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Checklist of the ants of Mt. Hamiguitan, Mindanao Island, Philippines (Hymenoptera: Formicidae)

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Abstract

The ant diversity of Mt. Hamiguitan, Mindanao Island, Philippines was surveyed using a variety of collection techniques in several sites. A total of 122 species belonging to 51 genera in 8 subfamilies was recorded. Fourteen species are newly recorded from the Philippines: *Acropyga* near *rubescens*, *Meranoplus malaysianus*, *Paratopula ankistra*, *Pheidole* cf. *planidorsum*, *Ph. deltea*, *Ph.* near *tjibodana*, *Ph. retivertex*, *Strumigenys dryas*, *S. euryale*, *S.* near *hispida*, *S.* n.sp. HAM01, *S. treptodens*, *Tetramorium adpressum* and *T.* cf. *vertigum*.

Keywords: *Philippines, invasive ants, Formicidae, Mt. Hamiguitan, pygmy forest.*

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Introduction

The Philippines is an archipelago with a complex geological history (Lohman *et al*., 2011). Large islands, such as Mindanao, may be accretions of several smaller proto-islands, according to some geological models (Hall, 2002). This geological complexity may provide a myriad of opportunities for colonization, isolation, and speciation (Clouse *et al*., 2011; General and Alpert, 2012). It is necessary to conduct systematic surveys in many localities to capture the rich biodiversity generated by this complexity.

The Mount Hamiguitan Range Wildlife Refuge is a UNESCO World Heritage Site and home to the largest mossy-pygmy forest (~225 ha) on Mindanao Island (Amoroso and Aspiras, 2011; UNESCO, 2017). The area is protected and managed by the Department of Environment and Natural Resources. Botanical and vertebrate surveys have been conducted there (Balete *et al*., 2008; Amoroso and Aspiras, 2011). Butterflies and dragonflies have also been surveyed (Mohagan and Treadaway, 2010; Villanueva and Mohagan, 2010). This paper reports the first ever survey of the ants on Mt. Hamiguitan.

Biogeographical studies rely on published distributions of species. The biogeography of Philippine ants is poorly understood principally because of the dearth of published checklists of specific localities. General and Alpert (2012) provided a list of species and their island distributions, however, the scale is too coarse, considering the complex geological history of the islands. This present study contributes a small piece to the largely incomplete jigsaw puzzle of Philippine ant biogeography. The purpose of this paper is to allow the data mining methods to find this published list of species from a small corner of the Philippines.

Materials and Methods

Study Site

Mount Hamiguitan Range is located in the Pujada Peninsula of southeastern Mindanao Island. The range, composed of a series of peaks of varying elevations, runs roughly north to south. We conducted our sampling on the

western and southern faces of Mt. Hamiguitan, in the Municipality of San Isidro, Davao Oriental Province. Collection of biological specimens was authorized under Republic Act 10066 Section 17, with proper coordination with, and supervision of, the Protected Area Supervisor, Region XI Office of the Department of Environment and Natural Resources.

We conducted our fieldwork in July 2016, at the start of the rainy season. For convenience of reporting, we divided the surveyed area into four zones.

Zone 1: 400 masl, N 6° 44' 5.2", E 126° 8' 34.1", disturbed second-growth forest, at or near the Mt. Hamiguitan Range Wildlife Sanctuary Research Center (RC). This zone corresponds roughly with vegetation type 1 (agro-ecosystem) of Amoroso and Aspiras (2011).

Zone 2: no elevation or GPS coordinates recorded, the well-established trail from RC to "Camp 4". This zone corresponds roughly with vegetation type 2 (dipterocarp forest) of Amoroso and Aspiras (2011).

Zone 3: 940 masl, N 6° 43' 59.4", E 126° 9' 58.1", "Camp 4" and surrounding area, second growth forest, younger trees and more disturbed habitat near the camp, less disturbed away from camp. "Camp 4", the semi-permanent campsite used by forest guards, guides, and researchers, was originally a logging camp, as attested by a large piece of abandoned machinery on the ground near the trail. This zone corresponds roughly with vegetation type 3 (montane forest) of Amoroso and Aspiras (2011).

Zone 4: 1150 masl, N 6° 43' 35.3", E 126°10' 59", another semi-permanent "Camp 3", and surrounding area, including the pygmy forest. This zone corresponds roughly with vegetation type 5 (mossy-pygmy forest) of Amoroso and Aspiras (2011).

Collection Methods

We collected ants using a variety of methods. We used 95% EtOH to preserve all the specimens.

In Zone 2, we simply collected opportunistically during the hours-long trek to our campsite in Zone 3. Many ant species in this report were recorded only from this zone. These collections will not be included in any future ecological analysis.

In Zones 1, 3, and 4, we applied a modified and abbreviated ALL Protocol (Agosti and Alonso, 2000), namely, Winkler extraction of ants from the leaf litter, pitfall trapping, twig and log breaking and opportunistic search through 10 sampling stations in a 100m horizontal transect. These collections will be analyzed in an ecological study (General and Buenavente, in prep.). We also opportunistically collected outside the transects within these zones, e.g. around the campsites.

Winkler extraction – we gathered leaf litter from a randomly selected $1m^2$ area of forest floor, sifted the leaf litter in a sifting bag, and placed the siftate in a Winkler bag for 48 hours.

Pitfall trapping – at a spot diametrically opposite the leaf litter collection site, we inserted, flush to the ground, a plastic cup (70mm diameter, 85 mm depth) about half-filled with a weak soap solution (1-2 drops liquid dish detergent in 1 litre fresh water). We retrieved the trap after 24 hours to avoid maceration of the specimens. We immediately rinsed the soapy specimens in fresh water before transferring them to 95% EtOH.

Twig and log breaking – we broke open rotten twigs and logs on the forest floor and collected those that contained ant nests. We collected the ants either by hand or by Winkler extraction after comminuting the rotten woody material.

Opportunistic search – we collected any ants we saw within the transects.

Identification

We identified the ants first to genus using published keys (Borowiec, 2016; General and Alpert, 2012; Schmidt and Shattuck, 2014; Ward *et al*., 2016). We then used species-level keys for individual genera: *Acropyga* (LaPolla, 2004); *Aenictus* (Jaitrong and Yamane, 2011, 2012, 2013); *Anochetus* (Brown, 1978); *Cerapachys* (Brown 1975); *Crematogaster* (Hosoishi and Ogata, 2009, 2016); *Echinopla* (Xu and Zhou, 2015); *Gnamptogenys* (Lattke, 2004); *Lioponera* (Brown, 1975); *Meranoplus* (Schödl, 1998); *Myopias* (Probst *et al*., 2015); *Myrmoteras* (Zettel and Sorger, 2011); *Odontomachus* (Sorger and Zettel, 2011); *Paratopula* (Bolton, 1988); *Pheidole* (Eguchi, 2001); *Polyrhachis* (Dorow, 1995, Kohout, 1987, 2006, 2007, 2013, 2014); *Ponera* (Wilson, 1957, Taylor, 1967); *Pristomyrmex* (Wang,

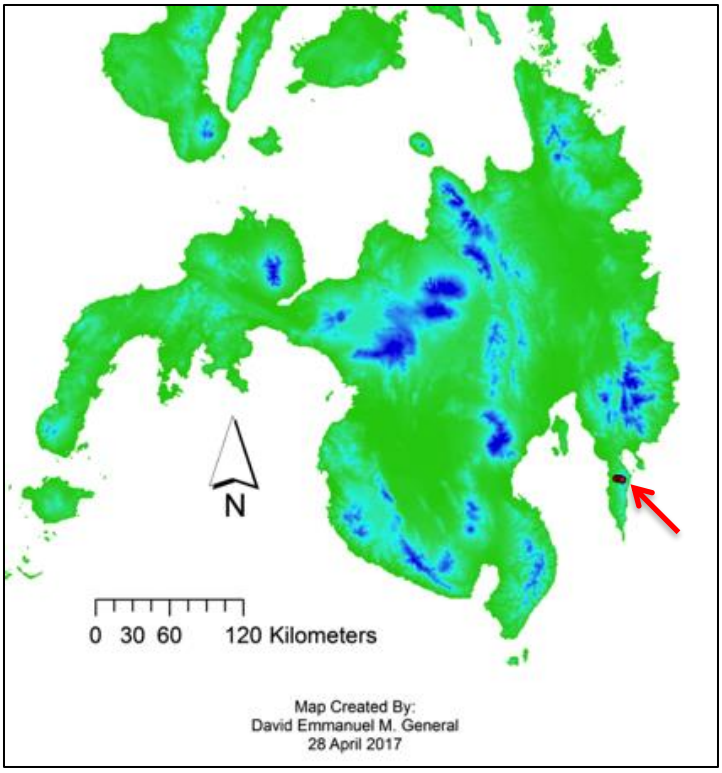

Figure 1. Map of Mindanao Island, red arrow indicating the location of study sites on Pujada Peninsula, in the extreme southeastern Philippines.

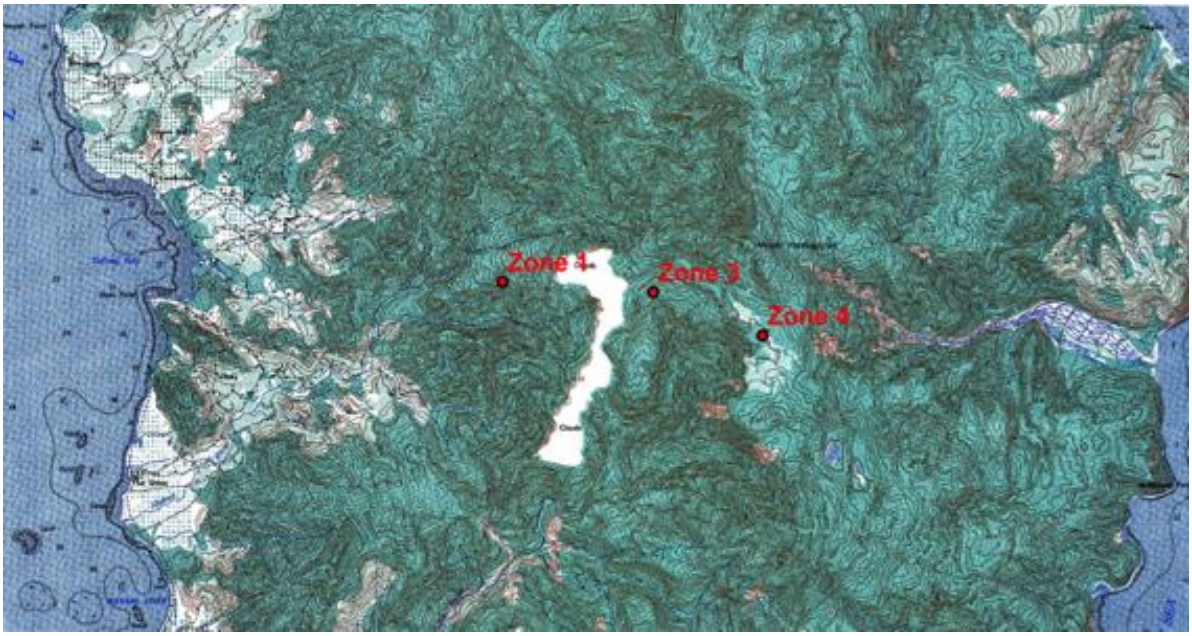

Figure 2. Map of sampling points, representing Zones 1, 3 and 4, overlaid on a topographic map (large white region is labeled "clouds") (NAMRIA 2017)

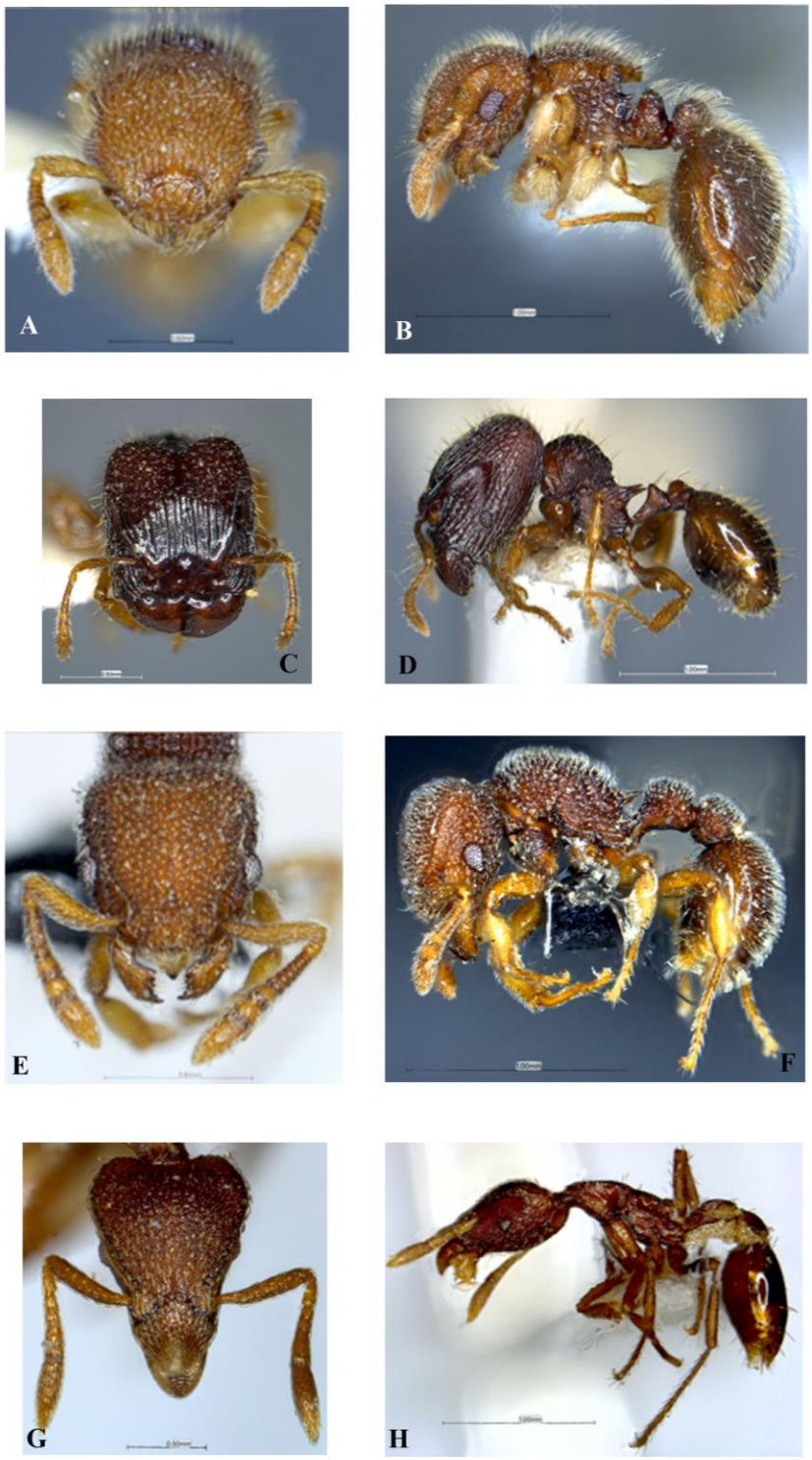

Figure 3. Some new Philippine species records from Mt. Hamiguitan, full-face view and lateral habitus. A-B: *Meranoplus malaysianus*. C-D: *Pheidole retivertex*. E-F: *Tetramorium adpressum*. G-H: *Strumigenys euryale*.

2003); *Recurvidris* (Bolton, 1992; Zettel, 2008); *Strumigenys* (Bolton, 2000); *Technomyrmex* (Bolton, 2007); *Tetheamyrma* (Bolton, 1991); *Tetramorium* (Bolton, 1976, 1977); and *Tetraponera* (Ward, 2001). We also used online resources to confirm our determinations (AntWeb, 2017, AntWiki, 2017). Finally, we also consulted with Dr. Francisco Hita Garcia regarding some problematic *Tetramorium* specimens.

All voucher specimens are deposited in the entomological collection of the National Museum of the Philippines.

Results

We collected a total of 1,677 ants belonging to 122 species in 51 genera and 8 subfamilies. Table 1 presents the incidence of species collected by zone and collection method. We established 13 new records of species for the Philippines. Since this is the first systematic transect study of the locality, most of these records in Table 1 represent first records for Mt. Hamiguitan.

Table 1. Checklist of ant species from Mt. Hamiguitan. Collection methods: W = Winkler extraction; P = pitfall trapping; T = twig breaking; R = rotten wood breaking; O = opportunistic collecting. Refer to text for definition of zones. * = new Philippine record of species. Species codes refer to locality where the species was first recorded: APO = Mt. Apo, Mindanao Island; BUL = Mt. Bulusan, Luzon Island; HAM = Mt. Hamiguitan (this study); PH = Philippines (indeterminate, widespread); WS = Western Samar, Samar Island.

No.	Species	Zone 1	Zone 2	Zone 3	Zone 4	# of Zones
	Dolichoderinae					
1	*Dolichoderus* cf. *affinis*				O	1
2	*Dolichoderus thoracicus*		O			1
3	*Philidris myrmecodiae*		O			1
4	*Tapinoma melanocephalum*	W				1
5	*Technomyrmex sundaicus*	W		W	W	3
6	*Technomyrmex vitiensis*				W	1
	Dorylinae					
1	*Aenictus gracilis*		O			1
2	*Aenictus laeviceps*		O			1
3	*Cerapachys jacobsoni*			O		1
4	*Lioponera suscitata*			W		1
	Ectatomminae					
1	*Gnamptogenys binghamii*		O	O		2
	Formicinae					
1	*Acropyga acutiventris*		O			1
2	*Acropyga* near *rubescens**	W				1
3	*Acropyga pallida*			W		1
4	*Anoplolepis gracilipes*	P				1
5	*Camponotus* sp HAM01			O	O	2
6	*Camponotus* sp HAM02			O	O	2
7	*Colobopsis corallina*		O			1
8	*Colobopsis leonardi*		O			1

9	*Colobopsis* sp APO01		O			1
10	*Colobopsis* sp HAM01	O	O			2
11	*Colobopsis* sp HAM02				O	1
12	*Colobopsis* sp HAM03	O	O			2
13	*Echinopla pallipes*				OP	1
14	*Lepisiota chapmani*		O			1
15	*Myrmoteras insulcatum*			W		1
16	*Myrmoteras mcarthuri*			W		1
17	*Nylanderia* sp HAM01	WP		W	W	3
18	*Paraparatrechina* sp HAM01			T		1
19	*Paraparatrechina* sp HAM02		O			1
20	*Paratrechina longicornis*	W	O			2
21	*Polyrhachis armata*		O		O	2
22	*Polyrhachis bicolor*		O			1
23	*Polyrhachis bihamata*	O				1
24	*Polyrhachis carbonaria*	W		O		2
25	*Polyrhachis* cf. *bicolor*		O			1
26	*Polyrhachis* cf. *diana*		O			1
27	*Polyrhachis inermis*		O			1
28	*Polyrhachis magnifica*		O	O		2
29	*Polyrhachis mucronata*	O				1
30	*Polyrhachis noesanensis*		O			1
31	*Polyrhachis olybria*		O			1
32	*Polyrhachis semiinermis*		O			1
33	*Polyrhachis* sp HAM02			T	O	2
34	*Polyrhachis* sp HAM03		O			1
35	*Prenolepis* sp HAM01				O	1
36	*Pseudolasius* sp HAM01	W		T		2
	Myrmicinae					
1	*Cardiocondyla* sp HAM01	W				1
2	*Carebara diversa*			P		1
3	*Carebara maccus*		O			1
4	*Carebara* sp HAM01	W		W		2
5	*Carebara* sp HAM02	W				1
6	*Carebara* sp HAM03			W		1
7	*Crematogaster ampullaris*		O			1
8	*Crematogaster inflata*		O			1
9	*Crematogaster philippinensis*	W	O	W		3
10	*Crematogaster* sp HAM01			O	WP	2
11	*Crematogaster* sp HAM02			O		1
12	*Crematogaster* sp HAM03		O			1

13	*Crematogaster* sp HAM04		O			1
14	*Crematogaster* sp HAM05				O	1
15	*Crematogaster* sp HAM06		O			1
16	*Eurhopalothrix philippina*	W		W		2
17	*Meranoplus malaysianus**	P		W		2
18	*Monomorium* sp HAM01	W				1
19	*Monomorium* sp HAM02	P				1
20	*Myrmecina* sp HAM01	WP		W		2
21	*Myrmicaria brunnea*	O	O		O	3
22	*Paratopula ankistra**	O				1
23	*Pheidole aglae*		O	WP	WP	3
24	*Pheidole* cf. *butteli*				W	1
25	*Pheidole* cf. *plagiaria*		O			1
26	*Pheidole* cf. *planidorsum**				W	1
27	*Pheidole clypeocornis*	W				1
28	*Pheidole deltea**	P			P	2
29	*Pheidole kikutai*			W	W	2
30	*Pheidole* near *tjibodana**	W				1
31	*Pheidole quadricuspis*	P		PT	O	3
32	*Pheidole retivertex**	W				1
33	*Pheidole sarawakana*			W	W	2
34	*Pheidole singaporensis*		O			1
35	*Pristomyrmex curvulus*			OT		1
36	*Recurvidris* sp HAM01			O		1
37	*Rhopalomastix* sp HAM01		O			1
38	*Solenopsis geminata*	WPO				1
39	*Solenopsis* sp HAM01	W				1
40	*Strumigenys arrogantia*	W				1
41	*Strumigenys chapmani*	W			W	2
42	*Strumigenys dryas**	W				1
43	*Strumigenys euryale**			W		1
44	*Strumigenys koningsbergeri*	W		W		2
45	*Strumigenys mitis*	W				1
46	*Strumigenys* near *hispida**	W		W	W	3
47	*Strumigenys serradens*			W		1
48	*Strumigenys* sp HAM01*	W				1
49	*Strumigenys treptodens**				W	1
50	*Syllophopsis* sp HAM01	W			W	2
51	*Tetheamyrma* sp PH01	W		W		2
52	*Tetramorium adpressum**	WP				1
53	*Tetramorium bicarinatum*	O				1

54	*Tetramorium* cf. *vertigum**			W		1
55	*Tetramorium eleates*			W		1
56	*Tetramorium khnum*			WP		1
57	*Tetramorium pacificum*		O	O		2
58	*Vollenhovia* sp HAM01			W		1
	Ponerinae					
1	*Anochetus princeps*			T		1
2	*Brachyponera* sp HAM01	W		W		2
3	*Brachyponera* sp HAM02			WTO		1
4	*Brachyponera* sp WS02	W		W	WP	3
5	*Cryptopone testacea*			T		1
6	*Diacamma rugosum*		O	WPO	O	3
7	*Hypoponera* sp HAM01	W		WT	W	3
8	*Hypoponera* sp HAM02			W		1
9	*Leptogenys chinensis*			P		1
10	*Leptogenys diminuta*		O			1
11	*Myopias lobosa*			T		1
12	*Odontomachus infandus*	W	O			2
13	*Odontomachus simillimus*	W				1
14	*Ponera* sp HAM01	W		WO	W	3
15	*Ponera* sp HAM02			W		1
	Proceratiinae					
1	*Discothyrea* sp HAM01	W				1
	Pseudomyrmecinae					
1	*Tetraponera extenuata*	T	O			2
	Species Count	49	43	52	29	

Discussion

Mt. Hamiguitan seems to harbor a high diversity of ants, including thirty species that were collected only along the established trail, namely Zone 2, in this study.

Some invasive ants were recorded, mainly in the more disturbed area of Zone 1, which includes the Visitor Center that receives the bulk of visitors and tourists and is partly agricultural. However, we also found a thriving twig nest of *Tetramorium pacificum* in Zone 3, perhaps attesting to the previous history of the area as a logging camp.

Mt. Hamiguitan is currently closed to hikers and mountaineers but is open to authorized academic researchers. In addition, forest guards continuously monitor unauthorized entry into the protected area while apprehended poachers of timber and wildlife are actively prosecuted by the park management. This strict control of visitors should be maintained to allow the different forest types to continue recovery from human-mediated disturbances. More surveys need to be conducted, perhaps on other sides of Mt. Hamiguitan, since this present study was conducted only on the regular trails of the mountain range.

The survey of ants in the Philippines must proceed piecemeal, depending on the availability of scarce funding and opportunity. The archipelago is very large and there are many islands, mountains, and forests that have never been sampled for ants. This present contribution is the first in a series of ant species lists for particularly interesting or important localities in the Philippines.

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