Inventory & Collection

Total protocol for understanding of biodiversity

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Introduction

Ants are one of the most abundant and diverse animal groups in tropical ecosystems (Stork, 1987, 1991), and they function at many levels in these ecosystems – as predators and prey, as detritivores, mutualists, and herbivores (Hölldobler and Wilson, 1990). Thus, ants have the potential to yield more meaningful biodiversity data than many other organisms, such as plants, birds, and butterflies. Moreover, since most species have stationary, perennial nests with fairly restricted foraging ranges, ants have a potential role as indicators of environmental change. Because of the potential usefulness, inventory of ants has been viewed as an important task in tropical biodiversity and conservation studies (Agosti et al., 2000).

The most difficult part of ant inventory in tropical region is identification process. Inventory data are usually analyzed by relying on the presence or absence of species. However, identification of tropical ant specimens to species will be very difficult or impossible, because most groups of the ants have yet to be studied in detail. This difficulty makes the recognition of morphospecies a necessary part of inventory studies for ants (Agosti et al., 2000).

The identifying ants to genus-level are not impossible, because excellent identification-key to ant genera of the all parts of the world is available in Bolton (1994). Thus, for sorting ant specimens into morphospecies, they should be identified to genus (i.e., “Ant species 1 and species 2” to “Aenictus sp. 1 and Camponotus sp.1”). This makes it easy to handle and analyze the data. Furthermore, ecological information, such as food habits, nest-site preference, colony size, etc., is provided to many genera (Hölldobler and Wilson, 1990). Thus identifying ants to genus-level can provide useful information on environmental monitoring, conservation evaluation, and ecological research.

However, the key of Bolton (1994) is technical, and requires some knowledge of taxonomic descriptions. For no-taxonomist, a more user-friendly and pictorial identification key to ant genera is need. Furthermore, for local inventory the regional identification key may be more convenient, because only a subset of the genera is found in each geographic region. In this chapter, therefore, I provide a pictorial identification key to Bornean ant genera.

Before attempting to identify an ant specimen, knowledge of the specimen mounting technique and the external anatomy must be confirmed. The chapter also provides instruction of the mounting techniques and glossary of ant morphology terms.

Outline of ant diversity in Borneo

The ant fauna of Borneo Island is very diverse and unique. The island may have 9 subfamilies, 94 genera and more than 1000 described species. Worldwide, there are 16 subfamilies, about 300 genera and about 15,000 described species of ants (Bolton 1995). Thus Borneo may have representatives of about 30% of its genera and about 7% of its species, though Borneo covers less than 0.2% of the earth’s land surface. The 6 genera, including Bregmatomyrmex, Epeulysidris, Ishakidris, Loweriella, Secostruma, Tetheamyrma, may be endemic to Borneo. In Indo-Australian region, which include Malaysia, Philippines, Indonesia, New Guinea and Pacific Ocean islands, 22 endemic genera are found (Bolton, 1995). Thus, about 27% of them are Bornean ants.
Borneo has tropical rain forests with the richest plant diversity in the world. This is one of reason why the island has very diverse and unique ant fauna. Ant fauna in Borneo, especially in the canopy of tropical rain forests, has yet to be studied in detail. As the ant inventory are completed, many additional or new genera and species should be found from Borneo.

Notes on the keys

The keys provided here are designed to identify workers only. This is because workers are the most commonly encountered caste of ants in inventory. For sake of no-ant specialist user, I try to select and use easily observable characters in the keys. However, the use of a microscope is essential for identification of ants, because of their small size.

To make reliable identification, it is advisable to check additional information to confirm your identification. The additional information includes the diagnostic characters and biological information of taxonomic group, and the known distribution of the group. The book of Hölldobler and Wilson (1990), and Social insect Web-site (http://research.amnh.org/entomology/social_insects/) can help you to search such information. This chapter also provide genus list of Bornean ants, with their taxonomic references and biological data.

In some case specimen may not identified certainly. When this happens, you try to use Bolton’s key (1994). The illustrations provided here should help you to understand the taxonomic descriptions in the key.

Preparation and Preservation of ant specimens

The preparation of ant specimen is more important than the collection of specimen in the field. Big size organisms, like mammal and birds, can be identified in the field. However, small organisms, like ants, are needed to preserve and prepare for identification in the laboratory. The use of good preservation and preparation techniques serves to facilitate the identification of species and improves research value of specimen. Preparation and preservation techniques of ant specimens, here, are outlined.

1) Pinning Specimens

Insect specimens are mounted on pins so that they may be handled and examined with the greatest convenience. Therefore, for identification and taxonomic study, pinning specimens should be used. Fig. 1 shows typical tools needed to make pinning specimens.

Commonly used specimen mounting tools include a pinning block, forcep, pins, points, glue.

Ants are usually too small to be pinned directly, and so should be pinned as double mounts, i.e., the specimen is glued to a card point and the point is pinned through the broad end with a No. 3 insect pin (Fig. 2). Card points are slender little triangles of stiff paper, which are cut from a strip of paper (they should be no more than 10 mm long and 5 mm wide). The choice of good quality paper for card points is important to prevent the specimen from working lose and rotating on the pin. To mount the specimens on card points, white glue is used commonly. Touch the tip of the point to the glue, and then the point is attached to the
Fig. 2 - Pinning ant specimen

Insect pine (No.3)

12-14 mm

12-15 mm

7-10 mm

Data labels

Card points

SB-00121202

Primary forest (alt., 86-400m)
NSAB1209'E118AB3702'

TABIN SABAH MALAYSIA
12 xii 2000
Y. Hashimoto leg.
platform formed by the middle and hind coxae, inserting the point from the right side. Only a small amount of glue should be used, since excessive glue may obscure certain structures necessary for identification. The height of the card point on the pin will depend somewhat on specimen size, but enough of the pin should always be exposed above it to be grasped without the fingers touching and possibly damaging the specimen. Good height may be obtained by using the pinning block.

Fig. 3 illustrates some right and wrong examples for mounting specimen. In well-mounted specimen, the side of the alitrunk, the dorsal profile, and the dorsal and ventral margins of the petiole are clearly visible (Fig. 3A). Otherwise, in poorly-mounted specimen, the legs are projecting upward, obscuring the dorsal profile and the petiole (Fig. 3B). In ants, the area around the alitrunk and petiole bear many identification characters, and therefore the parts of the body should be free for easy examination. The head is also an important area for identification. It is advisable to push upward a pair of antennae, so that they do not obscure the head (Fig. 3C). In many genera, the palp formula and mandibular dentition are diagnostic characters. One or more specimens in a series should have the mandibles opened and the mouthparts everted prior to mounting. It is somewhat troublesome and time-consuming work to make good mounted specimens. However, if any identification key is to be used with some hope of success, specimens must be mounted in the way that the characters needed for identification are clearly visible.

2) Labeling
Specimens without data labels have no scientific value. Therefore, during preparation and mounting, specimens should bear temporary data labels, and any time a sample is subdivided, the label must be copied so that every specimen continues to be accompanied by the data. Here, the important points for making the labels are described.

A) Paper and Size of Label
The paper used for making labels should be thick enough so that the labels remain flat and do not rotate loosely on the pin. Label size of insect specimen may depend on the size of the insect on a pin. An advantage of a label that exceeds the size of the insect is that if the specimen is accidentally dropped, the label may keep the insect from being damaged. However, for ant specimens, it is proper that the size should be no more than 12 mm long and 3 mm wide (Fig. 2), because most ants are very small and large labels are inconvenient to handle and examine specimen. If more data are included, more than one label should be used.
B) Label printing
The style and technique of label printing or writing may vary from one worker to another. Recently, computer-generated labels printed by laser printers become increasingly common. This way has made it easier to produce labels in very small font sizes. And word processor and database software that help in generating this kind of label is widely available. However, toner of laser printer may deteriorate with age so that laser printed label will peeled off the toner finally. Methods of computer-generated labels are subject to improvement. The best labels may still be professionally printed labels.

C) Label Data
Collection locality, date (day, month and year), and collector name is indispensable specimen data. These data should be printed on a label (Fig. 2). Furthermore, since Global Positioning System (GPS) is available now, it is recommendable to put latitude and longitude on a label in addition to the primary locality data. For ants, information about collecting or nesting site, such as soil, leaf-letter and tree, are of great importance for identification purposes, and so usually recorded on additional labels. When a colony can be collected, it is advisable that colony code-number is assigned to the specimens belonged to the colony. This way ensures to refer combination with different castes from same colony.

D) Placing the Labels
The pin is inserted through the center of the right side of the label (Fig. 2), with the long axis of the label oriented in the same direction as the card point.

Wet specimen - Liquid Preservation
In ants, liquid preservation is well used for duplication specimen storage, and also temporary storage of ant specimens, until the specimen can be mounted. Most commonly, 70-80% ethanol is used as preservation fluids. Fig. 4 shows typical tools needed to preserve wet-specimens. The specimens are kept in a small vial and then the vials are kept in a jar. Each vial should be individually labeled with complete collection data. Labels may also be placed on the outside of the jars to indicate the enclosed contents. Special care should be taken with labels for wet-specimens. Typewritten labels and laser printed labels are generally unacceptable, since such labels cannot withstand the constant exposure to the alcohol. The best may be the labels writing with soft lead pencil or India inks. Each vial and jar should be filled with alcohol to the top. And, the jars should be checked periodically to prevent alcohol evaporation.

Preservation for Molecular and Chemotaxonomic studies
In ants, specimens for molecular work should be collected in absolute (100%) ethyl alcohol. It is best that specimens are thoroughly dehydrated by changing the alcohol at least a couple of time before the specimens are stored for any length of time. It is also advisable to keep the specimens in refrigerator. For chemotaxonomic analysis of body-surface wax, ant specimen should be kept in less than 70% ethyl alcohol, to prevent dissolution of the wax into preservation fluid.
References
KEY TO BORNEAN SUBFAMILY OF FORMICIDAE
(No. 1)
KEY TO BORNEAN SUBFAMILY OF FORMICIDAE (No. 2)
KEY TO BORNEAN SUBFAMILY OF FORMICIDAE
(No. 3)
KEY TO BORNEAN SUBFAMILY OF FORMICIDAE (No. 4)

Cerapachyinae
(with the single genus Cerapachys)

Leptanilinae

Aenictinae
(with the single genus Aenictus)

Promesonotal sulci are dorsally distinct (A).

Promesonotal sulci are densely absent (A).

Upper surface of the tip of the gaster (the pygidium) rounded and without a row of spines or teeth on its outer and trailing edge (a).

Lower surface of the tip of the gaster (the pygidium) flattened and with a row of small spines or peg-like teeth along its outer and trailing edge (A).
Key to Bornean Genera of the Subfamily Dolichodeinae (No. 1)
Key to Bornean Genera of the Subfamily Dolichodeinae (No. 2)
Key to Bornean Genera of the Subfamily Dolichodeinae (No. 3)
Key to Bornean Genera of the Subfamily Formicinae (No. 1)
Key to Bornean Genera of the Subfamily Formicinae
(No. 2)
Key to Bornean Genera of the Subfamily Formicinae
(No. 3)
Key to Bornean Genera of the Subfamily Formicinae
(No. 3-1)
Key to Bornean Genera of the Subfamily Formicinae
(No. 4)
Key to Bornean Genera of the Subfamily Formicinae
(No. 4-1)
Key to Bornean Genera of the Subfamily Formicinae (No. 4-2)
Key to Bornean Genera of the Subfamily Formicinae
(No. 5)
Key to Bornean Genera of the Subfamily Leptanillinae
(No. 1)
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 1)
Key to Bornean Genera of the Subfamily Myrmicinae (No. 2)
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 3)
Key to Bornean Genera of the Subfamily Myrmicinæ (No. 4)
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 5)
Key to Bornean Genera of the Subfamily Myrmicinae (No. 5-1)
Key to Bornean Genera of the Subfamily Myrmicinae (No. 6)
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 6-1)
Key to Bornean Genera of the Subfamily Myrmicinae (No. 6-2)
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 6-2-1)
Key to Bornean Genera of the Subfamily Myrmicinae (No. 6-2-2)
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 7)
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 7-1)

1. Area of the clypeus immediately below the antennal sockets raised into a short-keeled ridge (A).
   - (No. 7)

2. Acanthomyrmex
   - Aphaenogaster
   - Dilobocentroidea
   - Lordomyrmex
   - Monomorium
   - Myrmecina
   - Parapagina
   - Pheidole
   - Progna
   - Rotundaria
   - Secostrum
   - Vollenhavia
   - Vombisidris

3. Head shape roughly square or rectangular (A). Frontal carinae present (AA).


5. Tetramorium (part) (Tetramorini)

6. Rhoptromyrmex (Tetramorini)

7. Cardiocentroidea (part) (Formicoxenini)

8. Lateral portions of clypeus flattened and projecting as a shelf over the mandibles (A).

9. Lateral portions of clypeus not flattened, not projecting as a shelf over the mandibles (aa).
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 7-2)
Key to Bornean Genera of the Subfamily Myrmicinae
(No. 7-3)
Key to Bornean Genera of the Subfamily Myrmicinae (No. 7-4)
Key to Bornean Genera of the Subfamily Myrmicinae (No. 7-5)
Key to Bornean Genera of the Subfamily Ponerinae (No. 1)
Key to Bornean Genera of the Subfamily Ponerinae
(No. 2)
Key to Bornean Genera of the Subfamily Ponerinae (No. 3)
Key to Bornean Genera of the Subfamily Ponerinae  
(No. 4)

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Horizontal frontal lobes completely absent so that antennal sockets are entirely visible and the antennal sockets not on a shelf-like projection which overhangs the mandibles (A)

Probolomyrmex  
(Platythyreini)

(No. 1)

Mandibles long and extensile (A)

(No. 4-1)  
Anachetus  
Harpeggnathos  
Myopias  
Odontomachus

Horizontal frontal lobes present and the antennal sockets never on a shelf-like projection overhanging the mandibles (A)

Centromyrmex  
Cryptopone  
Diacamma  
Emeryopone  
Hypoponera  
Leptogenys  
Odontoponera  
Pachycondyla  
Ponera
Key to Bornean Genera of the Subfamily Ponerinae (No. 4-1)
Key to Bornean Genera of the Subfamily Ponerinae (No. 4-2)
Key to Bornean Genera of the Subfamily Ponerinae
(No. 4-3)
Key to Bornean Genera of the Subfamily Ponerinae
(No. 4-4)
Key to Bornean Genera of the Subfamily Ponerinae (No. 4-5)
Key to Bornean Genera of the Subfamily Ponerinae
(No. 4-6)
Glossary of Ant Morphology

Abdomen
The abdomen in worker ants consists of seven visible segments (A1-7). The first abdominal segment is the propodeum (PPD, A1), which immovably fused to the thorax. The second abdominal segment is the petiole (PT, A2). Abdominal segment 3 is the first gastral segment when it is full-sized and broadly articulated to the following segment (A3), but when reduced and isolated it is called the postpetiole (PPT). Abdominal segment 3 or 4 through to 7 is called the gaster (GA). The last visible abdominal tergite (A7) is the pygidium (PY), and the last visible sternite is the hypopygium (HY).
See Petiole.

Acidopore (AC)
It is the orifice of the formic acid projecting system, which is formed from apex of the hypopygium, appearing a short nozzle, generally with a fringe of short setae.

Alitrunk (Mesosoma)
The alitrunk consists of the three segments of the true thorax (pro-, meso-, and metathorax) to which is fused the propodeum (the tergite of the first abdominal segment), to form a single unit (AL).

Pronotum (PN): The dorsal sclerite of the prothorax. In ants, the pronotum extends across to dorsum and down the sides of the prothorax.

Propleuron (PR): The lateral part of the prothorax. In ants, the propleuron is concealed by the lateral part of the propleuron.

Mesonotum (MS): The dorsal part of the mesothorax. In ants, the mesonotum may be separated from the pronotum by the promesonotal suture (PMS), or may be fused to it to form a single sclerite, the promesonotum (prs).

Mesopleuron (MSP): The lateral and ventral part of the mesothorax. The mesopleuron may consist of a single sclerite or may be divided by a transverse groove into an upper and a lower part.
Metanotum (MTN): The dorsal sclerite of the metathorax. In ants, the metanotum may be reduced, or obliterated.

Metanotal groove (MTG): In ants, the mesonotum and propodeum are often separated by a transverse groove or impression (Metanotal groove) representing the last vestige of the metanotum.

Metapleuron (MTP): The lateral and ventral part of the metathorax. In ants, the metapleuron is located posteriorly on the side of the alitrunk, below the level of the propodeum. The metapleuron bears metapleural grand (MG).

See metapleural grand

Antenna
It is a paired segmented sensory appendage of the head between the compound eyes, which consists of three parts, scape (SC), pedicel (PD) and funiculus (= flagellum, FU). The antenna in ants consists of 4-12 segments. The funicular segments may be filiform or enlarged to form a club.

Attenal scrobe (ASC)
It is a groove, impression, or excavation in the side of the head, which runs above or below the eye, for reception of antennal scapes.

Antennal socket (insertion)
The scape articulates with the head in the antennal socket (ASO). In ants, the antennal sockets usually are overhung and concealed the frontal lobe, but in some the frontal lobe absent or reduce so that they are exposed.
Club (CL)
The enlarged apical funicular segments of an antenna. In ants, apical 1-4 segments may be enlarged to form a club.

Frontal carina (FC)
A pair of longitudinal ridges on the head, located dorsally behind the clypeus and between the antennal sockets. Commonly the frontal carinae anteriorly are expanded into the frontal lobes. See Frontal lobes

Clypeus (CP)
Anterior sclerite of the dorsal head, bounded posteriorly by the fronto-clypeal suture (= posterior clypeal margin or border, FS). The anterior clypeal margin usually forms the anterior margin of the head in full-face view. The body of the clypeus consists of median portion and a pair of lateral portions (MC, LC). The median portion of the clypeus may be equipped with one or more longitudinal carinae, or may be variously specialized in shape.

In some taxa the clypeus is very reduced and extremely narrow from front to back.

Frontal lobe (FB)
The frontal lobes commonly are extensions, which partially or entirely cover and conceal the antennal sockets.

Leg segments
Each leg consists of a basal coxa (BC) that articulates with the alitrunk, followed in order by a trochanter (TR), femur (FE), a tibia (TB), and a tarsus (TA), the last consisting of five small segments and terminating apically in a pair of claws (CA).

Tibial spur (TBS) A socketed spur located at the apex of each tibia. The forelegs have a single pectinate tibial spur, modified into an antennal cleaner (strigil). The middle and hind legs may each have two, one, or no spurs present.
Mandible (MD)
The paired, heavily sclerotized appendage of the mouthparts between the labrum and maxilla (See Mouth parts). In ants, the mandibular margins usually form a triangular or subtriangular shape in full-face view, but in some become from elongate-triangular to linear mandibles. Extremely curved mandibles, usually quite short and with few or no teeth are termed falcate.

Apical margin (masticatory margin, MA): In full-face view, with the mandibles closed, the apical margin forms inner margin or border of each mandibular blade, and is usually armed with teeth.

Basal margin (MB): The basal margin of each mandible is transverse or oblique margin closest to an anterior clypeal margin. The apical and basal margins may join through a curve, or meet in an angle (Basal angle, BA). When the mandibles are narrow or linear, the basal angle may be lost. In a few taxa teeth may occur on the basal margin, but in most this margin is unarmed.

External margin (lateral margin, ME): The external margin of each mandible forms its outer border.

Teeth (T): Teeth are usually sharp and triangular in shape but may be rounded (crenulate), long, narrow, and spine-like (spiniform), or peg-like. The tooth at or nearest to the basal angle is the basal tooth (BT), and the distalmost tooth is apical tooth (AT). When teeth or a combination of teeth and denticles are present, the mandible is dentate. If only tiny denticles occur the mandible is denticulate, and if the margin lacks teeth and denticles it is edentate.

Denticles (DN): Denticles are short or very reduced acute teeth.

Diastema (DI): A diastema is a gap in a row of teeth.

Diastema (DI): A diastema is a gap in a row of teeth.
Metapleural grand (MG)
The metapleural grand is an exocrine gland whose orifice is usually situated in the posterolateral corner of the side of the alitrunk, above the level of the metacoxa and below the level of the propodeal spiracle.

Mouthparts
The appendages of the head used for feeding, including the labrum, hypopharynx, mandibles, maxillae, and labium.

Maxillary palps (MP): The segmented sensory palps of the maxillae. Each palp may have at most 6 segments but these are variously reduced in number in different ant groups.

Labial palps (LP): The segmented sensory palps of the labium. Each palp may have at most 4 segments but these are variously reduced in number in different ant groups. A way of indicating the number of segment in the maxillary and labial palps is termed as Palp Formula (PF). The number of maxillary palp segments is given first, the number of labial palp segments second.

Labrum (LB): Mouthpart sclerite that hinges on the anterior margin of the clypeus and usually folds back and down over the apices of the maxillae and labium when the mouthparts are not in use.

Occipital carina (OC)
A ridge on the posterior surface of the head that separates the occiput from the vertex and gena.

Petiole (PT)
The second abdominal segment (see Abdomen). The petiole takes the form of a node (nodiform) or of a scale (squamiform), but in some taxa it may be represented by only a narrow, subcylindrical segment.

Peduncle (PD): The relatively narrow anterior section of the petiole. When the peduncle is present, the petiole is termed pedunculate. When the peduncle is absent, so that the node or scale of the petiole immediately follows the articulation with propodeum, the petiole is termed sessile.
Spongiform (SP)
Specialized sponge-like external cuticular tissue, distributed mainly about the waist segments in some groups of ants.
Genus list of Bornean Ants

Subfamily Aenictinae
Tribe Anenictini

Genus Aenictus Shuckard 1840
Type species: Aenictus ambiguous, by original designation.

Taxonomic Reference

Biology: Army ants (Predators of other ants)

Subfamily Cerapachyinae
Tribe Cerapachyini

Genus Cerapachys Smith 1857
Type species: Cerapachys antennatus, designated by Bingham (1903).

Taxonomic References

Biology: Army ants (Predators of other ants)

Subfamily Dolichoderinae
Tribe Dolichoderini

Genus Bothriomyrmex Emery 1869
Type species: Bothriomyrmex costae Emery, by monotypy.

Taxonomic Reference

Habitat: Wide variety of habitats, from grasslands to lowland rain forests. Nests in soil or in rotten wood

Biology: Foraging on ground and trees. Some are temporary sociall parasites of Tapinoma and Iridomyrmex.

Genus Dolichoderus Lund 1831
Type species: Formica attelaboides, by monotypy.

Taxonomic References

Habitat: Arboreal

Biology: Generalized foragers, tend homopteras
Genus *Iridomyrmex* Mayr 1862

**Type species:** *Formica detecta*, designated by Bingham (1903).

**Taxonomic Reference**


**Habitat:** Wide variety of habitats, from grasslands to lowland rain forests. Nests in soil or in rotten wood

**Biology:** Generalized foragers, tend homopteras

Genus *Loweriella* Shattuck 1992

**Type species:** *Loweriella boltoni*, by original designation.

**Taxonomic References**


**Habitat:** Leaf litter in rain forests

**Note:** The single species, *Loweriella boltoni*, is known from Sarawak and Brunei

Genus *Philidris* Shattuck 1992

**Type species:** *Formica cordata*, by original designation.

**Taxonomic References**


**Habitat:** Forests

**Biology:** Generalized foragers, tend homopteras

Genus *Tapinoma* Foerster 1850

**Type species:** *Tapinoma collina*, by monotypy.

**Taxonomic Reference**


**Habitat:** Wide variety of habitats, from grasslands to lowland rain forests. Nests in soil or in rotten wood

**Biology:** Generalized foragers, tend homopteras

**Note:** One species, *T. melanocephalum*, is a tramp species widely distributed in tropical regions

Genus *Technomyrmex* Mayr 1872

**Type species:** *Technomyrmex strenuus*, by monotypy.

**Taxonomic Reference**


**Habitat:** Moist forests. Nests in soil, in branches, or in carton nests under leaves or tree trunks.

**Biology:** Generalized foragers, tend homopteras

**Note:** One species, *T. albipes*, is a tramp species widely distributed in tropical regions
Subfamily **Dorylinae**  
Tribe **Dorylini**

Genus **Dorylus** Fabricius 1793  
**Type species:** *Vespa helvola*, by monotypy.

**Taxonomic Reference**  


**Biology:** Army ants. Generalized predators

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Subfamily **Formicinae**  
Tribe **Brachymyrmeccini**

Genus **Cladomyrma** Wheeler 1920  
**Type species:** *Aphomomyrmex hewitti*, by original designation.

**Taxonomic Reference**  


**Habitat:** Nests in live pithy

**Biology:** Generalized foragers. Tend coccoids (Pseudococcidae) inside the nest hollows.

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Tribe **Bregmatomyrmini**

Genus **Bregmatomyrma** Wheeler, 1929  
**Type species:** *Bregmatomyrma carnosa* Wheeler, by original designation.

**Taxonomic Reference**  

**Note:** Only single species, *B. carnosa*, (queen only) is known from Borneo.

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Tribe **Camponotini**

Genus **Camponotus** Mayr 1861  
**Type species:** *Formica ligniperda Latreille*, designated by Bingham (1903).

**Taxonomic Reference**  

**Habitat:** Nests in ground, in dead wood, or in trees.

**Biology:** Generalized foragers.

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Genus **Echinopla** Smith 1857  
**Type species:** *Echinopla melanarctos*, designated by Wheeler (1911).

**Taxonomic Reference**  

**Habitat:** Arboreal

**Biology:** Foraging on trees
Genus *Polyrhachis* Smith 1857

*Type species:* *Formica bihamata,* by original designation.

**Taxonomic Reference**


**Habitat:** Many arboreal. some in silk-woven leaf nests.

**Biology:** Generalized foragers

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Tribe *Gesomyrmecini*

Genus *Gesomyrmex* Mayr 1868

*Type species:* *Gesomyrmex hoernesi,* by monotypy.

**Taxonomic Reference**


**Habitat:** Arboreal

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Tribe *Lasiini*

Genus *Euprenolepis* Emery 1906

*Type species:* *Prenolepis procera,* by original designation.

**Taxonomic Reference**


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Genus *Paratrechina* Motschoulsky 1863

*Type species:* *Paratrechina currens,* designated by Wheeler (1911).

**Taxonomic Reference**


**Habitat:** Nests in open soil or under rocks or other objects, or in rotten wood on the ground.

**Biology:** Generalized foragers

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Genus *Pseudolasius* Emery 1887

*Type species:* *Formica familiaris,* designated by Bingham (1903).

**Taxonomic Reference**


**Habitat:** Nest in soil under rocks or logs or in rotten wood on the ground.

**Biology:** Cryptic foragers. Tend homopterans
Tribe Myrmoteratini

Genus *Myrmoteras* Forel 1893  
**Type species:** *Myrmoteras binghamii*, by monotypy.

**Taxonomic Reference**

**Habitat:** Epigaeic  
**Biology:** Predators on forest floor

Tribe Oecophyllini

Genus *Oecophylla* Smith 1860  
**Type species:** *Formica virescens*, designated by Bingham (1903).

**Taxonomic Reference**

**Habitat:** Nesting in arboreal, silk-woven leaf nests.  
**Biology:** Predator, tend homopterans.

Tribe Plagiolepidini

Genus *Acropyga* Roger 1862  
**Type species:** *Acropyga (Atopodon) inezae* Forel, designated by Wheeler (1913).

**Taxonomic Reference**

**Habitat:** Hypogaeic  
**Biology:** Tend coccids on the roots of plants

Genus *Anoplolepis* Santschi 1914  
**Type species:** *Formica longipes* Jerdon, by monotypy.

**Taxonomic Reference**

**Habitat:** Nesting in soil  
**Biology:** Generalized foragers

Genus *Lepisiota* Santschi 1926  
**Type species:** *Plagiolepis rothneyi*, by original designation.

**Taxonomic Reference**

**Biology:** Generalized foragers
Genus *Plagiolepis* Mayr 1861

**Type species:** *Formica pygmaea*, by monotypy.

**Taxonomic Reference**


**Biology:** Generalized foragers

**Subfamily LEPTANILLINAE**

**Tribe Anomalomyrmini**

Genus *Anomalomyrma* Taylor 1990, in Bolton 1990

**Type species:** *Anomalomyrma taylori* Bolton, by original designation.

**Taxonomic Reference**


**Habitat:** Nesting in soil

**Biology:** Cryptic predators

Genus *Protanilla* Taylor 1990, in Bolton 1990

**Type species:** *Protanilla rafflesi*, by original designation.

**Taxonomic Reference**


**Habitat:** Nesting in soil or in rotten wood

**Biology:** Cryptic predators

**Tribe Leptanillini**

Genus *Leptanilla* Emery 1870

**Type species:** *Leptanilla revelieri*, by monotypy.

**Taxonomic Reference**


**Habitat:** in soil

**Biology:** Cryptic mass predators (of centipedes)

**Subfamily MYRMICINAE**

**Tribe Basicerotini**

Genus *Eurhopalothrix* Brown & Kempf 1961

**Type species:** *Rhopalothrix bolaui*, by original designation.

**Taxonomic Reference**


**Habitat:** Nesting in leaf litter

**Biology:** Predators
Tribe Cataulacini

Genus *Cataulacus* Smith 1853

**Type species:** *Cataulacus taprobanae*, designated by Bingham (1903).

**Taxonomic Reference**


**Habitat:** Arboreal, nesting in plant cavities

Tribe Crematogastrini

Genus *Crematogaster* Lund 1831

**Type species:** *Formica scutellaris*, designated by Bingham (1903).

**Taxonomic Reference**

- **Habitat:** Arboreal, nesting in hollow tree trunks and branches. Some in soil

**Biology:** Generalized foragers

Tribe Dacetonini

Genus *Pyramica* Roger 1862

**Type species:** *Pyramica gundlachi*, by monotypy.

**Taxonomic Reference**

- **Bolton, B. 1999** Ant genera of the tribe Dacetonini (Hymenoptera: Formicidae). Journal of Natural History 33: 1639-1689
- **Habitat:** Nesting in leaf litter

**Biology:** Predators, mainly of collembolans

Genus *Strumigenys* Smith 1860

**Type species:** *Strumigenys mandibularis*, by monotypy.

**Taxonomic Reference**

- **Bolton, B. 1999** Ant genera of the tribe Dacetonini (Hymenoptera: Formicidae). Journal of Natural History 33: 1639-1689
- **Habitat:** Nesting in leaf litter

**Biology:** Predators, mainly of collembolans

Tribe Formicoxenini

Genus *Cardiocondyla* Emery 1869

**Type species:** *Cardiocondyla elegans*, by monotypy.

**Taxonomic Reference**

Habitat: Nesting in ground
Biology: Generalized forage on the ground surface

Genus \textit{Dilobocondyla} Santschi 1910
Type species: \textit{Atopomyrmex selebensis}, designated by Wheeler (1911).
Taxonomic Reference
Habitat: Arboreal, nesting in twigs.

Genus \textit{Paratopula} Wheeler 1919
Type species: \textit{Atopomyrmex ceylonicus}, by original designation.
Taxonomic Reference
Habitat: Arboreal (?)

Genus \textit{Rotastruma} Bolton 1991
Type species: \textit{Rotastruma recava}, by original designation.
Taxonomic Reference
Habitat: Arboreal
Biology: Foraging on tree

Genus \textit{Vombisidris} Bolton 1991
Type species: \textit{Vombisidris philax}, by original designation.
Taxonomic Reference
Habitat: Arboreal
Biology: Foraging on tree

Tribe \textit{Melissotarsini}

Genus \textit{Rhopalomastix} Forel 1900
Type species: \textit{Rhopalomastix rothneyi}, by monotypy.
Taxonomic Reference
Habitat: Nesting under bark (?)
Biology: Foraging on under bark, or on low vegetation
Tribe **Meranoplini**

Genus *Meranoplus* Smith 1853  
**Type species:** *Cryptocerus bicolor*, designated by Bingham (1903).

**Taxonomic References**  

**Habitat:** Nesting in the ground  
**Biology:** Scavengers (some specialize on seeds)

Tribe **Metaponini**

Genus *Liomyrmex* Mayr 1865  
**Type species:** *Myrmica caeca.*

**Taxonomic References**  
Ettershank, G. 1966 A generic revision of the world Myrmicinae related to Solenopsis and Pheidologeton.  
Australian Journal of Zoology 14: 73-171  

**Habitat:** Nesting under bark, or in rotten woods

Genus *Metapone* Forel 1911  
**Type species:** *Metapone greeni*, by monotypy.

**Taxonomic References**  
Forel, A. 1911 Sur le genre Metapone n.g. nouveau groupe des formicides et sur quelques autres formes nouvelles.  

**Habitat:** Nesting in hollow twings, or in rotten woods  
**Biology:** Predators of termites

Genus *Vollenhovia* Mayr 1865  
**Type species:** *Vollenhovia punctatostriata*, by monotypy.

**Taxonomic References**  

**Habitat:** Many nesting under bark in logs  
**Biology:** Predators (of termites)

Tribe **Myrmecinini**

Genus *Myrmecina* Curtis 1829  
**Type species:** *Myrmecina latreillii*, by monotypy.

**Taxonomic References**  

**Habitat:** Nesting in soil  
**Biology:** Predators of mites
Genus *Acanthomyrmex* Emery 1893  
**Type species:** *Acanthomyrmex luciolae* Emery, designated by Bingham (1903).

**Taxonomic References**

**Habitat:** Nesting in cavities in logs, or in leaf litter  
**Biology:** Seed harvesters (especially of ficus)

Genus *Pristomyrmex* Mayr 1866  
**Type species:** *Pristomyrmex pungens*, by monotypy.

**Taxonomic References**

**Habitat:** Nesting in rotten wood on the ground, or in soil under stones  
**Biology:** Generalized foragers.

**Tribe Myrmicarini**

Genus *Myrmicaria* Saunders 1842  
**Type species:** *Myrmicaria brunnea*, by monotypy.

**Taxonomic References**

**Habitat:** Many Arboreal  
**Biology:** Generalized foragers.

**Tribe Phalacromyrmecini**

Genus *Ishakidris* Bolton 1984  
**Type species:** *Ishakidris ascitaspis*, by original designation.

**Taxonomic References**

**Habitat:** Leaf litter  
**Note:** The single species, *I. ascitaspis*, is known from Winkler bag sample collected in Sarawak.

**Tribe Pheidolini**

Genus *Aphaenogaster* Mayr 1853  
**Type species:** *Aphaenogaster sardoa* Mayr, designated by Bingham (1903).

**Taxonomic References**

**Habitat:** Nesting in soil  
**Biology:** Generalized foragers
Genus *Chimaeridris* Wilson 1989  
**Type species:** *Chimaeridris boltoni*, by original designation.  

**Taxonomic References**  

Genus *Lophomyrmex* Emery 1892  
**Type species:** *Oecodoma quadrispinosa*, by monotypy.  

**Taxonomic References**  
**Habitat:** Nesting in soil near the base of trees  
**Biology:** General foragers

Genus *Pheidole* Westwood 1839  
**Type species:** *Atta providens*, by monotypy.  

**Taxonomic References**  

**Habitat:** Nesting in soil, or in rotten wood  
**Biology:** General foragers

**Tribe Pheidologetonini**

Genus *Oligomyrmex* Mayr 1867  
**Type species:** *Oligomyrmex concinnus*, by monotypy.  

**Taxonomic References**  
**Habitat:** in soil  
**Biology:** Prey on brood and eggs of termites, or ants

Genus *Pheidologeton* Mayr 1862  
**Type species:** *Oecodoma diversa*, designated by Bingham (1903).  

**Taxonomic References**  
**Habitat:** Nesting in soil  
**Biology:** Generalized and mass foragers

Genus *Recurvidris* Bolton 1890  
**Type species:** *Trigonogaster recurvispinosa Forel*, by monotypy. Replacement name for *Trigonogaster* Forel, by Bolton (1992).
Part 3 - COLLECTING, HANDLING, IDENTIFICATION AND STORAGE FOR SELECTED GROUPS

Taxonomic References


**Habitat:** Nesting in soil

**Biology:** Generalized foragers

**Tribe Solenopsidini**

Genus **Anillomyrma** Emery 1913

**Type species:** Monomorium decamerum Emery, by monotypy.

**Taxonomic References**


**Habitat:** Nesting in soil, or in termite nests

**Biology:** Prey on termites (?)

Genus **Epelysidris** Bolton 1987

**Type species:** Epelysidris brocha, by original designation.

**Taxonomic References**


**Habitat:** Moss forest, nesting in soil under the moss and rocks.

**Note:** Only single species, E. brocha, is known form Sarawak.

Genus **Monomorium** Mayr 1855

**Type species:** Monomorium minutum, by monotypy.

**Taxonomic References**


**Habitat:** Nesting under rocks, under bark, or in rotten branches.

**Biology:** Scavengers. Seed harvesters

Genus **Solenopsis** Westwood 1840

**Type species:** Solenopsis mandibularis, by monotypy.

**Taxonomic References.**


**Habitat:** Nesting in ground

**Biology:** Generalized foragers and thief ants
Tribe *Stenammini*

Genus *Calyptomyrmex* Emery 1887

**Type species:** *Calyptomyrmex beccarii* Emery, by monotypy.

**Taxonomic References**


**Habitat:** Leaf litter

Genus *Dacetinops* Brown & Wilson 1957

**Type species:** *Dacetinops cibdelus*, by original designation.

**Taxonomic References**


Genus *Lasiomyrma* Terayama & Yamane 2000

**Type species:** *Lasiomyrma gedensis* Terayama & Yamane, by original designation

**Taxonomic References**


**Habitat:** Nesting in rotten woods

Genus *Lordomyrma* Emery 1897

**Type species:** *Lordomyrma furcifera*, designated by Wheeler (1911).

**Taxonomic References**


**Habitat:** Nesting in soil, or in rotten woods

Genus *Mayriella* Forel 1902

**Type species:** *Mayriella abstinens*, by monotypy.

**Taxonomic References**


**Habitat:** Nesting in soil, or rotten logs

**Biology:** Foraging in leaf litter

Genus *Proatta* Forel 1912

**Type species:** *Proatta butteli*, by monotypy.

**Taxonomic References**

Habitat: Nesting in soil
Biology: Scavengers

Genus *Tetheamyrma* Bolton 1991
Type species: *Tetheamyrma subspongia*, by original designation.

**Taxonomic References**
Habitat: Nesting in leaf litter
Note: Only single species, *T. subspongia*, is known from Sabah, Poring.

**Tribe Tetramoriini**

Genus *Rhoptromyrmex* Mayr 1901
Type species: *Rhopalomastix rothneyi*, by monotypy.

**Taxonomic References**
Habitat: Nesting in soil
Biology: Social parasites (of Pheidole, Tapinoma)

Genus *Secostruma* Bolton 1988
Type species: *Secostruma lethifera*, by original designation.

**Taxonomic References**
Habitat: Nesting in soil
Note: Only single species, *S. lethifera*, is known from soil core sample collected in Sabah, Gunong Silam.

Genus *Tetramorium* Mayr 1855
Type species: *Formica caespitum*, designated by Girard (1879).

**Taxonomic References**
Habitat: Nesting in soil
Biology: Generalized foragers
Subfamily PONERINAE

Tribe Amblyoponini

Genus *Amblyopone* Erichson 1842
Type species: *Amblyopone australis* Erichson, by monotypy.

Taxonomic References


Habitat: Nesting in soil under rocks or logs, or in rotten wood.
Biology: Cryptic predators (some specialist to prey centipeds)

Genus *Myopopone* Roger 1861
Type species: *Myopopone maculata*, designated by Bingham (1903).

Taxonomic References


Habitat: Nesting in rotten wood or under bark.
Biology: Predator (some specialist predator on millipeds)

Genus *Mystrium* Roger 1862
Type species: *Mystrium mysticum*, by monotypy.

Taxonomic References


Habitat: Nesting under rocks or logs on the ground and in leaf litter.
Biology: Predator

Genus *Prionopelta* Mayr 1866
Type species: *Prionopelta punctulata*, by monotypy.

Taxonomic References


Habitat: Nesting under rocks or logs on the ground and in leaf litter.
Biology: Predator (of chilopda)

Tribe Ectatommini

Genus *Discothyrea* Roger 1863
Type species: *Discothyrea testacea*, by monotypy.

Taxonomic References

Roger, J. 1863 Die neu aufgefuhrten Gattungen und Arten meines Formiciden-Verzeichnisses, nebst Ergaenzung.
Genus *Gnamptogenys* Roger 1863  
**Type species:** *Ponera tornata*, designated by Emery (1911).  
**Taxonomic References**  
**Habitat:** Nesting in open soil, or in soil under rocks, or in rotten wood.  
**Biology:** Specialist predators on arthropod eggs.

Genus *Proceratium* Roger 1863  
**Type species:** *Proceratium silaceum*, by monotypy.  
**Taxonomic References**  
**Habitat:** Nesting in rotten logs on the ground.  
**Biology:** Predators (some specialist predators on millipeds)

Tribe *Platthyreini*  
Genus *Platythyrea* Roger 1863  
**Type species:** *Pachycondyla punctata*, designated by Bingham (1903).  
**Taxonomic References**  
**Habitat:** Nesting in soil, in rotten wood or in hollow twigs on trees  
**Biology:** Predator (some specialist predators on termites)

Genus *Probolomyrmex* Mayr 1901  
**Type species:** *Probolomyrmex filiformis*, by monotypy.  
**Taxonomic References**  

**Habitat:** Nesting in soil under rocks, in leaf litter or in rotten wood.

**Biology:** Cryptic predator

**Tribe** Ponerini

**Genus** Anochetus Mayr 1861

**Type species:** Odontomachus ghilianii Spinola, by monotypy.

**Taxonomic References**


**Habitat:** Nesting in soil, in termite nests or under logs.

**Biology:** Predator

**Genus** Centromyrmex Mayr 1866

**Type species:** Centromyrmex bohemanni, by monotypy

**Taxonomic References**


**Habitat:** Nesting in soil (in or near termite nest)

**Biology:** Predator of termite

**Genus** Cryptopone Emery 1893

**Type species:** Cryptopone testacea, by monotypy.

**Taxonomic References**


**Habitat:** Nesting in soil under rocks, or in rotten wood.

**Biology:** Cryptic predator

**Genus** Diacamma Mayr 1862

**Type species:** Ponera rugosa, designated by Bingham (1903).

**Taxonomic References**


**Habitat:** Nesting in soil

**Biology:** Predator

**Genus** Emeryopone Forel 1912

**Type species:** Emeryopone buttelreepeni, by monotypy.

**Taxonomic References**

- Baroni Urbani, C. 1975 Contributo alla conoscenza dei generi Belonopelta Mayr e Leiopelta gen.n. Mitteilungen
Genus *Harpegnathos* Jerdon 1851
*Type species:* *Harpegnathos saltator*, by monotypy.

**Taxonomic References**

Genus *Hypoponera* Santschi 1938
*Type species:* *Ponera abeillei*, by original designation.

**Taxonomic References**

Genus *Leptogenys* Roger 1861
*Type species:* *Leptogenys falcigera*, designated by Bingham (1903).

**Taxonomic References**

Genus *Myopias* Roger 1861
*Type species:* *Myopias amblyops*, by monotypy.

**Taxonomic References**
- Roger, J. 1861 Die Ponera-artigen Ameisen. (Schluss.) *Berl. Entomol. Z.* 5: 1-54

Genus *Odontomachus* Latreille 1804
*Type species:* *Formica haematoda*, by monotypy.

**Taxonomic References**

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Genus *Odontoponera* Mayr 1862  
**Type species:** *Ponera denticulata*, by monotypy.  

**Taxonomic References**  

**Habitat:** Nesting in soil  
**Biology:** Predator

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Genus *Pachycondyla* Smith 1858  
**Type species:** *Formica crassinoda*, designated by Emery (1901).  

**Taxonomic References**  

**Habitat:** Nesting in soil, or in logs  
**Biology:** Predator, scavengers

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Genus *Ponera* Latreille 1804  
**Type species:** *Formica coarctata*, designated by Westwood (1840).  

**Taxonomic References**  

**Habitat:** Nesting in the soil, in rotten wood, or under bark or moss on rotten logs.  
**Biology:** Cryptic predators

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**Subfamily PSEUDOMYRMECINAE**  
**Tribe Pseudomyrmecini**

Genus *Tetraponera* Smith 1852  
**Type species:** *Tetraponera atrata*, designated by Wheeler (1911).  

**Taxonomic References**  

**Habitat:** Arboreal, nesting in plants cavities  
**Biology:** Predator (?)