

Journal of Melittology

Bee Biology, Ecology, Evolution, & Systematics

The latest buzz in bee biology

No. 68, pp. 1–5

20 April 2017

BRIEF COMMUNICATION

A nesting aggregation of the solitary bee *Megachile atrata* (Hymenoptera: Megachilidae) in the Philippines

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Abstract. A nesting aggregation of *Megachile* (*Creightonella*) *atrata* Smith in the Philippines comprised almost 300 active nests. The bees in rapid flight resemble the hornet *Vespa tropica* Linnaeus. The nest structure is similar to that reported for *M. (C.) frontalis* (Fabricius) in New Guinea.

Megachile (*Creightonella*) *atrata* F. Smith is a large, black leafcutter bee described from the Philippines (Smith, 1853: 182). It closely resembles and may be conspecific with *M. (C.) frontalis* (Fabricius); the two have a summed range from the Malay Peninsula and Sumatra to the Philippines and the Solomon Islands (Michener & Szent-Ivany, 1960; Michener, 2007). The published nesting biology of South Asian *Creightonella* Cockerell is largely limited to a single paper on *M. frontalis* in New Guinea (Michener & Szent-Ivany, 1960). Beyond that, these widespread and locally abundant bees are known to visit many species of flowering plants and may be valuable as pollinators of some crops (Cervancia & Bergonia, 1991; Klein *et al.*, 2003; Wilmer & Stone, 1989).

Michener & Szent-Ivany (1960) report that *M. frontalis* nests by burrowing in hard, clayey soil, often in large numbers. Burrows are mostly 14–16 mm in diameter and 4–15 cm in length. Longer burrows are often branched. Nest cells are formed of separate layers of mud, masticated leaf pulp, and round leaf fragments (Michener & Szent-Ivany, 1960: their fig. IV; redrawn as fig. 41 in Iwata, 1976). My purpose here is to report on a dense nesting aggregation of *M. atrata* in the Philippines, with notes on nest structure.

All observations are from outside the village of Matuod (13°59'N 120°38'E), on Talim Bay in Batangas province, Philippines during September 1986 (mid-rainy season). The study site was an eroded low gulch surrounded by a mostly flat area, the whole with sparse low vegetation. I thoroughly examined the gulch and marked the location of each open nest burrow, followed by a wider, less thorough search. I exca-

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doi: <http://dx.doi.org/10.17161/jom.v0i68.6467>



Figure 1. Part of a low gulch in a field near Matuod, Batangas, Philippines. The core of a *Megachile* (*Creightonella*) *atrata* Smith nesting aggregation is at the foot of one of the banks (middle ground), where the positions of 67 nests are marked with bamboo stakes. These protrude on average about 15 cm above the ground. There is only one nest on the ledge above, two on the steep bank face, and none in the relatively bare foreground.

vated 30 nests, with an effort to collect their adults.

Specimens in the National Museum of Natural History (Washington) collected by C.K. Starr in Batangas Province, Philippines and identified by S.W.T. Batra as *M. atrata* will serve as vouchers.

My observations began when two local men offered to show me the site of a “hilulumbo-lupa” (soil hornet) colony in disused farmland. This is the specific local name for the hornet *Vespa tropica* (Linnaeus), which usually nests underground (Matsuura, 1984; Matsuura & Yamane, 1990) and is common in farmland in much of the Philippines. In my experience, it can be quite defensive and delivers a very painful sting. In fact, what my friends had found was a nesting aggregation of *M. atrata*. The two species are of similar size, stoutness, and coloration, and both fly busily about their nesting sites, so that it is not surprising that they should mistake the bee for the hornet at a distance and should not approach close enough to realize the mistake.

Standing in the aggregation, I waved my net about on three occasions. Each time, a large mass of bees responded by flying close around me. Walking about five meters away, I was followed by several bees, which continued to fly around me in a manner similar to that of hornets. Twenty-two netted bees were all females.

No bees stung me voluntarily. On three occasions I induced a sting by holding a bee against my forearm. Each was a sharply painful medium 2 on the standard pain scale (Schmidt, 1990: 387–419; Starr, 1985), very localized and faded within minutes.

A search revealed 283 apparently active nests in an area estimated at 322 m². The core of the aggregation was 67 nests in an area of about 17 m² at the foot of a low vertical earth bank (Fig. 1). Nests outside this area were much more scattered. Within the

Table 1. Parameters of 30 *Megachile (Creightonella) atrata* Smith nests in a dense aggregation in Batangas province, Philippines. Nests are arranged in sequence of approximate presumed age. Angle = initial angle of descent of the burrow, estimated by sight to the nearest 15°. Length = length of the main burrow estimated to the nearest centimeter, followed by lengths of any side burrows. Where a burrow has n completed cells and another cell begun, the number is given as n+. Wing wear = fraying of the main female's forewings, where known: 0 = no visible fraying, 1 = slight fraying at the tips, 2 = moderate fraying extending into one or more wing cells.

Nest. No.	Angle	Length (cm)	No. of cells	Wing wear
1	60°	4	0	0
2	60°	4	0	0
3	45°	5	0	0
4	75°	5	0	0
5	60°	5	0	1
6	45°	8	0	0
7	90°	6	0	1
8	60°	7	0+	—
9	60°	9	0+	—
10	90°	12	0	1
11	90°	11	0+	1
12	90°	5	1	1
13	75°	11	1	—
14	45°	6	2	0
15	75°	11	2+	0
16	60°	8	3	0
17	60°	7	2	1
18	75°	9	2	1
19	45°	13	2	—
20	60°	16	2	1
21	60°	11	3	1
22	60°	11	3	1
23	60°	10	1	2
24	75°	7+3	3	1
25	75°	10	2	2
26	75°	16	2	2
27	75°	6+2+2+2	3	—
28	90°	15+3	4	—
29	90°	10+5+5	4	1
30	75°	9+4+4+4+2	7	1

core area, some burrow entrances were separated from nearest neighbors by no more than 2 cm.

Some parameters of nest structure are shown in Table 1. Nest burrows were mostly 9–11 mm in diameter, smaller than recorded from *M. frontalis*. The 22 nests with at

least the first cell started had lengths of 5–16 cm, very close to the range recorded from *M. frontalis*. Some descended approximately vertically, but most were at an angle. Most burrows were more or less straight throughout, while some curved downward. Five of the 30 nests had a total of a total of 11 side-branches, each with 1–3 cells. Most of these were close to horizontal, although two descended at about 60° from the horizontal. Cells at the end of a main burrow or a side branch kept the burrow/branch orientation.

The maximum number of cells recorded from a nest was seven. Twenty finished cells had a mean length of 22.7 mm, shorter than those recorded from *M. frontalis*. However, their composition and structure showed no evident differences from those of *M. frontalis*. The few cells that I opened had closures of chewed leaf pulp sandwiched between 1–4 layers of intact leaf. As in *M. frontalis*, the leaf disks forming the outer cell wall were coarsely irregular in shape. The mass of cell provisions was in the opposite end of the cell, with the egg placed on top of it, as in *M. frontalis*.

Four of 25 nests examined after dark had closed burrows, of which two had the appearance of temporary closures. No bee was at the entrance of open burrows, and probing several of them with grass leaves produced no indication of bees inside.

The relationship between nest size and female wing wear (Table 1) was only weakly positive (Spearman's rank correlation test, $p \approx 0.10$). This is an odd result, although at least four nests with no completed cells had females with some wing-wear, suggesting that it was not their first attempt at nesting.

Iwata (1976: ch. 13) characterized the habit of digging their own nest burrows as unusual among megachilids, although this appears not to be the case in all parts of the world (Eickwort *et al.*, 1981). This leaves open the question why females nest so close to each other. Giovanetti *et al.* (2006) reviewed possible advantages to aggregated nesting in Hymenoptera, dividing these into abiotic and biotic factors. Among the former, a scarcity of suitable nest sites is almost certainly not a factor in *M. atrata*, at least in the study area. The most commonly cited biotic factor is parasite pressure. As an example, Larsson (1986) inferred this as a key factor in the solitary soil-nesting wasp *Bembix rostrata* (Linnaeus), suggesting not collective active defense but a selfish-herd effect. The introduced fire ant *Solenopsis geminata* (Fabricius) is abundant in the study area and could certainly pose a threat to brood and provisions, although it is doubtful that aggregated nesting can provide any protection against these much smaller insects.

My working hypothesis is that the resemblance to *V. tropica* of a mass of flying *M. atrata* provides protection against vertebrate brood predators through intimidation, a possibility not treated by Giovanetti *et al.* (2006). The shrew rat *Chrotomys mindorensis* Kellogg is a likely candidate. This diurnal, semi-fossorial rodent is fairly common in the lowlands of Luzon, where it feeds on soft-bodied soil invertebrates (Heaney, 2010, & pers. comm.). The civets *Paradoxurus hermaphroditus* (Pallas) and *Viverra tangalunga* Gray may also prey on bee brood if the soil is not very hard (L.R. Heaney, pers. comm.).

ACKNOWLEDGEMENTS

Thanks to De La Salle University, Manila, for use of its marine field station during this study, S. Animaw and E. Reyna for showing me the nesting aggregation, S.W.T. Batra for identifying *M. atrata*, J. Thomas for a key bibliographic assist, and C.D. Michener, C. Praz, and V.H. Gonzalez for critical comment.

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A Journal of Bee Biology, Ecology, Evolution, & Systematics

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The *Journal of Melittology* was established at the University of Kansas through the efforts of Michael S. Engel, Victor H. Gonzalez, Ismael A. Hinojosa-Díaz, and Charles D. Michener in 2013 and each article is published as its own number, with issues appearing online as soon as they are ready. Papers are composed using Microsoft Word® and Adobe InDesign® in Lawrence, Kansas, USA.

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ISSN 2325-4467