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The Formicidae of Borneo (Insecta: Hymenoptera): a preliminary species list

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ABSTRACT. More than ninety years after Wheeler's 1919 "Ants of Borneo," we present a comprehensive list of the Bornean ant fauna, recorded in the states of Brunei, Sabah and Sarawak (Malaysia), and Kalimantan (Indonesia). Our critical review of ant literature resulted in a catalogue of 97 ant genera with 717 valid species and 52 additional subspecies of ants from 12 subfamilies, including eight genera for which, up to now, only morphospecies have been recorded in Borneo. The subfamilies Myrmicinae (315) and Formicinae (213) comprised the most species; the most speciose genera were *Polyrhachis* (98) and *Strumigenys* (71), followed by *Pheidole*, *Camponotus* and *Crematogaster*. However, half of the Bornean ant genera included only one or two species, for example, the endemic monotypic genera *Anomalomyrma*, *Bregmatomyrma*, *Ishakidris*, *Loweriella*, *Secostruma* and *Tetheamyrma.* Ant taxonomic research in Borneo dates back to the nineteen century and has resulted in 418 type descriptions, of which 390 are currently valid. Since many habitats of Borneo have still not been effectively sampled, the actual number of Bornean ant species may be much higher; we estimate that at least 1,100 species are to be expected. As destruction of natural habitat on Borneo is accelerating, great conservation efforts must urgently be made if current ant diversity is to be saved.

Keywords: ants, biodiversity, conservation, checklist, endemism, faunistic similarity, Indonesia, Malaysia, species classification, taxonomic history

INTRODUCTION

Species checklists have for a long time been regarded by some as an outdated scientific contribution, and still seem to be considered as of minor value for the scientific community, given the low impact factor these publications usually achieve (Ware 1990, Krell 2000). However, they can be essential instruments for species conservation and of high value to conservation policy. Given today's dramatic pressures on biodiversity and the ongoing

destruction and conversion of natural landscapes worldwide, species checklists are fundamental to conservation, as sound knowledge of the present state of the biota is a basis for all future conservation actions.

Tropical Southeast Asia comprises four of the 25 biodiversity hotspots defined by Myers *et al*. (2000). One of these hotspots is the Sundaland subregion, which covers the areas of the Malay Peninsula, Sumatra, Java and Borneo. This region is very rich, both in species numbers and endemism, but its biodiversity is particularly endangered by habitat loss, fragmentation and degradation that are operating on a massive scale (Sodhi *et al*. 2004). In particular Borneo, the world's third-largest island, is experiencing one of the highest rates of habitat destruction. The current deforestation rate for Borneo has been calculated on a long-term basis to be about 8,800 km^2 per year (Stibig & Malingreau 2003). Based on this rate the island has lost over 30 percent of its forest cover in the last twenty years and just one-third of Borneo will remain forested by 2020 (Rautner *et al*. 2005, Stibig *et al*. 2007). Thus, within half a human generation, much of the biodiversity in the splendid lowland primary forests of Borneo will be lost, probably including many species unknown to science.

Our species list aims at recording the present state of knowledge of the Bornean fauna of ants, a family of insects with special significance for ecology and ecosystem functioning. Ants are virtually everywhere, especially in the tropics, where they exhibit an amazing diversity, populating all forest strata, acting as mutualists, predators, prey and bioturbators (Folgarait 1998). Recent ant studies in Malaysian Borneo have found 61 species on a single rainforest tree in Sabah (Floren & Linsenmair 1997), 32 species in a single square metre of forest floor, 206 species in soil and leaf litter on 100 m^2 of Gunung Mulu National Park in Sarawak (Mezger & Pfeiffer, forthcoming) and 640 species sampled over a series of studies in Poring Hot Springs, Kinabalu National Park in all strata of a tropical rainforest (Brühl *et al*. 1998, Pfeiffer 2005).

Ant research on Borneo started long ago with the work of Le Guillou in 1842, who described *Diacamma rugosum* and *Polyrhachis arcuata* from the island. In 1841, the English adventurer James Brook had been proclaimed Rajah of Sarawak and he turned out to be a patron and frequent host for nineteen century naturalists. The famous A.R. Wallace was his guest during 1855, and ten years later he invited the botanist O. Beccari to Kuching. Both men were diligent collectors of ants and their collections were evaluated by the most important ant taxonomists of the time. In 1857, F. Smith published "Catalogue of the hymenopterous insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore, by A. R. Wallace," which contained the first species list of Bornean ants; and in 1872, G. Mayr wrote "*Formicidae Borneenses collectae a J. Doria et O. Beccari in territorio Sarawak annis 1865–1867*." Both papers were for a long time the best sources of information about the ant fauna of the island. A much more comprehensive species list was published in 1919, when W.M. Wheeler released his famous "Ants of Borneo," which included records and descriptions of more than 260 species. This paper was until now the most important directory of Bornean ants, as the 1951 "Checklist of the ants of Asia" (Chapman & Chapco 1951) cited only some of its species and included no further information for Borneo. Later studies focused on the description of certain systematic groups, rather than on documentation of overall faunal diversity, but recent research on Bornean ants resulted in ample taxonomic inventories (e.g., Bolton 2000, 2007; Eguchi 2001).

In spite of all efforts at species identification and due to the extremely high biodiversity, many recent ecological studies on Bornean ants are still working with a high proportion of morphospecies, rather than using exact species classifications, and it is therefore difficult to assess total species richness or beta diversity of plots within the region. However, for more than ten years, web-based databases (e.g., antbase.org, AntWeb, AntBase.Net) have been available that provide help in the identification of ant specimens, by supplying a variety of tools including specimen photographs, keys, and location records. The species list we present here may further help researchers investigate the Formicidae of Borneo, as it includes all recorded species. Thus, it provides a platform for further myrmecological research on the island. Hopefully, it will also help to conserve this most interesting

fauna, to which ant researchers have dedicated many of their studies.

MATERIALS AND METHODS

We collected all available information about ant species from Borneo, including revisions of species groups, original species descriptions, and species lists from the Internet. We used the Primary Taxonomic Publications Databank on www.antbase.org (Agosti & Johnson 2005) to assess the available taxonomic literature. Additionally, we searched for species records and photographs of ant species from Borneo in the online databases www.antweb.org (Fisher 2002–2011) and www.antbase.net (Pfeiffer 2003–2011) and included those species in our list for which specimen records were available. Moreover, 116 specimen records from Borneo were collected during a stay in the Natural History Museum London (BMNH) and 150 records came from the AntBase.Net Collection of the University of Ulm (ABNC), which is curated by the first author. Additional collection records were included from Rudy Kohout and Bakhtiar Effendi Yahya. All data were cross-checked to assess their validity and the correctness of species identifications. All species names were first checked by the Hymenoptera name server at www.antbase.org (Agosti & Johnson 2005) to assess synonyms and relevant species descriptions and were later confirmed based on the work of Bolton (1995, 2007, 2010), especially his world species list on www.antweb.org (Bolton 2010). On subfamily and genus level, we entirely followed Bolton's nomenclature (e.g., Bolton 1999, 2000), not diverging opinions (e.g., Baroni Urbani & De Andrade 2007). Some open questions were resolved by direct communication with other taxonomists (B. Bolton, B. Seifert, M.G. Branstetter, M.L. Borowiec). While most species records were assessed from the literature, we included new records for certain species and genera from the collections of the authors. Only extant species were considered (for the record of a fossil species, see De Andrade & Baroni Urbani 2004) and nominate subspecies are not listed.

We compared the Bornean species list with lists recently presented for the Philippines (Alpert & General 2010) and New Guinea (Janda 2010) and assessed the similarity of the species pools using the Sörensen Index. To compare regional ant faunas, we used the software SPADE (Chao & Shen 2009) to calculate the incidence-based Sörensen Index, following the formula $SD = 2D_{1,2}/(D_1 + D_2)$, with D_1 and D_2 being the species richness of each of two communities, and $D_{1,2}$ being the number of species they share. We used Venn diagrams to distinguish the different subsets of those species.

RESULTS

Literature survey

The ant fauna of Borneo Island is highly diverse and unique. Our preliminary list of the Bornean ant species comprises 717 species and 52 additional subspecies of ants for which valid names were accessible (see Appendix 1). These species originate from 89 genera; additionally, we found eight genera for which only morphospecies have been listed until now. The Bornean ant fauna comprises 12 subfamilies of ants, with very varied contributions to overall species richness (Table 1). The largest number of described species (315) is in the Myrmicinae, but Formicinae is also strongly represented (213 species). These two subfamilies comprise more than 70 percent of the valid Bornean ant species and subspecies, while the smallest five subfamilies together have less than 5 percent.

The most speciose and commonly encountered genera are *Polyrhachis* (98 species), *Strumigenys* (71 species), *Pheidole* (56 species), *Camponotus* (55 species) and *Crematogaster* (33 species) (see Table 2). Other genera with many species in Borneo include *Cerapachys*, *Dolichoderus*, *Europhalothrix*, *Gnamptogenys*, *Myrmicaria* and *Myrmoteras* (for number of species, see Table 2). However, these figures are skewed by the presence of recent species-rank revisions for many of them. There are other genera with large numbers of Bornean species, but as most of these remain unnamed, they do not show up in this paper. For example, *Hypoponera*, *Myrmecina*, *Tapinoma*, *Nylanderia*, and *Carebara* all have many undescribed Bornean species, as indicated by museum collections (B. Bolton, pers. comm.). Characteristically, for Borneo there are also many monotypic genera,

Table 1: Diversity of Bornean subfamilies of ants. Given for each subfamily is the respective number of genera, species and non-nominate subspecies, the total number of taxa (species and non-nominate subspecies), and the proportion of all ant taxa they contribute.

Subfamily	Genera	Species	Subspecies	Species + subspecies	Percentage of taxa
Myrmicinae	42	315	17	332	43.2
Formicinae	19	213	21	234	30.4
Ponerinae	14	59	10	69	9.0
Dolichoderinae	6	49	4	53	6.9
Ectatommatinae	2	22	0	22	2.9
Pseudomyrmecinae	1	16	0	16	2.1
Aenictinae	1	14	0	14	1.8
Proceratiinae	3	12	0	12	1.6
Cerapachyinae	1	10	0	10	1.3
Amblyoponinae	4	3	0	3	0.4
Leptanillinae	1	2	0	2	0.3
Dorylinae	3	2	0	2	0.3
All	**97**	**717**	**52**	**769**	**100**

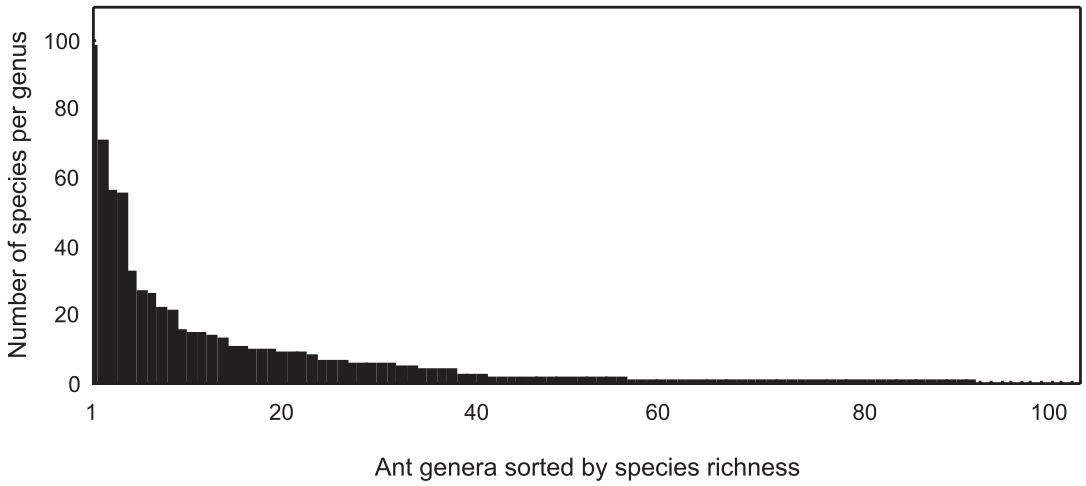

Fig. 1. Species richness of Bornean ant genera. The skewed distribution, featuring many genera with only a few species, is characteristic of tropical species assemblages. Subspecies, and genera without valid species, were excluded.

like the ecologically dominant *Oecophylla*, or the endemic *Anomalomyrma*[1], *Bregmatomyrma*, *Ishakidris*, *Loweriella*, *Propodilobus*, *Secostruma* and *Tetheamyrma*. Indeed, if Bornean ant genera are sorted by their species richness, the resulting curve is highly skewed (Fig. 1); while a few ant genera are speciose, the vast majority comprise much fewer species and subspecies. For the 89 genera for which valid species have been assigned, the species-genera ratio is only 8.06 (S.D. = 15.4), while the median number of species per genus is only 2.0.

Of the 769 listed taxa, 389 were originally described from Borneo; this rises to 417 if we include descriptions of synonyms, and the localities of paratypes. This high proportion points to both the diverse ant fauna of Borneo and the long history of taxonomic research on the island. In 2000, Bolton's revision of the Dacetini, with 64 new species described from Borneo, provided a sharp extension of the list (Fig. 2).

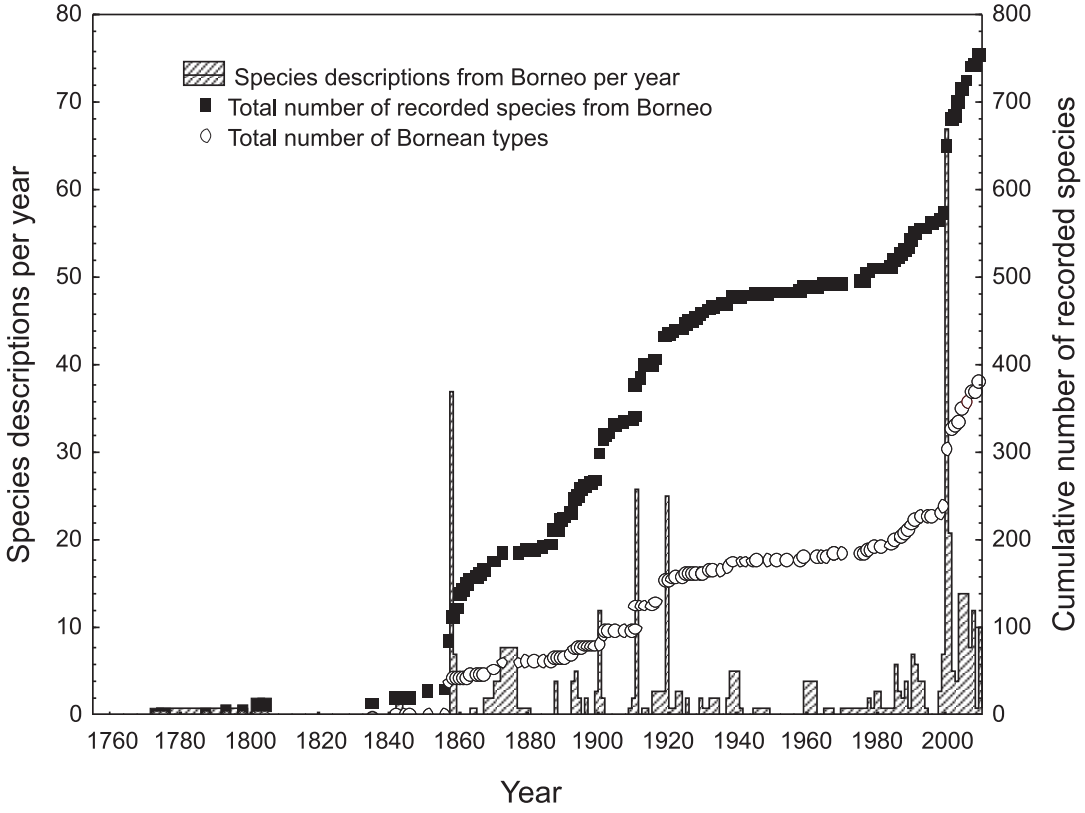

Fig. 2. History of taxonomic inventory of the Bornean ant fauna. Given are the yearly (left Y-axis) and cumulative (right Y-axis) numbers of all valid ant species and subspecies described from Borneo in the years 1760 to 2009. Note the different scaling of the left and right Y-Axes. In 1857, F. Smith recorded 37 new species from Borneo, bringing the number of valid ant taxa described from the island to 40, and the number recorded to 88. In 2000, Bolton and Eguchi altogether described 67 new species of ants, bringing the cumulative totals to 307 described and 652 recorded.

[1]*Anomalomyrma* is officially a monotypic genus. A second name, *A. kubotai* has been used in Japan but this name is currently unavailable.

Table 2: Number of valid Bornean ant species (excluding subspecies) per ant genus

Genus	No. of species	Genus	No. of species
Polyrhachis	98	*Paraparatrechina*	2
Strumigenys	71	*Philidris*	2
Pheidole	56	*Platythyrea*	2
Camponotus	55	*Probolomyrmex*	2
Crematogaster	33	*Recurvidris*	2
Technomyrmex	27	*Anillomyrma*	1
Tetramorium	26	*Anomalomyrma*	1
Gnamptogenys	22	*Anoplolepis*	1
Pyramica	21	*Bregmatomyrma*	1
Tetraponera	16	*Calyptomyrmex*	1
Dolichoderus	15	*Chimaeridris*	1
Pachycondyla	15	*Cryptopone*	1
Aenictus	14	*Emeryopone*	1
Leptogenys	12	*Forelophilus*	1
Cladomyrma	11	*Gesomyrmex*	1
Pristomyrmex	11	*Iridomyrmex*	1
Cerapachys	10	*Ishakidris*	1
Myrmoteras	10	*Lepisiota*	1
Proceratium	10	*Liomyrmex*	1
Acropyga	9	*Lordomyrma*	1
Anochetus	9	*Loweriella*	1
Eurhopalothrix	9	*Mayriella*	1
Vollenhovia	8	*Myopopone*	1
Echinopla	7	*Myrmecina*	1
Euprenolepis	7	*Myrmica*	1
Monomorium	7	*Mystrium*	1
Acanthomyrmex	6	*Oecophylla*	1
Cardiocondyla	6	*Paratrechina*	1
Cataulacus	6	*Plagiolepis*	1
Meranoplus	6	*Ponera*	1
Myrmicaria	6	*Prenolepis*	1
Odontomachus	5	*Prionopelta*	1
Paratopula	5	*Proatta*	1
Dacetinops	4	*Propodilobus*	1
Diacamma	4	*Protanilla*	1

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Table 2 (*continued*)

Genus	No. of species	Genus	No. of species
Pheidologeton	4	*Rhoptromyrmex*	1
Vombisidris	4	*Rotastruma*	1
Hypoponera	3	*Secostruma*	1
Pseudolasius	3	*Solenopsis*	1
Tapinoma	3	*Tetheamyrma*	1
Dilobocondyla	2	*Amblyopone*	0
Dorylus	2	*Aphaenogaster*	0
Harpegnathos	2	*Carebara*	0
Lasiomyrma	2	*Centromyrmex*	0
Lophomyrmex	2	*Discothyrea*	0
Metapone	2	*Leptanilla*	0
Myopias	2	*Rhopalomastix*	0
Nylanderia	2	*Rhytidoponera*	0
Odontoponera	2		

Records for new Bornean ant species

Our species list (Appendix 1) comprises several species newly recorded for Borneo. These are:

***Polyrhachis (Polyrhachis) craddocki* Bingham, 1903**
- Collection data: BORNEO, BRUNEI, Temburong Distr., Kuala Belalong Field Studies Centre, 15.iv.1993, R.J. Kohout acc. 93.7; ditto, 22–26.vi.1994, R.J. Kohout accs 94.34, 57; det. R. Kohout. New record for Borneo.

***Polyrhachis* (*Myrmothrinax*) *frauenfeldi* subsp. *sanguinea* Forel, 1911**
- Collection data: BORNEO, SARAWAK, Bako Nat. Park, 6.ii.1972, Pitcher; det. R. Kohout. New record for Borneo.

***Polyrhachis (Myrmhopla) gestroi* Emery, 1900**
- Collection data: BORNEO, BRUNEI, Tutong Distr., Bukit Sulang, nr Lamunin, 20.viii–10. ix.1982, N.E. Stork; SABAH, Danum Valley, ix.1996, fog. 9/49, E. Widodo; ditto, ix.1997, fog. 13/45, 14/6, E. Widodo; det. R. Kohout. New record for Borneo.

***Polyrhachis (Myrmhopla) ochracea* Karavaiev, 1927**
- Collection data: BORNEO, BRUNEI, Tutong Distr., Bukit Sulang, nr Lamunin, 20.viii–10. ix.1982, N.E. Stork; SABAH, Kinabalu Park, Poring, 1993, A. Floren; ditto, 22.iii.1995, USM coll.; Umas Umas, nr Tawau, 20.vi.1968, R.W. Taylor acc. 68.622; det. R. Kohout. New record for Borneo.

***Polyrhachis (Myrma) sumatrensis* F. Smith, 1858**
- Collection data: BORNEO, BRUNEI, Temburong Distr., Ulu Temburong, Base Camp hut, 04°26′N, 115°16′E, 16.ii–9.iii.1982, M.C. Day; SABAH, Forest Camp, 19 km N of Kalabakan, 16.x.1962, Y. Hirashima; KALIMANTAN TIMUR, 31 km N of Balikpapan, 21.vi.972, W.L. Brown; det. R. Kohout. New record for Borneo.

***Polyrhachis (Myrmhopla) tubifex* Karavaiev, 1926**
- Collection data: BORNEO, SABAH, Kinabatangan, Batu Tulug, 11.iv.1994, Maryati Mohamed; Keningau, 12–17.i.1959, T.C. Maa; SARAWAK, Baku National Park, 20.vi.1991, Maryati Mohamed; Kapit Distr., Merirai, 1–6. viii.1958, T.C. Maa; det. R. Kohout. New record for Borneo.

***Myrmicaria arachnoides adpressipilosa* Santschi, 1928**
- Collection data: BORNEO, SABAH: Lahad Datu, Danum Valley EG96-BOR-240, workers, K. Eguchi; Sandakan, Sepilok EG97-BOR-413, workers and males, K. Eguchi; det. Bakhtiar Effendi. New record for Borneo.

***Myrmicaria birmana* Forel, 1902**
- Collection data: BORNEO, BRUNEI: Tutong, Tasek Merimbun, winged queen, K. Eguchi; BORNEO, SABAH: Lahad Datu, Danum Valley, workers, C. Brühl; BORNEO, SARAWAK: Lambir Hills N.P., worker, H.O. Tanaka; Song, Ulu Katibas, worker, A. Rahman; det. Bakhtiar Effendi. New record for Borneo.

***Strumigenys rogeri* Emery, 1890**
- Collection data: BORNEO, SARAWAK, Gunung Mulu National Park, clearing at park headquarters, 04°02′36″ N, 114°48′49″ E, 13.x.2007 D. Mezger; det. D. Mezger. Worldwide distributed tramp species. New record for Borneo.

Regional beta diversity patterns

For Borneo (B), we found 97 genera of ants with 717 species, while 84 genera (715 species) are reported for New Guinea (NG) (Janda 2010) and 82 genera (400 species) for the Philippines (P) (Alpert & General 2010). When we compared the ant faunas using the Sörensen Index, which ranges from 0 (zero similarity) to 1 (equality), we found relatively high index values for ant genera (B–NG: 0.71, B–P: 0.80, NG–P: 0.81), while similarity was much lower at species level (B–NG: 0.11, B–P: 0.32, NG–P: 0.16). The corresponding raw data are given in Fig. 3. However, results have to be treated as preliminary, as all data sets are incomplete. For Sundaland, no corresponding data were available.

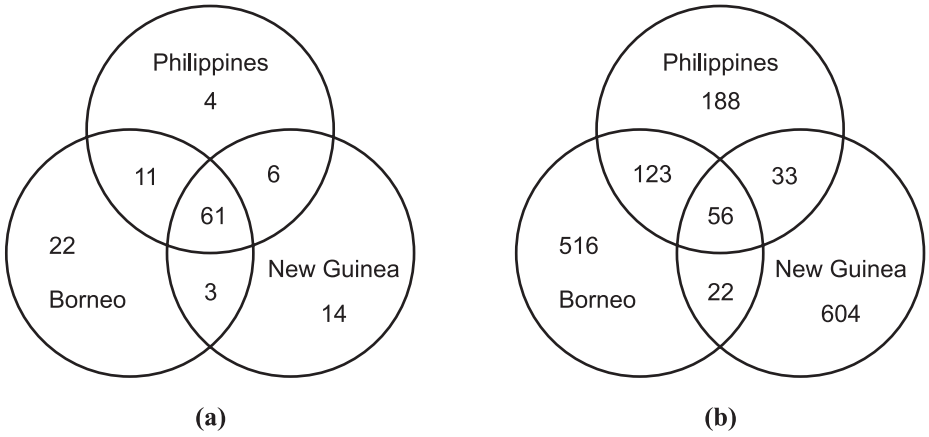

Fig. 3. Venn diagrams illustrating the overlap of ant genera (left) and ant species (right) between Borneo, New Guinea, and the Philippines. The total number of ant genera is 121, with 97 genera (717 species) from Borneo, 84 genera (715 species) from New Guinea, and 82 genera (400 species) from the Philippines. The total number of ant species is 1,542; subspecies were ignored. Venn diagrams demonstrate the species subsets of the respective areas: e.g., Fig. 3a shows 61 genera found in all three areas, three shared only by Borneo and New Guinea (so altogether 64 genera in common), and 11 only with the Philippines (altogether 72 in common), while 22 genera are restricted to Borneo island.

DISCUSSION

Borneo's ant fauna includes 12 subfamilies, with at least 97 genera and 769 species and subspecies. Worldwide, there are 22 subfamilies, 299 genera and 14,095 described species of ants (Bolton 2010). Thus, Borneo has representatives of about a third of the world's genera and about 5.5 percent of its species, though Borneo represents only about 0.5 percent of the earth's land surface. For comparison, temperate Mongolia, twice the size, harbours about 6 percent of world genera and 0.5 percent of species (Pfeiffer *et al*. 2007).

Our species list comprises records from more than two hundred years of ant research. It is clear that not all data are equally reliable, but it would be inappropriate to exclude older data, especially since all the material (species descriptions, etc.) is now well documented and easily accessible via the Internet (Agosti & Johnson 2005). The taxonomic literature is subject to frequent revisions and so we were able to find redundant citations for most of the species. The quality of each record can be accessed by evaluating the respective references. However, we have excluded the most doubtful records and commented on others. For example, *Polyrhachis relucens* and *Myrmicaria brunnea* were both listed for Borneo by Wheeler (1919), but recent results show that *P. relucens* is endemic to New Guinea (R. Kohout, pers. comm.), while *M. brunnea* is confined to the mainland of Asia (Bakhtiar E.Y., pers. comm.). These and other errors (e.g., from Chapman & Capco 1951) were deleted from the list without comment since the purpose of the present paper is to list the species reliably recorded from Borneo. Species suspected to occur but not listed here should be verified through field collection or study of unidentified specimens.

Species that have been recorded on the small island of Pulau Laut, about 400 km northeast of Kuching, for example, *Lepisiota rothneyi sundaica*, have traditionally been included with the Bornean records, and we follow the same convention. Wheeler (1919, p. 65) reported "*Myrmica ritae*" from "Pulo Laut" collected by W. Doherty; however, the type specimen of *Myrmica ritae* was found at Mt. Moolegit in Myanmar and the record of a *Myrmica* species from a location so far south had seemed dubious. Nonetheless, recent research by Radchenko & Elmes (2009) revealed that in Emery's material collected on Pulau Laut and housed in the Museum of Natural History in Genoa was indeed a new—the southernmost—*Myrmica* species, which was named "*Myrmica emeryi*" and is included in the Borneo list. Similarly, *Polyrhachis craddocki*, reported above for the first time from Borneo, was previously known only from Myanmar (Bingham 1903).

Some species which have to date been recorded only from regions adjacent to Borneo might occur on Borneo itself, but they are omitted from the list because their presence has not been confirmed. For example, the almost-cosmopolitan tramp species *Monomorium destructor* (Jerdon, 1851) is recorded from the Malay Peninsula, Java, the Philippines and Sulawesi (Wetterer 2009), but not from Borneo itself; however, it is likely that this distribution gap represents only a sampling artefact. Similarly, *Amblyopone reclinata* is distributed from Java to the Philippines, but is not listed for Borneo, while *Overbeckia subclavata* and *Tyrannomyrmex* sp. are registered for Malaysia and the Philippines, but have not yet been recorded in Borneo (www.antweb.org).

The ant species richness of the island has still not been assessed. The current number of 717 described species may comprise only about one-half to two-thirds of the expected total, but available data do not allow meaningful estimate of the actual figure. Although many of the large and striking species may have already been named, especially those from the lower strata, little is known about some of the ecologically-cryptic ant genera, for example, *Pseudolasius*, *Myrmecina*, *Carebara* and *Hypoponera*. Even in some more conspicuous ant genera few species are described, for example, in *Paraparatrechina* and *Philidris*. Similarly, we expect additional species even for *Camponotus*, although our list already comprises 70 species and subspecies. In *Crematogaster*, we currently recognise about 11 additional undescribed species (Hosoishi, own observations), in *Polyrhachis*, 48 new species are presently under description (Kohout, manuscript in preparation) and for *Myrmicaria*, six new species from Borneo will be described soon (Bakhtiar, manuscript in preparation). *Tetramorium* is another genus with many species

awaiting formal description; the BMNH alone holds specimens of about 100 undescribed *Tetramorium* from the Indo-Australian region, including many from Borneo (B. Bolton, pers. comm.; see also Sorger 2011, this issue of AM).

Numerous habitats of Borneo remain to be sampled in detail; these include mangroves, kerangas, swamp forest, and the various mountains of the island, especially limestone mountains. The latter proved to be the most species-rich habitat in our study in Gunung Mulu National Park (Mezger & Pfeiffer, 2011a). In fact, most Bornean ant research has concentrated on only a few locations: Gunung Mulu National Park, Gunung Kinabalu National Park, Danum Valley and Lambir Hills Park have been well sampled in modern times, while Tadjong (Tanjong near Sri Aman, Sarawak) and Hayvep were favourite sites of former ant collectors. More species doubtless await discovery at other places, especially since most of Kalimantan is not sampled at all. Although the highly diverse lowland sites have been almost cleared, high ant diversity may be predicted in the vast mountain ranges of Borneo, as ecological theory predicts the highest species richness is in the middle of an island (Colwell & Lees 2000). In this area, the chances for a diversification of the ant fauna are quite high, for example, when differing geological or altitudinal patterns provide more patchy habitat structure that leads to isolation of subpopulations. Recent studies have shown that a large proportion of soil and leaf litter ant species have indicator value for the forest types in which they have been collected (Mezger & Pfeiffer, 2011b, this issue of AM), so abiotic factors have considerable impact on ant diversity. Due to the high habitat heterogeneity, species diversity in Bornean mountains is driven by high beta diversity between habitats, rather than by high values of alpha diversity at single locations (Mezger & Pfeiffer, forthcoming). Faunal surveys should include exhaustive methods (like Winkler sampling and insecticide fogging) as well as nest sampling, as each method has different merits.

A certain proportion of the Bornean ant species seem to be restricted to the topsoil (the first 5 to 15 cm of soil with high organic content above the mineralic deep soil), for example, *Eurhopalothrix elke* (Mezger & Pfeiffer 2010a), certain species of *Cerapachys* (Borowiec 2009) and *Pheidole schoedli* (Eguchi *et al.* 2006). For some species, it was not specified in which soil stratum they were collected, for example, *Secostruma* (Bolton 1988) and *Crematogaster masukoi* (Hosoishi *et al.*, 2011). A new method for sampling soil ants in even deeper layers has been developed by Wilkie *et al.* (2007) in the Neotropics where it found species restricted to layers lower than 15 cm, but this method has not yet been applied in other regions; thus, better sampling of the soil stratum would also increase the species total. The forest canopies remain another "biotic frontier" even after decades of studies, because only a relatively small amount of the formicid material has been identified to species level from the lower canopy (e.g., Floren & Linsenmair 2005), while from the higher canopy few studies are known, including the sampling of ferns (Ellwood *et al*. 2009) and direct observation from canopy platforms (Tanaka *et al.* 2010).

A high percentage of Bornean species sampled in ecological studies can still not be identified; for example, in our recent large-scale study of soil and leaf litter ants (100 m^2 sampled, Mezger & Pfeiffer, 2011a), we could identify only 63 percent of species, although our study area in Gunung Mulu National Park is one of the most intensively surveyed areas on the island, from which many of the Dacetini described by Bolton (2000) were collected. One reason for the low proportion of identified species is the lack of comprehensive studies with identification keys to speciose genera like *Paraparatrechina*, *Camponotus* and *Anochetus*. Moreover, many of the tropical species are rare or very rare and rarefaction methods reveal that sampling efficiency in all ecological studies conducted in primary forests of Borneo, in the tree canopy as well as in the soil stratum, never reached more than 85 percent (e.g., Floren & Linsenmair 2000; Brühl *et al.* 2003; Mezger & Pfeiffer, in prep.); thus, leaving a large number of species undetected (Longino *et al.* 2002). Given the limited sampling effort and the rarity of species it is unsurprising that records of certain species remain scarce, for example, *Polyrhachis muara* has been described on the basis of two specimens (Kohout 2008), and the monotypic ant genus *Secostruma* is represented by a single worker from a soil core (Bolton 1988).

The low abundance of many species in tropical primary forests is demonstrated in studies of ant community ecology by steep rarefaction curves and the long tail of rare species in local species abundance curves (e.g., Floren & Linsenmair 2000; Brühl *et al.* 2003; Mezger & Pfeiffer, forthcoming). Bornean ant genera, with a few speciose genera and a long tail of genera with only one or two species, show an analogous pattern (Fig. 1). While some of the less diverse genera (e.g., *Anoplolepis*, *Oecophylla and Paratrechina*) contain very abundant species, many of them include rare species, indicating that in these cases evolutionary forces restrict local abundance as well as regional radiation of the species.

The median species-per-genus value in Borneo of only 2.0 indicates that half of the genera with valid species (49) have only one or two species. On the other hand, some of the genera present a very rich diversification. So, although the species:genera ratio in Bornean ants of 8.06 is low compared with that of the world's ants (47.14, based on 14,095 species in 299 genera: Bolton 2010), it is similar to that of New Guinea (8.5) and higher than those of the Philippines (4.9) and temperate Mongolia (4.0). However, due to the low percentage of described species in certain ant genera, for Borneo at least, this ratio is likely to be a substantial underestimate.

A considerable percentage of the 389 species with types from Borneo are not recorded from other places and might be endemic to Borneo. In many cases, it is hard to assess whether a certain species is really restricted to this island or whether this just represents a collection bias, since many of the surrounding islands like Sumatra, Java and Sulawesi have been less intensively sampled and have received less attention from taxonomists than Borneo. But some better-studied taxa have been well sampled all over the region; thus, conclusions about their endemism are possible. Of the seven species of the conspicuous *Dolichoderus cuspidatus*-group, six are recorded only from Borneo despite collection trips to the Malay Peninsula, Sumatra and Java, as well as museum collection and literature surveys, and are most likely endemics to this island (Dill 2002). On the other hand, *Pheidole* shows a lower percentage of endemics; of the 56 species described by Eguchi (2001) from Borneo in a comprehensive study, only 12 seemed to be endemics.

Many Borneo-endemics are not evenly distributed over the whole island, but seem to be restricted to a certain area. Mountains like Gunung Kinabalu are prominent hotspots of endemism. However, making quantitative statements on this issue is difficult, since most sampling was conducted in a few locations with most of Borneo poorly sampled, so many "local endemics" might be sampling artefacts. Many of the *Strumigenys* and *Pyramica* species described by Bolton (2000) were only reported from one locality on Borneo. Other possible local endemics include the rare *Anillomyrma tridens* and members of the six Bornean monotypic genera *Anomalomyrma*, *Bregmatomyrma*, *Ishakidris*, *Loweriella*, *Secostruma* and *Tetheamyrma* that have been rarely documented. A question here is how many more such genera await discovery? Many other genera show an allopatric distribution on Borneo, with species restricted to certain localities, for example, the three species of the *Eurhopalothrix platisquama*-group (Mezger & Pfeiffer 2010a) and the two species of the *Cerapachys sexspinus*-group (Borowiec 2009). Local-endemic species are especially endangered by habitat destruction and climate change. As nest temperature is an important niche factor for tropical ants (Mezger & Pfeiffer 2010b), higher temperatures due to global warming may endanger species in fragmented forest islands in the lowlands, as well as isolated species on mountain tops.

Little is known about the presence of taxonomically-cryptic ant species. Studies on the subgenus *Decacrema* of *Crematogaster* have shown that specimens of the same morphotype that had been gathered from a wide geographic range (West Malaysia and Borneo) were in fact species-complexes that differed widely in their DNA codes (Feldhaar *et al.* 2003). *Camponotus rufifemur*, too, may represent a cluster of several closely related species (F. Menzel, pers. comm.). Similarly, a high percentage of the valid subspecies may turn out to be true species. Ant subspecies have rarely been described in recent decades and all putative subspecies should eventually be reassessed by genetic investigations.

We took the opportunity to compare the species list from Borneo with those of New

Guinea (Janda 2010) and the Philippines (Alpert & General 2010). New Guinea is separated from Borneo and the Phillipines by the Wallace Line, and this faunal border reduces the similarity of the fauna. However, at genus level, the faunal similarity of the three areas is quite high and even for species we found quite high similarity with the Philippine fauna. As comprehensive species lists of the ant fauna from the Malay Peninsula, Sumatra and Java are missing, it is currently impossible to compare the Bornean data with other Sundaland areas at species level. The most complete species list from Peninsular Malaysia is from Pasoh Forest Reserve where Malsch *et al.* (2003) collected 489 ant species belonging to 76 genera and nine subfamilies, although most specimens could only be identified to morphospecies level and sampling was from only a single location. When we compared this ant fauna at genus level with that of Borneo using the Sörensen Index, we found a value of 0.83, slightly higher than the generic similarity with the Philippines.

Taken together, the ant fauna of Borneo is of immense diversity and importance and our paper can only be a further step towards its full description. More intensive sampling at diverse locations on the island is necessary to get a more comprehensive idea about its entire ant fauna. Two-hundred-and-twelve years of ant research have still revealed only a portion of Borneo's immense diversity. However, without a halt to the ongoing habitat destruction, many species of the Bornean rainforests will become extinct before they are known to science. This holds for ants as well as for all other organisms in this wonderful ecosystem. It is time for a change towards more responsible human behaviour if we want to conserve this treasure for future generations.

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Each citation is tagged with a number which refers to a number in Appendix 1.

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Appendix 1. List of species and subspecies of the Formicidae of Borneo. Given are the subfamily and the species names, including authors and publication year, the existence of type-material from Bornean locations, the numbers of references which prove a Bornean location, and remarks on some of the species. Nominate subspecies are not listed. Type-material: X denotes a holotype collected on Borneo, (X) stands for any other type collected from Borneo (e.g., syntype, paratype, also for subsequently described gynes), and for types of junior synonyms, collected from the island. Codes and remarks: ◆ picture or location data from Borneo listed at www.antweb.org, ⭘ picture or location data from Borneo listed at www.antbase.net, A = stored in ABNC, B = stored in BNHM. Reference numbers referring to species locations on Borneo are listed at the end of the respective references. Species descriptions are listed in the references list, but not necessarily noted as numbers. Data published after July 2010 are incompletely included. Data (n = 5) added after 28 February 2011 were only joined to the list, but not included in the text of the paper.

Species and subspecies	Type	Codes and remarks
Aenictinae		
Aenictus aratus Forel, 1900		40, 122, 246
Aenictus camposi Wheeler & Chapman, 1925		122, 129
Aenictus ceylonicus (Mayr, 1866)		124
Aenictus chapmani Wilson, 1964		169
Aenictus cornutus Forel, 1900	**X**	40, 104, 225, 246, 255
Aenictus dentatus Forel, 1911		170, 225
Aenictus gracilis Emery, 1893	**X**	◆ 40, 74, 225, 228
Aenictus inflatus Yamane & Hashimoto, 1999	**X**	⭘ 259
Aenictus javanus Emery, 1896		⭘
Aenictus laeviceps (Smith, 1857)	**X**	◆ 40, 163, 170, 202, 225, 246
Aenictus latifemoratus Terayama & Yamane, 1989		⭘ 128
Aenictus levior Shattuck, 2008		⭘ A (added 1. 3. 2011)
Aenictus minutulus Terayama & Yamane, 1989		⭘ A (added 1. 3. 2011)
Aenictus pfeifferi Zettel & Sorger 2010	**X**	⭘ A, 260
Aenictus punctiventris Emery, 1901	**X**	40, 79, 246
Aenictus silvestrii Wheeler, 1929		128
Amblyoponinae		
Amblyopone Erichson, 1842		⭘ 122
Myopopone castanea (Smith, 1860)	**(X)**	B, 40, 169, 205, 246
Mystrium camillae Emery, 1889		◆ ⭘ A, B, 153
Prionopelta kraepelini Forel, 1905		⭘ 198
Cerapachyinae		
Cerapachys antennatus Smith, 1857	**X**	40, 202, 246

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Cerapachys bryanti Wheeler, 1919	X	◆ 40, 246
Cerapachys crawleyi Wheeler, 1924		◆
Cerapachys dohertyi Emery, 1902	X	A, 40, 80, 246
Cerapachys doryloides Borowiec, 2009	X	◆ 29
Cerapachys hewitti (Wheeler, 1919)	X	246
Cerapachys kodecorum Brown, 1975	X	34
Cerapachys paradoxus Borowiec, 2009	X	⊙ 29
Cerapachys pubescens (Emery, 1902)	X	◆ 40, 80, 246
Cerapachys suscitatus (Viehmeyer, 1913)		40, 122
Dolichoderinae		
Dolichoderus affinis Emery, 1889		170
Dolichoderus beccarii Emery, 1887		218
Dolichoderus coniger (Mayr, 1870)	X	◆ ⊙ A, B, 40, 48, 162, 163, 246
Dolichoderus cuspidatus (Smith, 1857)	X	◆ ⊙ A, B, 40, 48, 162, 163, 202, 233, 246
Dolichoderus indrapurensis Forel, 1912		⊙ B, 168
Dolichoderus indrapurensis nigrogaster Viehmeyer, 1922	X	233
Dolichoderus kinabaluensis Dill, 2002	X	⊙ A, 48
Dolichoderus magnipastor Dill, 2002	X	⊙ B, 48
Dolichoderus maschwitzi Dill, 2002	X	⊙ 48
Dolichoderus pastorulus Dill, 2002	X	◆ ⊙ 48, 246
Dolichoderus patens (Mayr, 1870)	X	◆ B, 40, 162, 163
Dolichoderus pilinomas Dill, 2002	X	⊙ 48
Dolichoderus semirugosus (Mayr, 1870)	X	◆ 162, 163, 246
Dolichoderus sulcaticeps (Mayr, 1870)	X	⊙ B, 162, 163, 246
Dolichoderus taprobanae (Smith, 1858)		246
Dolichoderus taprobanae borneensis Forel, 1911	X	113, 246
Dolichoderus thoracicus (Smith, 1860)		⊙ 163, 218, 218b, 246
Dolichoderus thoracicus borneonensis (Roger, 1863)	X	◆ 188, 246
Iridomyrmex anceps (Roger, 1863)		123, 163, 246
Loweriella boltoni Shattuck, 1992	X	◆ A, 196

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Philidris cordata protensa (Forel, 1911)	**X**	40, 113, 246
Philidris myrmecodiae (Emery, 1887)		246
Tapinoma flavidum André, 1892	**X**	7, 40, 246
Tapinoma indicum Forel, 1895		124, 246
Tapinoma melanocephalum (Fabricius, 1793)		A, 239, 246
Technomyrmex albipes (Smith, 1861)		⊙ A, 26, 163, 246
Technomyrmex brunneus Forel, 1895		26
Technomyrmex butteli Forel, 1913		⊙ 26
Technomyrmex certus Bolton, 2007	**X**	B, 26
Technomyrmex difficilis Forel, 1892		⊙ B, 26
Technomyrmex elatior Forel, 1902		26
Technomyrmex fornax Bolton, 2007	**X**	B, 26
Technomyrmex gaudens Bolton, 2007	**X**	B, 26
Technomyrmex grandis Emery, 1887		B, 26
Technomyrmex horni Forel, 1912		B, 26
Technomyrmex horrens Bolton, 2007	**X**	⊙ B, 26
Technomyrmex impressus Bolton, 2007	**X**	◆ ⊙ B, 26
Technomyrmex kraepelini Forel, 1905		⊙ A, B, 26, 218b
Technomyrmex lisae Forel, 1913		⊙ A, B, 26
Technomyrmex mandibularis Bolton, 2007		⊙ 26
Technomyrmex modiglianii Emery, 1900		⊙ A, 26, 218b
Technomyrmex pratensis (Smith, 1860)		⊙ 26
Technomyrmex reductus Bolton, 2007	**X**	◆ ⊙ B, 26
Technomyrmex rotundiceps Karavaiev, 1926		⊙ B, 26
Technomyrmex schimmeri Viehmeyer, 1916		26
Technomyrmex strenuus Mayr, 1872	**X**	⊙ 26, 40, 113, 163, 246
Technomyrmex subgracilis Bolton, 2007	**X**	⊙ 26
Technomyrmex sundaicus (Emery, 1900)		⊙ 26
Technomyrmex tatius Bolton, 2007	**X**	⊙ B, 26
Technomyrmex textor Forel, 1909		B

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Technomyrmex vitiensis Mann, 1921		⊙
Technomyrmex wheeleri (Emery, 1909)		⊙ B, 26
Dorylinae		
Dorylus laevigatus (Smith, 1857)	**X**	⊙ A, 40, 163, 202, 246, 255
Dorylus orientalis Westwood, 1835		40, doubtful, usually only recorded from India to Thailand
Ectatommatinae		
Gnamptogenys biloba Lattke, 2004	**X**	◆ ⊙ 149
Gnamptogenys binghamii (Forel, 1900)	**(X)**	⊙ A, B, 104, 149, 246
Gnamptogenys chapmani Brown, 1958		B, 32, 149
Gnamptogenys costata (Emery, 1889)	**(X)**	◆ A, B, 40, 70, 149, 202, 246
Gnamptogenys coxalis (Roger, 1860)		40, 163, 186
Gnamptogenys cribrata (Emery, 1900)	**(X)**	⊙ B, 78, 149, 246
Gnamptogenys fontana Lattke, 2004	**X**	⊙ B, 149
Gnamptogenys gabata Lattke, 2004	**X**	⊙ B, 149
Gnamptogenys helisa Lattke, 2004	**X**	◆ B, 149
Gnamptogenys lacunosa Lattke, 2004	**X**	⊙ B, 149
Gnamptogenys laevior (Forel, 1905)	**(X)**	B, 109, 149
Gnamptogenys leiolabia Lattke, 2004	**X**	◆ B, 149
Gnamptogenys menadensis (Mayr, 1887)		B, 40, 149, 218b, 246
Gnamptogenys ortostoma Lattke, 2004		⊙ A, B, 149
Gnamptogenys palamala Lattke, 2004	**X**	◆ ⊙ A, 149
Gnamptogenys pertusa Lattke, 2004	**X**	◆ B, 149
Gnamptogenys posteropsis (Gregg, 1951)		⊙ B, 149
Gnamptogenys rugodens Lattke, 2004	**X**	149
Gnamptogenys scalpta Lattke, 2004	**X**	B, 149
Gnamptogenys sila Lattke, 2004	**X**	◆ B
Gnamptogenys toronates Lattke, 2004	**X**	B, 149
Gnamptogenys treta Lattke, 2004	**X**	⊙ A, B, 149
Rhytidoponera Mayr, 1862		122, doubtful

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Formicinae		
Acropyga acutiventris Roger, 1862		⊙ 124, 145
Acropyga ambigua Emery, 1922		145
Acropyga butteli Forel, 1912		⊙ B, 145
Acropyga dubia Karavaiev, 1933		⊙ B, 145
Acropyga hystrix LaPolla, 2004	**X**	⊙ B, 145
Acropyga inezae Forel, 1912		145
Acropyga nipponensis Terayama, 1985		⊙ 145
Acropyga oceanica Emery, 1900		⊙ 145
Acropyga pallida (Donisthorpe, 1938)		⊙ B, 145
Anoplolepis gracilipes (Smith, 1857)		⊙ A, 163, 180, 246
Bregmatomyrma carnosa Wheeler, 1929	**X**	⊙ 249
Camponotus anguliceps Stitz, 1938	**X**	217
Camponotus angusticollis sanguinolentus Forel, 1895	**(X)**	40, 102
Camponotus arrogans (Smith, 1858)		⊙ 168, 218b
Camponotus auriventris Emery, 1889		⊙ 122
Camponotus autrani Forel, 1886		246
Camponotus badius (Smith, 1857)		40, 202, 246
Camponotus badius saginatus Stitz, 1925	**X**	◆ 40
Camponotus barbatus Roger, 1863		Sri Lanka, listed for Borneo by antbase.org
Camponotus barbatus samarus Santschi, 1932	**X**	40, 192
Camponotus bedoti Emery, 1893	**X**	⊙ 40, 74, 180, 246
Camponotus bellus leucodiscus Wheeler, 1919	**X**	246
Camponotus bruneiensis Viehmeyer, 1922	**X**	40, 233
Camponotus camelinus (Smith, 1857)	**(X)**	◆ ⊙ A, 123, 202, 246
Camponotus carin Emery, 1889		254
Camponotus clerodendri (Emery, 1887)	**X**	◆ 40, 67
Camponotus compressus (Fabricius, 1787)		40, 246
Camponotus contractus Mayr, 1872	**X**	40, 163, 246
Camponotus cylindricus (Fabricius, 1798)	**X**	◆ 40, 163, 246

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Camponotus dolichoderoides Forel, 1911	X	⊙ 13, 40, 113, 218b, 246
Camponotus dracocephalus Stitz, 1938	X	◆ 40, 217
Camponotus exsectus Emery, 1900		40, 246
Camponotus fasciatus (Mayr, 1867)		7, 246
Camponotus fervidus Donisthorpe, 1857		40, 202, 246
Camponotus festinus (Smith, 1857)	X	◆ ⊙ 40, 74, 163, 202, 246
Camponotus festinus cetegus Forel, 1911		113
Camponotus festinus eximius Emery, 1900		40, 246
Camponotus gigas (Latreille, 1802)		⊙ A, B, 40, 163, 168, 218b, 246
Camponotus gigas borneensis Emery, 1887	X	◆ 40, 67, 74, 246
Camponotus gilviceps Roger, 1857	X	⊙ 202, 218b, 246
Camponotus hosei Forel, 1911	X	◆ 40, 113, 246
Camponotus hosei mimus Forel, 1911	X	◆ 40, 113, 246
Camponotus hospes (Emery, 1884)		⊙ (added 2. 3. 2011)
Camponotus hypoclineoides Wheeler, 1919	X	◆ 40, 246
Camponotus inconspicuus Mayr, 1872	X	◆ 163
Camponotus irritabilis (Smith, 1857)	X	◆ ⊙ 40, 164, 202, 246
Camponotus irritabilis winkleri Forel, 1911	X	113, 246
Camponotus irritans (Smith, 1857)		40, 74, 202, 246
Camponotus irritans inferior Emery, 1920	X	◆ 40, 82, 113, 246
Camponotus irritans pallidus Smith, 1857	X	⊙ B, 40, 163, 202, 246
Camponotus leonardi Emery, 1889	**(X)**	70, 202, 246
Camponotus maschwitzi Dumpert, 2006		58
Camponotus megalonyx Wheeler, 1919	X	⊙ ◆ 40, 123, 246
Camponotus melanus Dumpert, 1995		57
Camponotus misturus (Smith, 1857)	X	◆ ⊙ 113, 163, 202, 246
Camponotus misturus fornaronis Forel, 1892		⊙
Camponotus moeschi Forel, 1910		⊙ (added 2. 3. 2011)
Camponotus pallidus (Smith, 1857)	X	⊙ (added 2. 3. 2011) Unresolved junior primary homonym
Camponotus pressipes Emery, 1893	X	◆ 40, 73, 105, 246

Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Camponotus quadrisectus (Smith, 1858)		246
Camponotus reticulatus Roger, 1863		⊙
Camponotus rufifemur Emery, 1900		⊙ 40, 168, 246
Camponotus rufoglaucus (Jerdon, 1851)		⊙
Camponotus satan Wheeler, 1919	**X**	246
Camponotus saundersi Emery, 1889		⊙ 168, 246
Camponotus schmitzi Stärcke, 1933	**X**	◆ ⊙ 40, 171, 212
Camponotus sedulus (Smith, 1857)	**X**	40, 163, 202, 246
Camponotus setitibia Forel, 1901	**X**	◆ 105, 246
Camponotus severini Forel, 1909	**X**	40, 111, 246, from Labuan island
Camponotus singularis (Smith, 1858)		⊙ 40, 123, 163
Camponotus singularis rufomaculatus Donisthorpe, 1941	**X**	◆ 51
Camponotus smithianus Wheeler, 1919	**X**	40, 246
Camponotus spenceri Clark, 1896		40, 218
Camponotus striatipes Dumpert, 1995	**(X)**	⊙ 57
Camponotus strictus (Jerdon, 1851)		246
Camponotus sucki Forel, 1901	**X**	40, 105, 246
Camponotus tenuipes (Smith, 1857)	**X**	◆ ⊙ 40, 202, 246
Camponotus variegatus stenonotus Stitz, 1938	**X**	40, 217
Camponotus vigilans (Smith, 1858)	**X**	◆ 40, 203, 246
Camponotus vitiensis Mann, 1921		122
Camponotus vitreus (Smith, 1860)		40, in Wheeler ,1935, reported for Malaya and Papua
Camponotus vitreus latinotus Stitz, 1925	**X**	40, 215, unresolved junior homonym
Camponotus vitreus praerufus Emery, 1900		⊙ (added 2. 3. 2011)
Cladomyrma andrei (Emery, 1894)	**X**	◆ ⊙ A, 3, 1, 40, 246
Cladomyrma aurochaetae Agosti, Moog & Maschwitz, 1999	**X**	◆ ⊙ 3
Cladomyrma crypteroniae Agosti, Moog & Maschwitz, 1999	**X**	◆ ⊙

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Cladomyrma dianeae Agosti, Moog & Maschwitz, 1999	**X**	⊙ 3
Cladomyrma hewitti (Wheeler, 1910)	**X**	◆ ⊙ 40, 48, 244, 246
Cladomyrma hobbyi Donisthorpe, 1937	**X**	◆ ⊙ 3, 49
Cladomyrma maryatiae Agosti, Moog & Maschwitz, 1999	**X**	◆ ⊙ A, 3
Cladomyrma maschwitzi Agosti, 1991		⊙ 3
Cladomyrma nudidorsalis Agosti, Moog & Maschwitz, 1999		⊙ 3
Cladomyrma petalae Agosti, 1991	**(X)**	3, 1
Cladomyrma yongi Agosti, Moog & Maschwitz, 1999	**X**	◆ ⊙ 3
Echinopla densistriata Stitz, 1938	**X**	40, 217
Echinopla lineata Mayr, 1862	**(X)**	40, 105, 157, 163, 246, 254
Echinopla melanarctos Smith, 1857		⊙ 40, 113, 122, 163, 246
Echinopla pallipes Smith, 1857	**X**	◆ 40, 202, 246
Echinopla rugosa André, 1892	**X**	7, 40, 246
Echinopla striata Smith, 1857		40, 123, 163, 246
Echinopla tritschleri Forel, 1901		105, 123, 246
Euprenolepis echinata LaPolla, 2009	**X**	146
Euprenolepis maschwitzi LaPolla, 2009	**X**	146
Euprenolepis negrosensis (Wheeler, 1930)		146
Euprenolepis procera (Emery, 1900)		146
Euprenolepis thrix LaPolla, 2009	**X**	◆ 146
Euprenolepis variegata LaPolla, 2009	**X**	◆ 146
Euprenolepis zeta LaPolla, 2009	**X**	146
Forelophilus overbecki Kutter, 1931		◆
Gesomyrmex chaperi André, 1892	**X**	◆ 7, 246
Lepisiota rothneyi sundaica (Emery, 1921)	**X**	◆ 83, from Puolo Laut
Myrmoteras arcoelinae Agosti, 1992	**X**	⊙ 2
Myrmoteras bakeri Wheeler, 1919	**X**	⊙ 2, 40, 246
Myrmoteras barbouri Creighton, 1930		2, 40
Myrmoteras chondrogastrum Moffett, 1985	**X**	◆ ⊙ A, 2, 173

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Myrmoteras danieli Agosti, 1992	**(X)**	⊙ 2
Myrmoteras diastematum Moffett, 1985	**X**	◆ ⊙ A, 2, 173
Myrmoteras donisthorpei Wheeler, 1916	**X**	⊙ A, 2, 40, 245, 246
Myrmoteras iriodum Moffett, 1985	**X**	⊙ 2, 173
Myrmoteras mjoebergi Wheeler, 1930	**X**	◆ 2, 40
Myrmoteras tonboli Agosti, 1992	**X**	2
Nylanderia kraepelini (Forel, 1905)		246, comb. nov. LaPolla et al. 2010
Nylanderia obscura (Mayr, 1862)		246, comb. nov. LaPolla et al. 2010
Oecophylla smaragdina (Fabricius, 1775)		⊙ A, 74, 163, 180, 218b, 246
Paraparatrechina butteli (Forel, 1913)		Sumatra listed for Borneo by antbase.org
Paraparatrechina butteli bryanti (Forel, 1916)	**X**	40, 119, 246, comb. nov. LaPolla et al. 2010
Paraparatrechina opaca (Emery, 1887)		218, comb. nov. LaPolla et al. 2010
Paratrechina longicornis (Latreille, 1802)		⊙ A, 180, 246
Plagiolepis alluaudi Emery, 1894		180
Polyrhachis abdominalis Smith, 1858		⊙ 40, 137, 233, 246
Polyrhachis achterbergi Kohout, 2006	**X**	◆ 139
Polyrhachis acuminata Kohout, 2007	X	◆, 141b
Polyrhachis aequalis Forel, 1910		40, 112, 254, doubtful
Polyrhachis arcuata (Le Guillou, 1842)	**X**	◆ 40, 138, 150, 246
Polyrhachis armata (Le Guillou, 1842)	**(X)**	◆ ⊙ A, 113, 140, 150, 163, 202, 218b, 246
Polyrhachis aspasia Forel, 1911	**X**	40, 113, 246
Polyrhachis atossa aequicuspis Wheeler, 1919	**(X)**	40, 246, possibly queen caste of *P. frauenfeldi*
Polyrhachis atrovirens Emery, 1900		40, 246
Polyrhachis banghaasi Viehmeyer, 1922	**X**	◆ 40, 137, 233
Polyrhachis basirufa Emery, 1900		123
Polyrhachis beccarii Mayr, 1872	**X**	◆ ⊙ 40, 137, 163, 246
Polyrhachis bellicosa Smith, 1859		⊙ 40, 74, 123, 163, 246
Polyrhachis bicolor aurinasis Forel, 1901	**X**	105, 246
Polyrhachis bicolor Smith, 1858		⊙ A, 40, 74, 105, 137, 163, 246
Polyrhachis bihamata (Drury, 1773)		◆ 40, 137, 163, 202, 246

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Polyrhachis boltoni Dorow & Kohout, 1995		⊙ 137
Polyrhachis bruehli Kohout, 2006	**X**	◆ 139
Polyrhachis caeciliae Forel, 1912		137
Polyrhachis caligata Emery, 1895		254, doubtful
Polyrhachis calypso Forel, 1911		137
Polyrhachis castaneiventris Smith, 1858	**X**	◆ 40, 203, 246
Polyrhachis cephalotes Emery, 1893		⊙ A, 137, 246
Polyrhachis chalybea Smith, 1857		40, 137, 163, 218b, 246
Polyrhachis constructor Smith, 1857	**X**	40, 202
Polyrhachis craddocki Bingham, 1903		new record
Polyrhachis cryptoceroides Emery, 1887		⊙ 254
Polyrhachis cybele Wheeler, 1919	**X**	40, 246, raised to species, Kohout, 2008
Polyrhachis danum Kohout, 2006	**X**	◆ 137, 139, 254
Polyrhachis daphne Wheeler, 1919	**X**	246
Polyrhachis diotima Forel, 1911	**X**	40, 113, 246
Polyrhachis dives Smith, 1857		40, 122, 246
Polyrhachis dolomedes Smith, 1863		254, doubtful-Seram I., New Guinea
Polyrhachis elii Emery, 1900		137
Polyrhachis equina Smith, 1857	**X**	◆ ⊙ A, 40, 113, 140, 202, 246
Polyrhachis flavicornis Smith, 1857		listed for Borneo by antbase.org
Polyrhachis flavoflagellata Karavaiev, 1927		143
Polyrhachis frauenfeldi sanguinea Forel, 1911		new record
Polyrhachis fruhstorferi Emery, 1898		⊙
Polyrhachis furcata Smith, 1858		⊙ A, 40, 137, 246
Polyrhachis gestroi Emery, 1900		new record
Polyrhachis gestroi rufiventris Forel, 1911		137
Polyrhachis gribodoi Emery, 1887		40, 140, 246
Polyrhachis hashimotoi Kohout, 2007	**X**	⊙ 140
Polyrhachis hector Smith, 1857	**(X)**	⊙ A, 137, 150, 163, 202, 218b, 246
Polyrhachis hippomanes Smith, 1861		124, doubtful , endemic to Sulawesi?

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Polyrhachis hippomanes boettcheri Stitz, 1925		137
Polyrhachis hodgsoni Forel, 1902		137
Polyrhachis hosei Donisthorpe, 1942	X	◆ 138
Polyrhachis illaudata Walker, 1859		40, 137, 163, 246
Polyrhachis inermis Smith, 1858	**(X)**	⭘ A, 40, 137, 203
Polyrhachis javanica Mayr, 1867		40, 246, doubtful -Java
Polyrhachis laevigata Smith, 1857		40, doubtful-Malay Peninsula
Polyrhachis laevissima Smith, 1858		139, 246, 139b
Polyrhachis lepida Kohout, 2006	**X**	137
Polyrhachis lilianae Forel, 1911		listed for Borneo by antbase.org
Polyrhachis lugens Mayr, 1867	**X**	161, 246
Polyrhachis maryatiae Kohout, 2007	**X**	⭘ 141
Polyrhachis mitrata Menozzi, 1932		⭘ 137
Polyrhachis montana Hung, 1970	**X**	127
Polyrhachis muara Kohout, 2009	**X**	143
Polyrhachis muelleri Forel, 1893		A, 101, 137
Polyrhachis murina Emery, 1893	**X**	◆ ⭘ 40, 74, 246
Polyrhachis mutata Smith, 1858		203
Polyrhachis nigropilosa Mayr, 1872	**X**	◆ ⭘ A, 40, 137, 138, 163, 246
Polyrhachis nitida Smith, 1857	**X**	40, 202, 246
Polyrhachis noesaensis Forel, 1915		137
Polyrhachis obesior Viehmeyer, 1916		137
Polyrhachis ochracea Karavaiev, 1927		new record
Polyrhachis oedacantha Wheeler, 1919	**X**	40, 137, 246
Polyrhachis olybria Forel, 1912		137
Polyrhachis personata Wheeler, 1919	**X**	◆ 40, 246
Polyrhachis phalerata Menozzi, 1926		⭘ 40, 218, doubtful-probably *P. oedacantha*
Polyrhachis platynota Stitz, 1933	**X**	216
Polyrhachis pressa Mayr, 1862		40, 246
Polyrhachis pruinosa Mayr, 1872	**X**	◆ ⭘ 40, 137, 163, 246

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Polyrhachis rastellata (Latreille, 1802)		122, 163, 246, doubtful see Kohout, 2006
Polyrhachis reidi Kohout, 2007	**X**	⊙ 140
Polyrhachis rixosa Smith, 1858		40, 122, 246
Polyrhachis romanovi Santschi, 1928		Raised to species: Kohout, 1998: 517.
Polyrhachis ruficornis Smith, 1857	**X**	◆ 40, 202, 246
Polyrhachis rufipes Smith, 1858	**X**	◆ 137, 203
Polyrhachis rugifrons Smith, 1860		246, doubtful, endemic to Sulawesi?
Polyrhachis saevissima argentea Mayr, 1862		40, 246, doubtful
Polyrhachis saevissima Smith, 1860		137, 254
Polyrhachis sculpturata Smith, 1860		40, 122, 246
Polyrhachis storki Kohout, 2008		143
Polyrhachis striata Mayr, 1862		163, 246
Polyrhachis striatorugosa Mayr, 1862		40, 254, doubtful, Java, Sumatra
Polyrhachis sukarmani Kohout, 2007	**X**	⊙ 140
Polyrhachis sulang Kohout, 2006	**X**	139
Polyrhachis sumatrensis Smith, 1858		revived status (unpublished) R. Kohout, new record
Polyrhachis tibialis Smith, 1858		⊙ A, 246, 254
Polyrhachis triaena Wheeler, 1919	**X**	◆ 40, 246
Polyrhachis tristis Mayr, 1867		A, doubtful, endemic to Java?
Polyrhachis tubifex Karavaiev, 1926		new record
Polyrhachis tyrannica Smith, 1858		123, doubtful - China
Polyrhachis villipes Smith, 1857	**X**	◆ 40, 113, 138, 163, 202, 246
Polyrhachis vindex Smith, 1857	**X**	◆ 40, 202, 246 senior synonm of *P. orsylla*
Polyrhachis wheeleri Mann, 1919		⊙ A
Polyrhachis widodoi Kohout, 2006	**X**	◆ 139
Polyrhachis ypsilon Emery, 1887		⊙ A, 40, 67, 168, 246
Prenolepis jerdoni Emery, 1893		246, 254
Pseudolasius familiaris (Smith, 1860)		⊙
Pseudolasius leopoldi Santschi, 1932	**X**	192

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Pseudolasius mayri Emery, 1911	**(X)**	81, 246
Pseudolasius mayri sarawakanus Forel, 1913	**X**	◆ 40, 117, 246
Leptanillinae		
Anomalomyrma taylori Bolton, 1990	**X**	◆ 20
Leptanilla Emery, 1870		A
Protanilla rafflesi Taylor, 1990		⭘ A, 169
Myrmicinae		
Acanthomyrmex careoscrobis Moffett, 1986	**X**	◆ ⭘ 174
Acanthomyrmex concavus Moffett, 1986	**X**	◆ ⭘ B, 174
Acanthomyrmex dusun Wheeler, 1919	**X**	◆ ⭘ B, 40, 174
Acanthomyrmex ferox Emery, 1893	**(X)**	◆ ⭘ A, B, 40, 73, 174
Acanthomyrmex foveolatus Moffett, 1986	**X**	◆ 174
Acanthomyrmex mindanao Moffett, 1986		174
Anillomyrma tridens Bolton, 1987	**X**	◆ ⭘ 18, 63
Aphaenogaster Mayr, 1853		⭘
Calyptomyrmex emeryi Forel, 1901	**X**	◆ 40, 105, 122, 246
Cardiocondyla emeryi Forel, 1881		124
Cardiocondyla kagutsuchi Terayama, 1999		B
Cardiocondyla nana Seifert, 2003	**X**	◆ ⭘
Cardiocondyla nuda (Mayr, 1866)		124, 246
Cardiocondyla tjibodana Karavaiev, 1935		195
Cardiocondyla wroughtonii (Forel, 1890)		⭘ 218
Carebara Westwood, 1840		⭘ A, 122
Cataulacus granulatus (Latreille, 1802)		40, 246
Cataulacus hispidulus Smith, 1856	**(X)**	B, 40, 123, 163, 201, 246
Cataulacus horridus Smith, 1857	**X**	⭘ A, B, 40, 169, 202, 246
Cataulacus latissimus Emery, 1893	**(X)**	⭘ B, 40, 74, 218b, 233, 246
Cataulacus praetextus Smith, 1867	**X**	◆ ⭘ B, 40, 209, 246
Cataulacus reticulatus Smith, 1857	**X**	B, 202
Chimaeridris burckhardti Wilson, 1989	**X**	256

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Crematogaster angulosa André, 1896	**X**	8, 40, 246
Crematogaster anthracina Smith, 1857		40, 163
Crematogaster biformis André, 1892	**X**	◆ 7, 40, 246
Crematogaster borneensis André, 1896	**X**	8, 40, 246
Crematogaster borneensis capax Forel, 1911	**X**	◆ 40, 113, 246
Crematogaster borneensis harpyia Forel, 1911	**X**	◆ 40, 113, 246
Crematogaster borneensis hosei Forel, 1911	**X**	40, 113, 246
Crematogaster borneensis insulsa Forel, 1911	**X**	◆ 40, 113, 246
Crematogaster borneensis macarangae Viehmeyer, 1916		40, 113
Crematogaster borneensis novem Forel, 1911	**X**	40, 113, 246
Crematogaster borneensis symbia Forel, 1911	**X**	○ 40, 113, 246
Crematogaster brunnea Smith, 1857	**X**	◆ 40, 202, 246
Crematogaster captiosa Forel, 1911	**X**	◆ 40, 113, 246
Crematogaster cephalotes Smith, 1857	**X**	◆ 40, 202, 246
Crematogaster coriaria Mayr, 1872	**X**	◆ ○ 40, 163, 180, 246
Crematogaster daisyi Forel, 1901	**X**	◆ ○ 105, 246
Crematogaster decamera Forel, 1910	**X**	◆ 40, 112, 218, 246
Crematogaster difformis Smith, 1857	**(X)**	○ 40, 74, 126, 163, 170, 202, 218b, 246
Crematogaster egidyi Forel, 1903		246
Crematogaster egidyi spinozai Forel, 1911	**X**	◆ 40, 113, 246
Crematogaster ferrarii Emery, 1888		74, 246
Crematogaster fraxatrix Forel, 1911	**X**	40, 113, 246
Crematogaster inflata Smith, 1857		○ A, 40, 126, 163, 170, 202, 246
Crematogaster innocens Forel, 1911	**X**	40, 113, 246
Crematogaster longipilosa Forel, 1907		113, 246
Crematogaster macracantha Creighton, 1945	**X**	◆ 40, 46
Crematogaster masukoi Hosoishi, Yamane and Ogata, 2010	X	126b
Crematogaster modiglianii Emery, 1900	**(X)**	○ ◆ A, 40, 113, 126c , 218, 246
Crematogaster myops Forel, 1911	**X**	◆ 40, 113, 246

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Appendix 1 (*continued*)

Species and subspecies	**Type**	**Codes and remarks**
Crematogaster obscura Smith, 1857	**X**	40, 202, 246
Crematogaster onusta Stitz, 1925		⭘ A, 126
Crematogaster physothorax Emery, 1889		246
Crematogaster reticulata Hosoishi, 2009	**X**	125
Crematogaster rogenhoferi fictrix Forel, 1911	**X**	113, 246
Crematogaster rogenhoferi Mayr, 1879		⭘ A, 13
Crematogaster sewardi Forel, 1901	**X**	◆ ⭘ 105, 126, 246
Crematogaster spengeli Forel, 1912		218
Crematogaster subcircularis Mayr, 1879	**X**	164
Crematogaster subnuda Mayr, 1879		246
Crematogaster tanakai Hosoishi & Ogata, 2009	**X**	⭘ 126
Crematogaster tumidula Emery, 1900		⭘
Crematogaster vacca Forel, 1911		⭘ 126
Dacetinops cirrosus Taylor, 1985	**X**	◆ ⭘ A, 223
Dacetinops concinnus Taylor, 1965	**X**	◆ 220, 223
Dacetinops solivagus Taylor, 1985	**X**	◆ 223
Dacetinops wilsoni Taylor, 1985	**X**	◆ ⭘ 223
Dilobocondyla borneensis Wheeler, 1916	**X**	⭘ 40, 122, 245, 246
Dilobocondyla selebensis (Emery, 1898)		122
Eurhopalothrix browni Taylor, 1990	**X**	◆ 224
Eurhopalothrix coronata Taylor, 1990	**X**	224
Eurhopalothrix dubia Taylor, 1990	**X**	⭘ 224
Eurhopalothrix elke Mezger & Pfeiffer, 2010	**X**	A, 169
Eurhopalothrix jennya Taylor, 1990	**X**	◆ ⭘ A, 224
Eurhopalothrix omnivaga Taylor, 1990	**(X)**	A, 224
Eurhopalothrix procera Emery, 1897	**(X)**	40, 75, 246
Eurhopalothrix rothschildi Taylor, 1990	**X**	◆ 224
Eurhopalothrix seguensis Taylor, 1990	**X**	◆ ⭘ 224
Ishakidris ascitaspis Bolton, 1984	**X**	⭘ 17
Lasiomyrma gracilinoda Terayama & Yamane, 2000	**X**	◆ 226

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Lasiomyrma maryatiae Terayama & Yamane, 2000	X	◆ 226
Liomyrmex gestroi (Emery, 1887)		122
Lophomyrmex bedoti Emery, 1893		⭘ A, B, 184, 246
Lophomyrmex longicornis Rigato, 1994	X	⭘ A, B, 184, 218b
Lordomyrma reticulata Lucky & Sarnat, 2008	X	◆ ⭘ A, 152
Mayriella transfuga Baroni Urbani, 1977		⭘ A, 1, 199
Meranoplus bicolor (Guérin-Méneville, 1844)		194
Meranoplus borneensis Schödl, 1998	X	⭘ A, B, 194
Meranoplus castaneus Smith, 1857	X	◆ ⭘ A, B, 40, 163, 194, 202, 246
Meranoplus malaysianus Schödl, 1998		⭘ A, B, 194
Meranoplus montanus Schödl, 1998	X	◆ ⭘ A, 194
Meranoplus mucronatus Smith, 1857		⭘ 40, 194, 246
Metapone hewitti Wheeler, 1919	X	◆ 40, 246
Metapone quadridentata Eguchi, 1998	X	59
Monomorium australicum Forel, 1907		⭘ A, 124
Monomorium brocha (Bolton, 1987)	X	◆ 18
Monomorium floricola (Jerdon, 1851)		⭘ A, 163, 218, 218b, 246
Monomorium latinode Mayr, 1872	X	◆ 40, 163, 246
Monomorium monomorium Bolton, 1987		123
Monomorium pharaonis (Linnaeus, 1758)		⭘ A, 163, 246
Monomorium sechellense Emery, 1894		123
Myrmecina undulata Emery, 1900		⭘ 40, 246
Myrmica emeryi Radchenko & Elmes, 2009	X	181 Pulo Laut
Myrmicaria arachnoides (Smith, 1857)	X	◆ 9, 40, 105, 163, 202, 246, 254
Myrmicaria arachnoides adpressipilosa Santschi, 1928		9
Myrmicaria arachnoides latinoda Stitz, 1938		40, 217 will be synonymize with *M. arachnoides*
Myrmicaria arachnoides lutea Emery, 1900		⭘ B, 9
Myrmicaria birmana Forel, 1902		9
Myrmicaria brunnea flava Forel, 1913		9
Myrmicaria brunnea subcarinata (Smith, 1857)	X	◆ ⭘ A, 9, 105, 163, 202, 246

Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Myrmicaria carinata (Smith, 1857)	**X**	◆ B, 9, 40, 105, 202, 246
Myrmicaria carinata gagatina Wheeler, 1919	**X**	9, 40, 246
Myrmicaria luteiventris Emery, 1900		B, checked by Bahktiar & Yamane
Myrmicaria melanogaster Emery, 1900	**X**	⊙ B, 9, 40, 78, 113, 246
Paratopula ankistra Bolton, 1988	**X**	⊙ 19
Paratopula demeta Bolton, 1988	**X**	⊙ 19, 218b
Paratopula longispina (Stitz, 1938)	**X**	40, 217
Paratopula macta Bolton, 1988	**X**	◆ ⊙ 19
Paratopula oculata (Smith, 1857)	**X**	246
Pheidole acantha Eguchi, 2001	**X**	◆ ⊙ A, B, 62
Pheidole aglae Forel, 1913		⊙ A, 62, 218b
Pheidole angulicollis Eguchi, 2001	**X**	⊙ B, 62
Pheidole annexus Eguchi, 2001	**X**	◆ ⊙ A, 62, 218b
Pheidole aristotelis Forel, 1911	**X**	◆ ⊙ A, B, 40, 62, 113, 246
Pheidole bugi Wheeler, 1919	**X**	A, 40, 62, 246
Pheidole butteli Forel, 1913		⊙ A, 62
Pheidole cariniceps Eguchi, 2001	**X**	⊙ A, 62
Pheidole cingulata (Smith, 1857)	**X**	40, 62, 202, 246, unidentifiable taxon (Eguchi 2001)
Pheidole clypeocornis Eguchi, 2001	**X**	◆ ⊙ A, B, 62
Pheidole comata Smith, 1858	**X**	⊙ B, 40, 60, 62, 203, 246
Pheidole deltea Eguchi, 2001	**X**	◆ ⊙ A, 62
Pheidole elisae Emery, 1900		⊙ A, B, 62
Pheidole fantasia Chapman, 1963		62
Pheidole fervens Smith, 1858		⊙ A, B, 62, 163, 246
Pheidole ghigii Emery, 1900		62
Pheidole gombakensis Eguchi, 2001		⊙ A, 62
Pheidole guineensis (Fabricius, 1793)		163, 246
Pheidole havilandi Forel, 1911	**X**	◆ A, 40, 62, 113
Pheidole hortensis Forel, 1913		⊙ A, 62
Pheidole huberi Forel, 1911		⊙ 62

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Pheidole inornata Eguchi, 2001	X	⊙ A, 62
Pheidole jacobsoni Forel, 1911		A, 62
Pheidole kikutai Eguchi, 2001	X	62
Pheidole lokitae Forel, 1913		⊙ 62
Pheidole longipes (Latreille, 1802)		A, B, 40, 60, 62, 202, 246
Pheidole lucioccipitalis Eguchi, 2001	X	⊙ A, 62, 218b
Pheidole manukana Eguchi, 2001	X	◆ 62
Pheidole megacephala (Fabricius, 1793)		A, 62, 246
Pheidole merimbun Eguchi, 2001	X	62, 218b
Pheidole modiglianii Emery, 1900		⊙ 62
Pheidole montana Eguchi, 1999	X	⊙ A, B, 60, 62
Pheidole parva Mayr, 1865		
Pheidole parvicorpus Eguchi, 2001	X	⊙ A, B, 62
Pheidole plagiaria Smith, 1860		⊙ A, B, 62, 218b
Pheidole planidorsum Eguchi, 2001	X	◆ ⊙ 62
Pheidole plinii Forel, 1911	X	◆ A, B, 62, 113
Pheidole poringensis Eguchi, 2001	X	◆ A, 62
Pheidole quadrensis Forel, 1900		⊙ A, B, 62
Pheidole quadricuspis Emery, 1900		⊙ A, B, 62
Pheidole quinata Eguchi, 2000	X	61, 62
Pheidole rabo Forel, 1913		⊙ A, 62
Pheidole retivertex Eguchi, 2001	X	◆ ⊙ A, 62
Pheidole rinae Emery, 1900		124
Pheidole rugifera Eguchi, 2001	X	⊙ A, B, 62
Pheidole sabahna Eguchi, 2000	X	⊙ A, B, 61, 62
Pheidole sarawakana Forel, 1911	X	◆ ⊙ A, B, 62, 113
Pheidole sauberi Forel, 1905		⊙ A, B, 62
Pheidole sayapensis Eguchi, 2001	X	⊙ 62
Pheidole schoedli Eguchi, Hashimoto & Malsch, 2006	X	◆ ⊙
Pheidole spinicornis Eguchi, 2001	X	◆ ⊙ A, 62

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Pheidole submonticola Eguchi, 2001	**X**	⊙ A, 62
Pheidole tawauensis Eguchi, 2001	**X**	A, 62
Pheidole tenebricosa Eguchi, 2001	**X**	⊙ A, 62
Pheidole tjibodana Forel, 1905		⊙ A, 62
Pheidole upeneci Forel, 1913		⊙ A, 62
Pheidologeton affinis (Jerdon, 1851)		A, B, 169, 246
Pheidologeton diversus (Jerdon, 1851)		B, 246
Pheidologeton pygmaeus Emery, 1887		A, B, 180
Pheidologeton silenus (Smith, 1858)	**(X)**	⊙ A, 40, 203, 249, 254
Pristomyrmex bicolor Emery, 1900		⊙ B, 235
Pristomyrmex brevispinosus Emery, 1887		⊙ B, 235
Pristomyrmex costatus Wang, 2003	**(X)**	B, 235
Pristomyrmex modestus Wang, 2003	**X**	B, 235
Pristomyrmex occultus Wang, 2003		◆ B, 235
Pristomyrmex picteti Emery, 1893		235
Pristomyrmex pollux Donisthorpe, 1944		B, 235
Pristomyrmex profundus Wang, 2003		◆ ⊙ 235
Pristomyrmex punctatus (Smith, 1860)		⊙ A, 235
Pristomyrmex rigidus Wang, 2003		⊙ A, B, 235
Pristomyrmex trachylissus (Smith, 1858)	**X**	B, 40, 203, 235, 246
Proatta butteli Forel, 1912		⊙ A, 169
Propodilobus pingorum (DuBois, 1998)		30
Pyramica acheron Bolton, 2000	**X**	25
Pyramica aello Bolton, 2000	**X**	◆ ⊙ A, 25
Pyramica bubisnoda Bolton, 2000	**X**	25
Pyramica clotho Bolton, 2000	**X**	25
Pyramica daspleta Bolton, 2000	**X**	25
Pyramica deinognatha Bolton, 2000	**X**	◆ 25
Pyramica disjuncta Bolton, 2000	**X**	25
Pyramica dohertyi (Emery, 1897)		⊙ A, 25

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Pyramica dyschima Bolton, 2000	**X**	◆ A, 25
Pyramica euryale Bolton, 2000	**X**	25
Pyramica extemena (Taylor, 1968)		○ A
Pyramica karawajewi (Brown, 2000)		A, 25
Pyramica kempfi (Taylor & Brown, 1978)	**X**	A, 25
Pyramica medusa Bolton, 2000	**X**	◆ 25
Pyramica megaera Bolton, 2000	**X**	25
Pyramica mitis Brown, 2000		○ A, 25
Pyramica mnemosyne Bolton, 2000	**X**	○ A, 25
Pyramica mutica (Brown, 1949)		A
Pyramica ocypete Bolton, 2000	**X**	◆ 25
Pyramica runa Bolton, 2000	**X**	25
Pyramica theia Bolton, 2000	**X**	◆ 25
Recurvidris browni Bolton, 1992	**X**	○ A, 22
Recurvidris kemneri (Wheeler & Wheeler, 1954)		○ A, 22
Rhopalomastix Forel, 1900		A
Rhoptromyrmex wroughtonii Forel, 1902		A, 246
Rotastruma recava Bolton, 1991	**X**	◆ ○ 21
Secostruma lethifera Bolton, 1988	**X**	○ 19
Solenopsis geminata (Fabricius, 1804)		○ A, 171, 246
Strumigenys aechme Bolton, 2000	**X**	◆ ○ A, 25
Strumigenys akalles Bolton, 2000	**X**	25
Strumigenys amasara Bolton, 2000	**X**	◆ ○ A, 25
Strumigenys arrogantia Bolton, 2000	**X**	◆ ○ 25
Strumigenys baal Bolton, 2000	**X**	25
Strumigenys baladria Bolton, 2000	**X**	25
Strumigenys barylonga Bolton, 2000		25
Strumigenys blanda Bolton, 2000	**X**	◆ 25
Strumigenys bryanti Wheeler, 1919	**X**	25, 40, 246
Strumigenys chorosa Bolton, 2000	**X**	◆ 25

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Strumigenys cygarix Bolton, 2000	**X**	⭘ A, 25
Strumigenys diasphax Bolton, 2000	**X**	⭘ 25
Strumigenys doriae Emery, 1887		⭘ A, 25, 67
Strumigenys dromica Bolton, 2000	**X**	◆ 25
Strumigenys dyak Brown, 1959	**X**	25, 33
Strumigenys edaragona Bolton, 2000		⭘ A, 25
Strumigenys emmae (Emery, 1890)		236
Strumigenys eumekes Bolton, 2000	**X**	◆ 25
Strumigenys forficata Brown, 1959	**X**	25, 33
Strumigenys fuarda Bolton, 2000	**X**	◆ ⭘ A, 25
Strumigenys geminata Bolton, 2000		25
Strumigenys gloriosa Bolton, 2000	**X**	A, 25
Strumigenys gnathosphax Bolton, 2000		25
Strumigenys godeffroyi Mayr, 1866		A, 25
Strumigenys gyrogenys Bolton, 2000	**X**	25
Strumigenys halpas Bolton, 2000	**X**	◆ 25
Strumigenys hastur Bolton, 2000	**X**	A, 25
Strumigenys hekate Bolton, 2000	**X**	25
Strumigenys ignota Bolton, 2000	**X**	⭘ A, 25
Strumigenys indigatrix Wheeler, 1919	**X**	◆ ⭘ A, 25, 40, 246
Strumigenys inhonesta Bolton, 2000		⭘ A, 25
Strumigenys juliae Forel, 1905		⭘ A, 25
Strumigenys kapryx Bolton, 2000	**X**	⭘ A, 25
Strumigenys koningsbergeri Forel, 1905		⭘ A, 25
Strumigenys kraepelini Forel, 1905		⭘ A, 25
Strumigenys lebratyx Bolton, 2000	**X**	⭘ A, 25
Strumigenys leptorhina Bolton, 2000	**X**	25
Strumigenys liophila Bolton, 2000	**X**	◆ 25
Strumigenys macerina Bolton, 2000	**X**	◆ ⭘ A, 25
Strumigenys magnifica Bolton, 2000		25

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Strumigenys mjoebergi Brown, 1959	**X**	◆ 25, 33
Strumigenys mododonta Bolton, 2000	**X**	◆ 25
Strumigenys morphica Bolton, 2000	**X**	25
Strumigenys naberia Bolton, 2000	**X**	⭘ A, 25
Strumigenys natynion Bolton, 2000	**X**	◆ 25
Strumigenys ochosa Bolton, 2000	**X**	◆ 25
Strumigenys offina Bolton, 2000	**X**	◆ 25
Strumigenys perturba Bolton, 2000	**X**	◆ A, 25
Strumigenys pliocera Bolton, 2000	**X**	◆ 25
Strumigenys propinqua Bolton, 2000	**X**	◆ ⭘ A, 25
Strumigenys prosopis Bolton, 2000		⭘ A, 25
Strumigenys rhadina Bolton, 2000	**X**	◆ 25
Strumigenys rofocala Bolton, 2000	**X**	◆ ⭘ A, 25
Strumigenys rogeri Emery, 1890		⭘ tramp species, new record
Strumigenys rotogenys Bolton, 2000	**X**	◆ ⭘ A, 25
Strumigenys seynoka Bolton, 2000	**X**	◆ ⭘ A, 25
Strumigenys signeae Forel, 1905		⭘ A, 25
Strumigenys strenosa Bolton, 2000	**X**	◆ A, 25
Strumigenys strygax Bolton, 2000		⭘ A, 25
Strumigenys sublaminata Brown, 1959	**X**	25, 33
Strumigenys superba Bolton, 2000	**X**	◆ 25
Strumigenys sytaria Bolton, 2000	**X**	25
Strumigenys tadynastes Bolton, 2000	**X**	◆ 25
Strumigenys taraxis Bolton, 2000	**X**	◆ 25
Strumigenys tomodonta Bolton, 2000	**X**	◆ 25
Strumigenys treptodens Bolton, 2000	**X**	25
Strumigenys trixodens Bolton, 2000	**X**	◆ 25
Strumigenys ulteria Bolton, 2000	**X**	25
Strumigenys vertigosa Bolton, 2000	**X**	25
Strumigenys vindala Bolton, 2000	**X**	◆ 25

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Appendix 1 (*continued*)

Species and subspecies	**Type**	**Codes and remarks**
Strumigenys zagan Bolton, 2000	**X**	25
Tetheamyrma subspongia Bolton, 1991	**X**	◆ ⭘ A, 21, 169
Tetramorium adelphon Bolton, 1979	**X**	B, 16
Tetramorium adpressum (Bolton, 1976)		123
Tetramorium aptum Bolton, 1977		B, 211b
Tetramorium bicarinatum (Nylander, 1846)		⭘ A, B, 15
Tetramorium chepocha (Bolton, 1976)	**X**	14
Tetramorium curtulum Emery, 1895		15, 246
Tetramorium flagellatum Bolton, 1977	**X**	A, 15
Tetramorium indicum Forel, 1913		B
Tetramorium insolens (Smith, 1861)		A, B, 180
Tetramorium kheperra (Bolton, 1976)		B, 211b
Tetramorium lanuginosum Mayr, 1870		⭘ A, 162, 180, 246
Tetramorium laparum Bolton, 1977		⭘ A 218b
Tetramorium lucyae Sorger sp. nov.	**X**	⭘ A 211b, this issue of AM
Tetramorium meshena (Bolton, 1976)		A
Tetramorium noratum Bolton, 1977		◆ ⭘ A, B, 15
Tetramorium obtusidens Viehmeyer, 1916		⭘ A, B
Tetramorium ocothrum Bolton, 1979	**X**	◆ 16
Tetramorium pacificum Mayr, 1870		⭘ A, B, 105, 162, 164, 193b, 246
Tetramorium palaense Bolton, 1979	**X**	◆ B, 16, 218, 218b
Tetramorium parvispinum Emery, 1893	**X**	◆ 40, 74, 246
Tetramorium parvum Bolton, 1977		123
Tetramorium scabrum Mayr, 1879	**X**	193b
Tetramorium seneb Bolton, 1977		B, 211b
Tetramorium simillimum (Smith, 1851)		⭘ A, 15, 246
Tetramorium smithi Mayr, 1879		15
Tetramorium tonganum Mayr, 1870		⭘ A, 15
Tetramorium tylinum Bolton, 1977	**X**	15
Vollenhovia banksi kuchingensis Wheeler, 1919	**X**	202, 246

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Vollenhovia fridae Forel, 1913		123
Vollenhovia hewitti Wheeler, 1919	**X**	40, 246
Vollenhovia oblonga alluaudi Emery, 1894		246
Vollenhovia oblonga laevithorax Emery, 1889		246
Vollenhovia oblonga rufescens Emery, 1894	**X**	◆ 40, 246
Vollenhovia penetrans (Smith, 1857)	**X**	202, 246
Vollenhovia pertinax (Smith, 1861)		123
Vollenhovia punctatostriata Mayr, 1856		158, 163, 246
Vollenhovia rufiventris Forel, 1901	**X**	○ 40, 105, 246
Vombisidris dryas Bolton, 1991	**X**	◆ ○ A, 21
Vombisidris harpeza Bolton, 1991	**X**	21
Vombisidris regina Bolton, 1991	**X**	◆ ○ 21
Vombisidris xylochos Bolton, 1991	**X**	◆ ○ 21
Ponerinae		
Anochetus agilis Emery, 1901	**X**	○ B, 35, 40, 79, 124, 246
Anochetus graeffei Mayr, 1870		A, B, 123
Anochetus incultus Brown, 1987		○ B
Anochetus modicus Brown, 1978	**X**	◆ 35
Anochetus muzziolii Menozzi, 1932		B
Anochetus myops Emery, 1893		○ B
Anochetus princeps Emery, 1884		○ B, 122, 34b
Anochetus rugosus (Smith, 1857)	**(X)**	○ B, 35, 123, 202
Anochetus tua Brown, 1987		124
Centromyrmex Mayr, 1866		B, 122
Cryptopone testacea Emery, 1893	**(X)**	○ 40, 252
Diacamma holosericeum (Roger, 1860)		40, 163, 246
Diacamma intricatum (Smith, 1857)	**X**	○ 40, 163, 202, 246, 257
Diacamma intricatum kershawi Wheeler, 1919	**X**	◆ 40, 246
Diacamma rugosum (Le Guillou, 1842)	**X**	◆ ○ A, 105, 150, 163, 202, 246
Diacamma sculpturatum (Smith, 1859)		123

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Emeryopone buttelreepeni Forel, 1912		⭘ A, 169
Harpegnathos hobbyi Donisthorpe, 1937	**X**	49
Harpegnathos venator (Smith, 1858)		◆ ⭘ A
Hypoponera confinis javana (Forel, 1905)		40, 246
Hypoponera gleadowi Forel, 1895		◆ 40, 246
Hypoponera truncata (Smith, 1860)		40, 163, 246
Leptogenys aspera (André, 1889)		B
Leptogenys borneensis Wheeler, 1919	**X**	◆ ⭘ B, 40, 124, 246
Leptogenys chalybaea (Emery, 1887)	**X**	◆ 40, 67, 123, 246
Leptogenys diminuta (Smith, 1857)	**X**	◆ ⭘ 40, 105, 202, 246
Leptogenys diminuta laeviceps Smith, 1857	**X**	◆ 40, 164, 202, 246
Leptogenys hysterica Forel, 1900		122
Leptogenys iridescens (Smith, 1857)	**X**	◆ 40, 163, 164, 202, 246
Leptogenys iridescens currens Forel, 1901	**X**	40, 246
Leptogenys kitteli (Mayr, 1870)		124
Leptogenys kitteli laevis (Mayr, 1879)		40, 246
Leptogenys kitteli transiens Forel, 1911	**X**	113
Leptogenys mutabilis (Smith, 1861)		B, 40, 123, 163, 164, 246
Leptogenys myops (Emery, 1887)		⭘ B, 124
Leptogenys parvula Emery, 1900		122
Leptogenys pompiloides (Smith, 1857)	**X**	40, 202, 246
Leptogenys processionalis (Jerdon, 1851)		40, 105
Leptogenys processionalis distinguenda (Emery, 1887)	**X**	67, 246
Myopias breviloba (Wheeler, 1919)	**X**	◆ 40, 246
Myopias maligna (Smith, 1861)		122
Odontomachus latidens Mayr, 1867		122, 34b
Odontomachus malignus Smith, 1859		40, 163, 246, 34b
Odontomachus monticola Forel, 1912		◆
Odontomachus rixosus Smith, 1857		A, 40, 163, 169, 246, 34b
Odontomachus simillimus Smith, 1858		122

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Odontoponera denticulata (Smith, 1858)		122, 163, 258b
Odontoponera transversa (Smith, 1857)		⊙ A, 40, 169, 246
Odontoponera transversa nitens Creighton, 1929	**X**	40, 44
Pachycondyla amblyops (Emery, 1887)		122, 246
Pachycondyla apicalis Smith, 1857	**X**	40, 202, 246, unresolved junior secondary homonym of *Formica apicalis* Latreille
Pachycondyla astuta Smith, 1858		⊙ 257
Pachycondyla darwinii indica (Emery, 1899)		246
Pachycondyla insularis (Emery, 1889)		A, 169, 246
Pachycondyla insularis brevior (Forel, 1901)	**X**	105
Pachycondyla leeuwenhoeki (Forel, 1886)		⊙ 123
Pachycondyla luteipes (Mayr, 1862)		246
Pachycondyla obscurans (Walker, 1859)		218c
Pachycondyla obtusa Emery, 1900	**X**	◆ 40, 78, 246
Pachycondyla pilidorsalis Yamane, 2007		⊙ A, 258
Pachycondyla rubra (Smith, 1857)		B
Pachycondyla sandakana (Wheeler, 1919)	**X**	40, 246
Pachycondyla sharpi (Forel, 1901)		B, 122
Pachycondyla tridentata Smith, 1858	**X**	◆ A, B, 40, 163, 169, 246
Pachycondyla tridentata debilior (Forel, 1901)	**X**	105
Pachycondyla vidua (Smith, 1857)	**X**	40, 202, 246
Platythyrea parallela (Smith, 1859)	**(X)**	◆ 122, 204, 218b, 246
Platythyrea tricuspidata Emery, 1900		254
Ponera borneensis Taylor, 1967	**X**	221
Proceratiinae		
Discothyrea Roger, 1863		⊙ A
Probolomyrmex itoi Eguchi, Yoshimura & Yamane, 2006		64
Probolomyrmex maryatiae Eguchi, Yoshimura & Yamane, 2006	**X**	⊙ A, 64
Proceratium angulinode De Andrade, 2003		11
Proceratium banjaranense De Andrade, 2003		11

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Appendix 1 (*continued*)

Species and subspecies	Type	Codes and remarks
Proceratium dayak De Andrade, 2003	**X**	◆ ⭘ 11
Proceratium deelemani Perrault, 1981	**X**	⭘ 11, 122
Proceratium dusun De Andrade, 2003	**X**	⭘ 11
Proceratium foveolatum De Andrade, 2003		◆ 11
Proceratium microsculptum De Andrade, 2003		◆ 11
Proceratium papuanum Emery, 1897		11
Proceratium striativenter De Andrade, 2003		◆ 11
Proceratium sulawense De Andrade, 2003		11
Pseudomyrmecinae		
Tetraponera allaborans (Walker, 1859)		236
Tetraponera apiculata Ward, 2001		236
Tetraponera attenuata Smith, 1877	**X**	◆ ⭘ A, 105, 210, 236, 246
Tetraponera bita Ward, 2001		236
Tetraponera buops Ward, 2001		◆ 236
Tetraponera conica Ward, 2001		◆ 236
Tetraponera crassiuscula (Emery, 1900)		A, 236
Tetraponera difficilis (Emery, 1900)		⭘ A, 236, 246
Tetraponera extenuata Ward, 2001		236
Tetraponera inversinodis Ward, 2001		◆ 236
Tetraponera modesta (Smith, 1860)		⭘ A, 236
Tetraponera nigra (Jerdon, 1851)		⭘ 202, 236, 246
Tetraponera nitida (Smith, 1860)		⭘ A, 236
Tetraponera nodosa Ward, 2001		236
Tetraponera pilosa (Smith, 1858)	**X**	◆ ⭘ A, 203, 236, 246
Tetraponera polita Ward, 2001		236