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Preliminary study on population density, diversity and abundance of Odonata and Orthoptera

Lokesh Daiya[1], Lekhu Gehlot[2], Naman Songara[1], Neha Parihar[1], Kheev Raj[1]
[1] Department of Zoology, Entomology Lab, Jai Narain Vyas University, Jodhpur, Rajasthan, India
[2] Assistant Professor, Department of Zoology, Entomology Laboratory, Jai Narain Vyas University, Jodhpur, Rajasthan, India
Corresponding Author: Lekhu Gehlot

Abstract
A preliminary study was conducted to assess the population density, abundance, and diversity of insects belonging to the order Odonata and Orthoptera at New Campus, Jai Narain Vyas University, Jodhpur, Rajasthan, India. The survey was conducted from March 2023 to July 2023 across Various habitats. A total of 4 Odonata and 9 Orthoptera species were recorded. Orthoptera showed higher species richness than Odonata. Variations in species occurrence were observed across habitats. The study provides baseline information on insect diversity and highlights its importance for future ecological studies and conservation.

Keywords: Population density, abundance, diversity, odonata, orthoptera

Introduction

Insects are the most diverse class with over 1.9 million named species and up to 4 million undescribed species (Bladon *et al*., 2026; Goswami *et al*., 2025) [5, 10] and play an important role in maintaining ecological balance by performing essential functions such as pollination, decomposition, nutrient cycling, and working as a vital component of food chains (Kirti and Sidhu, 2015) [13]. Among the diverse insect groups, the orders Odonata (dragonflies and Damselflies) and Orthoptera (grasshoppers, locusts, crickets, and katydids) have particular ecological importance (Kalkman *et al*., 2020; Emmanuel and Anuoluwa, 2019) [9, 12]. Odonata are directly associated with aquatic habitats and widely recognised as bioindicators of water quality (Koneri *et al*., 2020; Kumar and Sexena, 2024) [15, 16], and feed on mosquitoes, blackflies and other blood-sucking flies, acting as biocontrol agents (Subramanian and Babu, 2018) [28]. Orthoptera are dominant in terrestrial ecosystems and reflect vegetation dynamics and climatic variability (Meena *et al*., 2021; Pareek *et al*., 2017) [18, 20]. Orthopteran insects, especially grasshoppers, significantly contribute to the diet of the Great Indian Bustard, an endangered bird of the Thar Desert (Dutta & Jhala 2021) [8].

In the arid and semi-arid landscapes of India, these insects are particularly vital. There are about 508 species of Odonata (Goswami *et al*., 2025; Paulson *et al*., 2025) [10, 23] and over 1274 species of Orthoptera (Chand *et al*., 2024) [6] recorded from India. In Rajasthan, Singh *et al*. (2017) [27] reported 37 Odonata species in Keoladeo National Park; Koli *et al*. (2015) [14] reported 54 species from southern Rajasthan. Pati *et al*. (2025) [22] reported 24 species of Orthoptera in the Desert National Park; Prajapat *et al*. (2025) [24] reported 29 species of Orthoptera from the Aravalli Forest range. Therefore, the study of population density, abundance, and diversity of these insect groups is crucial for understanding ecosystem health. Jai Narain Vyas University, located in Jodhpur, Rajasthan, is surrounded by a range of natural habitats that support diverse insect fauna. The variation in microhabitats across the campus offers an excellent opportunity to study the distribution and ecological patterns of Odonata and Orthoptera. It also concentrates on evaluating species richness, evenness, and dominance, along with their distribution across different habitats.

Material and methods

The present study was conducted at the New Campus, Jai Narain Vyas University, located in Jodhpur, Rajasthan, India. The campus covers an area of approximately 0.129267 km² and comprises a variety of habitats, including open fields, gardens, water bodies, and wooded areas, which support diverse insect fauna. For the purpose of the study, four different sites representing diverse habitats were selected and designated as Area A, B, C, and D.

Area A: Located behind the Department of Botany (26°14′44″ N, 73°01′25″ E) with an area of 0.070973 km².

Area B: Botanical Garden of the Department of Botany (26°14′48″ N, 73°01′16″ E) covering 0.030178 km².

Area C: Located near the Department of Zoology (26°14′51″ N, 73°01′10″ E) with an area of 0.010313 km².

Area D: Scout ground situated adjacent to the Department of Zoology (26°14′54″ N, 73°01′07″ E) covering 0.017803 km².

The Google Earth App is used for recording all geographical coordinates.

Study Period: The study was carried out over a period of five months, from March 2023 to July 2023, during which regular field surveys were conducted across the selected study sites.

Methodology

Sampling Design and Techniques: For the study of insect diversity, field visits were conducted regularly at weekly intervals over a course of five months. Sampling was done in the morning and evening hours, which represent peak activity periods for most insect species. The insects were collected and counted using random sampling. The quadrat method, a sweep net, and the hand-pinking method (Meena *et al*., 2022) [17]. During each visit, insects were observed, photographed, and selectively collected. The collected specimens were preserved in insect boxes for further identification with the help of taxonomic keys (Bishnoi and Dang, 2019) [5].

Data analysis

Relative abundance:

$$\mathrm{RA} = \frac{n_i \times 100}{N}$$

Where:

n_i = number of individuals of a particular species

N = total number of individuals of all species

The collected data were analysed using standard ecological indices, as applied in previous studies, including those by Belamkar and Jagesh (2014) [2] and Amrulloh *et al*. (2022) [1].

1. **Shannon-Wiener Diversity Index (H′):**

$$H' = -\sum P_i \ln P_i$$

$$P_i = \frac{n_i}{N}$$

Where:

n_i = number of individuals of a species

N = total number of individuals

$\ln$ = natural logarithm

2. **Simpson's Reciprocal Index (1/D):** Introduced by Edward H. Simpson.

$$D = \frac{1}{\sum P_i^2}$$

Where: $P_i = \frac{S}{N}$

S = number of species

N = total number of individuals.

3. **Species Richness (Margalef's Index):** Developed by Ramon Margalef.

$$\text{Margalef's Index} = \frac{S-1}{\ln N}$$

Where:

S = number of species

N = total number of individuals.

4. **Species Evenness (Pielou's Evenness Index):** Proposed by E. C. Pielou, 1966

$$e = \frac{H'}{\ln S}$$

Where:

H' = Shannon–Wiener index

S = total number of species

Fig 1: Map showing study area

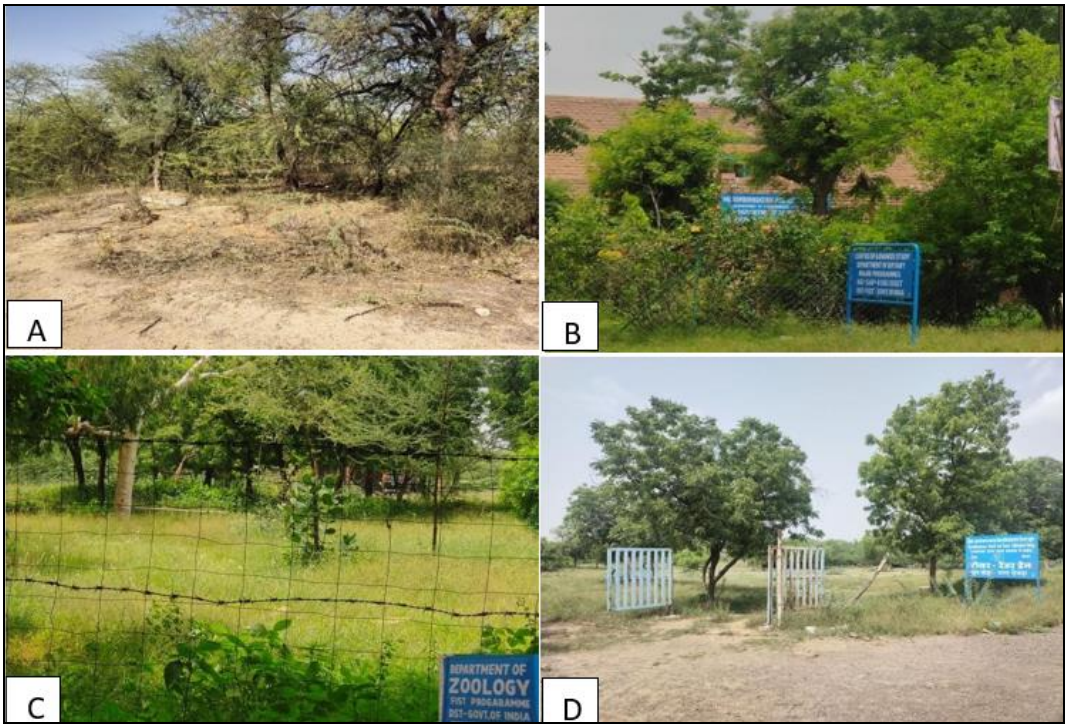

Fig 2: Study Areas; Area A-Behind Botany department, Area B-Botanical garden, Area C-Zoology department, Area D-Scout ground

Results and Discussion

The study recorded a total of 4 species of Odonata, with 360 individuals, and 1,184 individuals of the order Orthoptera belonging to 9 species within the study area during the sampling period. The relative abundance of different species belonging to the orders Odonata and Orthoptera is shown in Tables 1 and 2. The population density of Odonata was found to be lower than that of Orthoptera, with an average of 2784.94 individuals per km^2 for Odonata and 9159.34 individuals per km^2 for Orthoptera, as shown in Table 3.

Table 1: List of observed insects studied during the month from April 2023 to July 2023 Order – Odonata

Sr. No.	Family	Species	Common name	Relative abundance of Area A	Relative abundance of Area B	Relative abundance of Area C	Relative abundance of Area D
1.	Libellulidae	*Bradinopyga geminata*	Granite Ghost Dragonfly	32.99	31.18	32.08	29.17
2.	Libellulidae	*Pantala flavescens*	Wandering Glider	28.87	19.89	28.3	41.67
3.	Coenagrionidae	*Ischnura senegalensis*	Common Bluetail Damselfly	15.46	20.97	24.53	20.83
4.	Lestidae	*Lestes barbarus*	Damselfly	22.68	27.96	15.09	8.33

Table 2: List of observed insects studied during the month from April 2023 to July 2023 Order – Orthoptera

Sr. No.	Family	Species	Common name	Relative abundance of Area A	Relative abundance of Area B	Relative abundance of Area C	Relative abundance of Area D
1.	Acrididae	*Locusta migratoria*	Migratory Locust	12.5	3.58	2.78	11.54
2.	Acrididae	*Schistocerca gregaria*	Desert Locust	19.48	4.72	2.22	19.23
3.	Acrididae	*Hieroglyphus nigrorepletus*	Phadka Grasshopper	9.30	9.25	8.33	6.15
4.	Acrididae	*Acridinae*	Silent Slant Faced Grasshopper	7.27	14.72	12.22	7.69
5.	Tetrigidae	*Thoradonta*	(Toad grasshopper)	13.37	23.96	3.89	9.23
6.	Pyrgomorphidae	*Poekilocerus pictus*	Painted Grasshopper	7.85	13.02	13.33	14.61
7.	Tettigoniidae	*Tettigonia viridissima*	Green Bush-Cricket	11.34	10	20	11.54
8.	Gryllidae	*Gryllodes sigillatus*	House Cricket	6.67	7.92	14.44	6.15
9.	Gryllidae	*Gryllus bimaculatus*	Field Cricket	12.21	12.83	22.78	13.85

Table 3: Shows Population Density of Insect Fauna

Insect Order	Total no. Of individuals of all species	Total Area (in km^2)	Populationdensity = total no. Of population / total area (in per square km)
Odonata	360	0.129267	2,784.94
Orthoptera	1,184	0.129267	9,159.34

4: Diversity indices for insect orders studied in JNVU New Campus, Jodhpur Table 4.1 Area-A

S.no	Order	Total no. of families	Total no. of species	Total no. of Individuals	Simpson reciprocal Index	Margalef index	Shannon- wiener Index	Pielou's index
1.	Odonata	3	4	360	0.2675	0.6558	1.3497	0.9754
2.	Orthoptera	5	9	1,184	0.1238	1.3697	2.1438	0.9736

Table 4.2 Area-B

S.no	Order	Total no. of Families	Total no. of species	Total no. of Individuals	Simpson reciprocal Index	Margalef index	Shannon-wiener Index	Pielou's index
1.	Odonata	3	4	360	0.2589	0.5741	1.3685	0.9871
2.	Orthoptera	5	9	1,184	0.1408	1.2753	2.0679	0.94114

Table 4.3 Area-C

S.no	Order	Total no. of families	Total no. of species	Total no. Of individuals	Simpson Reciprocal index	Margalef index	Shannon-Wiener index	Pielou's index
1.	Odonata	3	4	360	0.2659	0.7556	1.3521	0.9753
2.	Orthoptera	5	9	1,184	0.1551	1.5405	1.9814	0.9018

Table 4.4 Area-D

S.no	Order	Total no. of families	Total no. of species	Total no. of individuals	Simpson reciprocal index	Margalef index	Shannon-wiener index	Pielou's index
1.	Odonata	3	4	360	0.309	0.944	1.258	0.9075
2.	Orthoptera	5	9	1,184	0.1261	1.6435	2.1306	0.9697

Orthoptera had higher species richness (1.3697, 1.2753, 1.5405, and 1.6435) than Odonata (0.6558, 0.5741, 0.7556, and 0.9440), suggesting a greater diversity of grasshoppers and crickets in the study area (A, B, C, and D). The Simpson's reciprocal index and Pielou's evenness were higher for Odonata than for Orthoptera, as shown in Table 4. The observed differences in population density and abundance of Odonata and Orthoptera could be attributed to variations in environmental factors, including vegetation cover, water availability, and microhabitat features. Odonata species, being aquatic insects, might exhibit lower densities due to the presence of only one or two water bodies, such as ponds and streams, within the study area. Orthoptera species, on the other hand, might be influenced by factors like vegetation structure and availability of suitable breeding sites, which may account for their higher population densities in certain areas.

The various publications were published on the diversity and abundance of these insects. Kumar and Sexena (2024) [16] recorded 31 species of dragonfly from the Sikar region; Deepak *et al*. (2025) [7] recorded 19 species of Odonata in Dhebar Lake (Salumbar, Rajasthan); Rekha *et al*. (2021) [26] recorded 2 species of Odonata in cropland of the Tarai region of Ramnagar, Uttarakhand; Islam *et al*. (2022) [11] reported 8 species of Odonata in an urban freshwater lake, Hatirjheel, Dhaka; Mohan and Padmanaban (2013) [19] recorded 15 species of Odonata and 12 species of Orthoptera in Erode, Tamil Nadu. Pareek *et al*. (2017) [20] recorded 10 species of the family Acrididae (Order: Orthoptera) from southern Rajasthan; Belamkar and Jadesh (2014) [2] recorded 3 species of Orthoptera in the agricultural field of Gulbarga district, Karnataka. Bhati and Srivastava (2016) [3] recorded 8 species of Orthoptera in an agroecosystem near Bikaner, Rajasthan. Parihar and Rajani (2022) recorded 11 species of Orthoptera and 2 species of Odonata in Pilibanga, Hanumangarh, Rajasthan; Rekha *et al*. (2023) [25] recorded 15 species of Orthoptera and 11 species of Odonata in the Bhabar region, Nainital, Uttarakhand

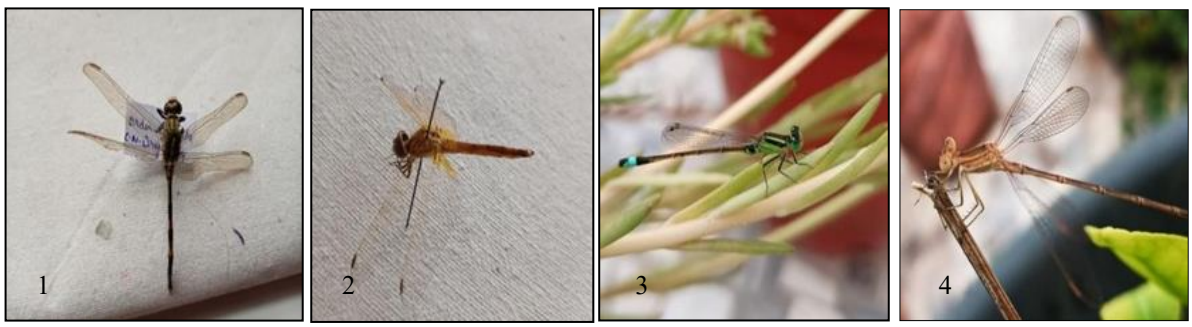

Fig 3: Order- Odonata: 1 *Bradinopyga geminate,* 2 *Pantala flavescens,* 3 *Ischnura senegalensis,* 4 *Lestes barbarous*

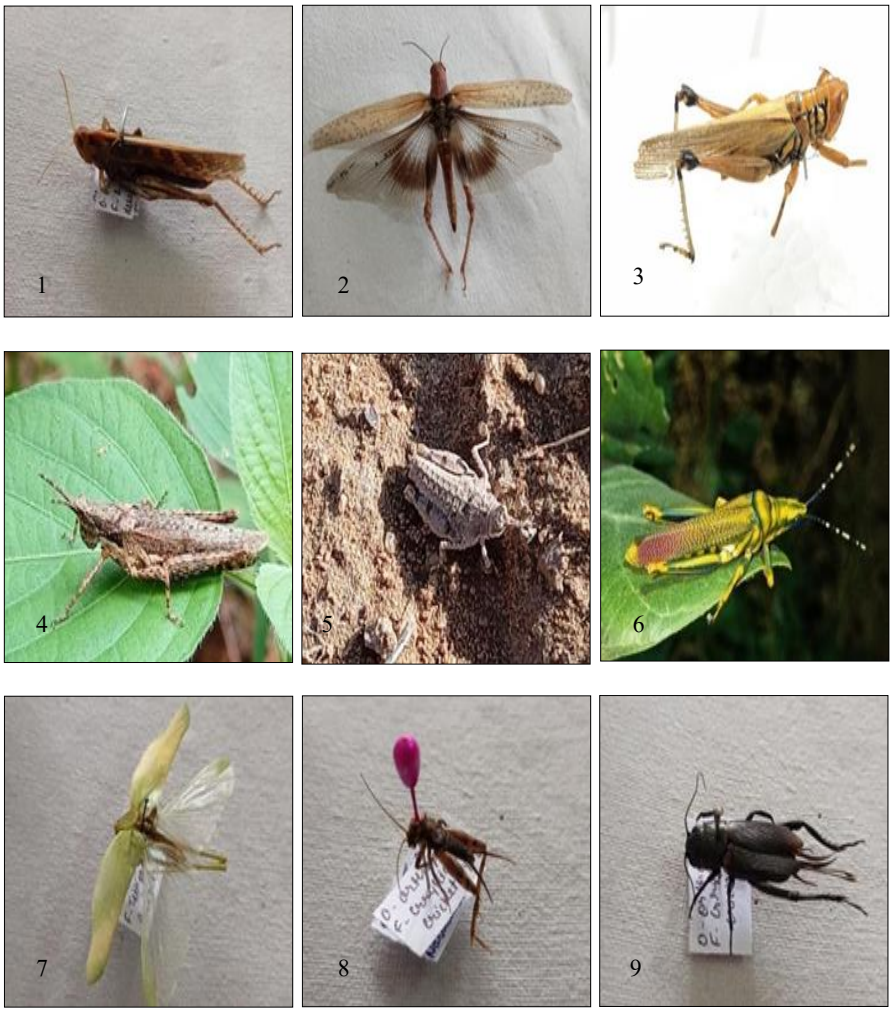

Fig 4: Order – Orthoptera: 1 *Locusta migratoria, 2. Schistocerca gregaria, 3. Hieroglyphus nigrorepletus* 4. *Acridinae, 5. Thoradonta,*6. *Poekiloerus pictus 7. Tettigonia viridissima,* 8.*Gryllodes sigillatus,* 9.*Gryllus bimaculatus*

Conclusion

The findings can serve as a baseline for future studies and contribute to the formulation of effective conservation and management strategies to preserve insect diversity in urban environments. Future research is warranted to explore additional factors influencing insect populations and to assess long-term changes in their abundance and diversity. Such investigations are essential for understanding the ecological dynamics of insect communities and ensuring their conservation in the face of ongoing urbanisation and habitat degradation.

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