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Abhinandan Yadav
CSIR-National Botanical Research Institute, Lucknow, Uttar Pradesh, India

Saurabh Sarma
ICAR-Krishi Vigyan Kendra Hailakandi, Hailakandi, Assam, India

Corresponding Author
Abhinandan Yadav
CSIR-National Botanical Research Institute, Lucknow, Uttar Pradesh, India

Diversity, distribution and abundance of hymenopteran and lepidopteran pollinators of Jorhat district, Assam, India

Abhinandan Yadav and Saurabh Sarma

Abstract
Study was carried out in the Jorhat district, Assam, India to understand the diversity, distribution and abundance of Hymenopteran and Lepidopteran pollinators. Targeted insects were collected from four different locations of the district *viz.*, Titabor, Teok, Nimati and Barbheta. Collected insects were examined, identified and preserved by following standard scientific protocols. This investigation recorded a collection of 663 numbers of specimens belonging to 3 super families and 8 families. Study yielded a total collection of 33 numbers of insect species out of which the order Hymenoptera posses four families (Apidae, Vespidae, Halictidae and Xylocopidae) comprises of 21 species in contrast with Lepidoptera that contains 12 species under four families (Nymphalidae, Pieridae, Hesperiidae and Papilionidae). The values of the Simpson Index of Diversity (1-D) were found as 0.904 and 0.906 against the order Hymenoptera and Lepidoptera, respectively along with high species richness (>0.5). The high species diversity observed during the investigation indicates that the study area is a real paradise for Hymenopteran and Lepidopteran pollinators. This may be because of the undisturbed vegetation and well maintained agricultural as well as horticultural ecosystem that not only provide suitable nectar source throughout the different seasons but also serves as breeding habitat to the pollinators.

Keywords: Diversity, pollinator, abundance, hymenoptera, lepidoptera, Assam

Introduction
Insects are widely spread in different ecosystems where they carried out various significant ecological activities (Sodhi *et al.*, 2010) [17]. Insects perform as pollinators, predators, parasitoids and decomposers that facilitate them beneficial for human. On the other hand, many insects are destructive to the forest as well as agricultural ecosystem. In terrestrial ecosystems, insect pollinators play vital roles (Weisser and Seimann, 2004) [19] in plant reproduction such as the number of pods, seeds per pod, seed weights per plant and seed germination (Atmowidi *et al.*, 2007) [1] and thereby providing goods and services to the society as many of the plants in the nature are dependent upon pollination for their productivity (Potts *et al.*, 2009) [11]. Varieties of insect *viz.*, bees, butterflies, moths, beetles, wasps and flies are reported as pollinators of plants out of which bees are considered as most important and promising pollinators among other insect groups (Tylianakis *et al.*, 2007) [18]. Insects are believed to pollinate nearly 70% of crop plants and over 98% of trees worldwide (Klein *et al.*, 2006) [8], failure of which would have adverse effect on food production. Whether beneficial or harmful, insects are highly susceptible to the adverse effects of deforestation, forest fragmentations, conversion of forest land to agriculture and climate changes. Changes in the ecosystem cause damages to the ovipotion sites, food sources, nesting places as well as breeding sites of many insects including pollinators (Kevan, 1999) [7] that directly affect on the abundance and species richness of these arthropods (Didham *et al.*, 1996) [3]. At present, declining of insect pollinators in agriculture as well as forest ecosystem is observed because of extreme habitat loss (Ricketts, 2004) [14] as well as changes in climate. On the other hand, the biodiversity study of insect pollinators is still in its childhood without absolute direction (Didham *et al.*, 1996) [3] and with not enough interest (Sodhi *et al.*, 2010) [17]. Earlier studies from this region mainly depicted various aspects of pollinators related to cultivated crops and its production. However, reporting on the diversity, distribution and abundance of insect pollinators in different habitat especially in agricultural ecosystem are scanty.
The main intention of this study was to understand the diversity, distribution and abundance of hymenopteran and lepidopteran pollinators in forest as well as agricultural ecosystem in the

aegis of extreme habitat loss and climate change.

Materials and Methods

Location, Constitution and Area: The district Jorhat of Assam is located at 26.75°N and 94.22°E and has an average elevation of 116 Meters (381 ft). Jorhat is surrounded by Sivasagar in the east, Lakhimpur in the north, Golaghat in the west and Wokha district (Nagaland) in the south. The district comes under semi-arid region during summer season the temperature 25°-35 °C and winter season the temperature 22°-10 °C. In case of vegetation structure of Jorhat is concerned, the district comprises of wide types of agricultural land to forest region.

Methods adopted for the study

Collection: Collections of hymenopteran and lepidopteran insects were made from various locations of Jorhat district *viz*. Titabor, Teok, Barbheta and Nimati during 2017-18. The areas chosen for the collection of insects comprises agricultural land and forest areas. Insects were collected preferably in the early hours of the day as insects, especially hymenopteran insects, are mostly active at this time. Following methods of collection were adopted:

a) **Picking by hand:** Ant species hiding underneath the soil and plant debris were manually collected from different habitat. Hand picking was done very carefully to avoid possible damage to the insects during the collection.

b) **Insect collecting net:** Active insects under the order hymenoptera and Lepidoptera were collected with insect net followed by killing of the collected specimens using killing agent.

c) **Baiting:** Sugar was used as baiting material to attract ants. Upon Congregation of ants on sugar, they were carefully collected manually.

d) **Light trap:** Positively phototaxis hymenopteran insects were collected from various light sources, viz., the house holed light, street light etc. of all the 4 study sites.

Equipments: Various insect collecting equipments were used to collect the target insects depending upon their habitat (Fenemore, 2005) [10]. Different equipments used for this purpose are as follows:

a) **Killing bottle:** Collected insects were handled carefully in the killing bottles to kill and preserve them without losing their original colour. Chloroform (CHCl3) was used to kill Insects. At the bottom of the glass jar, one layer of cotton is placed over which the killing agent was poured. Over the chloroform-soaked cotton layer one or two blotting papers were placed to prevent the direct contact of the specimen with cotton. Insects were taken out very carefully from the killing bottle to avoid breaking of any appendages.

b) **Glass/Plastic vials:** Small insects like ants were collected in small glass or plastic vials. A piece of blotting paper was soaked in chloroform and placed inside the vials to kill insects. Insects were taken out very gently to avoid any morphological damage.

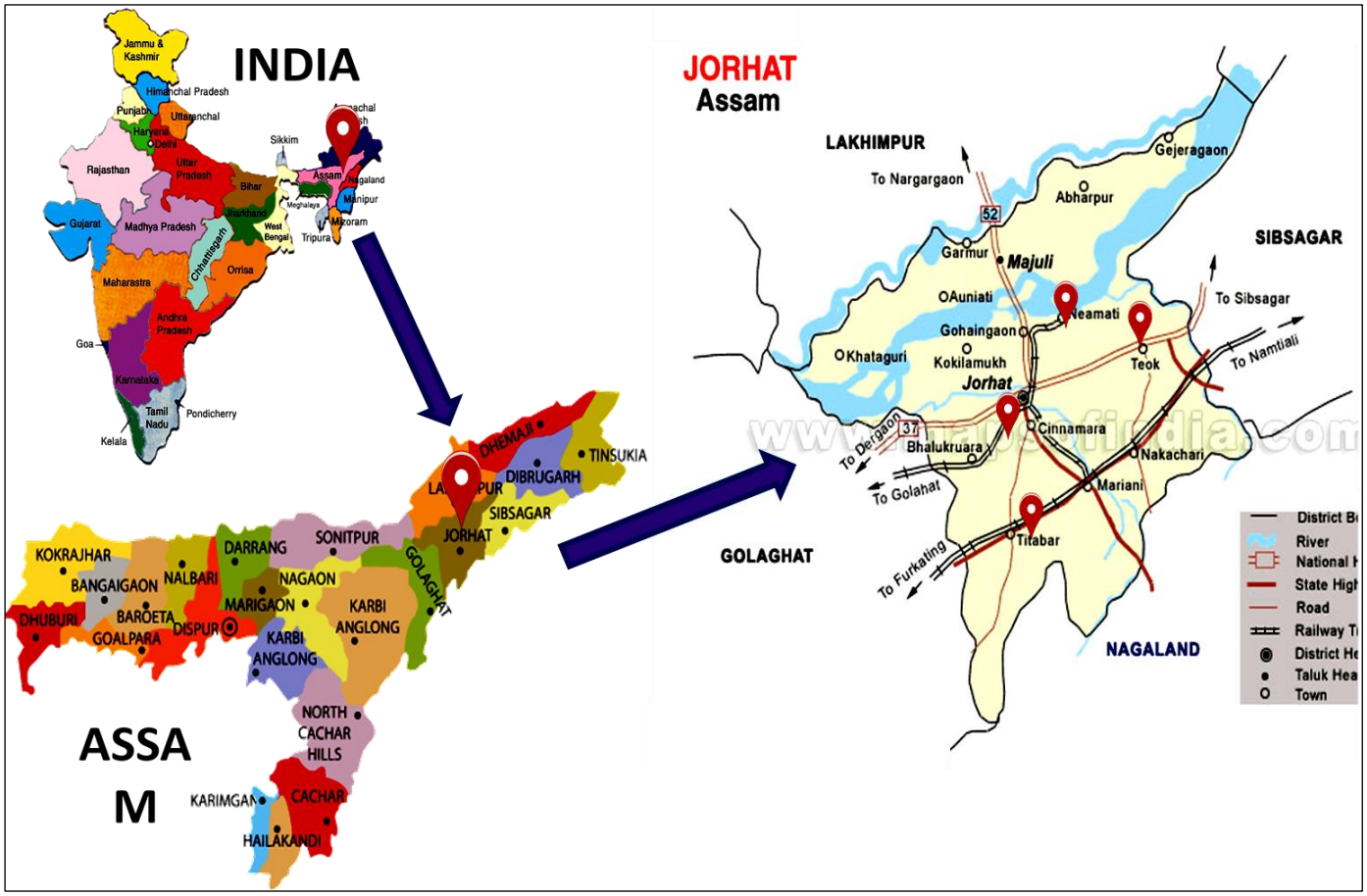
Preservation of insects for taxonomic study: The insects were preserved according to standard methods (Singh and Sachan, 2007, Srivastava, 2004) [12, 6].

a) **Insect pinning:** Entomological pins, numbering 0-5, were used to pin the insects carefully following the standard insect pinning norms.

b) **Spreading:** Wings of the insects, especially under the order lepidoptera, were spread with the help of spreading board and entomological pins.

c) **Card mounting:** Very small insects, being difficult to pin, were stick to the tip of a small triangle of a good quality white card and mounted on a pin. Good quality glue (water soluble) was used for this purpose. For handling the same fine setting spatula or forceps or dissection needles were used (Hangay and Dingley, 1985) [5].

d) **Labeling and storing of insects:** Collected insects were preserved and stored in the insect museum of the Department of Entomology, AAU, Jorhat. Proper labeling of the specimens were done with comprehensive information *viz*., common and scientific name, order, family, location and date of collection and collector's name. Dry preserved insects were stored in wooden boxes with a glass top (size: 45.5 x 15 x 6 cm3). To prevent fungal infestation naphthalene balls were ground and placed in four corners of the boxes in small cloth bags. However, insects preserved in liquid preservative were stored vertically in the wooden cabinet after properly sealing the screw cap of the glass tubes.



(Source: www.google.com)

Fig 1: The map showing the insect collection locations of the Jorhat district

Identification of insects: Taxonomic keys were used to identify the collected specimens. The purpose was attained by observing subsequent suitable diagnostic characteristics by comparing the specimen with dichotomous characters (Mayr, 1976) [9]. Both the dichotomous key and pictorial keys were used to identify the specimens. Moreover, the specimens preserved in the insectarium of the Department of Entomology, AAU, Jorhat, Assam, India were also referred to identify a number of specimens.

Statistical analysis

Collected data was analyzed using PASW statistics 18 and per cent distribution of different species in the survey area was calculated by the following formula:

Per cent Distribution = (Number of Species/Total number of Species Collected) X 100

Diversity index analysis

To establish the diversity among different orders of soil insects in the investigation area Diversity index was computed by following the Simpson Diversity Index (1-D) (Simpson, 1949) [16].

$$D = \frac{\Sigma[n_i(n_i-1)]}{N/(N-1)}$$

Where,

n_i = The total number of individuals of a particular species.

N = the total number of individuals of all species.

The value of this index ranges between 0 and 1 which indicates greater the value, greater the sample diversity.

Results and Discussion

This investigation on the diversity, distribution and abundance of Hymenopteran and Lepidopteran pollinators of Jorhat District recorded a handsome collection of 663 numbers of specimens belonging to 3 super families and 8 families (Table 1). Study also yielded a total collection of 33 numbers of insect species out of which the order Hymenoptera posses 21 species alone (Table 2). Besides, under the order Hymenoptera Apidae was found to be the major family with 9 species followed by Vespidae (6 species), Halictidae (4 species) and family Xylocopidae (2 species) (Figure 2). However, in case of the order Lepidoptera, family like Pieridae and Nymphalidae was recorded highest number of species (5 number of species each) as compared to the family Papilionidae and Hesperiidae (1 specie each) (Figure 3). Current study is akin with the findings of Rajkumari *et al*., (2014) who reported 21 families, 42 genera, and 50 species under the order Hymenoptera, out of which family Apidae was found to be dominant followed by Formicidae and Vespidae. Being a group of agriculturally important insects as well as bio-control agent, Elpino-Campos *et al*., (2007) [4] studied biodiversity of the order Hymenoptera and reported 29 species of social wasps species distributed in 10 genera which is similar to the present study where a total of 6 species of wasps (family Vaspidae) were enlisted.

Bora and Meitei (2014) [2] made an attempt to study the diversity of butterflies in Cachar district of Assam, India and encountered 23 genera including 34 species under the family

Nymphalidae followed by Lycaenidae (19 genera, 20 species), Hesperiidae (13 genera, 15 species), Pieridae (9 genera, 14 species) and Papilionidae (4 genera, 13 species) whereas, in the present study Nymphalidae (5 genera and 5 species) and Pieridae (3 genera and 5 species) were the most dominant followed by Papilionidae and Hespiriidae (1 genera and one species, each). The study area houses 21 and 12 species under the order Hymenoptera and Lepidoptera, respectively along with good diversity and high species index. This may be because of the undisturbed vegetation and well maintained agricultural as well as horticultural ecosystem that not only provide suitable nectar source throughout the different seasons but also serves as breeding habitat to the pollinators. Furthermore, diversity analyses (Table 2) showed higher species diversity of pollinators within the Jorhat district that indicated finely distributed individuals of different species under the order Hymenoptera and Lepidoptera. From the study, the values of the Simpson Index of Diversity (1-D) were found as 0.904 and 0.906 against the order Hymenoptera and Lepidoptera, respectively along with high species richness (>0.5). However, in the family level the Simpson Index of Diversity values against the pollinator species under Apidae (0.796), Vespidae (0.823), Halictidae (0.796), Nymphalidae (0.788) and Pieridae (0.763) showed high species richness (>0.5) whereas low species richness (<0.5) was recorded against the family Xylocopidae (0.449). This might be due to healthy climatic conditions and availability of natural resources necessary for their life processes and existence. Sarma *et al*., (2019) [15] also conducted analogous studies where they computed the diversity analysis of soil insects in grassland, woodland and agricultural land community of Jorhat district of Assam. Thus detailed biodiversity information is indispensable not only to conservation but also to environment impact and assessment. The high species diversity observed during the investigation indicates that the study area is a real paradise for Hymenopteran and Lepidopteran pollinators.

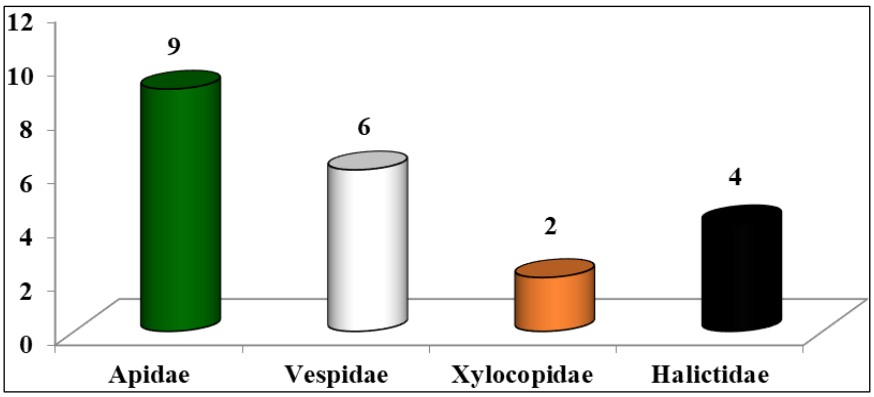


Fig 2: Species distribution at family level under the order Hymenoptera

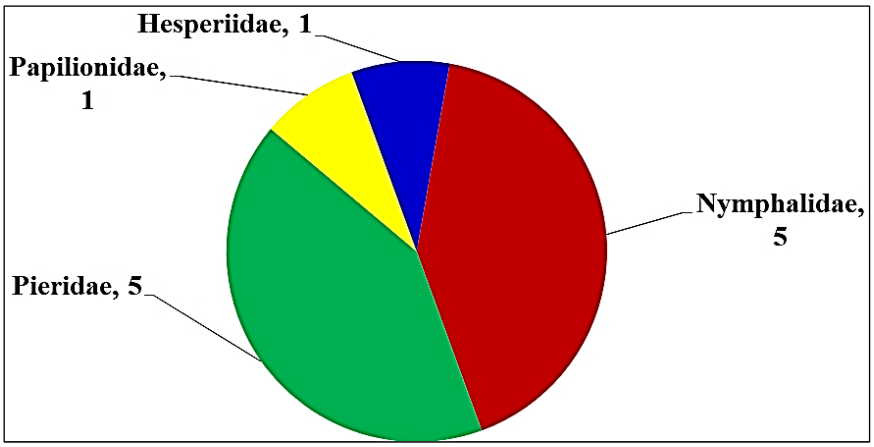


Fig 3: Species distribution at family level under the order Lepidoptera

Table 1: Diversity of insect pollinators collected from Jorhat district

Sl. No.	Order	Super family	Family	No. of the specimens collected	Percentage
1.	Hymenoptera	Apoidea	Apidae	289	43.59
			Halictidae	29	4.37
			Xylocopidae	55	8.30
		Vespoidea	Vespidae	86	12.97
2.	Lepidoptera	Papilionoidea	Nymphalidae	79	11.92
			Pieridae	78	11.76
			Hesperiidae	16	2.41
			Papilionidae	31	4.68
Total	02	03	08	663	

Table 2: Explicated checklist of collected insect pollinator species in Jorhat district, Assam

Sl. No.	Order	Family	Species	Specimen collected (no.)	D		1-D		Species richness	
					Order	Family	Order	Family	Order	Family
1.	Hymenoptera	Apidae	*Apis dorsata*	60	0.096	0.204	0.904	0.796	High	High
2.			*Apis cerana*	90						
3.			*Apis melifera*	40						
4.			*Apis florae*	35						
5.			*Tetragonula iridipennis*	52						
6.			*Ceratina sp.*	04						
7.			*Thyreus sp.*	04						
8.			*Amegilla sp.*	02						
9.			*Anthophora sp.*	02						
10.		Vespidae	*Vespa cinta*	20		0.177		0.823		High
11.			*Vespa orientalis*	19						
12.			*Vespa magnifica*	12						
13.			*Ropalidia spp.*	16						
14.			*Polistes fuscatus*	14						
15.			*Polistes hebraeus*	05						
16.		Xylocopidae	*Xylocopidae fenestrate*	37		0.551		0.449		Low
17.			*X. leucothorax*	18						
18.		Halictidae	*Halictus sp.*	08		0.204		0.796		High
19.			*Sphecodes sp.*	10						
20.			*Thrinchostoma sp*	05						
21.			*Homalictus sp.*	06						
22.	Lepidoptera	Nymphalidae	*Danaus plexippus*	11	0.094	0.212	0.906	0.788	High	High
23.			*Limeniti archippus*	13						
24.			*Junonia atlites*	25						
25.			*Aphantopus hyperantus*	18						
26.			*Athyma perius*	12						
27.		Pieridae	*Pieris brassicae*	30		0.237		0.763		High
28.			*Pieris rapae*	16						
29.			*Euchloe Olympia*	12						
30.			*Pieris napi*	11						
31.			*Colias croceus*	09						
32.		Papilionidae	*Popilio demoleus*	31		-		-		-
33.		Hesperiidae	*Hesperio comma*	16		-		-		-

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References

1. Atmowidi T, Buchori D, Manuwoto S, Suryobroto B, Hidayat P. Diversity of pollinator in relation to seed set of mustard (*Brassica rapa* L.: Cruciferae). Hayati J Bio Sci. 2007;14:155-e61.
2. Bora Atanu, Meitei LR. Diversity of butterflies (Order: Lepidoptera) in Assam university campus and its vicinity, Cachar district, Assam, India. Journal of Biodiversity and Environmental Sciences (JBES). 2014;5(3):328-339.
3. Didham RK, Ghazoul J, Stork NE, Davis AJ. Insects in fragmented forests: a functional approach. Trends Ecol. Evol. 1996;11:255-e60.
4. Elpino-Campos A, Del-Claro K, Prezoto F. Diversity of social wasps (Hymenoptera: Vespidae) in Cerrado fragments of Uberlandia, Minas Gerais State, Brazil. Neotropical Entomology. 2007;36(5):685-692.
5. Hangay G, Dingley M. Biological museum methods. Plants, invertebrates and techniques. Sydney: Academic Press (Harcourt Brace Jovanovich Publishers), 1985, 2.
6. Srivastava KP. Collection and Preservation of Insects and Classification and considerations for Life-Histories, A Text Book of Applied Entomology. 2004;2:36-64.
7. Kevan PG. Pollinators as bioindicators of the state of the environment: species, activity and diversity. Agric Ecosyst Environ. 1999;74:373-e93.
8. Klein AI, Steffan D, Tscharntke T. Rain forest promotes trophic interactions and diversity of trapnesting Hymenoptera in adjacent agro forestry, Journal of Animal Ecology. 2006;75:315-323.
9. Mayr E. Principles of Systematic Zoology. Tata McGraw-Hill Publishing Company Ltd. New Delhi, 1976, 428.
10. Fenemore PG. Collection, Preservation and Culture of Insects, Applied Entomology, Alka Prakash. New Age International (P) Ltd. Publishers, 2005, 253-265.
11. Potts SG, Woodcock BA, Roberts SPM, Tscheulin T, Pilgrim ES, Brown VK, *et al*. Enhancing pollinator biodiversity in intensive grasslands. Journal of Applied Ecology. 2009;46:369-379.
12. Singh R, Sachan GC. Elements of Entomology, Rastogy Publication, 2007, 27-70.
13. Rajkumari P, Sharmah D, Rahman A, Patgiri P. Divesity and Distribution pattern of hymenoptera insect in Jorhat District, Assam, India. International Journal of Science and Research. 2014;3:1938-1941.
14. Ricketts TH. Tropical forest fragments enhance pollinator activity in nearby coffee crops. Conser Biol. 2004;18:1262-e71.
15. Sarma Saurabh, Patgiri P, Rahman A, Singh NA. Biodiversity of soil insects and their important role in soil ecosystem: A study in the Jorhat district of Assam, India. Journal of Entomology and Zoology Studies.

2019;7(4):904-909.
16. Simpson EH. Measurement of diversity. Nature. 1949;163:688-691.
17. Sodhi NS, Koh LP, Clements R, Wanger TC, Hill JK, Hamer KC, *et al*. Conserving Southeast Asian forest biodiversity in human-modified landscapes. Biol Conserv. 2010;143:2375-e84.
18. Tylianakis JM, Tscharntke T, Lewis OT. Habitat modification alters the structure of tropical host parasitoid food webs. Nature. 2007;445:202-e5.
19. Weisser W, Siemann E. Insects and ecosystem function, Springer-Verlag, Berlin, 2004.