VOLUME 11 ISSUE 2 2025

ISSN 2454 – 3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 11, No. 2, 943-952 (2025)

International Journal of Zoological Investigations

Contents available at Journals Home Page: www.ijzi.net

Editor-in-Chief: Prof. Ajai Kumar Srivastav

Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

A Study on Insect Diversity and Abundance around Wetlands in Aligarh and Bulandshahar (India)

Varshney Akash

Department of Zoology, D.S. College, Aligarh, Uttar Pradesh, India

Received: 28th July, 2025; **Accepted:** 7th September, 2025; **Published online:** 19th November, 2025

https://doi.org/10.33745/ijzi.2025.v11i02.092

Abstract: Insects constitute largest class of animal kingdom and occupy all habitats- air, water and soil. In the present study insect diversity and abundance was studied around wetlands in Western Uttar Pradesh, India. Insects were collected from flowering plants, households and croplands around Shekha Bird Sanctuary (site 1) and NAPS Township (site 2) with the help of nets and aspirator. After collection they were preserved and identified. Insect diversity at both the sites was determined by Simpson's Diversity Index, Shannon's Diversity Index, Effective number of species, Richness, Evenness, Effective number of species and Sorenson's Index. Insects collected from Shekha Bird Sanctuary and NAPS Township was 334 and 363, respectively. *Apis dorsata* was the most abundant insect at Shekha Bird Sanctuary, while *Coccinella septempuncata* was most abundant species at NAPS Township. Lepidoptera was most diverse and abundant order at both the sites. At Shekha Bird Sanctuary highest 101 Lepidopterans of 7 species were recorded, making 30% of total number of insects and 29% of total species collected; whereas, Blattoidea was least (4) in terms of insect number (1%) and as minimum 1 species each (4%) was recorded from Blattoidea and Coleoptera. At NAPS Township 71 Lepidopterans of 8 species were recorded, constituting 19% of total insects and 31% of total species collected from this site; whereas, only 16 insects (4%) of 1 species (4%) were recorded from Blattoidea, making it least abundant Order here. The Simpson's Diversity index (1-D) for Shekha Bird Sanctuary and NAPS Township was calculated as 0.9494 and 0.9536, respectively; whereas, Shannon's Diversity Index (H) was calculated as 3.04 and 3.12, respectively. The Effective Number of Species for both the communities was calculated as 21 and 23, respectively. The evenness calculated for both the sites (1 and 2) was 0.957 and 0.958, respectively. The average population size of the communities was 13.92 and 13.96, respectively at Site 1 and 2. Out of 24 and 26 species recorded from both the sites 1 and 2, respectively, both the communities share 16 species and the value of Sorenson's Index was calculated as 0.64.

Keywords: Insect Biodiversity, Abundance, Lepidoptera, Hemiptera, Coleoptera, Diptera, Orthoptera, Hymenoptera

Citation: Varshney Akash: A study on insect diversity and abundance around wetlands in Aligarh and Bulandshahar (India). Intern. J. Zool. Invest. 11(2): 943-952, 2025.

https://doi.org/10.33745/ijzi.2025.v11i02.092

Introduction

Biodiversity can be described as variations among living entities from all habitats. India is a mega diversity hot spot. Insects constitute more than half of animal species of the world and contribute in biodiversity on the earth (Tihelka *et al*., 2021). Insects are found throughout the world and occur

in all habitats. Insect's biodiversity accounts for a large ratio on the earth. Major orders of Insects are Lepidoptera, Orthoptera, Diptera, Hemiptera, Odonata, Hymenoptera and Thysanoptera. Most of the insects are found on various plants including grasses, weeds, shrubs, trees and flowers. Insects are commonly considered as pests or disease carriers that influence agriculture, human health, and natural resources. Many insects are beneficial for humans too, as they serve to pollinate plants, produce useful substances, control pest insects, act as scavengers, and serve as food for other animals. Insects serve as pollinators, decomposers and predators of insect pests (Sollai and Solari, 2022).

Insects are the most diverse animals which evolved distinct genetic, morphological and functional characteristics to adapt to their complex and dynamic ecological conditions that result in significant variety. Among various insects, members of Coleopteran have forewings as hard shell to protect their hind wings, while those of Lepidoptera have colorful wings. One pair of wings occur in members of Order Diptera. Hymenopterans are usually colonial insects. Hemipterans possess a rostrum. Orthopterans feed on plants and jump with their legs. Odonatans prey on other organisms. The insect biodiversity also depends upon variety and abundance of suitable host plants, as these plants serve for their food source as well as oviposition site. Insect diversity is also affected by temperature of the area. Studies on biodiversity compare the richness of different areas.

Insects are able to occupy all the habitats because of their small size, high fecundity, areal respiration, food diversity, protective mechanisms and other traits. This served as the primary justification for examining insect diversity around wetlands in Western Uttar Pradesh, India. The wetland areas are rich and vibrant hub of insect life, which was explored during the study for their evolutionary adaptations, ecological significance and interaction with local environment. This region represents the fertile plains of Ganges river basin, having a vast array of habitats ranging from agricultural fields and urban landscapes to wetlands and forests supporting a variety of insects.

Materials and Methods

Study Sites:

In the present study insects were collected from two sites around the wetlands, which are Shekha Bird Sanctuary (site 1) and NAPS Township (site 2). Shekha lake was recognized as Shekha Bird Sanctuary. It is a wetland; its co-ordinates are 27° 51' 21" North and 78° 13' 05" East (Fig. 1). It is about 17 km away from Aligarh on the Atrauli-Chharra-Kasganj road. It proves a variety of habitats that support a wide variety of aquatic and terrestrial fauna including various insects. Narora Atomic Power Station (NAPS) Township is located at Narora of Bulandshahar District. It falls between 28° 09' 29" North and longitude 78° 24' 34" East (Fig. 2). River Ganga flows through Narora and it was recognized as Ramsar Site in 2005. It is an important wetland and possesses a variety of fauna including various insects.

Insect Collection:

Most of the insects are minute in size, so it is not possible to identify them without observing their minute morphological features. Thus insects were collected, preserved and brought to lab for their identification (Schauff, 2001). Insects occur everywhere; however, flowering gardens are most likely place for insect collection. Small insects may also be found in the soil near the roots of plants. Aquatic insects were collected from pond, lakes and streams. Mosquitoes, flies, fleas and bugs are found in the human dwellings. Dragon flies, Damsel flies and May flies are found near water bodies. In the present study the instruments used for insect collection include aerial nets, sweep nets, aquatic dip nets, aspirator, beating sheets, pitfall traps, light traps etc. Aerials nets were used for catching flying insects like wasps, bees, butterflies, moths, dragon flies etc. Aerial net scoops the insect from the air, its long bag is flipped over the hoop after the insect is trapped.

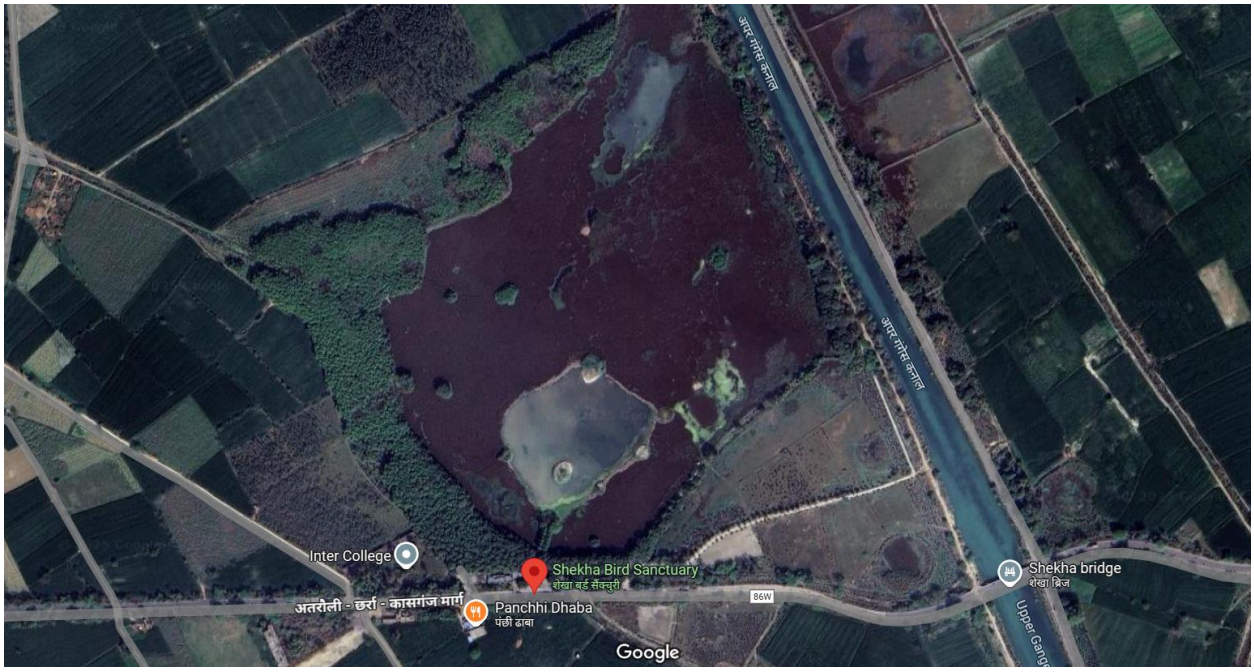

Fig. 1: Site Map of Shekha Bird Sanctuary.

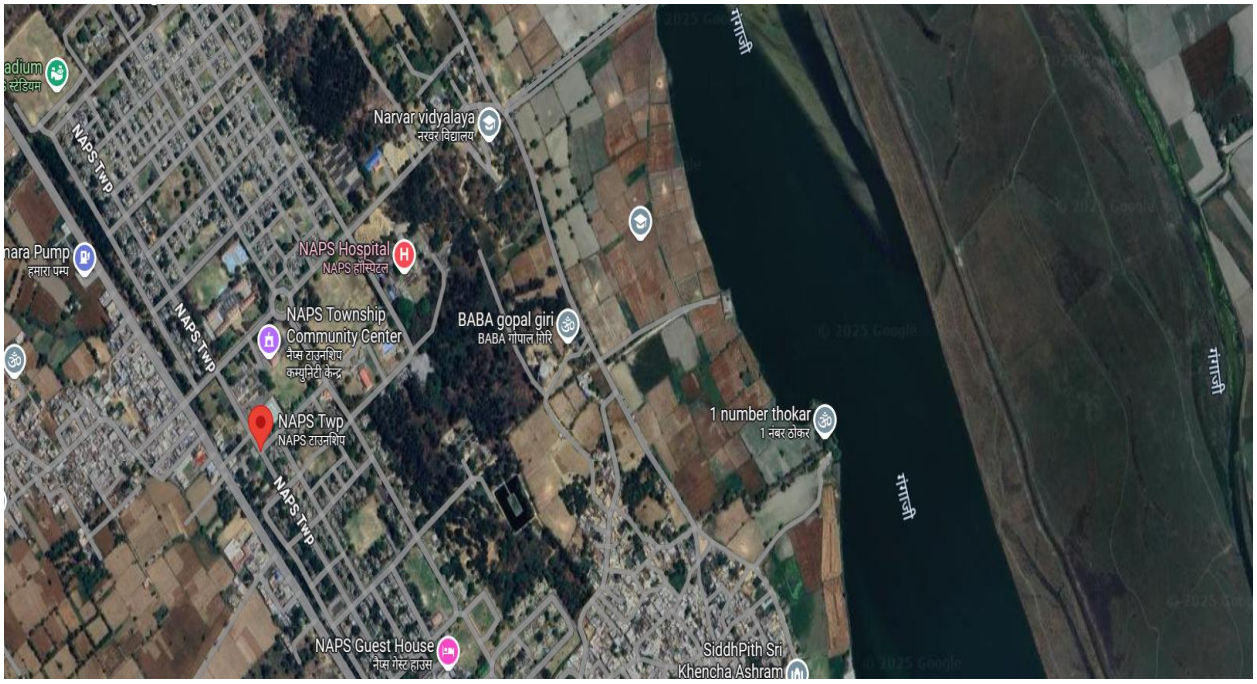

Fig. 2: Site Map of Narora Atomic Power Station Township.

Insects were then transferred to killing jars. Sweep nets were used for collection of insects from vegetation and cockroaches etc. (Kumar and Saksena, 2021). Sweep nets can be assaulted to the substrate with force so that insects become loose and collected in bag of net and then transferred to killing jars. Minute insects were caught with the help of Aspirators (Barnard and Mulla, 1977). Insects are sucked in and collected in vial. Killing jars are normal glass container with lid, having a cotton swab soaked with a killing agent. Normally ethyl acetate, alcohol and

chloroform are used as killing agent (Kumar *et al*., 2022). Insects are transferred from nets to these killing jars to be killed and then preserved. After that insects were brought to laboratory for their identification. Most of the insects were identified up to species level, however, for some of them species was not confirmed, then identification was done up to Genus.

Data Analysis:

Many diversity indices were used to determine insect diversity. These were Simpson's Diversity Index, Shannon's Diversity Index, Effective number of species, Evenness, Richness, Effective number of species and Sorenson's Index (Nurin Izzati *et al*., 2021).

Simpson's Diversity Indices:

These are Simpson's Index (D), Simpson's Index of Diversity (1-D) and Simpson's reciprocal index (1/D). Simpson's Index (D) measures whether two randomly selected individuals from a sample belong to the same species. It is calculated by following formula:

$$D = \sum \frac{n(n-1)}{N(N-1)}$$

Where, n = Total number of individuals of a species; N = Total number of individuals in the community.

The value of D ranges between 0 to1. Its higher value indicates lower diversity.Simpson's index of diversity (1-D) was calculated by subtracting D from 1. It also ranges between 0 to 1. Its higher value indicates higher diversity (Hill, 1973). Simpson's reciprocal index (1/D) is obtained by diving 1 from D. its higher value indicates higher diversity.

Shannon's Diversity Index:

It is also called as Shannon-Weiner's Diversity Index. It describes the richness of habitat i.e. the number of species found and evenness i.e. the abundance of species. Its higher value indicates higher species diversity (Mcdonald *et al*., 2010). It is denoted by H'. It is calculated as follow:

$$H' = -\sum [(pi)\times\log(pi)]$$

$$Pi = n/N$$

Where, pi = Proportion of individuals of i^{th} species in the community; Log = Natural logarithm; n = Total number of individuals of a species; N = Total number of individuals of all the species in the community.

Shannon's Diversity Index typically ranges from 1.5 to 3.5 for most of the ecological studies. It rarely exceeds 4.5. Its higher values (near maximum possible value) show higher diversity.

Effective Number of Species (*ENS*):

It is the number of equally abundant species that would be needed to achieve same diversity as the observed community. It essentially quantifies the biodiversity by indicating the number of equally abundant species that would be present in a community to produce the same level of diversity as observed in the actual community (Lou, 2006). It is derived from Shannon's Diversity Index.

Effective Number of Species (ENS) = exp (H')

Evenness:

It measures how evenly the individuals of different species are distributed within the community. It ranges between 0 to1. Its high value indicates that individuals of all the species are evenly distributed in the community i.e. all the species have almost equal abundance.

Evenness = H / ln (k)

Where, H = Shannon's Diversity Index; k =Total number of species

Sorenson's Index:

It is also known as Sorenson-Dice coefficient. It measures the similarity between species composition of two communities. It ranges from 0 to 1. Its higher value indicates that two communities have similar species (Chao *et al*., 2005).

Sorenson's index (SI) = $2\times N_c \div N_1 + N_2$

Where, N_c = Number of common species in

both communities; N_1 = Number of species in first community; N_2 = Number of species in second community.

Results and Discussion

Total 334 insects were collected from Shekha Bird Sanctuary; whereas, 363 insects were recorded from NAPS Township, indicating bit higher abundance of insects at NAPS Township. *Apis dorsata* was the most abundant insect (36 specimens) at Shekha Bird Sanctuary, which may be due to presence of abundant flowering plants, pollinated by honeybees; whereas *Coccinella septempuncata* was most abundant species (29 insects) at NAPS Township, indicating abundance of their prey which are soft bodied insects such as Aphids. Only 4 insects of *Periplanata americana* was recorded at Shekha Bird Sanctuary and 3 insects *Cepora nerissa* were collected from NAPS Township, which were the lowest numbers of insects collected at these sites, respectively. The total number of species recorded from Shekha Bird Sanctuary was 24, belonging to 17 Families and 26 species were recorded from NAPS Township, belonging to 18 Families, indicating almost little higher insect diversity at NAPS Township (Table 1). The insects collected from both the sites belong to 8 orders, among which Lepidoptera was most diverse and abundant order at both the sites. At Shekha Bird Sanctuary 101 Lepidopterans of 7 species were recorded, making 30% of total number of insects and 29% of total species collected; whereas, Blattoidea was least in terms of insect number (1%) and a minimum 1 species each (4%) was recorded from Blattoidea and Coleoptera (Figs. 3, 4). At NAPS Township 71 Lepidopterans of 8 species were caught, constituting 19% of total insects recorded and 31% of total species collected from this site; whereas, only 16 insects (4%) of 1 species (4%) were recorded from Blattoidea, making it least abundant Order here (Figs. 5, 6). Balakrishnan *et al.* (2014) observed diversity of insect fauna in coastal habitats of Tamil Nadu and recorded Coleoptera (26%), Lepidoptera (24%), Diptera (18%), Heteroptera (13%), Hemiptera (11%), and Orthoptera (8%). Saddam *et al.* (2017) studied insect biodiversity on flowering Teak at various sites of Aligarh and observed that majority of insects collected included Hymenoptera (49%), Lepidoptera (30%) and Diptera (9-15%). Ghani and Maalik (2020) studied fauna associated with wheat in Sialkot of Pakistan and observed that Hemiptera (37%) was most abundant, while Coleoptera (30%), Diptera (14%), Lepidoptera (10%) and Hymenoptera (9%) were the other orders of insects collected. Majeed et al. (2020) studied diversity and distribution of arthropods around wetlands and observed the Diptera as most diverse group followed by Coleoptera, Hymenoptera, Hemiptera, Orthoptera and Lepidoptera. Ramzan *et al*. (2020) observed insect abundance and diversity near pond area in Faisalabad, Pakistan and recorded Lepidoptera, Hymenoptera, Coeloptera and Diptera, Coleoptera being the most abundant order. Rekha *et al.* (2021) studied insect biodiversity and their abundance in croplands at Ramnagar of Uttarakhand and recorded Lepidoptera (79%) being the highest contributor to the insect diversity while Coleoptera (7%), Hymenoptera (7%) and Odonata (7%) were the other Orders collected. Nurin Izzati *et al.* (2021) surveyed insect diversity during flowering and fruiting seasons in mango orchards in Malaysia and recorded that most of the insects collected during flowering season belonged to Thysanoptera, Diptera and Coleoptera; whereas during fruiting season Diptera was the major order (80%). Goswami *et al.* (2024) studied diversity and abundance of insects at Nainital of Uttarakhand and recorded Lepidoptera as most abundant Order followed by Hymenoptera, Coleoptera, Orthoptera and Diptera. The variations in the insect diversity and abundance among present study and previous studies by other workers may be due to the fact that previous workers focused on a particular crop for their study, while in the present study insects were collected from general habitat.

The statistical analysis for various diversity indices of data collected during present study also confirmed that insect diversity was bit higher at

Table 1: List of Species collected from Shekha Bird Sanctuary and NAPS Township

S. No.	Order	Family	Scientific Name	Common Name	Site- 1 (Shekha Bird Sanctuary)	Site- 2 (NAPS Township)
1	Hemiptera	Pentatomidae	*Bagrada hilaris*	Bagrada bug	15	-
2		Scutelleridae	*Chrysocoris stollii*	Jewel bug	12	7
3		Aphidae	*Aphis gossypii*	Cotton bug	-	14
4	Blattoidea	Blattidae	*Periplanata americana*	American cockroach	4	16
5	Diptera	Syrphidae	*Episyrphus balteatus*	Marmalade hoverfly	18	-
6		Muscidae	*Musca domestica*	Housefly	17	13
7		Tipulidae	*Nephrotoma serricornis*	Tiger Crane fly	-	22
8		Culicidae	*Culex*	Common mosquito	20	27
9	Coleoptera	Scarabaeidae	*Onitis*	Scarab Beetle	-	25
10		Coccinellidae	*Coccinella septempuncata*	Seven spot ladybird beetle	21	29
11	Odonata	Libellulidae	*Bradinopyga geminata*	Granite ghost	18	7
12			*Orthetrum sabina*	Slender skimmer	5	-
13			*Libellula quadrimaculata*	Four spotted chaser	-	10
14		Coenagrionidae	*Ceriagrioin coromandelianum*	Yellow waxtail	12	-
15			*Teinobasis*	Red breasted longtail	7	-
16			*Ischnura elegans*	Blue tailed Damsel fly	-	16
17	Lepidoptera	Papilionidae	*Papilio polytes*	Common Mormon	18	10
18		Nymphalidae	*Danus chrypsipus*	Plain tiger	24	10
20			*Tirumala limniace*	Blue tiger	22	15
21			*Melanitis leda*	Common evening brown	-	15
22			*Euploea klugii*	Brown king crow	10	7
23		Pieridae	*Eurema hecabe*	Common grass yellow	12	5
24			*Cepora nerissa*	Common Gull Butterfly	8	3
25			*Catopsilia pyranthe*	Mottled emigrant	7	6
26	Hymenoptera	Apidae	*Apis dorsata*	Rock bee	36	-
27			*Xylocopa fenestrata*	Carpenter bee	-	27
28		Formicidae	*Oecophylla*	Weaver ant	12	21
29			*Tetraponera rufonigra*	Bicolour arboreal ant	11	-
			Camponotus spp.	Carpenter Ant	-	16
30	Orthoptera	Grillidae	*Gryllodes sigillatus*	Tropical	-	8

				house cricket		
31			*Oxya*	grasshopper	5	8
32		Acrididae	*Anacridium aegyptium*	Egyptian tree locust	15	-
33		Tettigonidae	*Conocephalus melaenus*	Black kneed conehead	-	18
34		Pyrgomorphidae	*Poekilocerus pictus*	Painted grasshopper	5	8

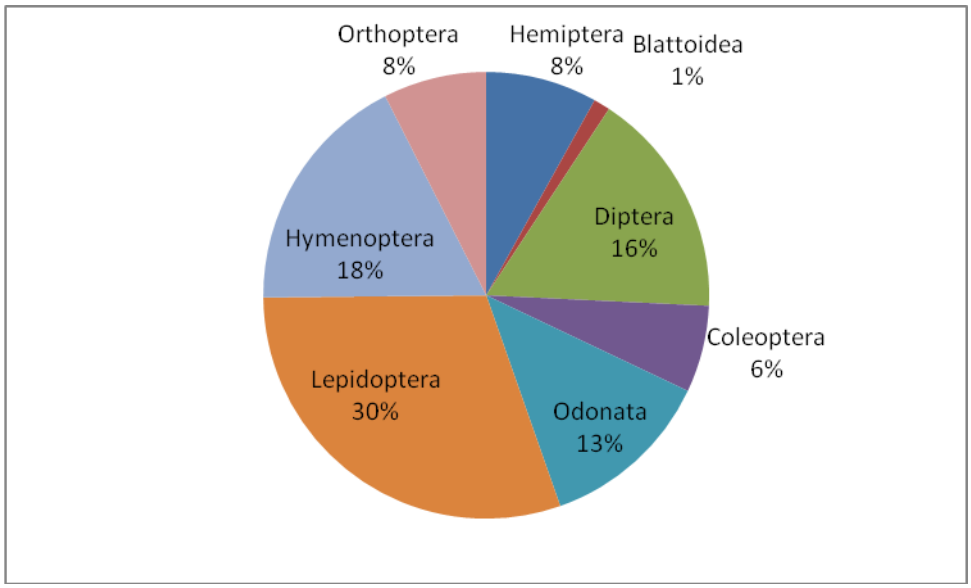

Fig. 3: Percentage of Insects collected according to Orders from Shekha Bird Sanctuary.

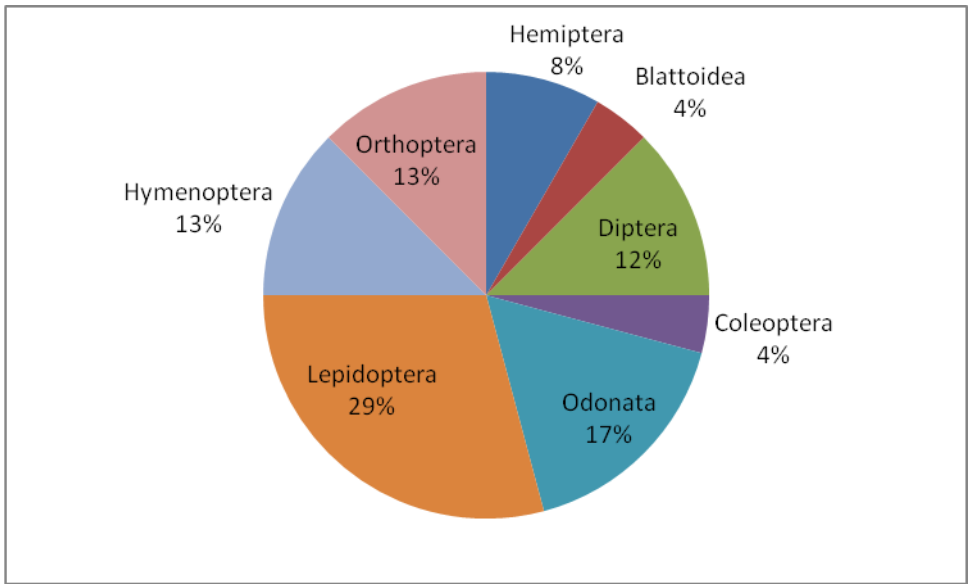

Fig. 4: Percentage of Species collected according to Orders from Shekha Bird Sanctuary.

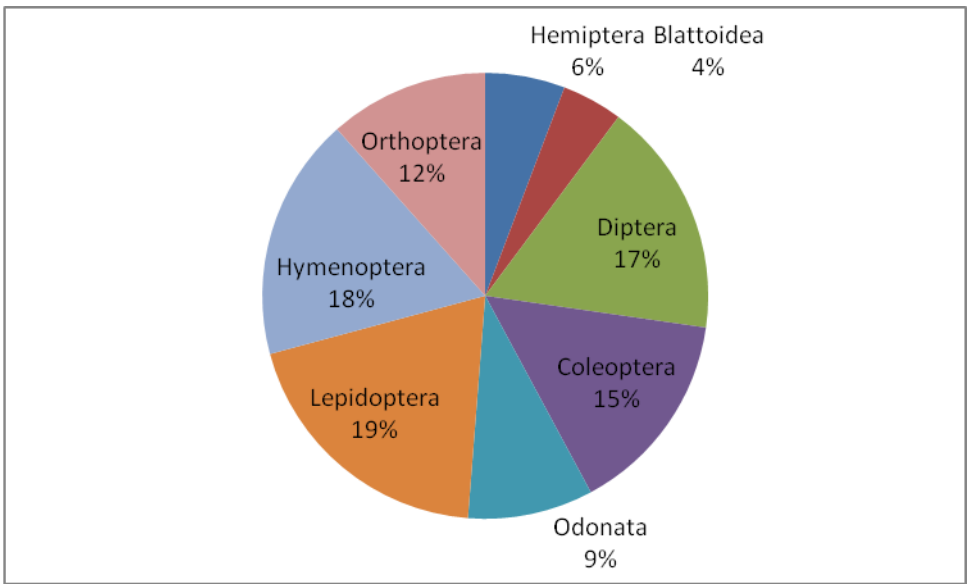

Fig. 5: Percentage of Insects collected according to Orders from NAPS Township.

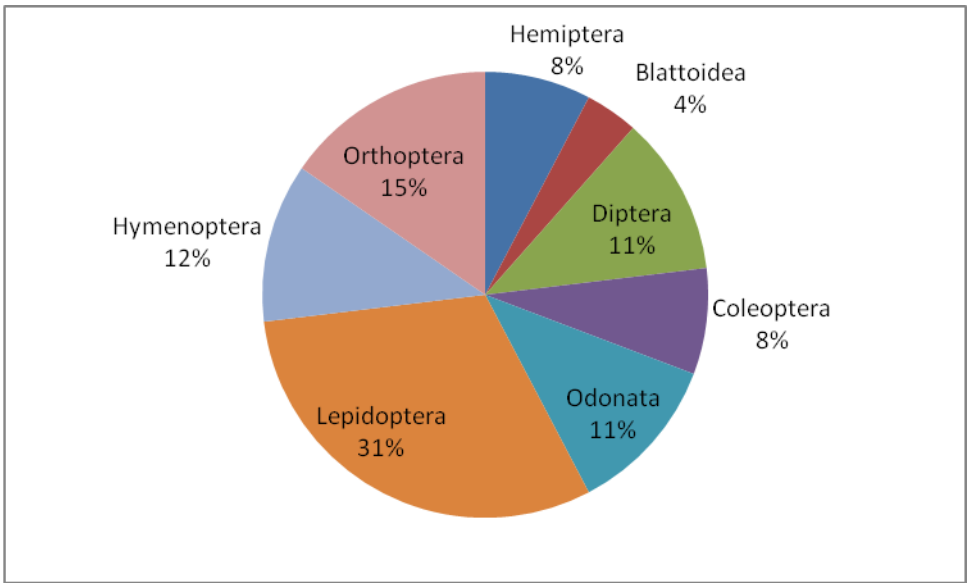

Fig. 6: Percentage of Species collected according to Orders from NAPS Township.

NAPS Township than Shekha Bird Sanctuary. The Simpson's Diversity index (1-D) for the Site 1 and 2 was calculated as 0.9494 and 0.9536, respectively (Table 2), which confirms that insect diversity is high at both the sites. Simpson's Index (D) for both the sites was calculated 0.0506 and 0.0464, respectively (Table 2) and Simpson's Reciprocal Index (1/D) was calculated as 19.7628 and 21.5517, respectively (Table 2) for both the sites, confirming the higher diversity at NAPS Township. The value of Shannon's Diversity Index (H) was calculated as 3.04 and 3.12 at Shekha Bird Sanctuary and NAPS Township, respectively, confirming higher insect diversity at these sites, NAPS Township to be more diverse than Shekha Bird Sanctuary. The Effective Number of Species for both the communities was calculated as 21 and 23, respectively (Table 2), confirming higher

Table 2: Comparison of Various Diversity Indices at Shekha Bird Sanctuary and NAPS Township

Diversity Indices	Site 1 Shekha Bird Sanctuary	Site 2 NAPS Township
Simpson's Index (D)	0.0506	0.0464
Simpson's Diversity Index (1-D)	0.9494	0.9536
Simpson's Reciprocal Index (1/D)	19.7628	21.5517
Shannon's Diversity Index (H')	3.04	3.12
Effective Number of Species (ENS)	21	23
Evenness	0.957	0.958
Richness (Number of Species)	24	26
Total number of Individuals	334	363
Average Population Size	13.92	13.96
Sorenson's Index	0.64	

diversity at NAPS Township. The Evenness calculated for both the sites was 0.957 and 0.958, respectively (Table 2), showing that insects are almost evenly distributed in both the communities, with slightly higher at NAPS Township. The average population size of the communities was 13.92 and 13.96 at Site 1 and 2, respectively (Table 2). Out of 24 and 26 species recorded from both the sites respectively, both communities share 16 species and the value of Sorenson's Index was calculated 0.64, which is moderate, indicating mild similarity between the fauna at both the sites.

Ethical Statement

The author confirms that all ethical issues have been dealt with the research ethics guidelines provided by the Department of Zoology, D.S. College, Aligarh, Uttar Pradesh, India.

Conflict of Interest

The author declares no conflicts of interest.

References

Balakrishnana S, Srinivasana M and Mohanraj J. (2014) Diversity of some insect fauna in different coastal habitats of Tamil Nadu, southeast coast of India. J Asia-Pacific Biodivers. 7(4): 408-414.

Barnard DR and Mulla M.S. (1977): A non-attractive sampling device for collection of adult mosquitoes. Mosq News (37): 142-144.

Chao A, Chazdon RL, Colwell RK and Shen TJ. (2005) A new statistical approach for assessing similarity of species composition with incidence and abundance data. Ecol Letts. (8): 148-159.

Ghani A and Malik S. (2020) Assessment of diversity and relative abundance of insect fauna associated with *Triticum aestivum* from district Sialkot, Pakistan. J King Saud Univ Sci. 32(1): 986-995.

Goswami D, Babita Arya D, Singh Vishal and Negi D. (2024) Diversity and relative abundance of insects in agricultural ecosystem of Bajoon, Nainital district, Uttarakhand, India. Int J Entomol Res. 9(3): 68-73.

Hill MO. (1973) Diversity and evenness: a unifying notation and its consequences. Ecology 54: 427-432.

Kumar M, Ranjan R, Sinha MP, Dhan A, Naaz F, Khanum G, Rani KA, Sharma S and Raipat VS. (2022) A review on insect collection and preservation techniques. European J Pharmaceut Med Res. 9(7): 233-239.

Kumar R and Saksena S. (2021) Insect collection and preservation techniques. Adv Agricult Entomol. 15: 105-117.

Lou J. (2006) Entropy and diversity. Oikos 113(2): 363-375.

Majeed W, Rana N, Koch EVA and Nargis S. (2020) Seasonality and climatic factors affect diversity and distribution of Arthropods around wetlands. Pakistan J Zool. 52(6): 2135-2144.

Mcdonald C, Smith R, Scott M and Dick J. (2010) Using indices to measure biodiversity change through time. METMAV International workshop on Spatio-Temporal modeling, 1-5.

Nurin Izzati MZ, Siti Noor AAH, Saiful ZJ, Zul HMS, Ali MSM and Ahmad AA. (2021) Preliminary survey of insect diversity and population abundance during flowering and fruiting season in *Mangifera odorata*

(Kuini) Orchard, Sintok, Kedah, Malaysia. Serangga 24(1):103-115.

Ramzan U, Majeed W, Rana N and Nargis S. (2020) Occurrence of different insect species with emphasis on their abundance and diversity in different habitats of Faisalabad, Pakistan. Int J Tropical Insect Sci. 41: 1237-1244.

Rekha Goswami D, Arya D, Arya G, Bisht M, Joshi A and Kaushal BR. (2021) Diversity and abundance of insects in cropland of Himalayan Tarai region of Ramnagar, Uttarakhand. Int J Agricult Appl Sci. 2(2): 151-155.

Saddam B, Ahmed SI, Sitaram Faisal M and Anjam S. (2017) Insect biodiversity in flowering teak (*Tectona grandis* L.f.), and insects pollinating efficiency on Teak. Comparison in disturb area and undisturbed area of teak insect pollinators in Aligarh Muslim University Campus (U.P.) India. Int J Fauna Biol Stud. 4(2): 50-54.

Schauff ME. (2001) Collecting and preserving insects and mites. Systematic Entomol Laboratory, USDA National Museum of History. Washington, DC.

Sollai G and Solari P. (2022) An overview of "Insect Biodiversity". Diversity 14: 134.

Tihelka E, Cai C, Giacomelli M, Lozano-Fernandez J, Rota-Stabelli O, Huang D, Engel MS, Donoghue PCJ and Pisani D. (2021) The evolution of insect biodiversity. Curr Biol. 31: 1299-1311.