbyi* Wheeler (= *Pecolatrechus citadula* (Nylander)), and *Prenolepis* sp. The other three records came from previously published reports: *L. niger*, *M. minutum* (= *M. monomorium*), and *T. caespitum*. Wheeler (1906) believed, however, that the last two records were probably misidentifications of *Monomorium pharaonis* (L.) and *Tetramorium guineense* (Bernard) respectively.

Ogilvie (1926) presented a Bermuda ant list that was the same as Wheeler's (1906), except that it included *O. arenatorius insularis* (= *O. insularis*) instead of *O. ruginodis*, and omitted *Prenolepis* sp.

Starting in 1927, Haskins repeatedly visited Bermuda, recording the ecological dominance of *P. megacephala* (Haskins 1939). Haskins (1939) noted that *O. insularis* was common in 1927, but became rare in the 1930s, writing: "In the few *Odontomachus* colonies remaining on the Islands great numbers of *Pheidole* workers are to be found killing and carrying off the larvae, fastening themselves in myriads to the bodies of the workers, and forcing their early abandonment of the site. Within another ten years, the *Pogonomyia* [*Odontomachus*] species, which inhabited Bermuda as its undisturbed Arthropod mistress for millennia, and has in fact developed a characteristic variety there, will have been exterminated."

The first published record of *L. kamohi* in Bermuda included it as prey recovered from stomachs of exotic *Anolis* lizards (Simmonds 1958). Simmonds (1958) found 4105 prey in 176 *Anolis grahami* Gray specimens, of which 2176 were ants (21% *L. kamohi*, 26% *P. megacephala*, 52% *Brachymyrmex* sp., 2% ant species A), and 587 prey in 46 *Anolis leachii* Dumeril & Birton specimens of which 151 were ants (37% *L. kamohi*, 3% *Brachymyrmex* sp.). Bennett & Hughes (1959) reported that *L. kamohi* "was first recorded in Bermuda in 1945 and has since become numerous." Further, Bennett & Hughes (1959) reported that *L. kamohi* was gradually replacing *P. megacephala*. Nonetheless, Wingate (1965) found that *P. megacephala* was still common among 319 ant prey of 30 *Anolis sagrei* Lacépède (12% *L. kamohi*, 85% *P. megacephala*, 3% *B. obscurior*).

Haskins & Haskins (1965) documented interactions in Bermuda between *P. megacephala* and *L. humile*, with some mention of other ant species, e.g., noting that "in 1933, no *O. insularis* could be found," and that areas not occupied by either of the dominant species, "were extensively occupied by colonies of *B. heeri*, and required considerably more careful examination. Occasional colonies of *Panera opaciceps* [= *H. opaciceps*] were also found in such areas."

Crowell (1968) further studied *P. megacephala* and *L. humile* in Bermuda and noted four other ant species: *B. obscurus*, *O. insularis*, *Wasmannia auropunctata* (Roger), and *Paratrechina* sp. Crowell (1968) wrote, "the presence of *Wasmannia auropunctata* has been recognized by the Bermuda Department of Agriculture and Fisheries since 1950" (Leberburg et al. 1975); in another study of *L. humile* and *P. megacephala* in Bermuda, noted six other ant species: *B. heeri*, *H. opaciceps*, *Odontomachus brunneus* (Patten), *W. auropunctata*, *Cardiocondyla* sp., and *Paratrechina* sp. Crowell (1968) added a personal communication from C. Haskins who found one *O. insularis* colony in 1965.

Kerppel (1972), in his catalog of Neotropical ants, listed ten taxa known from Bermuda: *B. heeri*, *Brachymyrmex heeri* aphidicola Forel (= *B. obscurus*), *B. obscurus*, *C. emeryi*, *H. opaciceps*, *O. insularis*, *O. nigritula*, *P. megacephala*, *Plagiopsis ulgarudi* Forel, and *T. coespitum*. Brandão (1981), in his addendum to Kerppel's (1972) catalog, listed *B. obscurus*, *O. brunneus*, *O. insularis*, and *P. viridula* from Bermuda.

Haskins & Haskins (1985) revisited Bermuda for a "final survey" of *P. megacephala* and *L. humile*. Haskins & Haskins (1985) wrote that "the genus *Odontomachus* (*insularis* and *brunnei*) . . . is now a rare form. Other long-term survivors include the genus *Brachymyrmex* (still relatively abundant in niches unoccupied by either tramp ant) and the genera *Paratrechina*, *Cardiocondyla*, *Hypomyrma*, and *Wasmannia*."

Hilburn et al. (1990) listed 14 ant taxa reported from Bermuda, eight apparently based on specimens: *B. heeri*, *Brachymyrmex* sp., *C. vavayci*, *L. humile*, *Monomorium* sp., *Paratrechina* sp., *P. megacephala*, and *W. auropunctata* and six apparently from published reports: *H. opaciceps*, *L. niger*, *M. pharaonis*, *O. brunneus*, *P. viridula*, and *T. coespitum*. Hilburn et al. (1990) also listed three additional ant species that had been intercepted on goods being imported into Bermuda, but had not become established: *Coelopogon novboracensis* (Fitch), *Crematogaster* sp., and *Paratrechina longicornis* (Latreille).

#### MATERIALS AND METHODS

We looked for Bermuda ant specimens in the collections of the American Museum of Natural History, New York (AMNH), the Academy of Nat-

ural Sciences, Philadelphia (ANS), the Bermuda Aquarium, Museum and Zoo (BAMZ), the Bermuda Dept. of Agriculture (BDQA), British Natural History Museum in London (BNHM), Harvard's Museum of Comparative Zoology (MCZ), the Smithsonian Institute (SI), and Yale's Peabody Museum (YPM).

From 27 February to 5 March 2002, we surveyed ants using visual search in a wide range of habitats. Our sites included both highly disturbed environments (e.g., port areas in Hamilton, St. George, and Ireland Island North) and lesser-disturbed reserve areas (e.g., Spittal Pond and Paget Marsh). We also surveyed ants in two small, isolated islands, Nonsuch and Horn. These two islands are nesting areas for the endemic catbird (*Pterodroma onchou* Nichol's & Mowbray). In addition, we resurveyed ten sites that Haskins & Haskins (1985) had repeatedly surveyed to evaluate changes over time in which ant species dominated an area. In June-August 2002, A. James, W. Steiner, and Z. Anaral of the BAMZ collected additional ant specimens.

Stefan Cover examined most specimens. Mark Deyrup examined all specimens with uncertain identifications. Further evaluations were made by Xavier Espadaler (*Monomorium*, *Plagiopsis*), Bernhard Seifert (*Cardiocondyla*), and James Trager (*Paratrechina*, *Crematogaster*). We will deposit vouchers at the BAMZ, MCZ, and Archbold Biological Station.

#### RESULTS

We examined ant specimens from Bermuda representing 20 ant species, including nine new records (Table 1, for details species accounts). At the BNHM, we did not find the specimens Kirby (1884) identified as *Lasius niger*. At the YPM, Raymond Popelis (pers. comm.) found catalog numbers for Hymenoptera specimens in alcohol collected in Bermuda: 4916-4928 (April 1901, AE Verrill & WJ Van Nune) and 5003-5008 (Dec 1901, TG Goslin). We did not, however, find any of Verrill's ant specimens in the pinned collection. Chris Cutler searched through all available vials and bottles in the Yale collection with no success.

In 2002, we found *L. humile* in large numbers at all ten sites studied by Haskins & Haskins (1985; see Table 2). At four of the sites, we also found *P. megacephala* (Table 2). At the intersection of Krapton Hill Road and Harrington Hundreds, we found *L. humile* to the north of Krapton Hill Road and *P. megacephala* south of the road. At Spittal Pond Reserve, we found *L. humile* throughout, except for *P. megacephala* at the eastern entrance and parking area. At Newstead Hotel complex, we found *L. humile* throughout, except for *P. megacephala* at the westernmost end. Finally, in Ireland Island North, we found *L. humile* in all areas we searched, except for

TABLE 1. ANTS OF BERMUDEA.

	2000-2002 records	Record dates	Range	Status
<i>Lasiothorax humile</i>	27	1948-2002	T F XAME	NX
<i>Brachymyrmex obscurior</i>	19	1905-2002	TWFBX	N?
<i>Pheidole megacephala</i>	17	1899-2002	TWFOXAME	OX
+ <i>Pezomachus longicornis</i>	7	1990-2002	TWFOXAME	OX
<i>Rhynchomyrmex heeri</i>	6	1905-2002	TWFRX--E	N?
<i>Hypomyrma caquibana</i>	4	1905-2002	TWFRX---	N?
+ <i>Solenopsis</i> sp.	4	1991-2002	X	?
+ <i>Tetramorium sanctithomae</i>	2	1922-2002	TWFBX--E	OX
+ <i>Crematogaster pennsylvanicus</i>	2	2001-2002	F-X---	NX
<i>Odontomachus ruginotus</i>	1	1899-2002	TWFRX---	N?
<i>Monomorium monomorium</i>	1	1905-2002	W X E	OX
<i>Cardiocondyla caryi</i>	1	1905-2002	TWFRX-M-	OX
+ <i>Tetramorium caudatum</i>	1	2002	TWFOXAME	OX
<i>Brachymyrmex albolineatus</i>		1945-1987	-W--X---	OX
+ <i>Cardiocondyla obscurior</i>		1987	-WF-X---	OX
+ <i>Crematogaster</i> sp. male		1987	X	?
+ <i>Dacotina</i> male		1987	X	?
<i>Wasmannia antipunctata</i>		1925-1986	TWFBX E	NX
<i>Paratrechina rufidula</i>		1905-1926	TWFBX E	OX
<i>Hypomyrma parviflora</i>		1919	TWFRXAME	OX
Unofficial records				
<i>Paratrechina</i> sp.		1966-1973	?	?
<i>Prenolepis</i> sp.		1905	?	?
<i>Tetramorium caespitum</i>		1900	T---?A-E	?
<i>Lasius niger</i>		1873	----?--E	?
<i>Monomorium pharaonis</i>		?	TWFB? ME	OX

Species ranked according to number of collection sites in 2000-2002 or date last recorded. + = new record for Bermuda. Range: T = Tropical South and Central America, W = West Indies, F = Florida, B = Bahamas, X = Bermuda, A = Azores, M = Madeira, E = Europe. Status: N = New World native, H = Old World native, X = exotic, ? = possible native.

*P. megacephala* on the northeast corner east of the entrance to the Maritime Museum and out the entire length of the North Breakwater, which serves as a cruise ship terminal.

#### Species Accounts

+ = new record for Bermuda. Collectors: H = H. J. Hilburn et al., W = JK Wetterer & AL Wetterer in 2002. Collections: BDOA = Bermuda Department of Agriculture, BAMZ = Bermuda Museum, Aquarium and Zoo, BNHM = British Natural History Museum, London, MCZ = Museum of Comparative Zoology, Harvard University, YPM = Yale Peabody Museum.

#### 1. *Brachymyrmex heeri* Emery

Specimens examined: No site data (1905, T Kincaid, MCZ); Near Hamilton (1910, EG Vassalla, ANS); Padet (1911, Marsh (1922, HH WHEELER, MCZ); Paget (1925, L. Ogilvie, MCZ); No site data (1926, L. Ogilvie, AMNH); Hamilton (1934, NA Weber, MCZ); Many sites (1987-1988, H, BAMZ); Admiralty House (1987, H, BAMZ) - male labeled

"prob Dolichoderine male det. DH Smith"; BAMZ; Ops (2001, L. Hinton, BAMZ); Bermuda Biological Station for Research (BBSR); under boards in wooded area (W); Blue Hole Park, forested area (W); Hamilton, waterfront, in a flower planter (W); Wreck Road (W); Jennings Road (2002, A Lines);

Wheeler (1906), Haskins (1939), Haskins & Haskins (1965), Kempf (1972), Lichtenburg et al. (1975), and Hilburn et al. (1990) all recorded this species in Bermuda and it was the most common ant in the collections of Kincaid (in 1905) and Ogilvie (in 1925) in the MCZ. It was also common in Hilburn et al.'s collection of 1987-88. We collected this species in both natural and highly disturbed areas. This very small, orange, New World species is widespread and probably fairly common in Bermuda, but often overlooked because of its very small size.

#### 2. *Brachymyrmex obscurior* Emery

Specimens examined: No site data (1905, T Kincaid, MCZ); Paget (1925, L. Ogilvie, MCZ); Hamilton (1934, NA Weber, MCZ); Hamilton (1966, KM, BAMZ, male and queen); Paget (1971,

TABLE 2. SITES SURVEYED BY HASKINS &amp; HASKINS IN 1983-1990 AND THE PRESENT STUDY IN 2002

Site	Year				
	1983	1986	1973	1996	2002
Great Head Park			both	F	F
Mullet Bay Rd. & Ferry Road	F	both	both	F	F
Leamington Caves	L		F	L	F
Knapton H.E. Inter-section	L		both	L	F
Knapton Hill-Leamington Hills	F	-	F	L	both
Christchurch Brighton Hill	both	-	F	L	L
Spiral Pond	F		F	F	both
Newstead Hotel	L		L	both	both
Week Road	both		both	F	L
Ireland Island	-	F	-	F	both
<i>P. megacephala</i> & <i>L. humile</i> sites	1-7	2-9	1-6	1-6	1-4

F = *Pheidole megacephala*; L = *Leptothorax humile*; both = both species; - = not sampled

N Krauss, SI). Many sites (1987-1988, H. BAMZ, Paget Parish (1987, H. BAMZ, labeled "*Paratrechina* sp. det. DR Smith"; St. George's (1987, R. Gordon, BAMZ, queen, labeled "*Paratrechina* sp. det. D.R. Smith"; 19 sites (W).

Wheeler (1906), Simmonds (1958), Wingate (1965), Crowell (1968), Kempf (1972), Haskins & Haskins (1988), and Brandao (1991) all recorded the presence of *B. obscurus* in Bermuda. As noted in the specimens listed above, we found *B. obscurus* specimens in the BAMZ collection misidentified as "*Paratrechina* sp." Many others were labeled "*Brachymyrmex* sp." Records listed as *Brachymyrmex* sp. and *Paratrechina* sp. by Hiltburn et al. (1990) were probably all *B. obscurus*.

We collected *B. obscurus* at 19 scales across Bermuda, often in areas with dense populations of *P. megacephala* or *L. humile*. In some localities, where neither *P. megacephala* or *L. humile* were present (e.g., forest areas near Blue Hole), we found only this species and/or *B. heeri*. It appears to be the second most common ant species in Bermuda, after *L. humile*. We expect that a close inspection would find these ants at virtually every site in Bermuda. This New World species is extremely variable in size and color, making identification much more difficult.

#### #3. *Crematogaster pennsylvanicus* (De Geer)

Specimens examined: Rockville Close, inside house (2002, E. Beck, BMOA). Same site (W-Rockville Close, Bermuda Lumber Company (W).

A resident in Rockville Close reported to the BMOA that ants first she exterminated in her house in August 2001 had returned in January 2002. We collected specimens at the same house. At a lumberyard a few blocks away, employees told us that they often saw large ants. We searched an area where they had killed the ants earlier that day under Virginia cedar lumber from

Florida and found one live and several dead *C. pennsylvanicus* workers. It is unclear whether this North American carpenter ant is actually established in Bermuda. This species has a broad range in the U.S. from Pennsylvania to Florida, so it seems likely that climate would not limit its establishment in Bermuda. The BMOA had a number of samples of this species intercepted by quarantine in the past few years, often on imported Christmas trees and lumber (see below).

#### 1. *Crematogaster curvica* Fernald

Specimens examined: No site data (1906, T. Krauss, AMNH); Ireland Island North, in grassy area outside clayworks (W).

Wheeler (1906), Kempf (1972), Lieberburg et al. (1975), Haskins & Haskins (1988), and Hiltburn et al. (1990) also noted the presence of *C. curvica*. This African native, though apparently not very common, certainly appears to be established in Bermuda. Due to its very small size, it is probably often overlooked.

#### 2. *Crematogaster obscurus* Wheeler

Specimen examined: Paget Parish (1987, H. BAMZ). Identified by S. Cover & B. Seifert.

This Old World tramp species is often misidentified as another tramp, *C. voughsiana*, but may be distinguished from this species based on coloration and discriminant function analysis (Seifert 2001). Due to its small size, the species often may be overlooked.

#### #6. *Crematogaster* sp. male

Specimen examined: Berry Hill Road, light trap (1987, H. BAMZ, one male). James Trager identified this specimen as *Crematogaster* sp. Mark Deyrup concurred.

This species, collected only once, appears to be rare in Bermuda.

7. *Hypocryptus opaciceps* (Mayr)

Specimens examined: Spittal Pond, black light (1987, H, BAMZ, one queen), Spittal Pond, under rock (W), Spittal Pond, near Spanish Rock (W), Ireland Island North, under board by dock (W, one queen), Jennings Road (2002, A Lines).

Wheeler (1966), Haskins & Haskins (1965, 1988), Kempf (1972), and Lieberburger et al. (1975) reported this record as "probably misidentified or no longer established," but the BAMZ actually had a specimen collected by Hilburn. We found a small area near Spanish Rock where *H. opaciceps* was the only species present. This New World native is largely subterranean and often overlooked.

48. *Hypocryptus punctatissimus* (Roger)

Specimen examined: Hamilton (1910, EC Vanatta, ANS, one queen).

We have seen only one specimen of *H. punctatissimus* from Bermuda. It is a well-known tramp species distributed throughout the tropics and subtropics and almost certainly an exotic in Bermuda. Due to its subterranean habits *H. punctatissimus* is probably often overlooked.

9. *Lasius alienus* (Mayr)

Specimens examined: No site data (1953, FJ Bennett, BNHM), many sites (1987-1988, H, BAMZ), 25 sites in Bermuda (W), Walsingham-Jungle (2002, A Lines), Spittal Pond (2002, A Lines).

Starting with Bennett & Hughes (1959), every paper on Bermuda ants recorded this species. This South American native is currently the most common ant in Bermuda in both terms of the number of sites we found this species and in terms of its extremely high densities at these sites. We found this ant almost everywhere we collected in Bermuda, though we did not find it on three small islands we surveyed, Nonsuch Island, Horn Island, and Ordnance Island.

10. *Monomorium monomorium* Holmgr.

Specimens examined: Spittal Pond (1987, H, BAMZ, male labeled "*Monomorium* sp. male det DR Smith"), Ordnance Island, flowerbeds (W), Identified by X Espadale.

Verrill (1992) identified *Monomorium mixtum* (= *M. monomorium*) and specimens of *M. monomorium* collected in 1987 and 2002 support this identification. Hilburn et al. (1990) list the above 1987 specimen as *Monomorium* sp. We collected this species at only one site, Ordnance Island, a small island where slips dock, connected to the town of St. George's by a bridge. *Monomorium monomorium* is common in the Mediterranean.

In the West Indies it has been recorded in Barbados (Kempf 1972).

11. *Odontomachus rugicollis* Smith

Specimens examined: No site data (1905, T Kincaid, AMNH), Near Sharks Hole (1910, EG Vanatta, ANS, labeled *O. haematodes insularis* det Gregg 1956), Nonsuch Island (1931, no collector data, AMNH, labeled *O. haematodes insularis*), Walsingham Jungle (2002, A Lines & W Sterrer, BAMZ), Identified by M Deyrup.

Dahl (1892) identified Bermuda specimens as "probably" *Odontomachus insularis*. Wheeler (1906) recorded a closely related variety, now considered a separate species: *O. rugicollis*. Later authors list one or two *Odontomachus* species from Bermuda: *O. insularis* under *O. brevicornis*. Based on worker morphology, Brown (1976) regarded *O. rugicollis* as synonymous with *O. brevicornis*. Brown (in Deyrup et al. 1985), however, changed his mind, and again separated them into two distinct species. Because all specimens that we examined were *O. rugicollis*, we will assume that all other published records were this species as well.

Jeremy Madeira (Bermuda Department of Conservation Services, pers. comm.) reported seeing this large trap-jaw ant twice at night in 2001, on Long Rock and near Spanish Rock. We searched the area around Spanish Rock for more than an hour without finding this ant. After we left Bermuda, Alex Lines & Wolfgang Sterrer of the BAMZ, collected two specimens in Walsingham. This species used to be common in Bermuda but now appears to be quite rare (see Introduction). It is considered to be native to the West Indies and the Bahamas (Deyrup et al. 1988), but may be exotic in Florida (Deyrup 1991).

412. *Prenolepis imparis* (Latreille)

Specimens examined: Brighton Nursery, on *Polisette* from California (1990, no collector data, BDOA), Hamilton, three sites (W), Ireland Island North, four sites (W).

Hilburn et al. (1990) recorded this species as intercepted on imported plants in 1971 and on imported *Taxia* bulbs in 1987, but considered it not established in Bermuda. We found *P. imparis* well established over broad stretches of the Hamilton waterfront as well as on a large portion of Ireland Island North. This conspicuous Old World tramp has never before been recorded out of quarantine in Bermuda.

15. *Prenolepis curvicauda* Nylander

Specimens examined: No site data (1905, T Kincaid, MCZ, types for *Prenolepis kincaidii*), Paget (1925, L Ogilvie, MCZ).

*Ponera* *hans enclata* has not been collected since 1925 and may be extinct in Bermuda. This Old World tramp species has been widely distributed through human commerce.

14. *Ponera megacephala* (F.)

Specimens examined: No site data (no date, Pergande collection, SI, "480", probably collected c.1890). No site data (1905, T. Kincaid, MCZ & AMNH), Five sites (1910, EG Vanatta, ANS; Padet Marsh (1922, HH Wheelzel, MCZ); Cooper's Island (1922, HC Hoyt, ANS); Hamilton (1934, NA Weber, MCZ); Paget (NLH Krauss, 1971, St. Mary's sites (1987-1988, H. BAMZ), 15 sites (W. Brimstone Hill (2002, Z. Amaral), Lambdin Island (2002, A. Lines).

Every paper on Bermuda ants beginning with Duhl (1892) has recorded *P. megacephala*. Of 122 specimens collected by Vanatta in 1910, 117 were *P. megacephala*, suggesting that this species was dominant in Bermuda at this time. At the ten sites repeatedly surveyed since 1963, the latest survey found *P. megacephala* at four sites and *L. humile* at all ten, the lowest ratio of *P. megacephala* to *L. humile* yet recorded. Still, we found *P. megacephala* in numerous other sites in Bermuda, including three islands where *L. humile* was absent, Nonzeli Island, Horn Island, and Ordinance Island.

15. *Pogonocherus* (Ferd)

Specimens examined: No site data (1945, Stern & Pruitt, SI, "NY-95303 46-1072 Sumner Cherry (vs)"); No site data (1950, no collector data, SI, "NY110550 50-3046 on *Zebrawia pendata* cut"); No site data (1950, no collector data, SI, "52-3330"), Warwick Parish (1987, J. Hendrickson, BAMZ, "Brightside on *Cassia*").

Kemp (1972) listed this species in the New World from Bermuda, St. Kitts, and St. Lucia. This small orange ant is an African tramp species that has been spread around the world, particularly in the Pacific, through human commerce (Wilson & Taylor 1967).

16. *Solenopsis* (*Diplocephalus*) sp.

Specimens examined: Hamilton (1934, NA Weber, MCZ); Brimstone Hill (2000, no collector data, BDOA); BBSR, under boards and under concrete (W); Hamilton, waterfront, in planters (W); Hamilton, around Anbony Point (W).

We suspect that this small orange thief ant is probably overlooked due to its size and primarily subterranean habits. Thief ants commonly persist at high densities in areas invaded by dominant exotic ants such as *P. megacephala* and *L. humile* (Wetterer et al., 2001). The taxonomy of thief ants

is in disarray and more than one species of thief ant may have been collected in Bermuda.

17. *Tetrasolenopsis californicus* Roger

Specimen examined: Newstead Hotel complex, west end (W).

We collected a single *T. californicus* worker found battling with a *P. megacephala* worker on a bare dirt bank. It is the only species that we found for the first time in 2002. This Old World tramp species appears to be rare in Bermuda.

18. *Tetrasolenopsis quadratum* Smith

Specimens examined: Padet Marsh (1922, HH Wheelzel, MCZ); Ferry Point Park entrance, side of the road (W); Devonshire, Happy Talk Road (2002, A. Lines).

This Old World tramp species seems to have a long history in Bermuda but remains rare.

19. *Wasmannia auropunctata* Roger

Specimens examined: Paget (1925, I. Ogilvie, MCZ).

We examined one *W. auropunctata* specimen collected by Ogilvie, though this species was not on Ogilvie's (1928) list. Crowell (1968) recorded *W. auropunctata* and mentioned a 1950 record (Lieberburg et al. 1975). Haskins & Haskins (1988) and Hilburn et al. (1990) also reported *W. auropunctata*. Hilburn et al. (1990) wrote that this species is "now fairly common." However, because we did not collect this ant and did not find any specimens collected by Hilburn, we believe that Hilburn and others may have mistaken other small orange ants in Bermuda (e.g. *P. basseti*, *P. ul-tranoides*, or *Solenopsis* sp.) as being *W. auropunctata*. Populations of *W. auropunctata* may have declined or become extinct in Bermuda. This ant was first recorded in Florida in 1921 and soon became a major pest. However, densities of *W. auropunctata* appear to have declined in many parts of Florida (Doyney et al. 2000). Bermuda is the northernmost outdoor locale reported for *W. auropunctata* (Wetterer & Porter 2004).

20. Dacotina male

Specimen examined: Paget Parish, Malaise trap (1987, H. BAMZ, one male, labeled "Myrmecinae male, det DR Smith").

No dacotines have been previously reported from Bermuda. Unfortunately, no one could identify this specimen to genus. Barry Bolton (BNHM, personal communication) wrote "there is so little male-associated material that defining the genus on this sex just can't be achieved yet. As far as I can tell, *Stenogobys* and *Pyrochroa* cannot be separated on males." Xavier Españolater determined that it was not a European species.



## Unconfirmed Status (No Specimens Examined)

*Lasius niger* (L.)

Although Kirby (1854) listed *L. niger* from Bermuda, *Lasius* specimens from Madeira and the Azores, originally identified as *L. niger*, have been recently reclassified as *L. grandis* (Seifert, 1992), so the same may be true for the *Lasius* of Bermuda. It is also possible that the ants were not *Lasius* at all. Clark (1930) re-examined other ant specimens evaluated by Kirby and considered his identifications and descriptions to be "worthless." We did not find these specimens in the BNEHM where Kirby worked.

*Monomorium pharaonis* (L.)

Wheeler (1906) speculated without examination that Verrill's (1902) *M. monomorium* specimens were actually *M. pharaonis*, a conclusion accepted by Ogilvie (1928) and Hilburn et al. (1990). Ogilvie (1928) wrote that *M. pharaonis* is a common house species, and Hilburn et al. (1990) wrote that it was "not an important household pest in Bermuda in recent years," but it is unclear whether either actually examined any *M. pharaonis* specimens from Bermuda.

*Paratrechina* sp.

Crowell (1966), Lieberburg et al. (1975), Haskins & Haskins (1988), and Hilburn et al. (1990) reported an unidentified *Paratrechina*. Hilburn et al. (1990) wrote that this species was "now common and widespread." However, all of the specimens from Hilburn et al. (1990) at the BAMZ labeled "*Paratrechina* sp." were actually *B. obscurus*. The same may be true of the other records.

*Prenolepis* sp.

Wheeler (1906) wrote that the *Prenolepis* sp. sample collected by Kincaid included "seven workers, apparently all from the same colony, but varying much in size (from 2-3 mm). They are very pilose and pubescent, with subopaque surface and finely punctate mesonotum." Wheeler (1906) felt that males were needed for definitive identification. We did not find these specimens at the MCZ, where Wheeler worked. It is possible that this species is a *Paratrechina* or perhaps a *Pogonomyrmex*.

*Tetramorium caespitum* (L.)

Verrill (1902) recorded *T. caespitum*, the European "pavement ant," in Bermuda. Wheeler (1906) speculated, without examining the specimens, that they were *T. guineense*. *Tetramorium*

*caespitum* is common in Europe and Asia, as well as in the Azores. *Tetramorium guineense* is native to Africa, though Wheeler (1906) was no doubt actually referring to *Tetramorium bewickianum* (Nylander), a common tramp ant once considered a synonym of *T. guineense*. Unfortunately, we did not find any of Verrill's specimens in the YPM, where he worked.

## Ants Intercepted by Bermuda Department of Agriculture

Several species of ants in the BDOA collection were intercepted on incoming products, including *Camponotus floridanus*, *C. noveboracensis*, *C. pennsylvanicus*, *Camponotus* sp. near *pennsylvanicus*, *Camponotus caryocarpus*, *Crematogaster steinhilfi*, and *Pheidole mexicana*.

## DISCUSSION

Our study confirms the conclusions of earlier research (Haskins & Haskins 1985, 1988; Crowell 1968; Lieberburg et al. 1975) that Bermuda is largely partitioned between two dominant ant species, *Pheidole megacephala* and *Lasius humile*. Although *P. megacephala* appeared to show a resurgence in the late 1960s and early 1970s (Table 2, Haskins & Haskins 1988), *L. humile* now has the upper-hand, dominating most parts of the main islands of Bermuda. The recent populations of *P. megacephala* in Bermuda appear to be the lowest recorded. Still, this species persists in pockets on the main islands and on small islands not connected to the main islands. We found that *P. megacephala* dominated and *L. humile* was absent on two small islands, Nonsuch and Horn, with breeding population of cahow (*Phaethon rubricauda*), an endangered endemic bird. The absence of *L. humile* is a relatively good news for the cahow because *L. humile* seems to pose a greater threat to ground-nesting birds than does *P. megacephala*. For example, Newell & Barber (1913) observed *L. humile* attacking young birds, swarming over and devouring nestlings.

In addition to the two dominant species, we examined specimens of 18 other ant species from Bermuda. *Brachymyrmex obscurus*, though small and inconspicuous, is very common in Bermuda and coexists with both *L. humile* and *P. megacephala*. *Paratrechina longicornis*, which was not previously reported from Bermuda, has substantial populations in two urban areas. Three other ant species appear to be well established, but very inconspicuous due to their very small size (*Brachymyrmex heeri* and *Solenopsis* sp.) or subterranean habits (*Hypomyzomera spiciceps*). The rest of the recorded ant species appear to be rare. Only three ant species with confirmed records from Bermuda have not been collected recently (1987 or later), *Hypomyzomera punctatissima*, *Paratrechina vernalis*

*ula*, and *Wasmannia stramineiventris*. All three are common tramp species and almost certainly exotic to Bermuda.

It is an open question as to whether Bermuda ever had any native ants. It is feasible that Bermuda, like Hawaii, had no ants before people arrived. In fact, 13 of the 17 confirmed ant taxa in Bermuda identified to species are almost certainly exotic. Candidate for native status include *Ponoponera bicolor*, *Brachymyrmex obscurus*, *Hypoponera opaciventris*, and *Oecophylla rugiceps*, all native to the West Indies and the Bahamas. Some species may have had native populations augmented by subsequent human-assisted immigration.

DNA analyses should be useful in evaluating native versus exotic status of ants in Bermuda, e.g., to determine whether or not populations of *B. bicolor*, *B. obscurus*, *H. opaciventris*, and *O. rugiceps* show the genetic uniformity consistent with exotic introductions. DNA analyses may also allow evaluation of the geographic origins of populations of exotic species. DNA analyses of 95 of our *I. krombeini* specimens (five each from seven populations) showed that all individuals had the same haplotype for two mitochondrial markers (cyt b and COI). These haplotypes have been found in one native Argentine population and in one introduced Chilean population, and but in no other introduced populations analyzed (A. Vogel, et al., unpublished data; see Giraud et al. 2002).

More thorough ant surveys of Bermuda would be valuable. Of the 20 ant species with confirmed records from Bermuda, five have been collected only once. From this, we expect that there are several additional undocumented ant species established in Bermuda. The impact of ants on the native fauna and flora of Bermuda also deserves careful study.

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#### REFERENCES CITED

BENNETT, F. D., AND I. W. HUGHES. 1959. Biological control of insect pests in Bermuda. *Bull. Entomol. Res.* 50: 423-436.

- BRANTON, C. B. V. 1991. Advances on catalogs abbreviados (Formigas de região neotropical) (Hymenoptera: Formicidae). *Rev. Brasileira Entomol.* 35: 819-112.
- BROWN, W. L., JR. 1978. Contributions toward a reclassification of the Formicidae. Part VI. Ponerinae: tribe Ponerini. *Labrida-Golummichia*. Section A. Introduction: subtribe clauseni. Genus *Oecophylla*. *Stud. Entomol.* 19: 87-171.
- CLARKE, J. 1980. New Formicidae, with notes on some of the known species. *Proc. Royal Soc. Victoria* 49: 2-27.
- CROWELL, K. L. 1968. Rates of immigration: evidence by the Argentine ant in Bermuda. *Ecology* 49: 103-105.
- DAVIS, F. 1892. Die Landfauna von Bermuda. In *Ergebnisse der Zoologischen Expedition 1988 der Humboldt Stiftung* (A. Hensler, ed.), 1: 705-712.
- DEVRUP, M. 1987. Evolving ants of the Florida Keys, pp. 17-24. In *Proc. 9th Symp. Nat. Hist. Bahamas, Bahamian Field Station, San Salvador, Bahamas*.
- DEVRUP, M., J. DAVIS, AND S. BIRNBAUM. 1988. Composition of the ant fauna of three Bahamian islands, pp. 23-31. In *Proc. 7th Symp. Nat. Hist. Bahamas, Bahamian Field Station, San Salvador, Bahamas*.
- DEVRUP, M., J. DAVIS, AND S. CHIVERS. 2000. Fauna of the Florida Keys. *American Entomol. Soc.* 128: 203-326.
- DEVRUP, M., J. TRUJILLO, AND N. CAVALLI. 1987. The genus *Oecophylla* in the southeastern United States (Hymenoptera: Formicidae). *Entomol. News* 9(4): 196-198.
- EACLES, J. M. 1911. The displacement of native ant species by the introduced Argentine ant (*Iridomyrmex heisteria* Mayr). *Psyché* 28: 257-258.
- GAFFNEY, T., J. S. DUDLEY, AND L. R. H. 2002. Evolution of supercolonies: The Argentine ants of southern Europe. *Proc. Nat. Acad. Sci.* 99: 8075-8079.
- HASKINS, C. P. 1939. *Of Ants and Men*. Prentice-Hall, New York, 241 pp.
- HASKINS, C. P., AND L. F. HASKINS. 1965. *Phenology of *Iridomyrmex heisteria* in Bermuda: a study in natural or slow replacement*. *Ecology* 46: 770-781.
- HASKINS, C. P., AND F. F. HASKINS. 1968. Field observations on *Phoridomyrmex heisteria* and *Iridomyrmex heisteria* in Bermuda. *Psyché* 95: 177-183.
- HILKES, D. J., F. M. MAYER, AND M. E. S. (EDS.). 1980. *Hydrocarbons of Bermuda*. *Florida Field* 7: 161-176.
- HOLWAY, D. A. 1989. Competitive mechanisms underlying the displacement of native ants by the introduced Argentine ant. *Ecology* 80: 238-251.
- HOLMAN, K. G., AND D. M. LINDSEY. 1990. Exploitation and interference competition between the introduced Argentine ant, *Iridomyrmex heisteria*, and native ant species. *Oecol.* 105: 107-112.
- HUGHES, I. W. 1927. Rough notes and memoranda relating to the natural history of the Bermudas. H. H. Botten, London.
- JONES, J. M. 1856. *The Naturalist at Bermuda*. Reeves & Turner, London, 206 pp.
- KEMPER, W. W. 1972. Catalogue of new species belonging to the genus *Leptomyrmex* (Hymenoptera: Formicidae). *Stud. Entomol.* 17: 3-34.
- KEMPER, W. W. 1987. The genus *Leptomyrmex* of the Bermudas: an historical review of our knowledge. *Arch. Nat. Hist.* 10: 1-28.
- KIRBY, W. F. 1982. On the Hymenoptera collected during the recent expedition of H.M.S. "Thetis" to the Ant. Mag. *Nat. Hist.* 5: 5111-5115.
- LEFFLER, J. H., ed. 1892. *History of the Bermudas: a Summary*. London: Edited from a manuscript written

- 1618-25 in the Sloman Collection. British Museum, Hakluyt Society, London.
- LIEBERBERG, L. P., M. KRANZ, AND A. SEIT. 1975. Bermudian ants revisited: the status and interaction of *Pheidole mesocephala* and *Iridomyrmex humilis*. *Ecology* 56: 472-476.
- NEWELL, W. AND T. C. RAINGER. 1912. The Argentine Ant. United States Dept. Agric., Bur. Entomol., Bull. 122.
- ORRILL, L. 1928. The insects of Bermuda. Dept. Agric. Bermuda, Hamilton.
- SEIFEITZ, B. 1992. A taxonomic revision of the Palaearctic members of the ant subgenus *Lasius* s. str. (Hymenoptera: Formicidae). *Abh. Dez. Naturkundem. Gesell.* 68(5): 1-68.
- SEIDT, H. 2003. The ant genus *Crematogaster* (Hymenoptera: Formicidae)—a taxonomic revision of the species *bulgarica*, *berlesei*, *negrei*, *sinclairi*, *stankovitschi*, *troughiana*, *emeryi*, and *orientalis* species groups. *Annalen des Naturhistorischen Museums Wien* (in press).
- SIMMONS, E. J. 1958. The effect of lizards on the biological control of scale insects in Bermuda. *Bull. Entomol. Res.* 49:191-192.
- VAN DER WOUDE, J., J. A. LOUW DE BUIJEN, AND A. P. N. HOUTGE. 2003. Response of an open-forest ant community to invasion by the introduced ant, *Pheidole megacephala*. *Austral Ecol.* 28: 257-259.
- VEIDILL, A. E. 1902. The Bermuda Islands, an account of their scenery, climate, physiography, natural history, and geology with Sketches of Their Discovery and Early History, and the Changes in Their Flora and Fauna Due to Man Trans. Connecticut Acad. Arts Sci. 11: 413-656.
- WATTERER, J. K. 2002. Ants of Tonga. *Pacific Sci.* 56: 125-136.
- WATTERER, J. K., AND S. D. PORTER. 2003. The bumble bee ant, *Wasonnema caryocarpae*: distribution, impact, and control. *Sociobiol.* 42: 1-11.
- WATTERER, J. K., P. S. WAJDU, A. L. WETTERER, J. T. LOSHINO, J. C. TILGER, AND S. E. MILLER. 2000. Ants of Santa Cruz Island, California. *Bull. South. California Acad. Sci.* 99: 25-31.
- WATTERER, J. K., A. L. WETTERER, AND F. HEBARD. 2001. Impact of the Argentine ant, *Linepithema humile* (Mayr.) on the native ants of Santa Cruz Island, California. *Sociobiol.* 38: 709-721.
- WHEELER, W. M. 1936. The ants of the Bermudas. *Bull. American Mus. Nat. Hist.* 22: 347-352.
- WILSON, E. O., AND R. W. TAYLOR. 1967. Ants of Polynesia. *Pacific Insects Monogr.* 14: 1-109.
- WINDALL, D. B. 1935. Terrestrial beetles of Bermuda. *Hesperid.* 21: 202-218.