

TWO NEW ENIGMATIC *MELOPHORUS* SPECIES (HYMENOPTERA: FORMICIDAE) FROM AUSTRALIA

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Abstract.—Two new species of the Australian ant genus *Melophorus* are described. *M. majeri* new species is morphologically very distinct from all the other species with spines on the propodeum, and the worker caste extremely elongate. It has so far only been collected at two localities in Western Australia in heath vegetation. *M. anderseni* new species was found once in the backyard of the CSIRO labs in Darwin. It displayed a perplexing behavioral pattern, with hugging and rubbing intimately the worker of the meat ant *Iridomyrmex sanguineus*, rushing into their nest and carrying out their larvae without being interrupted by the hosts. A possible reaction of the meat ant might be the blocking of the nest entrance of the robbers by piling up little stones over their nest entrance.

Melophorus is one of the more specious and dominant ant genera in Australia. The 21 currently known species (Bolton, 1995) are quite an underestimate of the total number of species which will certainly exceed the number of 100 species (Agosti, unpubl.). *Melophorus* ants are endemic to Australia, and their main radiation was in the arid to hyper arid ecosystems, from open forested land to almost barren desert, where they are often found foraging during the hottest hours of the day, with surface temperature above 60°C (Christian and Morton, 1992; Andersen, 1997), and reports on nocturnal activities could not be confirmed (Taylor and Brown, 1985). Nests are found even in the driest habitats such as between sand dunes or in salt pans, where they are one of the main food sources for lizards (Brown, 1955). Almost all the species are diurnal, and forage usually individually, but recruiting to food sources is possible as well (Agosti, unpubl.).

Various food sources are used, from harvesting seeds (e.g., Buckley, 1982), scavenging, exploiting extrafloral nectaries to lestopiosis (see below). One species group with such aberrant species as *M. fulvihirtus* with a very stout body, short, bristle like hairs and appendages, is known to live on or near nests of the large *Iridomyrmex purpureus* group (Greenslade, pers. comm.; Hölldobler and Wilson, 1990). It is thought that the often extreme life style of *Melophorus* ants is due to the competition with the dominant *Iridomyrmex* species (e.g., Andersen and Patel, 1994).

Nests are mostly small, normally with one queen, and in the ground. Mating flights take place in form of swarms few meters above ground, with the female and male in cupola falling on the ground. The female then starts immediately to dig a whole into the ground, which is closed from inside within a few hours (Observed for six species, including *M. bagoti* north of Alice Springs in January 1991 after heavy rainfall (Agosti, unpubl.)).

In many respects, the biology of *Melophorus* is very similar to the vicariant genera in the deserts on other continents, whereby the genus *Melophorus* seems to have the

widest spectrum of behavioral patterns (Andersen, 1997; Dlussky, 1981; Wehner et al., 1994).

The ants of the genus *Melophorus* are morphologically easily recognized. They belong to the ant subfamily Formicinae, characterized and best recognized by a fringe of hairs at the tip of the gaster (acidopore; see also Bolton, 1994:42 for an exhaustive diagnosis and visual documentation). They belong to the *Formica* genus group with the petiole insertion cavity not reaching in front of the hind coxal cavities, and the first gastral segment's tergite and sternite meeting ventrally of the helcium (the gastral part of the petiole-gaster joint) in a straight line (Agosti, 1991). The combination of a low number of mandibular denticles, a palp formula with 6 maxillary and 4 labial palps with the maxillary palps usually longer than half the head length, the insertion of the antennae adjacent to the clypeus, the presence of a psammophore with long J-shaped hairs inserted slightly set back to the anterior margin of the clypeus, often on the anterior margin of the clypeus, always on the maxillary stipes and sometimes the gula, the often extremely long, slit shaped propodeal spiracle, and internally the short, asepalous proventricule is unique. Phylogenetically, they are supposedly basal to most of the Formicinae (Agosti, 1994).

Despite their ecological importance, the systematics of this group are poorly known, and no modern monographic revision exists. Most of the samples in collections are indirectly collected in ecological studies or conservation surveys. Thus, the major *Melophorus* collections are at the Australian National Insects Collection in Canberra (ANIC: collected by Greenslade), the School of Environmental Biology, CURTIN University of Technology in Perth (CURTIN: collected by Majer), and the Division of Wildlife and Ecology at CSIRO in Darwin (CSIRO-TERC: collected by Andersen). The exception to this is the collection of the avid ant collector Lawrey at ANIC. Noteworthy collections outside Australia are at the Museum of Comparative Zoology, Harvard University, Cambridge (MCZ: mostly collected by Brown), the American Museum of Natural History in New York (AMNH: collected by Agosti). The Forel collection in Geneva, Switzerland (MHNG) and The Natural History Museum, London (BMNH) include mostly type material. Additional images and documentation are accessible at <http://research.amnh.org/entomology/socialinsects>.

The following description of the two new species is an outcome of a travel grant to DA, which allowed collecting specifically *Melophorus* species in Australia's dry land, and checking through the collections in Australia during 1990/91. Though there are many more species to be described, the two species mentioned below deserve special attention. *M. anderseni* has an outstanding behavior, and *majeri* is morphologically very distinct.

Measurements are given in mm: CI cephalic Index ($HW \times 100/HL$); HL head length, from the anterior most point on the clypeus to the posteriormost on the occiput; HW head width, largest width of the head in full frontal view, below the eyes; SL scape length; SI scape index ($SL \times 100/HW$); TL mesosoma length, measured from the anteriormost point of the pronotum to the posteriormost on the propodeum. A series of images on the behavior of *Melophorus* ants is accessible on the World Wide Web (<http://research.amnh.org/entomology/socialinsects>).

Melophorus anderseni, new species

Holotype worker: Australia, NT, Darwin, CSIRO, backyard of Division of Wildlife and Terrestrial Ecology. 3.ii.1991, D. Agosti. Holotype deposited at ANIC. Figures 1–5.

Paratypes. 8 workers and 1 female; Australia, NT, Darwin, CSIRO, backyard of Division of Wildlife and Terrestrial Ecology. 3.ii.1991, D. Agosti. Paratypes deposited at AMNH, ANIC, BMNH, CSIRO-TERC, MCZ, MHNG.

Holotype worker: TL 1.84, HL 1.06, HW 1.00, SL 1.34, EL 0.26, CI 94, EI 26, SI 134.

Paratype workers (N = 7): TL 1.82–1.99, HL 1.08–1.14, HW 1.0–1.10, SL 1.24–1.48, EL 0.24–0.26, CI 91–96, EL 23–26, SI 127–148; *female* (N = 1) TL 2.92, HL 1.68, HW 2.08, SL 1.24, EL 0.38, CI 124, EI 18, SI .60

Description: *Worker*:

- Clypeus pointed and keeled, slightly projecting anteriorly
- Maxillary and labial palps extremely thin, not longer than half the head length
- long psammochaeta: J-shaped hairs on the clypeus, gula and maxillary stipes
- Long scape
- Mesosoma elongate with pronotum in cross-section dorsally rounded, and propodeum smoothly rounded
- Petiole nodiforme
- Short erect hairs on mesonotum, propodeum, petiole, gaster and legs.
- Body color reddish orange, with the gaster at most slightly darker
- Body not shining, and without a distinct sculpture

Female:

- same as worker, but with a complete set of wing sclerites, and the following differences
- larger than the worker
- distinctly much wider head than the worker.

Material examined: Holotype and paratypes.

Comment: The above combination of characters is unique within the genus. Other ants related to *Iridomyrmex* species are usually characterized by a stout body shape, short appendages and an excessive number of long hairs, or short and thick hairs, e.g., *fulvihirtus* (Clark, 1941). No large workers were observed, but, as it was a unique nest in perfect position to be observed further, it was not dug out completely. In many respects, this species with the nodiforme petiole, the smooth shining surface, and the few hairs resembles more *M. bagoti*.

Biology: *M. anderseni* was discovered whilst collecting a sample of *Iridomyrmex sanguineus* on the large pebble nest in the garden of the CSIRO Division of Terrestrial Ecology in Darwin, which just had the males leaving in the late morning. This very dominant species has little nest entrances, which three workers at a time seal off when threatened (Fig. 1). The seal is so tight that it is impossible to remove this plug, without tearing off the antennae of the workers. At the very time, it did not take the guards long to step aside, as the nest was just swarming and many males were leaving and entering the nest. The meat ant, *I. sanguineus*, is a very distinct species. It is easily recognized by the large soil material scattered around the nest

entrances, their steady pace, the bright red head and mesosoma, the relatively wide, heart-shaped head with the rather narrowly set eyes, and if there are any doubts left, there stinking smell when squeezed between the fingers.

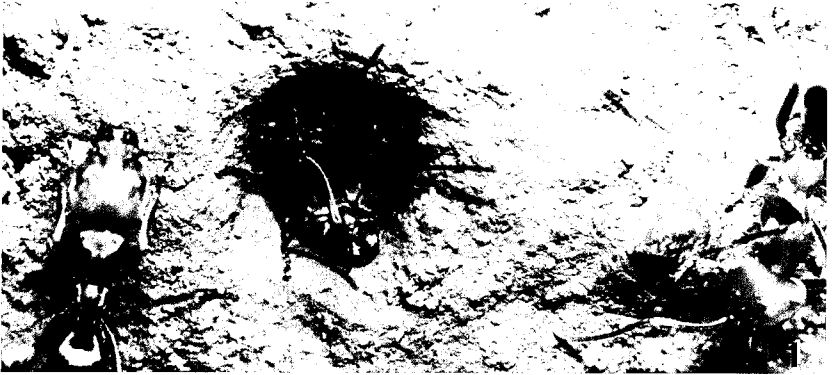
It was then very remarkable to discover, that there was a second species of ants intermingled with the workers, which even entered and left the nest entrances—albeit at a higher speed—with the *Iridomyrmex* workers (Fig. 2). Some of the *anderseni* were even carrying larvae out of the *sanguineus* nest. Following these workers, they disappeared into entrances at the outskirts of the *sanguineus* nest, with much narrower entrances, so that only these workers and not the *sanguineus* could enter. Obviously, the *sanguineus* workers did not care at all about the robbery. However, two more observations point out that this is a more complex interaction. In two cases, workers of *anderseni* were seen staying above the *sanguineus*, seemingly rubbing their bodies against one of the *sanguineus* (Fig. 3), which during this period did not move at all, but behaved similarly to an ant encountering a larger, non-conspecific ant. One way to react in such a situation is cowering on the ground, with legs and antennae as drawn up as possible, which is in this case with the smaller ant dominating over the larger. After about a minute, *anderseni* left without any further interactions with the meat ant. It seems as if the *anderseni* workers acquires the very pungent smell of the *sanguineus*, making her chemically invisible.

Cuticular hydrocarbons are assumed to be used as recognition cues (Nowbahari et al., 1990). The breakdown of nest mate recognition has been documented within species (Jeral et al., 1997), between ant species (e.g., Hölldobler, 1973; Lenoir et al., 1997), in many cases of the lycaenid-ant relationship, or many myrmecophiles (Hölldobler and Wilson, 1990). At least three types of breakdowns are known. In the thief ant *Ectatomma ruidum* a decreased amount of cuticular compounds might play the facilitator role (Jeral et al., 1997). Other ants and guests acquire the host odor either passively or actively by licking the host (known from many myrmecophilous beetles or ants of the genus *Formicoxenus*). Finally, the compounds are actively biosynthesized by the guests (Lenoir et al., 1997; Lorenzi et al., 1996). *M. anderseni* undoubtedly must belong to the second category.

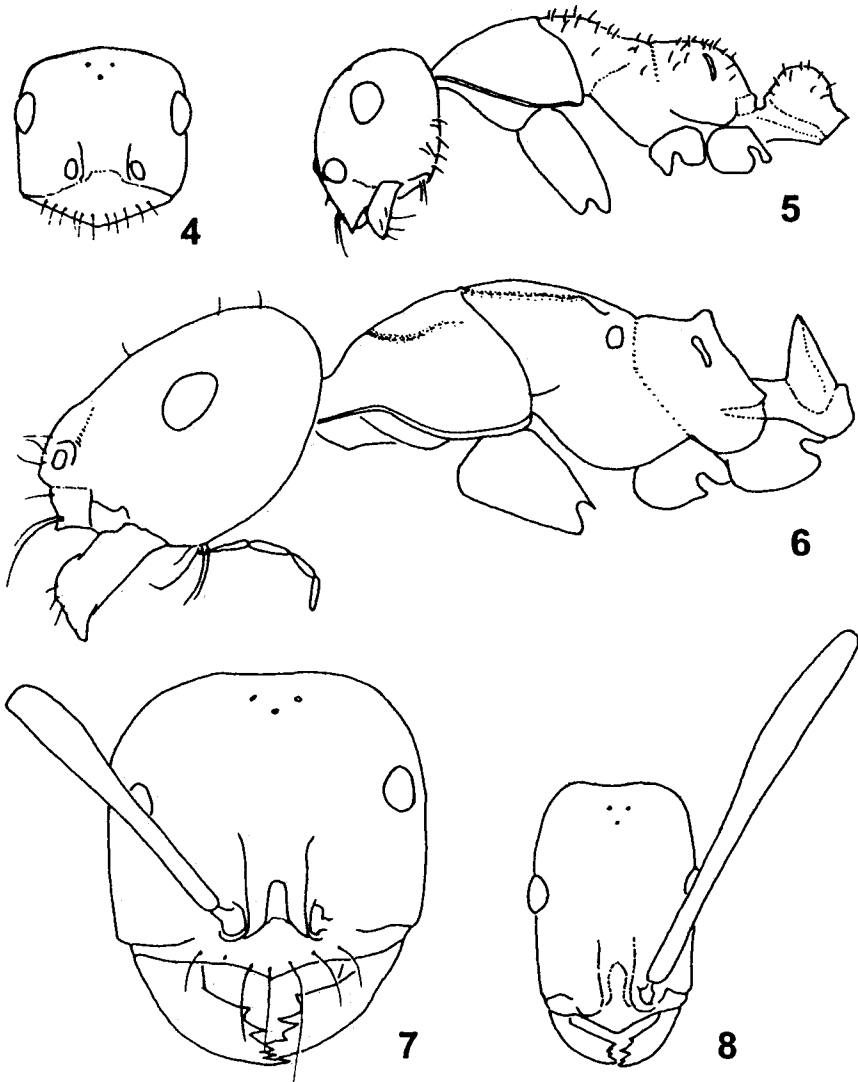
Among Australian ants, robbing of ant nests by other species seems to be rather widespread. More nest entrances are locked up after periods of activities in Australia than in other regions of the world. *Cerapachys* species can be seen quiet often carrying away brood from other ant nests, during the hottest ours of the day, or early in the morning (Clark, 1941; Agosti, unpubl.). Whereas raids of ant nests by *Cerapachys* include a number of workers, often accompanied by intense fights between the hosts, the two known *Melophorus* species, *fulvihirtus* and *anderseni*, operate singly, and are not recognized by their hosts (Clark, 1941). In some cases, when a meat ant seemed to notice an *anderseni* worker, the latter stopped moving for a moment, and almost played dead.

The other significant observation was that the *sanguineus* workers started to cover the nest entrance of the *anderseni* with small pebbles, until a distinct heap was formed, similar to the nest plugging described in North American desert ants (Möglich and Alpert, 1979; Gordon, 1988).

Robbing of meat ant larvae was described by Clark, 1941. *M. fulvihirtus*, a morphologically very distinct species, also lives at the outskirts of meat ant nests.



Figs. 1–3. Behavior of *Melophorus anderseni*. 1. The impassable living nest plug of *Iridomyrmex sanguineus*, formed of heads ant heads. 2. *M. anderseni* entering and leaving the *sanguineus* nest unmolested. 3. Rubbing of *M. anderseni* on *I. sanguineus*. This procedure lasts less than a minute, without any defense of *sanguineus* worker.



Figs. 4-5 *Melophorus anderseni* (Holotype worker): 4 head in full frontal view; 5 lateral view of head and mesosoma (TL = 1.84 mm). Figs. 6-8 *Melophorus majeri* (Paratype soldier and worker): 6 lateral view of head and mesosoma of soldier (TL = 1.32 mm); 7 head in full frontal view (soldier); 8 head in full frontal view (worker).

***Melophorus majeri*, new species**

Holotype worker: Australia, WA, Hassel Road, Jerramungup - Albany (15km SW Wellethead), at Mettler Lake Road 100 m left side. 34°40'S 118°36'E. WA, 23.iv.1988, B. Heterick; Holotype deposited at ANIC.

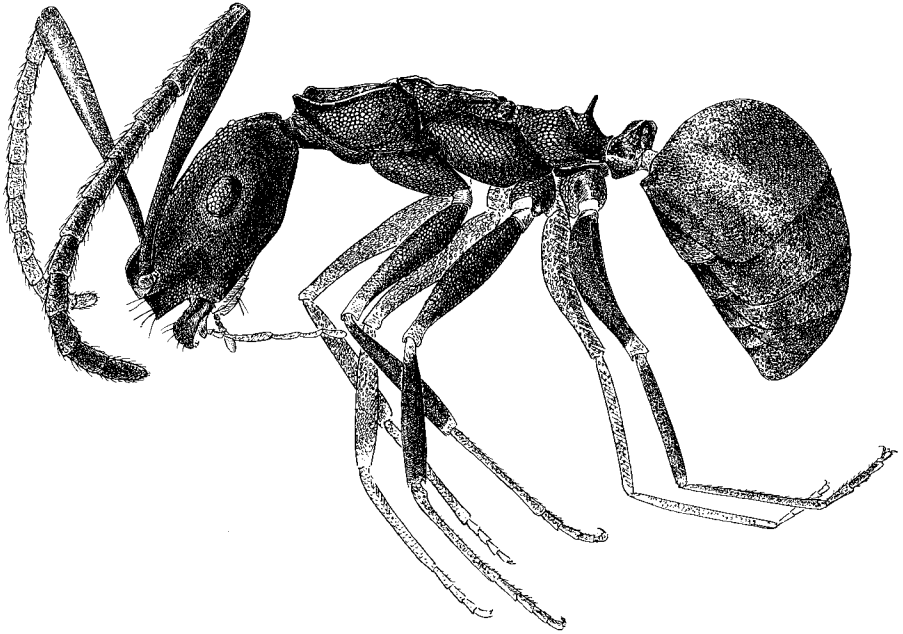


Fig. 9. *Melophorus majeri* (Paratype worker) in lateral view.

Paratypes: 17 workers, Australia, WA, Hassel Road, Jerramungup - Albany (15km SW Wellethead), at Mettler Lake Road 100 m left side. 34°40'S 118°36'E. WA, 23.iv.1988, B. Heterick; 18 workers Australia, WA, Hassel Road, Jerramungup - Albany (15km SW Wellethead), at Mettler Lake Road 100 m left side. 34°40'S 118°36'E. WA, 28.x.1990, D. Agosti; 1 worker, Australia, WA, Cape Arid NP, Yokinup Bay, xi.1988, A. H. Burbidge. Heath vegetation on quartz soil; pitfall trap. Paratypes deposited at AMNH, ANIC, BMNH, CSIRO-TERC, MCZ, MHNG.

Holotype worker: TL 1.08, HL 0.75, HW 0.45, SL 1.14, EL 0.14, CI 60, EI 31, SI 253.

Paratype workers ($N = 7$): TL 1.08–1.08, HL 0.70–0.75, HW 0.42–0.45, SL 1.04–1.16, EL 0.12–0.14, CI 58–63, EI 29–33, SI 231–267; large workers (soldiers) ($N = 2$): TL 1.32–1.32, HL 0.92–0.94, HW 0.90–0.94, SL 0.92–0.92, EL 0.18–0.18, CI 98–100, EI 19–20, SI 98–102.

Description: *Worker*:

- Maxillary palps almost as long as head, brownish and rather wide; not flattened
- Maxillary stipes with long erect hairs
- Mandible with four subequal teeth slightly decreasing in size from apical to basal, and with a distinct basal tooth
- Frontal carinae distinctly raised, closely set, forming almost an enclosure for the frontal triangle and the anterior part of the clypeus, which is slightly protruding behind the insertion of the antennae
- Extremely long antennal scape

- Extremely elongate head
- Humeri on pronotum well developed and projecting laterally
- Mesosoma laterally completely flat
- Propodeal spiracle very long, slit shaped, reaching the dorsal outline of the propodeum
- Propodeum armed with two distinct lateral spines
- Petiole almost rectangular, wider than long
- Insertion of petiole into the metanotum not reaching beyond a line spanned between the anteriormost point of the hind coxal cavities
- First gastral segment of *Formica* type (helcium at the antero-ventral part of the first gastral tergite, and the tergite and sternite meeting in a straight line)
- Proventricule short, asepalous
- Body almost without any pubescence
- Body color grayish black
- Surface sculpture densely reticulate; surface matte.

Soldier (large worker):

- Same as worker with the following differences;
- Head with a much wider and larger
- Mesosoma stouter, relatively much higher
- Propodeal spiracle less extended and not reaching the dorsal outline of the propodeum
- Propodeal spine short and blunt
- Petiole squamiform.

Material examined: Holotype and paratypes.

Comment: The morphology of the worker is unique among *Melophorus* ants. The most conspicuous feature is the elongation of the whole body (Fig. 9), the propodeal spines, as well as the blackish gray coloration. The presence of the dimorphic worker caste, sharing all the diagnostic characters of *Melophorus*, seems to justify the inclusion of this new species within *Melophorus*.

Biology: This species was collected in a nest under a piece of wood in a clearing in heath vegetation, and in a pitfall trap. Little is known of this species. It is moving rather nervously on the ground with the antenna almost fully stretched out, almost without an angle between the scape and the funiculus.

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Jonathan Majer and Alan Andersen are both extremely successful promoters of Australian ants around the globe, but nevertheless very cooperative and helpful, and curious about the identity of their ants. They both were very instrumental for this successful field trip to Australia. Brian Heterick was selfless to let me have his one and only vial of *Melophorus majeri*, and also let me know where to find more. Ian Nauman and Ebbe Nielsen were very generous in letting me have the base camp at the ANIC in Canberra, and to work through the melophorine collection. John Greenslade let me have his notes, both verbally and on paper. Nicolette Layover prepared the lavish drawing of *M. majeri*. Alan Andersen and Alain Lenoir made some useful comments on an earlier draft of the manuscript. Field work was generously supported by a fellowship of the Janggen-Poehn Foundation, St. Gall, Switzerland.

LITERATURE CITED

- Agosti, D. 1991. Revision of the oriental ant genus *Cladomyrma* with an outline of the higher classification of the Formicinae (Hymenoptera: Formicidae). *Syst. Entomol.* 16:293–310.
- Agosti, D. 1994. The phylogeny of the ant tribe Formicini (Hymenoptera: Formicidae) with the description of a new genus. *Syst. Entomol.* 19:93–117.
- Andersen, A. N. 1997. Functional groups and pattern of organization in North American ant communities: a comparison with Australia. *J. Biogeog.* 24:433–460.
- Andersen, A. N. and A. D. Patel. 1994. Meat ants as dominant members of Australian ant communities: an experimental test of their influence on the foraging success and forager abundance of other species. *Oecologia* 98:15–24.
- Bolton, B. 1994. Identification Guide to the Ant Genera of the World. Harvard University Press, Cambridge, Mass. 222 pp.
- Bolton, B. 1995. A New General Catalogue of the Ants of the World. Harvard University Press, Cambridge, Mass. 504 pp.
- Brown, W. L., Jr. 1955. A revision of the Australian ant genus *Notoncus* Emery, with notes on the other genera of Melophorini. *Bull. Mus. Comp. Zool.* 113(6):471–494.
- Buckley, R. C. (ed.) 1982. Ant-plant interactions in Australia. *Geobotany* 4:162 pp. Dr. W. Junk Publishers, The Hague.
- Christian, K. A. and S. R. Morton. 1992. Extreme thermophilia in a central Australian ant, *Melophorus bagoti*. *Physiol. Zool.* 65:885–905.
- Clark, J. 1941. Australian Formicidae. Notes and new species. *Mem. Nat. Hist. Mus. Victoria* 12:71–95.
- Dlussky, G. M. 1981. Desert Ants [In Russian]. Moskva, Nauka, 230 pp.
- Gordon, D. M. 1988. Nest-plugging: interference competition in desert ants (*Novomessor cockerelli* and *Pogonomyrmex barbatus*). *Oecologia* 75:114–118.
- Hölldobler, B. 1973. Chemische Strategie beim Nahrungserwerb der Diebsameise (*Solenopsis fugax* Latr.) und der Pharaoameise (*Monomorium pharaonis* L.). *Oecologia* 11(4):371–380.
- Hölldobler, B. and E. O. Wilson. 1990. The Ants. Harvard University Press, Cambridge, Mass., 732 pp.
- Jeral, J. M., M. D. Breed, and B. E. Hibbard. 1997. Thief ants have reduced quantities of cuticular compounds in a ponerine ant, *Ectatonomia ruidum*. *Physiol. Entomol.* 22:207–211.
- Lenoir, A., C. Malosse, and R. H. Yamaoka. 1997. Chemical mimicry between parasitic ants *Formicoxenus* and their host *Myrmica* (Hymenoptera, Formicidae). *Biochem. Syst. Ecol.* 25:379–389.
- Lorenzi, M. C., A. G. Bagnères and J. L. Clément. 1996. The role of cuticular hydrocarbons in social insects: is it the same in paper wasps? *in*: S. Turillazzi and M. J. West-Eberhard (eds.), *Natural History and Evolution of Paper Wasps*. 178–189. Oxford University Press, Oxford.
- Möglich, M. and G. D. Alpert. 1979. Stone dropping by *Conomyrma bicolor* (Hymenoptera: Formicidae): a new technique of interference competition. *Behav. Ecol. Sociobiol.* 6(2): 105–113.
- Morton, S. R. 1982. Granivory in the Australian arid zone: diversity of harvester ants and structure of their community. *in*: W. R. Barker and P. J. M. Greenslade (eds.), *Evolution of the Flora and Fauna of Arid Australia*. 257–262. Peacock Publications.
- Taylor, R. and D. R. Brown. 1985. Hymenoptera: Formicoidea, Vespoidea, and Sphecoidea. *Zoological Catalogue of Australia* 2:381 pp.
- Wehner, R., S. Wehner, and D. Agosti. 1994. Patterns of biogeographic distribution within the *bicolor* species group of the North African desert ant, *Cataglyphis* FOERSTER 1850. *Senckenberg. Biol.* 74(1/2):163–191.

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