

SURVEY OF HYMENOPTERANS DIVERSITY IN JNANA BHARATHI CAMPUS BANGALORE UNIVERSITY

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Abstract: The Hymenopterans are one of the largest order of Insects, which includes Saw flies, wasp, bees and Ants. The survey of Insect fauna in JB campus BU was carried out from June 2014-Feb 2015. Altogether 38 spp of Hymenopterans were recorded in the study area belongs to group Aculeata and 2 super family Apoidea and Vespoidea 6 families viz Ampulicidae, Sphecidae, Megachilidae, Apidae, Formicidae and Vespidae were recorded in the entire JB campus BU. Out of 6 families most dominated family was Formicidae which includes 5 sub families, 13 genera and 19 spp. Second most dominated family was Vespidae which includes 3 sub family, 4 genera and 6 spp the occurrence of high no of Formicidae (Ant family) is mainly due to thick vegetation, enough space and good climatic conditions have made favourable to increase the population of the spp, and to lead a predator free life. This study serves as a base line for further studies of Hymenopterans in the entire JB campus.

Key words: Ampulicidae, Apidae, Apoidea, Formicidae, Megachilidae, Sphecidae and Vespidae Vespoidea.

Introduction: The Hymenoptera are the third largest Orders of insects, comprising the sawflies, wasps, bees and ants. Till now 1,50,000 species are recognized. The name Hymenoptera is derived from the Greek words "hymen" meaning "membrane" and "ptera" meaning "wings". The hind wings are connected to the fore wings by a series of hooks called hamuli. Hymenoptera first appeared in the fossil record in the late Triassic period, about 230 million years ago. The primitive lineages were plant feeding; the parasitoid mode of life and stinging hymenoptera did not appear until about 210 and 155 million years ago, respectively (Grimaldi and Engel, 2005). Both extinct and extant hymenoptera are classified into two broad groups, Symphyta and Apocrita respectively (Ronquist, 1999).

In the Symphyta the abdomen is broad with no basal constriction or petiole behind the propodeum which is only partially amalgamated with thorax. In Apocrita the abdomen stalked or constricted between the propodeum and the true second segment. They are divided into two main groups, the Aculeata and the Parasitica.

The ants or Formicidae are all social insects whose female loses her wings after mating. The petiole behind the propodeum is raised into one or two nodes. The more primitive ants rear their larvae on insect prey, but other ants store seeds, cultivate fungi or obtain honey-dew from aphids. The true wasps or Vespoidea include many solitary nest-making species nearly all of which store paralyzed caterpillars for their offspring; and the of family, Vespidae, however has social habits. The bees, or Apoidea, are closely related to them but many of their body hairs are branched and the hind basitarsus is usually broad. Many bees make nests very like those of some solitary wasps but they store a mixture of pollen and nectar for their larvae. A few groups, of

which the honey-bees and the bumble-bees are the best known, are social.

Anatomy: Hymenoptera range in size from very small to large insects, and usually have two pairs of membranous wings. The hind pair is smaller and connected with fore pair by hooklets and venation specialized by reduction. They have large compound eyes. Abdomen with 1st segment more or less closely fused with thorax, a sawing or piercing ovipositor is present. 1st abdominal segment, or propodeum with the metathorax which occurs in the prepupa and is found in all except the symphyta. The propodeum bears the 1st pair of abdominal spiracles. Mandibles are present, while the maxillae and labium have all the usual components, glossae are fused to form a broad tongue. An ovipositor is always present. A hymenopteran larva has a well-developed head, three thoracic and nine or ten abdominal segments. There are usually nine or ten pairs of spiracles, except in endoparasitic larvae where the number is variable.

Feeding habits: Different species of hymenoptera show wide range of feeding habits. Mouthparts are of biting and licking type. The most primitive form is typically herbivores, feeding on leaves or pine needles. Stinging wasps are predators, and provide their larvae with immobilized prey, while bees feed on nectar and pollen. A number of species are parasitoid as larvae. The adults inject the eggs into paralyzed host, which they begin to consume after hatching. Some species are even hyper parasitoid, with the host itself being another parasitoid insect.

Social groups in hymenopterans - Wasps and Bees: The highly specialized eusocial hymenopterans comprise the ants, wasps, Vespinae, bees, including the Apinae. Bees are derived from Sphecid wasps and differ from wasps in anatomy, physiology and behavior in association with their dietary specialization. Colony and castes in eusocial wasps

and bees: The female castes are dimorphic, Queen is larger than any worker, The typical eusocial wasps' queen has a differentiated enlarged gaster.

The task of the queen is only reproduction. In the vespine wasp, the colony founding queen or gyne produces only workers in the first brood. Immediately after these are hatched, the queen wasp ceases to forage and devotes herself exclusively to reproduction. The tasks of vespine workers include distribution of protein-rich food to larvae and carbohydrate-rich food to adult wasp, cleaning cells, disposal of dead larvae, ventilation and air-conditioning of the nest by wing fanning, nest defense by guarding entrances, foraging outside for water, sugary liquids and insect prey, and construction, extension and repair of the cells. Honey bee workers are more or less monomorphic. Young workers tend to be hive bees, engaged in within-hive activities such as nursing larvae and cleaning cells, while older workers are foraging field bees. Caste differentiation in honey bees, as in eusocial hymenopterans generally, is largely trophogenic. Food given to future queens is known as "royal jelly" and differs from worker food in having high sugar content and being composed predominantly, pantothenic acid and bipterin. The queen maintains control over the workers reproduction principally through pheromones. The mandibular glands of queens produce a compound identified as (E) -9-oxodec-2-enoic acid (9-ODA), but the intact queen inhibits workers ovarian development more effectively than this active compound.

Nest construction in eusocial wasps: The founding of a new colony of eusocial vespine wasp takes place in spring, following the emergence of an overwintering queen. Nest construction begins with the use of mandibles to scrape wood fibers from, rotten wood. The wasp returns to the nest site using visual cues, carrying the wood pulp in the mandibles. The pulp is formed into a descending pillar, upon which is suspended ultimately the embryonic colony of 20-40 cells. The first two cells, rounded in cross section, are attached and then an umbrella like envelope is formed over them. The envelope is elevated by about the width of queens body above the cells, allowing the queen to rest there. The developing colony grows by the addition of further cells, now hexagonal in cross section and wider at the open end, and by the extension of the envelope or construction of a new one. As the colony grows further pillar are added, providing support to more lateral areas where brood filled cells are aligned in colony.

Nest construction in honey bees: In honey bees, initiation of new colony is triggered when the old one gets too crowded when a bee colony becomes too large and the population density too high, a founder

queen, accompanied by a swarm of workers, seeks a new nest site. After finding the new site, workers start building a nest using wax. Wax is unique to social bees and is produced by workers that metabolize honey in fat cells located close to the wax gland. For cell construction by mixing with saliva. Workers start to construct combs. Cell sizes vary, with small cells used to rear workers and larger ones for drones. The brood develops and the pollen is stored in lower and more central cells, whereas honey is stored in upper and peripheral cell

Eusocial hymenopterans - Ants: Colony and caste in ants: All ants are social and their species are polymorphic. There are two major female castes, the reproductive queen and the workers. Many ants have monomorphic workers but others have distinct sub-castes called minor, medium or major workers, according their size. Workers are wingless, and present only in queens, which shed them after mating, most of the males which die after mating. Winged individuals are called as alates. Polymorphism in ants is accompanied by polyethism, the queen's role is restricted to oviposition and the workers performed all other tasks. Young workers take internal duties like nursing and older ones foraging outside the nest. In others, workers have functional ovaries. Queens lay the fertile eggs. Caste differentiation is largely trophogenic, involving biased allocation of volume and quality of food given to the larvae. A protein diet promotes differentiation of queen and a less rich, more dilute diet leads to differentiation of workers.

Nesting in ants: The subterranean soil nest of *Myrmica* and the mounds of plant debris of *Formica* are typically temperate ant nests. Colonies are founded when a mated queen sheds her wings and over winter, sealed into a newly dug nest that she will never leave. In *Oecophylla* sps called weaver ants have extended territories that are continually explored by workers for any leaf that can be bent; a remarkable collaborative construction effort follows in which leaves are manipulated into a tent shape by linear ranks of workers, often involving "living chains" of ants that bridge wide gaps between the leaf edges. Another group of workers take larvae from existing nests and carry them delicately between their mandibles to the construction site. These larvae are induced to produce silk thread from their well-developed silk glands and a nest is woven to link the frame work of leaves.

Study area: The study area, Jnanabharathi campus (12° 56' 35. 58" N and 77° 30' 26. 92" E) is at an elevation of 2743 feet in the South-East part of Bangalore. It encompasses a geographical area of approximately about 449.74 hectares (1100 acres) and lies in the Deccan Plateau with topography mostly of flat to moderate slopes with persistent dry deciduous,

shrub type of vegetation that has given a good habitat for Hymenopterans. Jnanabharathi campus, Bangalore University is surrounded by, various institute buildings, such as various departments, hostels, canteens, sports ground, residential quarters, research centers and biodiversity parks, which are all human dwelling places involving both residential and non residential areas; a sign of urbanized area.



Sample collection: To collect wide range of sps, we have used the following methods:

Net sweeping: Two types of nets (aerial and sweeping) were used for insect collection. The aerial net was used for collecting 'flying insects'. By using sweep net, the random insects which were not seen easily were collected by sweeping the net throughout the vegetation.

Hand picking: Consists of searching for ants on the ground, under rocks, in rotten wood on the ground or on trees, on tree trunks and under bark. Specimens are collected using forceps or a fine, moistened paint brush, or with fingers. Individuals are placed in or glass tubes which containing 75-95% of alcohol.

Pitfall trap: The pitfall trap is commonly used tool for collecting ants. A pitfall trap can be any small container placed in the same ground top level and filled with sugar syrup. Ants are collected when they fall into the trap while foraging.

Photography: Photographs of all important ants, wasps and bees (Bee hives) were taken with Nikon 16.1 Mega pixels and 26x optical zoom digital camera.

Sample preservation: Once collected, specimens are identified from either live or preserved specimens, which are transferred to 70% ethyl alcohol. Specimens are usually preserved by point mounting method.

RESULT: Altogether 38 species of Hymenopterans were recorded in the study area, Jnanabharathi campus, Bangalore. This 38 species belonged to the group Aculeata, 2 superfamily (i.e., Apoidea and Vespoidea) and 6 families, Ampulicidae, Sphecidae,

Megachilidae, Apidae, Formicidae and Vespidae. Out of 38 species, 1 species belonged to family Ampulicidae, 4 species to family Sphecidae, 1 species to family, Megachilidae, 7 species to family Apidae, 19 species to family Formicidae and 6 species to family Vespidae. Out of 6 families found family Formicidae were found in abundance which included 5 subfamilies, 13 genera and 19 species. The family Vespidae included 3 subfamilies, 4 genera and 6 species. The family Apidae included 2 subfamilies. It is also observed that the honey bee nests are as follows: 180 hives of *Trigona iridipennis*, 30 hives of *Apis dorsata*, 6 hives of *Apis cerana* and 3 hives of *Apis florea*. It is evident from data that the number of *Trigona iridipennis* hives were higher (82%) followed by *Apis dorsata* (14%), *Apis cerana* (3%) and *Apis florea* (1%).

FAMILY 1: AMPULICIDAE

The Ampulicidae or Cockroach wasp, are a small (about 170 species), primarily tropical family of sphecoid wasps, all of which use various cockroaches as prey for their larvae. They tend to have elongated jaws, pronounced neck-like constrictions behind the head, strongly petiolate abdomens, and deep grooves on the thorax. Many are quite ant-like in appearance, though some are brilliant metallic blue or green. Most species sting the cockroach more than once and in a specific way.

Family: Ampulicidae



Scientific name: *Ampulex compressa* Fabricius, 1781

Common name: Emerald Cockroach Wasp

Distribution: Southeast Asia, Africa, Pacific island.

FAMILY 2: SPHECIDAE

The Sphecidae are a cosmopolitan family of wasps that includes digger wasps, mud daubers, and other familiar types that all fall under the category of thread-waisted wasps. Sphecid wasps are a familiar and diverse group of solitary wasps. They vary from slender to stout-bodied insects. Some are less than half an inch long but many are larger, ranging from 1/2 to 1 1/2 inches long (they can appear considerably larger when they are alive and active). However, you can find many in a small area as a lot of species live together gregariously. Most sphecid wasps nest in the ground, while some nest in cavities, such as in hollow plant stems or cavities in wood, while a few construct nests made of mud. Their hind legs are flattened while

sphecid wasps are generally smooth and have normal-looking back legs. Sphecids prey on insects or spiders which they paralyze and then feed to their young. They either drag the immobilized prey to their nest or they carry them back while they are flying. A common group of sphecid wasps are the thread-waisted wasps. They are recognized by the thin, conspicuous pedicel (actually part of the thorax) connecting the thorax and the abdomen. There are a couple of common species known as mud daubers.

FAMILY 3: MEGACHILIDAE

The Megachilidae are a cosmopolitan family of mostly solitary bees whose pollen-carrying structure (called a scopa) is restricted to the ventral surface of the abdomen (rather than mostly or exclusively on the hind legs as in other bee families). Megachilid genera are most commonly known as mason bees and leafcutter bees, reflecting the materials from which they build their nest cells (soil or leaves, respectively); a few collect plant or animal hairs and fibers, and are called carder bees. All species feed on nectar and pollen, but a few are cleptoparasites (informally called "cuckoo bees"), feeding on pollen collected by other megachilid bees. Parasitic species do not possess scopae. Megachilid bees are among the world's most efficient pollinators because of their energetic swimming-like motion in the reproductive structures of flowers, which moves pollen, as needed for pollination. One of the reasons they are efficient pollinators is their frequency of visits to plants, but this is because they are extremely inefficient at gathering pollen; compared to all other bee families, megachilids require on average nearly 10 times as many trips to flowers to gather sufficient resources to provision a single brood cell.

Genera : Megachile sps.

Common name : Leaf cutter bee



FAMILY 4: APIDAE

The Apidae are a large family of bees, comprising the common honey bees, stingless bees, carpenter bees, bumble bees and valuable pollinators. The family presently includes all the genera previously classified in the families Anthophoridae and Ctenoplectridae. Most of these are solitary species through a few are also cleptoparasites.

Subfamily: Apinae

The subfamily Apinae contains a diversity of 15 tribe lineages, the majority of which are solitary and whose nests are simple burrows in the soil. However, honey bees, stingless bees, and bumble bees are colonial or eusocial.

They are sometimes believed to have each developed this independently, and show notable differences in such characteristics as communication between workers and methods of nest construction.

Scientific name

Common name

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|---------------------------------|------------------|
| 1. <i>Trigona iridipennis</i> | Stingless bee |
| 2. <i>Apis dorsata</i> Fabricus | Giant honey bee |
| 3. <i>Apis cerana</i> Fabricus | Indian honey bee |
| 4. <i>Apis florea</i> Fabricus | Dwarf honey bee |

Subfamily: Xylocopinae

The subfamily xylocopinae, which includes carpenter bees, are mostly solitary, though they tend to be gregarious. Some tribe lineages, such as the Allodapini contain eusocial species. Most members of this subfamily make nests in plant stems or wood.

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|-----------------------------|----------------------|
| 1. <i>Xylocopa confusa</i> | Carpenter bee |
| 2. <i>Xylocopa violacea</i> | Violet carpenter bee |
| 3. <i>Xylocopa micans</i> | Carpenterbee |

FAMILY 5: FORMICIDAE

Ants are placed in a single family Formicidae. A characteristic of most formicids is the possession of the metapleural gland. This gland produces phenyl acetic acid, which fights against fungi and bacteria. It is made up of a pair of cell clusters which lead to two chambers in rear of the ant's middle body. While the gland is the most diagnostic trait separating ants from other Hymenoptera, it is not universal among ants. Many arboreal species lack the metapleural gland. The ant head is connected by a thin neck to the thorax, which is then connected by a thin "waist" to the abdomen. While this is the general structure of many insects, ants are distinguished by the waist, which is pinched down posteriorly at its connection with the abdomen.

Subfamily: Formicinae

The Formicinae are a subfamily within the Formicidae containing ants of moderate evolutionary development. Formicines retain some primitive features, such as the presence of cocoons around pupae, the presence of ocelli in workers, and little tendency toward reduction of palp or antennal segmentation in most species, except subterranean groups. Extreme modification of mandibles is rare, except in the genera *Myrmoteras* and *Polyergus*. On the other hand, some members show considerable evolutionary advancement in behaviors such as slave-making and symbiosis with root-feeding homopterans. Finally, all formicines have

very reduced stings and enlarged venom reservoirs, with the venom gland, specialized (uniquely among ants) for the production of formic acid.

Scientific name	Common name
1. <i>Componotus compressus</i>	Common Godzilla Ant
2. <i>Componotus irritans</i>	Gaint Honey Ant
3. <i>Componotus sericeus</i>	Golden Backed Ant
4. <i>Oecophylla smaragdina</i>	Weaver Ant
5. <i>Paratrechina longicornis</i>	Black Crazy Ant
6. <i>Polyhachis rastellata</i>	Shiny four star Ant

Subfamily: Myrmicinae

The Myrmicinae are a subfamily of ants, with about genera; their distribution is cosmopolitan. The pupae lack cocoons. Some species retain a functional sting. The petioles of Myrmicinae consist of two nodes. The nests are permanent and in soil, rotting wood, under stones, or in trees. Myrmicine worker ants have a distinct post petiole, i.e., abdominal segment III is notably smaller than segment IV and set off from it by a well-developed constriction; the pronotum is inflexibly fused to the rest of the mesosoma, such that the promesonotal suture is weakly impressed or absent; and a functional sting is usually present. The clypeus is well-developed; as a result, the antennal sockets are well separated from the anterior margin of the head. Most myrmicine genera possess well-developed eyes and frontal lobes that partly conceal the antennal insertions.

1. <i>Aphaenogaster beccari</i>	Long-Legged Hunchback
2. <i>Crematogaster</i> sps.1	—
3. <i>Crematogaster</i> sps.2	—
4. <i>Monomorium criniceps</i>	Spineless Harvester Ant
5. <i>Pheidole watsoni</i>	Spiny Harvester Ant
6. <i>Solenopsis geminate</i>	Common Red fire Ant
7. <i>Tetramorium</i> sps.	—

Subfamily: Ponerinae

The Ponerinae are a subfamily of ants in the Poneromorph subfamilies group, with about 1,600 species in 28 extant genera, including one of the world's largest species of ant. They are most easily identified from other subfamilies by a constricted gaster (abdomen). They are rare examples of stinging ants. Workers of these subfamily possess the outer borders of the frontal lobes form short semicircles or triangles, and have a pinched-in appearance posteriorly. The promesonotal suture is flexible. A constriction is present between abdominal segments 3 and 4, but segment 3 is not markedly reduced in size compared to segment 4 abdominal segments 3 and 4 exhibit tergo-sternal fusion. The sting is well developed.

1. *Leptogenys processionalis* Procession Ant

Jerdon, 1851	
2. <i>Diacamma rugosum</i>	Lesser striated Ant
Le Guillion, 1842	

Subfamily: Pseudomyrmicinae

The subfamily Pseudomyrmicinae, is a very distinct group of ants with elongated eyes and long slender bodies. They are arboreal ants preferring to nest in crevices of trees and rotting logs. These ants are solitary foragers and do not move in trails. They are extremely aggressive and are equipped with a sharp sting. Ants of this genus are very well known for their intricate ant-plant relationships.

1. <i>Tetraoponera allobrans</i>	Polished Leaf-Border
Walker, 1859	
2. <i>Tetraoponera rufonigra</i>	Arboreal Bicolored Ant
Jerdon, 1851	
3. <i>Tetraoponera aitkenii</i>	—
Forel, 1902	

Subfamily: Dolichoderinae

The Dolichoderinae are a subfamily of ants, which includes species such as the Argentine ant (*Linepithema humile*), the erratic ant, the odorous house ant, and the cone ant. This subfamily is distinguished by having a single petiole (no post-petiole) and a slit-like orifice, from which chemical compounds are released, rather than the round acidopore encircled by hairs that typifies the family Dolichoderine ants do not possess a sting, unlike ants in some other subfamilies, such as Ponerinae and Myrmicinae instead relying on the chemical defensive compounds produced from the anal gland. Of the compounds produced by dolichoderine ants, several terpenoids were identified including the previously unknown iridomyrmecinisoidomyrmecin, and iridodial.

1. <i>Tapinoma melanocephalum</i>	Odor Ant
Fabricius, 1793	

FAMILY 6: VESPIDAE

The Vespidae are a large (nearly 5000 species), diverse, cosmopolitan family of wasps, including nearly all the known eusocial wasps and many solitary wasps. In temperate social species, colonies usually last only one year, dying at the onset of winter. New queens and males are produced towards the end of the summer, and after mating, the queens hibernate over winter in cracks or other sheltered locations. Many species are pollen vectors

contributing to the pollination to several plants, being potential or even effective pollinators.

Subfamily: Polistinae

The polistinae are eusocial wasps closely related to the more familiar yellow jackets, containing four tribes, with some 1100 species total. It is the second most diverse family within Vespidae, and while most species are tropical or subtropical, they include some of the most frequently encountered large wasps in temperate regions. The queens are morphologically similar to workers, though sometimes slightly larger or differently colored; the abdomen is spindle-shaped, often petiolate. The antennae of males are curled. The nest is sometimes open and also builds nests out of paper. They are also known as paper wasps.

1. Ropalida marginata Paper wasp

Lepeletier, 1836

2. Polistine sps Paper wasp

Subfamily: Vespinae

The subfamily Vespinae contains the largest and best-known eusocial (genera *Dolicho vespula* and *Vespula*). The remaining genus, *Provespa* is a small, poorly known group of nocturnal wasps from Southeast Asia. One genus, has been described from the Eocene fossil record, from Colorado. Collectively, the group can be found on all continents except Antarctica, and several of these wasps are invasive species, introduced beyond their native range, and can be major pests.

1. *Vespa cincta* Yellow banded Wasp

Fabricus, 1775

Subfamily: Eumeninae

The name Eumeninae or potter wasp derives from the shape of the mud nests built by species of *Eumenes* and similar genera. Potter wasps are the most diverse subfamily of vespids, with more than 200 genera and contain the vast

majority of species in the family. The nest may have one to multiple individual broad cells. The most widely used building material is mud made of a mixture of earth and regurgitated water, but many species use chewed plant material, instead.

1. *Eumenes Fraternus* Say, 1824 Potter Wasp

2. *Eumenes* sps 1 Potter Wasp

3. *Eumenes* sps 2 Potter Wasp

DISCUSSION: Insects are the most diverse group of animals comprising nearly 80% of the living fauna. The species diversity of hymenopterans observed for the Jnana bharathi campus can be attributed to the high diversity of flora and other insects.

The insect diversity in the study area, Jnana bharathi campus, Bangalore University we have recorded total of 38 species which belonged to 6 families of group Aculeata were identified. The high nest density of *Trigona iridipennis* indicates the richness of this

species, the number of honey bee colonies rapidly increases generally during the flowering period. The seasonality of insects depends upon the floral species diversity. The 7 species was recorded from Apidae and they are said to be important pollinators. The *Ampulex compressa* of the family Ampulicidae which uses cockroaches as prey for their larvae is a parasitoid and was rarely seen during the study period. Most of the mud daubers nest and 4 species of Sphecid wasps were observed, this species are also as importance as a parasitoid. In the family Vespidae 2 eusocial species and 4 solitary species was observed. The family Formicidae was more abundantly found in this habitat and 18 species was collected in the same study area. In the present study 19 species of ants were observed which belonged to 5 subfamilies. The subfamily myrmicinae was richer followed by formicinae, pseudomyrmicinae, ponerinae and dolichoderinae. Ants are most important component of ecosystems because they not only constitute a great part of the animal biomass but also they act as ecosystem engineers. All the known species of ants are eusocial.

SUMMARY AND CONCLUSION: A project study has been made for sampling survey of hymenopterans present in the Jnanabharathi campus, Bangalore University, which encompasses a geographical area of approximately about 1100 acres with rich fauna and flora. Different collection methods were followed, photographs of the observed species has been documented which belonged to the 6 families of group aculeata. index has been Further an attempt has also been made to find the nest density of honey bees found in the present study area, which showed the richness of *Trigona iridipennis* followed by *Apis dorsata* and others.

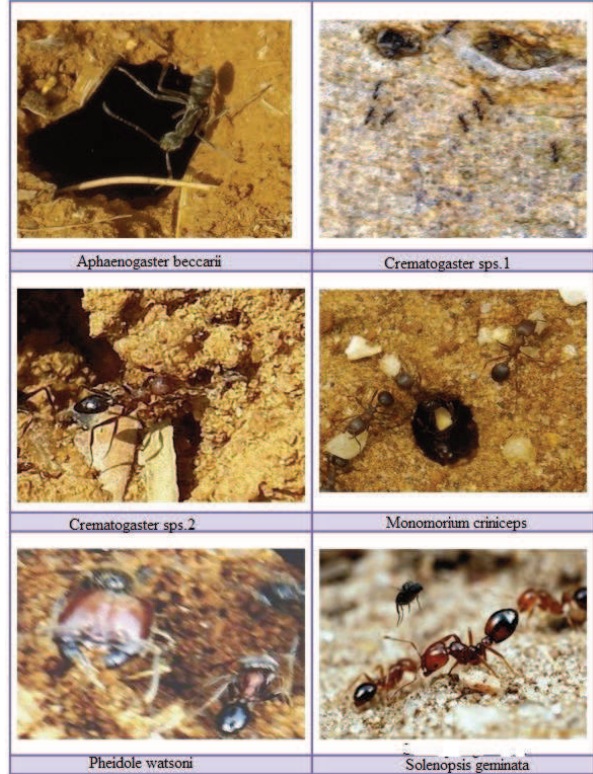
This study serves as a base line for further studies of hymenopterans in the Jnanabharathi campus by using additional collecting methods in different seasons of the year. Seasonal variation will be a more important determinant factor than the habitat type alone.

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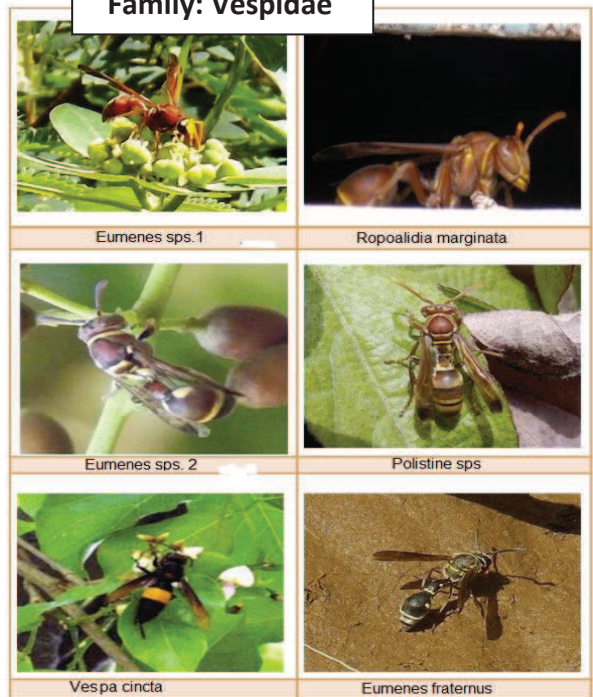
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Photo plates Family :Formicidae



Family: Vespidae



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