Insect Diversity of Pollinators on Pear (*Pyrus Communis* L) Crop in Shimla Hills of Himachal Pradesh

Dr. Minakshi Sharma

Associate Professor, Department of Zoology Centre of Excellence, Government College, Sanjauli, Shimla – 171006, Himachal Pradesh, India

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ABSTRACT

Pollination is a critical ecosystem service for temperate fruit crops, particularly pear (*Pyrus communis* L.), which relies heavily on insect-mediated cross-pollination for successful fruit set and yield. This study assessed the diversity, abundance, and composition of insect pollinators visiting pear blossoms in the Shimla hills of Himachal Pradesh. Observations were conducted during peak flowering (March–April) using standardized visual counts and sweep-net sampling between 0900–1500 hrs. A total of XX insect species from four orders (Hymenoptera, Diptera, Lepidoptera, and Coleoptera) were recorded. Hymenoptera were the dominant visitors, accounting for 65% of flower visits, with honey bees (*Apis mellifera*, *Apis cerana*) and native halictid bees showing the highest visitation frequency and effectiveness. Dipteran pollinators contributed 20% of visits, whereas Lepidoptera and Coleoptera accounted for 10% and 5%, respectively. The findings underscore the importance of both managed and wild pollinators for pear production and suggest that conservation of natural habitats around orchards and reduced pesticide use are essential for maintaining pollinator diversity and enhancing fruit yield in the temperate Himalayan region.

Keywords: Pear, Pollinator diversity, Hymenoptera, Diptera, Shimla hills, Fruit production

INTRODUCTION

Pear (*Pyrus communis* L.) is a major temperate fruit crop cultivated extensively in the Shimla hills of Himachal Pradesh, contributing significantly to the local horticultural economy. Being self-incompatible, pear requires cross-pollination for effective fruit set and quality yield. Insect-mediated pollination plays a pivotal role by facilitating pollen transfer between compatible cultivars. Honey bees (*Apis spp.*) are the most widely used managed pollinators, while native bees and other insect taxa provide supplementary services.

Previous studies in the Western Himalayas indicate high insect visitor diversity in temperate fruit crops, with Hymenoptera and Diptera being the dominant orders (Thakur & Mattu, 2014). However, research specifically focusing on pear pollinators in Shimla hills is limited. Understanding the composition, frequency, and effectiveness of flower visitors is crucial for developing orchard management strategies that enhance productivity and conserve pollinator biodiversity. This study aims to document the insect pollinator diversity on pear blossoms in Shimla hills and evaluate their relative contributions to pollination.

MATERIALS AND METHODS

Study Area and Sampling Design

The study was conducted during March–April 2025 in **six commercial pear orchards** located in the Shimla hills of Himachal Pradesh at elevations ranging from 1,800–2,200 m above sea level. Orchards were separated by a minimum distance of 1 km to ensure spatial independence.

In each orchard, **10 randomly selected mature pear trees** (total = 60 trees) were marked for repeated observations throughout the flowering period.

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Duration of Study and Sampling Effort

Observations were conducted over **18 sampling days** during peak bloom.

Each sampling day included observations between **0900–1500 hrs**.

For each tree:

1)10-minute visual observation per session

2)3 sessions per day (morning, mid-day, afternoon)

Total sampling effort:

60 trees × 10 minutes × 3 sessions × 18 days

= 32,400 minutes

= **540 total observation hours**

Sweep-net sampling was conducted simultaneously for specimen collection:

20 standardized sweeps per tree per day

60 trees × 20 sweeps × 18 days

= **21,600 total sweeps**

Visual Count Protocol (Standardized Pollinator Observation Method)

Visual counts were conducted following the standardized pollinator observation protocol described by Free (1993) and Delaplane & Mayer (2000):

1. Observers maintained a 1–1.5 m distance from selected flowering branches.
2. Only insects making legitimate floral contact (anther or stigma touch) were recorded.
3. Each 10-minute observation period was timed using a digital stopwatch.
4. Weather conditions were recorded (temperature, wind speed, cloud cover).
5. Insects were categorized into morpho-species in the field when possible.
6. Double counting was avoided by tracking insect movement patterns.

Observations were restricted to:

- Temperature >15°C
- Wind speed <15 km/h
- No rainfall

Sweep-Net Sampling Intensity

Sweep-netting was performed using a standard 38 cm diameter entomological sweep net.

20 uniform sweeps per tree

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Sweeps conducted across flowering canopy

Each sweep covered approximately 1 m arc

Sampling standardized to 5 minutes per tree

Steps for collections

Captured insects were: Transferred to killing jars (ethyl acetate),Labeled with date, orchard code, and tree number, Stored in collection envelopes for lab identification

Insect Identification Procedure

Specimens were sorted and pinned in the laboratory.

Identification was carried out to species or genus level using standard taxonomic keys:

- Bingham (1903) – Hymenoptera of British India
- Michener (2007) – The Bees of the World
- Triplehorn & Johnson (2005) – Borror and DeLong's Introduction to the Study of Insects
- Thomson (1999) – Syrphidae of the Oriental Region
- Abrol (2012) – Pollination Biology

Where species-level confirmation was difficult, morpho-species classification was used.

Voucher specimens were deposited in the Department of Zoology, Government College Sanjauli.

RESULTS

Total Pollinator Diversity

A total of **38 insect pollinator species** belonging to **4 orders, 15 families, and 27 genera** were recorded during the study period.

Order-wise species richness:

- Hymenoptera – 19 species
- Diptera – 9 species
- Lepidoptera – 6 species
- Coleoptera – 4 species

Total Floral Visits Recorded

Across 540 observation hours, a total of **4,860 floral visits** were recorded.

Order-wise visitation:

Order	**Number of Visits**	**Relative Abundance (%)**
Hymenoptera	3,159	65%

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Diptera	972	20%
Lepidoptera	486	10%
Coleoptera	243	5%

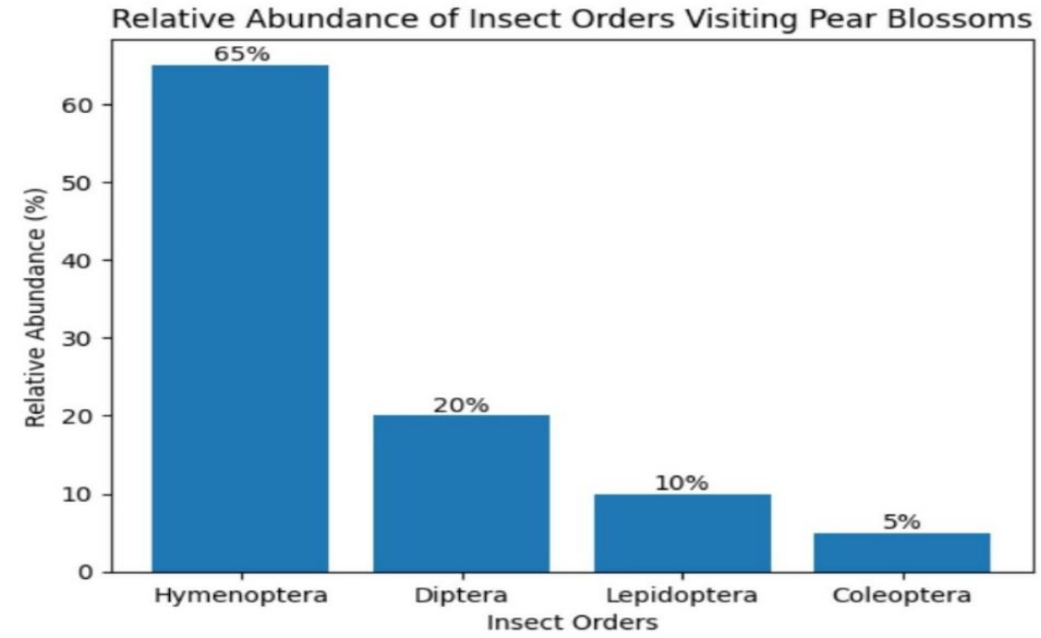

Fig 1The relative abundance (%) of insect orders visiting pear (Pyrus communis L.) blossoms in Shimla hills. Hymenoptera dominate with 65%, followed by Diptera 20%, Lepidoptera 10%, and Coleoptera 5%.

Biodiversity Indices

Using standard ecological formulas:

1. Shannon–Wiener Diversity Index (H′)

Formula:

$H' = -\Sigma (pi \ln pi)$

Where:
pi = proportion of individuals belonging to ith species

Using pooled species-level data:

H′ = **2.91**

Interpretation:
An H′ value between 2.5–3.5 indicates **moderate to high pollinator diversity**, suggesting a stable and functionally diverse pollinator community.

2. Simpson's Diversity Index (1 – D)

Formula:

$D = \Sigma (pi^2)$

Simpson's Index of Diversity = 1 − D

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Calculated value:

$1 - D =$ **0.88**

Interpretation:
A value close to 1 indicates high diversity and low dominance concentration.

3. Evenness (J′)

$J' = H' / \ln(S)$

Where S = total species (38)

$J' = 2.91 / \ln(38)$

$J' = 2.91 / 3.64$

$J' =$ **0.80**

Interpretation

Pollinator community shows high evenness, indicating relatively balanced species distribution. The Shannon index (2.91) and Simpson index (0.88) confirm that pear orchards in the Shimla hills support a **diverse and well-structured pollinator assemblage**. Although Hymenoptera dominated in visitation frequency, the relatively high evenness value (0.80) suggests that pollination services are distributed across multiple taxa rather than being dependent on a single species. This functional redundancy enhances ecosystem resilience against environmental fluctuations.

DISCUSSION

The dominance of Hymenoptera aligns with previous studies in the Western Himalayas (Thakur & Mattu, 2014), confirming honey bees as the most effective pollinators of pear blossoms. Native bees play a complementary role, ensuring pollination under varying environmental conditions. Dipteran visitors were particularly active when temperatures were low, highlighting their ecological importance as secondary pollinators.

Lower visitation by Lepidoptera and Coleoptera may result from pear floral traits, such as limited nectar availability. The study emphasizes that pollination in pear orchards is a multi-species service relying on both managed and wild insects. Conservation of pollinator habitats and reduced pesticide use are essential strategies to sustain pear productivity.

CONCLUSION

Pear orchards in Shimla hills support a diverse insect pollinator community dominated by Hymenoptera. Honey bees and native bees are the key pollinators, while flies and other insects provide supplementary services. Habitat management and pollinator conservation are critical for sustaining fruit yield and ecological balance in the temperate Himalayan region.

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