



Biodiversity assessment of insects in the Chunchale–Belgaon Dhaga biodiversity zone of Nashik, Maharashtra

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Abstract

Insects are vital components of ecosystems, providing key services such as pollination, pest regulation, nutrient cycling, and food web stability. This study assessed insect diversity in the Shree Nasik Panchavati Panjrapole's Chunchale–Belgaon Dhaga Biodiversity Zone, a certified organic reserve in Nashik, Maharashtra. Field surveys were conducted during December–January 2021–2022 using line transect and opportunistic sampling methods, with non-destructive photographic documentation. A total of 57 insect species were recorded, belonging to 33 families and 8 orders. Lepidoptera (28.07%), Odonata (15.79%), and Diptera (15.79%) were the most represented orders, while Nymphalidae was the dominant family (12.28%). The findings highlight the rich insect diversity supported by pesticide-free habitats and emphasize the importance of conserving such organic reserves as refuges for biodiversity. This study also establishes baseline data for future monitoring and contributes to ecological conservation efforts in the region.

Keywords: Insect biodiversity, lepidoptera, pollinators, Nashik, organic reserve, ecosystem services

Introduction

Insects represent the largest, most diverse, and ecologically dominant group of animals on Earth. Their abundance and adaptability allow them to thrive in nearly every habitat—ranging from high mountains and deserts to forests, aquatic ecosystems, agricultural landscapes, and even human dwellings. Because of their sensitivity to environmental change, insects are widely recognized as reliable indicators of ecosystem health (Kremen *et al.*, 1993; McGeoch, 1998) [5, 8].

The extraordinary diversity of insects underpins their vital contributions to agriculture, ecosystem stability, and human welfare. While only 2–3% of insect species are harmful, modern pest control practices primarily emphasize chemical methods (Pedigo & Rice, 2009) [12]. This approach often disregards essential ecological services provided by beneficial insects, including pollination, biological control, nutrient cycling, and sanitation (Losey & Vaughan, 2006; Noriega *et al.*, 2018) [7, 9].

Pollination is among the most significant ecosystem services performed by insects. Bees, flies, beetles, butterflies, and moths play essential roles in the reproduction of many plant species (Ollerton *et al.*, 2011) [11]. Honeybees alone contribute to nearly 80% of pollination in flowering plants, yet their populations are declining globally due to pesticide use and habitat loss (Potts *et al.*, 2010; Goulson *et al.*, 2015) [5, 14]. Insects also act as natural regulators of pest populations through predation and parasitism, forming a key component of Integrated Pest Management (van Lenteren, 2012) [18].

In this context, the study of insect diversity is crucial for understanding their ecological roles and promoting conservation. The present investigation was carried out in

the Shree Nasik Panchavati Panjrapole's Chunchale–Belgaon Dhaga Biodiversity Zone, popularly known as the “oxygen factory” of Nashik City, which is free from pesticides and major pollution sources. This zone provides an ideal setting for evaluating insect biodiversity under sustainable ecological conditions.

Materials and Methods

The study was conducted at the Shree Nashik Panchavati Panjrapole (SNPP), Chunchale–Belgaon Dhaga Biodiversity Zone, approximately 13 km from Nashik City, Maharashtra, India (20.0°N, 73.8°E). The site is a certified organic reserve with mixed vegetation, grassland patches, and pesticide-free cultivated fields. The climate of the region is semi-arid with moderate seasonal variation (Gadgil, 2018) [4].

Field surveys were conducted during December–January 2024–2025, between 09:00 a.m. and 01:00 p.m., when insect activity was highest (Southwood & Henderson, 2000) [16]. Sampling was done using a line transect method (Pollard, 1977; Wolda, 1990) [13, 20] with three permanent transects (100 m × 5 m) established across agro-ecosystem, grassland, and forest patch habitats. Opportunistic sampling was also performed for rare species (Basset *et al.*, 1998) [1]. Insects were recorded using in-situ photography with a Canon digital camera (12 MP). Non-destructive photographic documentation was chosen to avoid disturbing biodiversity (Samways *et al.*, 2010; Cheesman *et al.*, 2017) [3, 15]. Insects were identified to the lowest possible taxonomic level using field guides, online databases (GBIF, iNaturalist, NBAIR India), and standard references (Triplehorn & Johnson, 2005) [17]. Data were analyzed at the order and family level.

Table No.1: List of the insect observed in the study area

Sr.No	Scientific Name of insects	Common Name of insects	Family of insects
1.	<i>Ischnura hastata</i>	Citrine Forktail	Coenagrionidae
2.	<i>Ischnura aurora</i>	Golden Dartlet	Coenagrionidae
3.	<i>Ischnura senegalensis</i>	Common Bluetail	Coenagrionidae
4.	<i>Telebasis</i>	Firetails (damselflies)	Coenagrionidae
5.	<i>Ischnura verticalis</i>	Eastern Forktail	Coenagrionidae
6.	<i>Diplacodes haematodes</i>	Scarlet Percher	Libellulidae
7.	<i>Vulgatum</i>	Common Hawker	Libellulidae
8.	<i>Trithemis aurora</i>	Crimson Marsh Glider	Libellulidae
9.	<i>Sympecma fucsa</i>	Common Winter Damselfly	Lestidae
10.	<i>Euploea core</i>	Common Crow	Nymphalidae
11.	<i>Polyura moori</i>	Blue Nawab	Nymphalidae
12.	<i>Junonia iphita</i>	Chocolate Pansy	Nymphalidae
13.	<i>Hypolimnas misippus</i>	Danaid Eggfly / Diadem	Nymphalidae
14.	<i>Junonia lemonias</i>	Lemon Pansy	Nymphalidae
15.	<i>Megisto cymela</i>	Little Wood Satyr	Nymphalidae
16.	<i>Melanargia lachesis</i>	Iberian Marbled White	Nymphalidae
17.	<i>Delias eucharis</i>	Common Jezebel	Pieridae
18.	<i>Cepora nerissa</i>	Common Gull	Pieridae
19.	<i>Eurema blanda</i>	Three-spot Grass Yellow	Pieridae
20.	<i>Borbo cinnara</i>	Rice Swift	Hesperiidae
21.	<i>Hermينيا vermiculata</i>	Shaded Fan-foot Moth	Erebidae
22.	<i>Erebus macrops</i>	Owl Moth	Erebidae
23.	<i>Haitian swallowtail</i>	Lime Swallowtail	Papilionidae
24.	<i>Leptotes cassius</i>	Cassius Blue	Papilionidae
25.	<i>idaea aversata</i>	Riband Wave Moth	Geometridae
26.	<i>Garothintha mendica</i>	Squash Bug	Coreidae
27.	<i>Liorhyssus hyalinus</i>	Bordered Plant Bug	Rhopalidae
28.	<i>Halyomorpha halys</i>	Brown Marmorated Stink Bug	Pentatomidae
29.	<i>Letocorisa oratoria</i>	Rice Bug	Alydidae
30.	<i>Dysdercus cingulatus</i>	Red Cotton Bug	Pyrrhocoridae
31.	<i>Dialeurodes citri</i>	Citrus Whitefly	Aleyrodidae
32.	<i>Psylla alni</i>	Alder Psyllid	Psyllidae
33.	<i>Atractomorpha granulata</i>	Granulate Toothed Grasshopper	Pyrgomorphidae
34.	<i>Trinerotropis pallidipennis</i>	Pallid-winged Grasshopper	Acrididae
35.	<i>Cheysochran Dispar</i>	Australian Plague Locust	Acrididae
36.	<i>Conocephalus dorsalis</i>	Short-winged Conehead	Tettigoniidae
37.	<i>Acauloplacella hasenpuschae</i>	Bush-cricket sp.	Tettigoniidae
38.	<i>Oecantus</i>	Tree Crickets	Gryllidae
39.	<i>Trcepaned Grassipes</i>	Fruit Fly sp.	Tephritidae
40.	<i>Pleciannearctica</i>	Lovebug	Bibionidae
41.	<i>Metopia</i>	Flesh Flies	Sarcophagidae
42.	<i>Stomorphina subapicalis</i>	Blowfly sp.	Calliphoridae
43.	<i>Lucilia sericata</i>	Green Bottle Fly	Calliphoridae
44.	<i>Erstalinus arvorum</i>	Flower Fly sp.	Syrphidae
45.	<i>Epiyrphus balteatus</i>	Marmalade Hoverfly	Syrphidae
46.	<i>Musca domestica</i>	Housefly	Muscidae
47.	<i>Sepsis indica</i>	Black Scavenger Fly	Sepsidae
48.	<i>Coccinella transversalis</i>	Transverse Ladybird	Coccinellidae
49.	<i>Coccinella septempunctata</i>	Seven-spot Ladybird	Coccinellidae
50.	<i>Alphitobius</i>	Darkling Beetle	Tenebrionidae
51.	<i>Oecophylla smaragdina</i>	Asian Weaver Ant	Formicidae
52.	<i>Megachile sculpturalis</i>	Giant Resin Bee	Megachilidae
53.	<i>Apis cerana indica</i>	Indian Honeybee	Apidae
54.	<i>Apis dorsata</i>	Giant Honeybee	Apidae
55.	<i>Apis florea</i>	Dwarf Honeybee	Apidae
56.	<i>Archimantis latistyla</i>	Large Brown Mantis	Hyenopodidae
57.	<i>Heterochaetula tricolor</i>	Flower Mantis	Mantidae

Table 2: Total number of insects and the percentage of insect family in the study area

Sr.No	Insect Family	Total	Percentage
1.	Coenagrionidae	5	8.77
2.	Libellulidae	3	5.26
3.	Lestidae	1	1.75
4.	Nymphalidae	7	12.28
5.	Pieridae	3	5.26

6.	Hesperiidae	1	1.75
7.	Erebidae	2	3.51
8.	Papilionidae	2	3.51
9.	Geometridae	1	1.75
10.	Coreidae	1	1.75
11.	Rhopalidae	1	1.75
12.	Pentatomidae	1	1.75
13.	Alydidae	1	1.75
14.	Pyrrhocoridae	1	1.75
15.	Aleyrodidae	1	1.75
16.	Psyllidae	1	1.75
17.	Pyrgomorphidae	1	1.75
18.	Acrididae	2	3.51
19.	Tettigoniidae	2	3.51
20.	Gryllidae	1	1.75
21.	Tephritidae	1	1.75
22.	Bibionidae	1	1.75
23.	Sarcophagidae	1	1.75
24.	Calliphoridae	2	3.51
25.	Syrphidae	2	3.51
26.	Muscidae	1	1.75
27.	Sepsidae	1	1.75
28.	Coccinellidae	2	3.51
29.	Tenebrionidae	1	1.75
30.	Formicidae	1	1.75
31.	Megachilidae	1	1.75
32.	Apidae	3	5.26
33.	Mantidae	2	3.51
Total no of insects recorded 57			

Table 3: Total number of insects and the percentage of insect order in the study area

Sr. No	Insect Order	Total	Percentage
1.	Odonata	9	15.79
2.	Lepidoptera	16	28.07
3.	Hemiptera	7	12.28
4.	Orthoptera	6	10.53
5.	Diptera	9	15.79
6.	Coleoptera	3	5.26
7.	Hymenoptera	5	8.77
8.	Mantodea	2	3.51
Total no of insects recorded 57			

Results

A total of 57 insect species were recorded (Table No.1), representing 33 families and 8 orders.

Order-wise distribution (Table No. 3) : Lepidoptera (16 species, 28.07%) was dominant, followed by Odonata (9 species, 15.79%), Diptera (9 species, 15.79%), Hemiptera (7 species, 12.28%), Orthoptera (6 species, 10.53%), Hymenoptera (5 species, 8.77%), Coleoptera (3 species, 5.26%), and Mantodea (2 species, 3.51%).

Family-wise distribution (Table No. 2) : Nymphalidae (7 species, 12.28%) was the most abundant, followed by Coenagrionidae (8.77%) and Apidae (5.26%). Most other families were represented by one or two species, indicating broad taxonomic diversity.

Functional groups: Pollinators (bees, butterflies, hoverflies), predators (ladybirds, mantids, weaver ants), and decomposers (flies, beetles) were all present, suggesting a well-balanced ecosystem.

Discussion

The results demonstrate a high level of insect diversity in the Chunchale–Belgaon Dhaga Biodiversity Zone. The

dominance of Lepidoptera, Odonata, and Diptera is consistent with insect biodiversity studies in organic landscapes, where floral resources and microhabitats are abundant (Kremen *et al.*, 1993; McGeoch, 1998) [5, 8].

The presence of pollinators such as honeybees (*Apis cerana*, *Apis dorsata*, *Apis florea*), butterflies (Nymphalidae, Pieridae), and hoverflies underscores their importance in maintaining ecosystem stability and agricultural productivity. Pollinators are estimated to contribute significantly to global food production (Ollerton *et al.*, 2011; Potts *et al.*, 2010) [11, 14]. With ongoing pollinator declines linked to pesticide use and habitat fragmentation, organic reserves like this provide crucial refuges (Goulson *et al.*, 2015) [5].

Predatory insects such as ladybirds, mantids, and weaver ants indicate the natural regulation of pest populations, reducing dependence on chemical pesticides. This aligns with the principles of Integrated Pest Management (IPM), which emphasizes biological control (van Lenteren, 2012; Losey & Vaughan, 2006) [7, 18].

The relatively lower representation of Hemiptera and Orthoptera may be seasonal, as these groups often peak during monsoon and summer (Wolda, 1990) [20]. Long-term monitoring is necessary to capture full diversity trends.

The use of non-destructive photographic documentation was highly effective, supporting conservation-oriented research. This approach is increasingly recognized as a reliable tool for insect biodiversity studies (Samways *et al.*, 2010; Cheesman *et al.*, 2017) [3, 15]. Furthermore, photographic records enhance citizen science contributions to biodiversity platforms (Oliver & Beattie, 1996) [10].

Overall, the study emphasizes the ecological significance of organic biodiversity reserves in conserving insect diversity and the ecosystem services they provide (Wilson, 1987; Cardoso *et al.*, 2020) [2, 19].

Conclusion

The Chunchale–Belgaon Dhaga Biodiversity Zone supports a rich insect community with representation across eight major orders. Lepidoptera, Odonata, and Diptera were dominant, while pollinators and predators highlighted the ecological health of the reserve. The findings demonstrate the value of pesticide-free, organically managed landscapes for sustaining insect diversity. This baseline study provides essential data for future monitoring and underscores the need for long-term conservation strategies.

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