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A Preliminary Study on Abundance and Diversity of Insect Fauna in Gulbarga District, Karnataka, India

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Abstract: ***A preliminary study was conducted on the abundance and diversity of insects species in agriculture fields of Hadgil Harutti village, Gulbarga, Karnataka. The present study was aimed to determine the species richness, dominance and evenness of insect fauna from agriculture fields. The study was carried out during the month from June 2013 to September 2013. A total of 11,318 insects from 6 orders, 26 families and 54 species were recorded. This study shows that Hymenoptera (78.86%) was the most dominant order according to total number of individuals, followed by Coleoptera (15.45%), Lepidoptera (3.22%), Hemiptera (1.47%), Orthoptera (0.95%) and Diptera (0.05%). The Simpson's Reciprocal Index diversity is highest in order Coleoptera (8.048) and lowest in order Diptera (1.000). The species richness, evenness and diversity of insects were calculated by Margalef's Index, Pielou's Index and Shannon-Wiener Index respectively.***

Keywords: Insects, Abundance, Richness, Evenness, Diversity.

1. Introduction

Insects are the world's most diverse group of animals on Earth , in terms of both taxonomic diversity and ecological function. Insects represent the vast majority of species in terrestrial and freshwater ecosystem. They have adopted for almost every conceivable type of environment from the equator to the arctic and from sea level to the snowfield of highest mountains, on land, in air and water and almost everywhere. The insects are considerably estimated to comprise more than 75 percent of the known species of the animals. The insect fauna of India is vast. In an old estimate, Lefroy and Howlett (1909) in the monumental book 'Indian Insect Life' reported 25,700 Indian species. Roonwal (1989) estimated that insects constitute two-thirds of the total fauna in India and comprise nearly 1, 00,000 species, of which about half remain yet to be studied. Varshney (1998) [26] has reported 589 families and 51,450 species of insects from India. In a recent estimate, Alfred *et al.* (1998) estimated 59,353 species of insects from India belonging to 619 families. Indian insects belong to 27 orders of which Coleoptera is most dominant with about 15,500 species. Butterflies and Moths with about 15,000 species is another important group. These are followed by Hymenoptera (10,000 spp.), Diptera (6093 spp.) and Hemiptera (6500 spp.) (Varshney, 1998) [26]. Insects are closely associated with our lives and affect the welfare of humanity in diverse ways. At the same time, large numbers of insect species, including those not known to science, continue to become extinct or extirpated from local habitats worldwide.

Insects play critical roles in ecosystem function. They cycle nutrients, pollinate plants, disperse seeds, maintain soil structure and fertility, control populations of other organisms, provide a major food source for other taxa (Majer 1987) [17] and are parasites or disease vectors for many other organisms, including humans. Many insects have considerable capacity for long distance dispersal, enabling them to find and colonize isolated resources as these appear. Other insects are flightless, and hence vulnerable to environmental change or habitat fragmentation. Because of their small size, short life spans, and high reproductive rates, the abundances of many species can change by several orders of magnitude on a seasonal or annual time scale, minimizing time lags between environmental changes and population adjustment to new conditions. Such changes are easily detectable and make insects more useful as indicators of environmental changes than are larger or longer-lived organisms that respond more slowly. In turn, insect responses to environmental change can affect ecosystem structure and function dramatically. Insects are highly responsive to environmental changes, including those resulting from anthropogenic activity to agriculture fields. The diversity of insect species represents an equivalent variety of adaptations to variable environmental conditions.

The present study is carried in agriculture fields at Hadgil Harutti village, Gulbarga district, Karnataka. The main objectives of the study were to determine the insect diversity and the relative abundance of the insect species in agriculture fields.

2. Materials and Method

2.1 Study Area

Gulbarga district lies in the northern part of Karnataka between 16°11' – 17°45' N. latitudes and 76°03' - 77°30' E. longitudes, with a geographical area of 16,174 sq. km. The entire district is on the Deccan Plateau, and the elevation ranges from 300 to 750 m above MSL. The district is bounded by Bidar district in the north, Bijapur district in west, Raichur district in south and Telangana state in the east. Gulbarga district has semi – arid type of climate. Dry climate prevails for most part of the year. December is the coldest month with mean daily maximum and minimum temperatures being 29.5°C & 15° to 10°C respectively. During peak summer, temperature shoots up to 45°C. The southwest monsoon sets in the middle of June and extends

till the end of September. Bulk of the annual rainfall occurs during this season, which constitutes over 75% of the annual rainfall. Significant rainfall occurs during the winter monsoon owing to northeastern monsoon, which constitutes 15% of the annual rainfall. Normal Rainfall of the district is 777 mm (1901 - 70) and actual rainfall is 881.10 mm (2005). The study area is located at Hadgil Harutti village which is 10 km away from Gulbarga city. The preliminary survey of insects diversity is carried out at agriculture fields of Hadgil Harutti village.

2.2 Methodology

The present study was carried out during the month from June 2013 to September 2013 in agriculture fields by following methods:

2.2.1. Pitfall Trap
A total 240 traps i.e 60 traps per month were placed in agriculture fields. Pitfall traps each consisted of a single 1000-ml-capacity plastic cup (top diameter = 12 cm, height = 14 cm) buried so that the top was flush with the ground surface and filled with 2 cm of dishwashing soap and water solution to prevent escape by captured invertebrates. Collected specimens were preserved; dry pinned or preserved in 70% ethanol and sorted upto Genus level taxa.

2.2.2 Sweep net
Sweep sampling was done from the herb and shrub layers of the vegetation using a sweep net. This method is specially suited for sampling insects from ground layer vegetation. The sweeps were done during the morning hours while walking in the agriculture fields present within the study area. The insects collected in the sweeping were temporarily transferred in polythene bags and plastic bottles. Later they are taken to the laboratory and killed using ethyl acetate. These insects were stretched, pinned and preserved.

2.2.3. Hand collection
Insects were directly collected by hand and transferred in killing bottles. The insects were processed for pinning and preserved in wooden insect box in dry condition.

3. Statistical Analysis

3.1 Measurement of Diversity

The type of diversity used here is α- diversity which is the diversity of species within a community or habitat. The diversity index was calculated by using the Shannon – Wiener diversity index (1949).

3.2 Shannon-Wiener Diversity index:

$H = - \sum Pi \ In \ Pi$
where $Pi = S / N$
S = number of species
N = total number of individuals
In = logarithm to base e

3.3 Simpson's Reciprocal Index (1/D):

$D= 1/\sum(Pi^2)$
where $Pi = S / N$
S = number of species
N = total number of individuals

3.4 Measurement of species richness:

Margalef's index was used as a simple measure of species richness (Margalef, 1958).
Margalef's index = $(S – 1) / In \ N$

S = total number of species
N = total number of individuals in the sample
In = natural logarithm

3.5 Measurement of evenness:

For calculating the evenness of species, the Pielou's Evenness Index (e) was used (Pielou, 1966).
Pielou's Evenness Index $e = H / In \ S$

H = Shannon – Wiener diversity index
S = total number of species in the sample

3.6 Measurement of dominance index:

The dominance index is calucated using this formula:
Relative dominance= niX100/N
N: the total number of individuals of all species
ni: the number of individuals of species

4. Results

A total 11,318 insects samples has been collected during the month from June 2013 to September 2013. Altogether 54 species of insects belonging to 26 families under 6 orders have been recorded (Table 1). According to the total number of species, dominant order is Coleoptera (26 species) , followed by Lepidoptera (13 species) , Hymenoptera (6 species) , Hemiptera (5 species) , Orthoptera (3 species) and Diptera (1 species).

Among order Coleoptera, the family Tenebrioniodae and Scarabacidae dominated with 5 species each respectively, Coccinellidae and Meloidae each shared 3 species, Chrysomelidae and Buprestidae each shared 2 species, Curculionidae, Cerambycidae, Trogidae and Lycidae each contained only 1 species. Among order Lepidoptera, the family Pieridae dominated with 6 species each, Nymphalidae 4 species, Papilionidae 2 species and Pieridae only 1 species. The order Hymenoptera has a total number of 6 species belonging to family Formicidae, Crabonidae and Halictidae each sharing 2 species. In order Hemiptera, it includes 5 families i.e Pentatomidae, Oxycarenidae, Coreidae, Delphacidae and Miridae which shared each only one species. Among order Orthoptera, family Acrididae includes 2 species and family Tettigonidae includes only 1 species and among order Diptera family Muscidae contained with only one species.

Table 1: List of insect fauna collected during the month from June 2013 to September 2013.

Insect Order	*Family*	*S.No*	*Species*	*Total No. Of Individuals*	*Collection Method*
COLEOPTERA	Carabidae	1.	*Omphra sp*	190	PT
		2.	*Chlaenius sp*	166	PT
	Tenebrioniodae	3.	*Notocorax sp*	160	PT
		4.	*Penthicoides sp*	153	PT
		5.	*Gonocephalum sp*	130	PT
		6.	*Platynotus sp*	133	PT
		7.	*Rhytinota sp*	131	PT
	Curculionidae	8.	*Myllocerus undecimpustulatus*	166	PT & HC
	Cerambycidae	9.	*Oberiopsis sp*	16	PT
	Trogidae	10.	*Trox sp*	150	PT
	Buprestidae	11.	*Sternocera chrysis*	5	HC
		12.	*Chrysochroa sp*	6	HC
	Scarabacidae	13.	*Gametis versicolor*	9	HC
		14.	*Bolboceros sp*	13	HC
		15.	*Scrabaeus sp*	15	HC
		16.	*Adoretus sp*	17	HC
		17.	*Maladera sp*	22	HC
	Chrysomelidae	18.	*Clytra sp*	34	SN
		19.	*Zygogramma bicolourta*	42	SN
	Lycidae	20.	*Lycostoma sp*	26	SN
	Coccinellidae	21.	*Epilachna sp*	33	SN
		22.	*Cheilomenes sexmaculata*	29	SN
		23.	*Brumoides suturalis*	19	SN
	Meloidae	24.	*Mylabris pustulata*	34	SN
		25.	*Lytta sp*	20	SN
		26.	*Mylabris sp*	30	SN
HEMIPTERA	Pentatomidae	27.	*Bathycocelia indica*	28	SN
	Oxycarenidae	28.	*Oxycarenus hyalinipennis*	45	SN
	Coreidae	29.	*Cletus sp*	24	SN
	Delphacidae	30.	*Perkinsiella sp*	19	SN
	Miridae	31.	*Creontoides sp*	51	SN
HYMENOPTERA	Formicidae	32.	*Camponotus compressus*	4,685	PT
		33.	*Monomoriun scabriceps*	4,128	PT
	Crabonidae	34.	*Cerceris sp*	51	SN
		35.	*Liris sp*	17	SN
	Halictidae	36.	*Halictus sp*	24	SN
		37.	*Nomia sp*	20	SN
DIPTERA	Muscidae	38.	*Musca sp*	6	SN
LEPIDOPTERA	Arctiidae	39.	*Uteheisa pulchella*	16	SN
	Nymphalidae	40.	*Danus chrysippus*	39	SN
		41.	*Hypolimnas bolina*	17	SN
		42.	*Byblia ilithyia*	31	SN
		43.	*Junonia lemonias*	32	SN
	Papilionidae	44.	*Papilio demoleus*	23	SN
		45.	*Atrophaneura aristolochiae*	35	SN
	Pieridae	46.	*Catopsilia sp*	27	SN

		47.	*Colotis danae*	49	SN
		48.	*Catopsilia pyranthe*	35	SN
		49.	*Eurema blanda*	30	SN
		50.	*Colotis eucharis*	19	SN
		51.	*Ixias marianne*	11	SN
ORTHOPTERA	Acrididae	52.	*Cyrtocanthacris tatarica*	7	HC
		53.	*Chrotogonus sp*	54	SN
	Tettigonidae	54.	*Conocephalus sp*	46	SN
TOTAL				11,318	

Where: PT-Pitfall trap, SN- Sweep net, HC- Hand Collection.

The diversity of insect is calculated by Shannon-Wiener index and Simpson's reciprocal index. The abundance, richness, evenness and diversity indices of insects are calculated during the month from June 2013 to September 2013 (Table 2).

Table 2: Diversity indices for insect orders collected from the agriculture fields of Hadagil Haruti village, Gulbarga.

S.No	Order	Total number of families	Total number of species	Total number of individuals	Dominanace %	Margalef index	Simpson reciprocal index	Shannon-Wiener index	Pielou's index
1.	Coleoptera	11	26	1,749	15.45	3.069	8.048	2.226	0.928
2.	Hemiptera	5	5	167	1.47	2.485	5.000	1.609	1.000
3.	Hymenoptera	3	6	8,925	78.86	1.116	3.000	1.099	1.000
4.	Diptera	1	1	6	0.05	-	1.000	1.000	-
5.	Lepidoptera	4	13	364	3.22	1.170	2.965	1.205	0.0869
6.	Orthoptera	2	3	107	0.95	0.910	1.800	0.637	0.918
	Total	26	54	11,318	100				

5. Discussion

This study highlights the richness of the insect fauna comprising 11,318 insects specimens belonging to 54 species. The result of this study shows that the agriculture fields are dominated by insect diversity. It is obvious that agroecosystem, though it was a man made modified farmland, reported to have a rich variety of entomofauna. The rich number of species available in the agroecosystem was mainly because of the availability of varieties of crop plants and microhabitats. Janzen (1973) [13], Nair and Mathew (1993), Edwin (1997) and Mathew (1986) [16] attributed diversity of plants to insect diversity.

The results shows that Hymenoptera were most dominant order (78.86%) representing 8, 925 insects samples of which 8,813 belongs to family Formicidae with 2 species i.e *Camponotus compressus* and *Monomorium scabriceps*, family Crabonidae is represented by 2 species i.e *Cerceris sp* and *Liris sp* and family Halictidae is repsented by *Halictus sp* and *Nomia sp*. Pioneer work on the Hymenoptera of Indian region was made by Bingham (1897, 1903) [5],[6] which found reference to species found in Kerala. Subsequent to this, some studies have been made specifically on species found in different regions of Kerala.

Coleopterans commonly known as beetles constitutes the largest order of all animals. The major ecological impact of beetles results from their effects on green plants, their contribution to breakdown of plant and animal debris and their predatory activities. India is well known for richness of coleopterans fauna and against an estimated total of 179 families of Coleopterans, about 103 families are known from India, of the 3,50,000 described species from all over the world, 15,000 species under 2,000 genera are known from India (Biswas, 1995). The present study revealed the presence of 26 species belonging to 11 families from the study area. According to total number of individuals it is second dominated order (15.45%). It has been analysed that order Coleoptera recorded highest Simpson's reciprocal index diversity (8.048), highest richness (3.069), Shannon-Wiener index(2.226) and evenness (0.928).

Lepidoptera are commonly known as 'butterflies' and 'moths'. Two pairs of well-developed wings with colored scales on them. Wings are brilliantly coloured in many species. The various publications on Butterflies of India have been published by Marshall and De Niceville (1882) [18], De Niceville (1886, 1890) [10],[11], Betham (1890, 1891a, 1891b, 1892) [1],[2],[3],[4], Evans (1932) [12], Talbot (1939, 1947) [23],[24] and Wynter-Blyth (1957) [30]. During the course of study order Lepidoptera is third dominated order by 3.22% which belong to 4 families and 13 species. The most dominated butterfly recorded were *Colotis danae* and *Danus chrysippu* where as *Ixias marianne* was least found.

Hemiptera insects that are usually called as 'true bugs' are of great economic importance as most of them are pests of various commercial crops. According to recent estimate about 80,000 Hemipteran species are present worldwide. In India 77 families having 6,500 species are found. Out of these, 2,421 species are endemic to India (Alfred, 2003). In the present study Hemiptera is fourth dominated order with 1.47% includes 5 species i.e *Bathycocelia indica, Oxycarenus hyalinipennis, Cletus sp, Perkinsiella sp, Creontoides sp* has been recorded. The Simpson's reciprocal

index diversity is 5.000 and Shannon-Wiener index 1.609 has been calculated.

The order Orthoptera includes common insects like grasshoppers, locusts, crickets, mole crickets and grouse locusts. Kirby (1914) [15] and Chopard (1969) [8] wrote the Fauna on Acrididae and Grylloidea of India, and several species were included from Sikkim. Uvarov (1927) [25] published the distributional record of family Acrididae of India. Most of the grasshoppers found in agriculture fields belongs to family Acrididae. These grasshoppers feed on plant foliage, with a particular fondness for grasses and spurges. When grasshoppers population increase to the point of crowding, swarms of locusts can compeletely defoliate grassland and agricultural crops over large areas. In the present study family Acrididae includes 2 species i.e *Cyrtocanthacris tatarica* and *Chrotogonus sp*. In family Tettigonidae one species has been recorded i.e *Conocephalus sp*.

The order Diptera comprises mosquitoes, midges and flies, which are generally two-winged, with two halteres, but there are some that have partially or entirely lost their wings, usually leaving their halteres intact behind. Through the works of Brunetti (1912, 1920, 1923), Christophers (1933), Baraud (1934), SeniorWhite et al (1940), Emden (1965), Delfinado and Hardy (1973,1975,1977), Joseph and Pauri (1980,1983,1990,1998), Datta (1983),Nandi (2002) and Cherian (2002) in their faunal and monographical work included number of species from Sikkim. Till 1998, 624 species belonging to 230 genera and 45 families were known from Sikkim and subsequently 10 more species and a family Sciomyzidae are added to the Diptera fauna of Sikkim through the work of Datta and Parui (2003) and Parui (2003) [22], which raised the number to 634 species under 46 families. In the present study Diptera is lowest dominated order with 0.05% includes one specises from family Muscidae i.e *Musca sp*. The Simpson's reciprocal index diversity is 1.000 and Zero diversity is shown in Shannon-Wiener index.

6. Conclusion

This work concludes that agriculture fields are dominated by insects. From these records it is obvious that the agroecosystem, even though it is a man-made one, it had diverse entomofauna with high level of distribution of the insects. It is an obvious fact that insects contribute much to the ecological welfare and insect conservation has been recognized as vital for sustainable world in view of their critical role in conservation of ecosystem. From this study, the agroecosystem is still considered to have a diverse and numerous insect fauna in Gulbarga city area. However, the results which were being presented in this paper might be the first comprehensive list of insects in the Hadgil Harutti village of Gulbarga . Hopefully, there will be a further research study on the insect biodiversity and taxonomy in this area, in order to get better and comprehensive information on those aspects to be documented for future reference.

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Reference

[1] Betham, J.A.1890. The Butterflies of Central Provinces, Part, III, J. Bombay nat.Hist.Soc.,:279-286.
[2] Betham, J.A.1891 a. The Butterflies of Central Provinces, Part, IV, J. Bombay nat.Hist.Soc.,:175-183.
[3] Betham, J.A.1891 b. The Butterflies of Central Provinces, Part, V, J. Bombay nat.Hist. Soc.,:318-331.
[4] Betham, J.A.1892. The Butterflies of Central Provinces, J. Bombay nat.Hist.Soc.,:425-429.
[5] Bingham, C.T. 1897.The fauna of British India including Ceylon and Burma. Hymenoptera. Vol. I. Taylor and Francis Ltd., London. 564 pp.
[6] Bingham, C.T.1903. The fauna of British India including Ceylon and Burma. Hymenoptera. Vol. IITaylor and Francis Ltd., London, 496 pp.
[7] Chima U. D., Omokhua G. E. and Iganibo-Beresibo E. (2013). Insect species diversity in fragmented habitats of the University of Port Harcourt, Nigeria.
[8] Chopard, L. 1969. The fauna of India and adjacent countries: Orthroptera: Grylloidea. Vol. II, Manager of Publications, Govt. of India, Delhi: 421 pp.
[9] Datta, M. and Parui, P. 2003. Insecta : Diptera . Fauna of Sikkim , State Fauna Series, 9 (Part-3) : 283-327. (Published by the Director, Zool. Surv. India, Kolkata).
[10] De Niceville, L.1886.The Butterflies of India, Burma and Ceylon. Vol.2. Reprinted by A.J.Reprints Agency, New Delhi: 332 pp.
[11] De Niceville, L.1890.The Butterflies of India, Burma and Ceylon. Vol.3. Reprinted by A.J.Reprints Agency, New Delhi: 503 pp.
[12] Evans, W. H.1932. The Identification of Indian Butterflies, 2nd ed. Bombay Natural History Society, 454 pp.
[13] Janzen, D.H. 1973. Sweep samples of tropical foliage insects: Effects of seasons, vegetation types, elevation, time of day and insularity. *Ecology*, **54**(3): 687-706.
[14] Khadijah A. R., Azidah A. A. and Meor S. R (2013) . Diversity and abundance of insect species at Kota Damansara Community Forest Reserve, Selangor.
[15] Kirby, W.F., 1914. The fauna of British India including Ceylon and Burma : Orthroptera (Acridiidae). Taylor and Francis Ltd., London, 276 pp.
[16] Madhumitha Jaganmohan , Lionel Sujay Vailshery and Harini Nagendra (2013). Patterns of Insect Abundance and Distribution in Urban Domestic Gardens in Bangalore, India
[17] Majer, J. D. 1987. The conservation and study of invertebrates in remnants of native vegetation. Pp. 333–335. *In* D. A. Saunders, G. W. Arnold, A. A. Burbridge, and A. J. M. Hopkins (eds). *Nature Conservation: The Role of Remnants of Native Vegetation*. Surrey Beatty and Sons, Sydney.

[18] Marshall, G.F.L. & De Niceville, L. 1882. The Butterflies of India, Burmah and Ceylon, Vol. 1. A. G. Reprints Agency, New Delhi: 327 pp.
[19] Mathew, G. 1986. Insects associated with forest plantations of *Gmelina arborea* Roxb. in Kerala, India. *Indian Journal of Forestry*, **9**(4): 308-311.
[20] McCafferty, W. P. 1981. *Aquatic Entomology: the Fisherman's and Ecologists' Illustrated Guide to Insects and Their Relatives*. Science Books International, Boston, Massachusetts. 448 pp.
[21] Nair, K.S.S. and Mathew, G. 1993. Diversity of insects in Indian forests: The state of our knowledge. *Hexapoda*, 5(2): 71-78.
[22] Parui, P. 2003. Insecta: Diptera: Asilidae. Fauna of Sikkim, State Fauna Series, 9 (Part-3): 329-339. (Published by the Director, Zool. Surv. India, Kolkata).
[23] Talbot, G. 1939. The fauna of British India including Ceylon and Burma, (Butterflies), 2nd ed.,.Taylor & Francis Ltd., London, 1: 600 pp
[24] Talbot, G.1947. The fauna of British India including Ceylon and Burma, (Butterflies), 2nd ed, Taylor & Francis Ltd., London, 2: 506 pp.
[25] Uvarov, B. P. 1927. Distributional records of Indian Acrididae. Rec. Ind. Mus., 29: 233.
[26] Varshney, R.K.1998. Faunal Diversity in India, Insecta, Zoological Survey of India: 146-157.
[27] Vikram Singh and H. S. Banyal(2013) . Insect Fauna of Khajjiar Lake of Chamba District, Himachal Pradesh, India.
[28] Whitford, W.G. 1986. Decomposition and nutrient cycling in deserts. In *Pattern and Process in Desert Ecosystems* (W.G. Whitford, Ed.), pp. 93–117. University of New Mexico Press, Albuquerque, NM.
[29] Wilson, E.O. 1992. The Diversity of Life. Harvard University Press, Cambridge, MA.
[30] Wynter- Blyth, M. A. 1957. Butterflies of the Indian Region. Bombay Natural History Society, Bombay, 523 pp., 72 pls.

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