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Quantitative status of population of insects from Lucknow region, Uttar Pradesh, India

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Abstract
Insects are found everywhere in our nature, yet, their diversity, abundance and characterization in various ecosystems are still not well defined, systematically. The present study was conducted to assess and compare the abundance, species richness and diversity of insects amongst four different spots of Lucknow district, Uttar Pradesh, India. A total of 746 insects which belonged to 6 insect species and 3 insect orders were collected from the different spots. The ecological parameters like evenness index, Margalef index, Shannon diversity index, Simpson index, Simpson diversity index and effective number of species were analysed to determine the population status of insects. The findings illustrated that the most abundant group of insects was Hymenoptera followed by Lepidoptera and Orthoptera, respectively. Notably, the differential biodiversity of insects and the variations in associated ecological parameters were observed due to the deviations in the environmental factors of four spots. Among four spots, spot 2 (Capital Public School) illustrated the highest Shannon diversity index (1.762), Simpson diversity index (0.829) and Margalef index (0.984). Thus, the assessed insect's diversity and other intended ecological parameters can be beneficial to build the strategic frameworks for setting up the agro-based economic standards of a particular region.

Keywords: Evenness index, Margalef index, Shannon diversity index, Simpson diversity index, species richness, hymenoptera

Introduction
Insects are the most abundant organisms on planet earth. Among animals, insects are the most species rich taxonomic group, making up more than 70 percent of the total. Over half of the estimated 1.5 million organism species on earth are of insects (Cheng 1976) [2]. As many 10 times species of insects are yet to be described. Approximately, 7, 51,000 are well known species of insects which is about 75% of all the living species of organisms on planet (Choudhary and Ahi 2015) [3]. More than 1, 00, 000 species of arthropods estimated on one hectare of Amazonian rainforest (Erwin 2004) [4]. Among these arthropods, roughly 85% species belong to the insects (May 1998) [10]. Insects are world's most diverse group of animals on earth in terms of both taxonomic diversity and ecological function (Belamkar and Jadesh 2012) [1]. There are many reasons of enormous diversification of insects. The millions of insects can live in single acre of land. The low extinction rate and their relative age are the reasons that give them more time for diversification. Insects can live almost everywhere. They can also survive on harsh environments from deserts to Antarctic. Ocean is the only place where insects are not commonly found. Due to their small size their requirement of food is very low therefore they can survive in very small niches. Indian insects constitute nearly 7% of the world's insect fauna (Ghosh and Singh 2000) [5].
Almost, in all habitat ecosystems, the most important component of animal diversity is insects. The richness of tropical insect fauna worldwide is beyond expectations. Insects are both beneficial and harmful organisms. For example large of moths or beetles play a very significant role in nutrient cycling by feeding on dead trees and wood (Majer 1987) [8]. In insects, the equivalent variety of adaptations to variable environmental conditions are due to their abundance, diversity and species richness of insects (Schowalter 2022) [15]. Their biodiversity may be defined as sum total of all life forms at every level of organization in biological system (Wilson 1988) [20]. It may be diversity within species and between different species of an ecosystem or habitat (Sankarganesh 2017) [14]. In the present study, area little is known about type of insect species living in the habitat. However many human activities like

Cutting of trees decrease the abundance diversity and species richness of insects. This study analyzes the insect abundance, species diversity, species richness and species evenness in well-known four spots of Lucknow district, Uttar Pradesh, India.

Materials and Methods

Study locations in Lucknow

In capital Lucknow of Uttar Pradesh, India, the sampling period starts from October 2021 till up to the end of February 2022. During these months, the atmospheric parameters like temperature, relative humidity and rain fall were also recorded in Lucknow zone (Table 1). The observation and collection of insects were carried out on four different sampling spots. These four spots were located in Lucknow: IT College near sport ground (spot 1), Capital Public School, Jankipuram garden (spot 2), Colony park-1, sector-J Jankipuram (spot 3), and Panchvati Park, sector-H, Jankipuram (spot 4). Sampling was conducted during commenced month for spot 1 (from 11:00 am to 1:40 pm), spot 2 (from 3:30 pm to 4:30 pm), spot 3 (from 4:45 pm to 5:45 pm) and spot 4 (from 5:55 pm to 6:55 pm).

Table 1 Data regarding meteorological factors of different months

Months	Temperature (ºC)	Relative Humidity (%)	Rain fall (mm)
October 2021	25.45±1.34	66±07	34±01
November 2021	21.28±1.06	58±11	22±03
December 2021	16.45±2.46	64±09	10±04
January 2022	15.93±2.04	67±08	19±03
February 2022	18.61±1.94	60±12	25±01

Observation and collection of insects

Four sites were selected as the sampling site for the observation of the insects. Insects can be collected by various methods, such as in situ count, knock down method, netting, trapping, extraction from soil, indirect technique, etc. These methods like netting and trapping are excessively used for counting the diversity of insects. Nets were used for the collection of flying insects. Nocturnal insects were usually trapped by light trapping method. Various trapping methods can be done by random walk for about minimum two to three hours walk during sampling period.

Identification of insects

The observed insects were identified up to the genus level by the classification. It can also be done by studying the stream habitat.

Diversity analysis

Methodology for the sampling and analysis of the insect's population plays a very important role in study of the insect's population dynamics. Nowadays, there are so many techniques available basically for the observation and collection of insects. The following mathematical procedures or representations were used for analysing data exhibited in tabular form. Biodiversity indices were calculated using the standard formulas.

Shannon diversity index (H)

Diversity of insect species at all four sites was calculated using the Shannon diversity index (H) (Shannon 1948) [16]. The Shannon index is given by the formula below-

$$H = -\sum pi \ln pi$$

Where,

Pi = S/N, S is the total number of individuals of one species, N is the total number of individuals in the sample and ln = logarithm to base e. The proportion of species relative to total number of species (pi) was calculated and multiplied by natural logarithm of this proportion (ln pi). The results were summed across the species and multiplied by -1.

Palou's evenness index

Equitability or evenness was calculated using the Palou's evenness index (Pielou 1966) [13]. The formula for Palou's evenness index is

$$E = H/\ln S$$

Where H is the Shannon-Weaver diversity index and S is the total number of species

Effective number of species

Effective number of species was calculated using the formula

$$E' = \text{Exponential}(H)$$

Where H is Shannon-Weaver index

Simpson index (λ)

Simpson index (λ) was used to determine diversity information of species present on the sites (Simpson 1949) [17]. The Simpson index is a measure of diversity, which takes into account both species richness and evenness of abundance among the species present. In short it measures the probability that two individuals randomly selected from an area will belong to the same species. The index is given by the formula below.

$$\lambda = \Sigma\, n\,(n-1)/\, N\,(N-1)$$

Where n is number of individuals of each species and N is total number of individuals of all species.

Simpson diversity index

Simpson diversity index was calculated using the formula 1- λ as lambda is measure of dominance it measures species diversity.

Margalef index

The species richness of insect was calculated using the Margalef index (Margalef 1958) [9]. Margalef index is given by the formula

$$D = (S-1)/\ln N$$

Where S is the total number of species, N is the total number of individuals in the sample and ln is the natural logarithm (logarithm to base e).

Results and Discussion

This study highlights the abundance, richness and diversity of insect fauna in Lucknow regions of Uttar Pradesh, India. A total of 746 insects which belonged to 6 insect species and 3 insect orders were sampled from four different spots of Lucknow region. Monthly wise, the total of 209 individuals of 6 insect species were sampled from IT College (spot 1), 161 from Capital Public School, Jankipuram Garden (spot 2), 193 insects from Colony Park of sector-J Jankipuram (spot 3) and 183 insects From Panchvati Park Sector-H Jankipuram (spot 4) (Table 2). Notably, the management practices of all four spots influenced the diversity of recorded insects and their abundance according to the size of land areas and the variable distribution of advantageous plant species. The multiple factors like environmental conditions and vegetation of particular geographical region were mainly responsible for differential abundance and diversity of insects in four selected urban ecological regions. Thus, the city's ecology and the structure of urban social lives were also important features for the faunal distribution (Warren *et al.* 2010) [19]. Besides, the most abundant order were Hymenoptera (338) followed by Lepidoptera (335) and Orthoptera (73) (Table 3). Insect order richness was prominently related to the richness in floral species, size of spot, and the percentage of grass covered region. Further, the taxonomic efforts are also required to decipher the additional insights in the faunal diversity studies (Kim and Loren 2006) [6].

Table 2: The number of insects sampled from ecological regions, spot 1 (IT college near sports ground), spot 2 (Capital Public School, Jankipuram Garden), spot 3 (Colony Park-1, Sector-J, Jankipuram) and spot 4 (Panchvati Park, Sector-H) of Lucknow district in documented months

S. No.	Insects	Months	Numbers on Spot 1	Numbers on Spot 2	Numbers on Spot 3	Numbers on Spot 4
1.	Bumble Bee	October 2021	07	04	04	04
		November 2021	08	02	03	03
		December 2021	10	04	06	05
		January 2022	09	05	03	04
		February 2022	12	05	04	04
Total			46	20	20	20
2.	Honey Bee	October 2021	08	05	09	08
		November 2021	06	06	12	06
		December 2021	07	05	06	04
		January 2022	08	06	11	05
		February 2022	08	06	07	09
Total			37	28	45	32
3.	Moth	October 2021	08	11	09	09
		November 2021	08	06	05	07
		December 2021	07	07	06	06
		January 2022	09	05	07	07
		February 2022	09	07	11	09
Total			41	36	38	38
4.	Butterfly	October 2021	10	09	10	10
		November 2021	09	08	11	08
		December 2021	08	06	09	09
		January 2022	12	07	12	11
		February 2022	07	04	10	12
Total			46	34	52	50
5.	Wasp	October 2021	04	04	03	06
		November 2021	06	07	02	05
		December 2021	05	04	03	04
		January 2022	08	05	04	05
		February 2022	04	04	02	05
Total			27	24	14	25
6.	Grasshopper	October 2021	03	03	04	04
		November 2021	02	04	03	02
		December 2021	03	03	04	03
		January 2022	01	05	06	05
		February 2022	03	04	07	04
Total			12	19	24	18
Total insects fauna			209	161	193	183

Table 3: Comparison of insect diversity from four different spots of Lucknow based on different diversity parameters

Insect order	Spots	Abundance	Shannon diversity index (H)	Simpson index (λ)	Simpson diversity index	Species evenness (E)	Species richness (Margalef index; D)	Effective number of species
Overall	Spot 1	209	1.721	0.183	0.817	0.960	0.936	5.589
	Spot 2	161	1.762	0.171	0.829	0.984	0.984	5.827
	Spot 3	193	1.697	0.193	0.807	0.947	0.950	5.459
	Spot 4	183	1.728	0.184	0.816	0.964	0.960	5.628

Hymenoptera	Spot 1	110	1.076	0.342	0.658	0.979	0.425	2.932
	Spot 2	72	1.089	0.330	0.670	0.992	0.468	2.972
	Spot 3	79	0.975	0.413	0.587	0.887	0.458	2.651
	Spot 4	77	1.080	0.337	0.663	0.983	0.460	2.946
Lepidoptera	Spot 1	87	0.691	0.496	0.504	0.998	0.224	1.997
	Spot 2	70	0.693	0.493	0.507	0.999	0.235	1.999
	Spot 3	90	0.681	0.507	0.493	0.982	0.222	1.976
	Spot 4	88	0.684	0.504	0.496	0.987	0.223	1.981
Orthoptera	Spot 1	12	0.011	0.997	0.003	0.001	0.005	1
	Spot 2	19	0.021	0.998	0.002	0.002	0.001	1
	Spot 3	24	0.010	0.990	0.010	0.005	0.003	1
	Spot 4	18	0.009	0.996	0.004	0.006	0.002	1

(Numbers in bold represent the highest values in their respective group)

Ecological diversity measurements such as index of dominance, species richness and species evenness form an integral part of the investigation of biodiversity for a particular region (Morris *et al.* 2014) [11]. Higher diversity is shown by an area with low dominance whereas an area with high dominance which indicates less diversity (Nikookar *et al.* 2015) [12]. In this study, Spot 2 revealed the highest Shannon diversity index (1.762) and highest Simpson diversity index (0.829). Likewise, the spot 2 illustrated higher species richness which was indicated by higher value of Margalef index (D = 0.984) as compared to other spots (Table 2). Comparatively, the abundance of insects amongst all four spots revealed significant differences. Remarkably, the differences in abundance and other ecological parameters of species may be due to availability of food resources and ecosystem stability. Further, a low value of Simpson index in spot 2 (0.171) as compared to other spots showed less species because of higher diversity in spot 2. Spot 3 had the highest value of Simpson index (0.193) followed by spot-4 and spot 1 which showed its values like 0.184 and 0.183, respectively.

Hymenoptera, a group of pollinators in many habitat types, was found less abundant on spot 2. The current study indicated the presence of 3 insects of Hymenoptera from the study sites. According to total number of individuals it is first dominated order. It has been analysed that order Hymenoptera recorded higher Shannon Weaver index (1.089), higher species richness (0.468) and evenness (0.992) on spot 2 as compared to other spot (Table 2). For pollinating insects, the availability of nest and forage sites are essential, however, the low floral diversity reduces the pollinator's abundance and their diversity. The abundance of insects in order Lepidoptera but found to be less abundant in spot 2. This may be caused by other factors such as insect sampling techniques, habitat preference during sampling hours. Lepidoptera consists of butterfly and moth which is second dominated order in present study. The higher value of Shannon Weaver index (0.693), species richness (0.235) and species evenness (0.999) is recorded on spot 2. Eventually, only one insect of Orthoptera that is grasshopper was considered in study, which was found most abundant in spot 3. Therefore, the higher dominating order was Hymenoptera followed by Lepidoptera and Orthoptera. This research work presented corroborates that the facts to the noteworthy stages of insects biodiversity and their abundance. The faunal diversity was supported by the factors, such as, small, local-scale patches of green vegetation in densely populated urban area (Lubbe *et al.* 2010) [7]. Similarly, the findings also collaborated to the outcomes of the study in which the steps were described to increase the micro-scale diversity of urban regions by adding more plants. These improvements elicit the invertebrate abundance and diversity (Sperling and Lortie 2010) [18].

Conclusion

The evaluating and monitoring biodiversity of insects develop a framework for foreseeing key species of Insects. Their diversity relied on many ecological factors. This collaborated research work will help to provide the platform for further soundings into the ecological factors or markers determining the distribution of faunal especially insect diversity in urban ecosystems in the current scenario of world. Further, this study can be an essential for the identification of insects in particular area. And, under the adverse scenario of developing world, the present investigation recommends that the particular area should give the conservation priority to promote its faunal biodiversity.

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Conflict of interests

Authors have declared that there is no conflict of interests.

References

1. Belamkar NV, Jadesh MA. Preliminary Study on Abundance and Diversity of Insect Fauna in Gulbarga District, Karnataka, India. Int. J Sci. Res. 2012;3(12): 1670-1675.
2. Cheng L. Insects in marine environments. In: Cheng L, editor. Marine Insects. North Holland Publishing Company; c1976. p. 1-4.
3. Choudhary A, Ahi J. Biodiversity of freshwater insects: A Review. 2015;4(10):25-31.
4. Erwin TL. The biodiversity question: how many species of terrestrial arthropods are there? Forest Canopies. 2004; 10:259-269.
5. Ghosh LK, Singh R. Biodiversity of Indian insects with special reference to aphids (Homoptera: Aphididae). Zoological Survey of India. 2000;14:113-123.
6. Kim KC, Loren B. Biodiversity loss and the taxonomic bottleneck: emerging biodiversity science. Ecol. Res. 2006;21(6):794-810.
7. Lubbe CS, Siebert SJ, Cilliers SS. Political legacy of South Africa affects the plant diversity patterns of urban domestic gardens along a socio-economic gradient. Sci. Res. Essays. 2010;5(19):2900-2910.
8. Majer JD. The conservation and study of invertebrates in remnants of native vegetation. Nature Cons. 1987;2:333-

335.
9. Margalef R. Information Theory in Ecology. General Systems. 1958;3:36-71.
10. May RM. The dimensions of life on Earth. Nature and Human Soc. 1998;1:30-45.
11. Morris EK, Caruso T, Buscot F, Fischer M, Hancock C, Maier TS, *et al*. Choosing and using diversity indices: insights for ecological applications from the German Biodiversity Exploratory Ecology and evolution. 2014;4(18):3514-3524.
12. Nikookar SH, Moosa-Kazemi SH, Oshaghi MA, Vatandoost H, Yaghoobi-Ershadi MR, Enayati AA, *et al*. Biodiversity of culicid mosquitoes in rural Neka township of Mazandaran province, northern Iran. Journal of vector borne diseases. 2015;52(1):63.
13. Pielou EC. The measurement of diversity in different types of biological collections. Journal of Theoretical Biology. 1966;13:131-144.
14. Sankarganesh E. Insect Biodiversity: The Teeming Millions- A review. Bull. Env. Pharmacol. Life Sci. 2017;6(3):101-105.
15. Schowalter TD. Insect ecology: an ecosystem approach. Academic press; c2022.
16. Shannon CE. A Mathematical Theory of Communication. The Bell System Technical Journal. 1948;27:379-423.
17. Simpson EH. Measurement of Diversity. Nature. 1949;163(4148):688-688.
18. Sperling CD, Lortie CJ. The importance of urban backgardens on plant and invertebrate recruitment: A field microcosm experiment. Urban Ecosyst. 2010;13: c223-235.
19. Warren PS, Harlan SL, Boone C, Lerman SB, Shochat E, Kinzig AP. Urban Ecology and Human Social Organization. In Urban Ecology; Gaston, K.J., Ed.; Camridge University Press: Cambridge, UK; c2010. 172-199.
20. Wilson EO. The current state of biological diversity. Biodiversity. 1988;521(1):3-18