

## Diversity of ladybird beetles (Coccinellidae: Coleoptera) in semi-urban area of district Udhampur, Jammu and Kashmir (UT), India

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### Abstract

A comprehensive survey was carried out from May 2024 to April 2025 to record the ladybird beetles in the agricultural fields of district Udhampur. The observed specimens were identified up to the species level and a total number of 14 coccinellid taxa were reported. The diversity indices showed good diversity and rich fauna of coccinellids. Shannon-Weiner diversity Index ( $H=2.15$ ), Pielou's Evenness Index ( $J=0.83$ ) and Menhinick's Index ( $S=0.96$ ) were recorded highest in the study area. Out of 14 coccinellid species, 5 were found common, 4 species were frequently, 4 species were occasional and one species was rare. The coccinellids species namely, *Coccinella septempunctata* was reported to be the dominant species in the study area.

**Keywords:** Coccinellid beetles, relative abundance, Shannon-Weiner index, Pielou index, Menhinick index, Udhampur

### Introduction

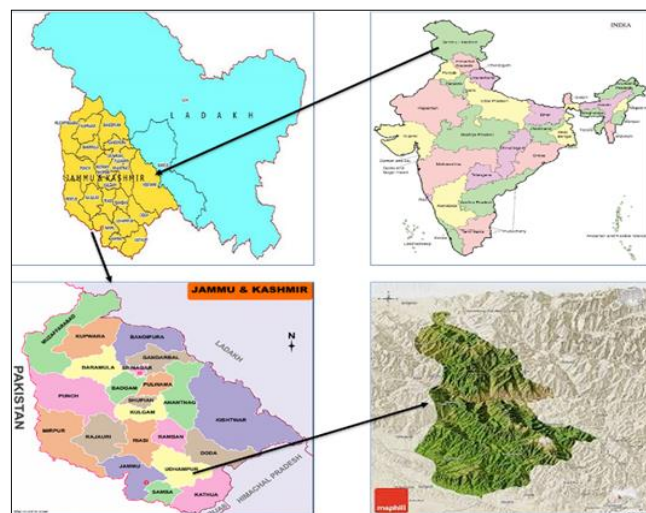
Ladybugs, often known as ladybirds or ladybug beetles, are classified under the family Coccinellidae. The family comprises 360 genera and around 6000 species globally (Vandenberg, 2002; Che *et al.*, 2021) [3]. India has documented more than 530 species of ladybird beetles belonging to approximately 100 genera (Kapur, 1954; Poorani, 2002; Poorani *et al.*, 2025) [8, 25, 26]. Ladybug beetles belong to the order Coleoptera, which is a group of winged insects with hard exoskeleton (Kovar, 1996; Hunt *et al.*, 2007) [5, 15]. Coccinellids are beneficial predatory insects that play a vital role in the biological control of insect pests across diverse crop ecosystems. (Obrycki and Kring, 1998) [22]. Both adults and larvae consume microscopic insects such as aphids, mealybugs, scale insects, whiteflies and mites (Moreton, 1969; Hawkeswood, 1987; Majerus, 1994; Salehi *et al.*, 2011) [4, 18, 21, 28]. In contrast, certain phytophagous coccinellids, including *Epilachna* spp., inflict damage on crops and are recognized as economically important pests (Omkar and Pervez, 2016) [23]. These phytophagous species consume the plants belonging to the Solanaceae family (Mishra and Yousuf, 2019) [20]. Coccinellids are also considered as bioindicators (Iperti and Paoletti, 1999) [6] and provide more general information about the ecosystem in which they occur (Anderson, 1999). The utilization of natural predators is an ecologically sustainable approach to pest management, as they regulate pest populations and minimize crop damage while reducing dependence on synthetic chemical pesticides (Stanley, 2008) [31]. Ladybug beetles have been also observed as effective models for addressing several issues related to ecology and evolution (Omkar and Parvez, 2016) [23]. Therefore, aim of the present study was to report the species composition and diversity indices of coccinellids beetles in semi urban area of district Udhampur, Jammu and Kashmir (UT).

### Materials and Methods

#### Study area

The present investigation was carried out in semi-urban area of Udhampur district, Jammu & Kashmir Union Territory (Fig. 1). The geographical extent of the study area ranges

between 32°34'-33°30' N latitude and 74°16'-75°38' E longitude. Survey was conducted from May 2024 to April 2025 across different horticultural ecosystems within the study area. Observations was done from agriculture fields, residential gardens, fruit trees, shrublands and kitchen gardens habitats of the study area.



**Fig 1:** Location of study sites in J&K (UT), India. (Kumar and Kaur, 2023) [16]

### Sampling Methods

Field sampling was undertaken across different horticultural ecosystems within the study area from May 2024 to April 2025. Beetles were collected at fortnightly intervals using a combination of hand-picking and net-sweeping techniques following Jonathan (1995) [7]. For net sweeping, a long-handled insect net fitted with a white muslin-cloth bag was used. However, hand collection was the principal method employed during the study, particularly for specimens observed directly on vegetation. To ensure representative sampling, 10 plants/tress were randomly selected within study area, while 10 quadrats, each measuring 1 m<sup>2</sup>, were randomly established in the crop-land ecosystem at each sampling location. For the identification of ladybird beetles

relevant published literature and descriptions by many taxonomists was taken into consideration. The taxonomic keys used during current study includes Kapur (1954, 1956, 1958, 1963, 1973); Poorani (2002) and Kuznetsov (1997) [8, 9, 10, 11, 17, 25].

### Calculation of diversity indices

To calculate the diversity of ladybird beetles, following indices were used.

#### Shannon-Wiener's index (Shannon, 1948) [29]

$$H' = -\sum_{i=1}^S p_i \ln p_i$$

Where,  $H'$  - Shannon- Wiener's diversity index.  $S$ - the community's total species count.  $P_i$  - Proportion of the  $i$ th species to total abundance value.  $Ln$  - Natural log of the number.

#### Pielou's Evenness Index (J) (Pielou, 1969) [24] was calculated by the equation:

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

Where,  $H$  is Shannon-Wiener's diversity index  $S$  is species richness.

Species richness was measured by Menhinick's index (Menhinick, 1964) [19]

$$D = \frac{S}{\sqrt{N}}$$

Where,  $S$ - total number of identified species.  $N$ - Total number of counted individuals.

### Results

The current study documented 14 coccinellid taxa, representing 12 genera and 13 species (Table 1). All the 14 species are being first documented records from district Udhampur. Detailed photographic documentation of the observed taxa is provided in Fig. 2 and 3.

The calculated value of Shannon-Weiner index (2.15) indicated relatively highest diversity from the study area. Similarly, the calculated values of Pielou's Evenness Index (0.83) and Menhinick's Richness Index (0.96) indicate a relatively high degree of species evenness and species richness, respectively, within the study area (Table 2). The rank-abundance curve (Fig. 4) revealed considerable variation in the relative abundance of the 14 Coccinellidae taxa recorded from the study area. *Coccinella septempunctata* occupied the first rank and exhibit the highest proportional abundance, indicating its clear dominance within the coccinellid assemblage. Based on their abundance status, the 14 recorded taxa comprised five common species, four frequent species, four occasional species and one rare species in the study area (Fig. 5). It has been observed that species namely, *Coccinella septempunctata*, *Cheilomenes sexmaculata* and *Propylea dissecta* shows elytral polymorphism.



**Fig 2:** a) *Anegleis cardoni*; b) *Cheilomenes sexmaculata*; c-d) *Cheilomenes sexmaculata* Polymorphs (elytral patterns); e) *Chilocorus circumdatus*; f) *Chilocorus circumdatus* (colour polymorphs); g) *Chilocorus circumdatus* Polymorphs (elytral patterns); h) *Coccinella septempunctata*; i) *Coccinella septempunctata* (pair); j-l) *Coccinella septempunctata* Polymorphs (elytral patterns).



**Fig 3:** a) *Coccinella transversalis*; b) *Coccinella transversalis* (colour polymorph); c) *Harmonia dimidiata* Polymorphs (elytral patterns); d) *Harmonia dimidiatae* Polymorphs (elytral patterns); e) *Henosepilachna vigintioctopunctata*; f) *Micraspis allardi*; g) *Oenopia mimica*; h) *Propylea dissecta* (♀); i) *Propylea dissecta* (♂); j) *Propylea dissecta* (♂) Polymorph; k) *Propylea dissecta* (pair); l) *Propylea japonica* (♀); m) *Propylea japonica* (♂); n) *Brumoides suturalis*; o) *Illeis koebelei*; p) *Novius* sp.

## Discussion

The present study documented 14 coccinellid taxa representing 12 genera and 13 species from district Udhampur. Although several of these taxa have previously been reported from other parts of Jammu and Kashmir, their documentation from Udhampur provides important district-level distributional information. Earlier studies have demonstrated considerable diversity of Coccinellidae in the region. Khan *et al.* (2009) <sup>[14]</sup> recorded 15 predaceous coccinellid species from different ecosystems of Srinagar, while Rasheed and Buhroo (2018) <sup>[27]</sup> reported 13 species belonging to 11 genera from horticultural and wild vegetation of Kashmir. More recently, Ali *et al.* (2024) <sup>[1]</sup> documented 12 coccinellid species from Gharana Wetland Conservation Reserve and adjoining agricultural fields in Jammu. These studies, together with the present findings, indicate that the Jammu and Kashmir Himalayan region supports a diverse assemblage of coccinellid beetles. The Shannon–Wiener diversity index ( $H' = 2.15$ ), Pielou's evenness index ( $J' = 0.83$ ) and Menhinick's richness index (0.96) indicate relatively high diversity, evenness and species richness of coccinellids in the study area. The high evenness suggests that, despite the dominance of certain

taxa, individuals were comparatively well distributed among the recorded species. Variations in diversity between the present study and earlier investigations may be related to differences in habitat composition, vegetation, altitude, seasonality, sampling effort and prey availability. Rasheed and Buhroo (2018) <sup>[27]</sup> also emphasized the influence of habitat characteristics on coccinellid diversity in Kashmir.

The rank-abundance curve revealed clear dominance of *Coccinella septempunctata*, which exhibited the highest proportional abundance in the present study. Similar dominance of *C. septempunctata* has been reported from Jammu and Kashmir. Ali *et al.* (2024) <sup>[1]</sup> recorded *C. septempunctata* among the dominant coccinellid species in Gharana Wetland and adjoining agricultural habitats. Its dominance in Udhampur may be attributed to its broad ecological tolerance and availability of suitable prey, particularly aphids, across agricultural, semi-urban and natural habitats. The occurrence of five common, four frequent, four occasional and one rare taxon further reflects variation in abundance and habitat utilization within the coccinellid assemblage.

A notable observation was the pronounced elytral polymorphism in *Cheilomenes sexmaculata* and *Coccinella*

*septempunctata*. Colour and pattern polymorphism in *C. sexmaculata* has been documented by Singh *et al.* (2016)<sup>[30]</sup>, who reported several distinct elytral morphs in Haryana. Kawakami *et al.* (2013)<sup>[13]</sup> also demonstrated geographical variation in elytral colour polymorphism of *C. sexmaculata*. Similarly, Thamseer *et al.* (2022)<sup>[32]</sup> reported multiple elytral morphs of *C. septempunctata* and observed seasonal variation in their occurrence. Thus, the polymorphism observed in the present study appears consistent with previously documented phenotypic variation in these species. The observed species diversity, together with the relatively even distribution of individuals among taxa, suggests that the habitats of Udhampur provide suitable

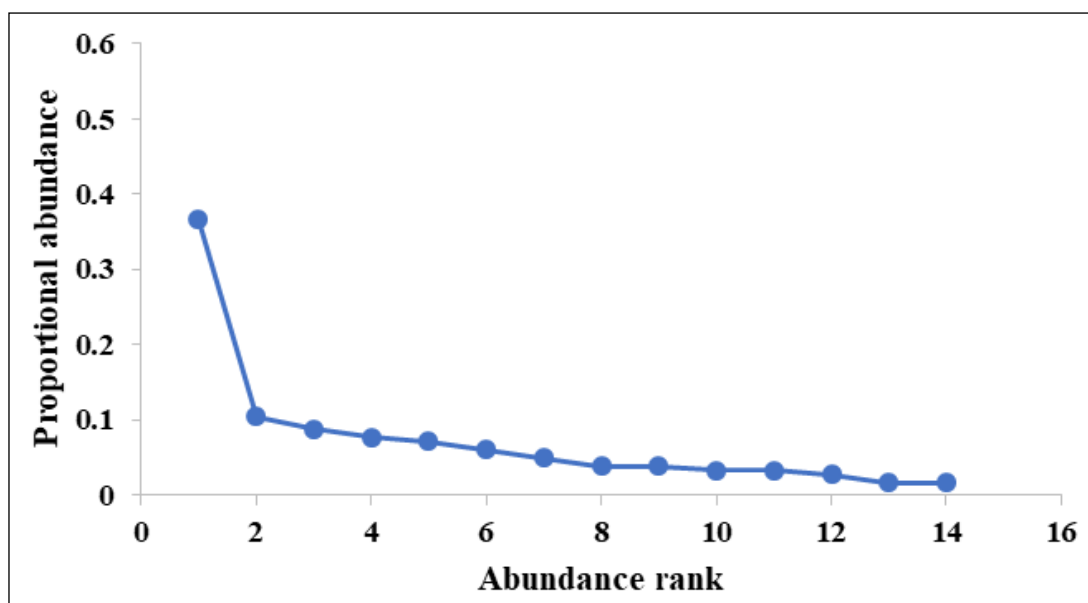
conditions for sustaining diverse communities of beneficial predatory insects and may consequently support natural biological suppression of phytophagous pests. The findings of the present study provide valuable baseline information on the occurrence and distribution of Coccinellidae at the district level and contribute to the existing knowledge of the coccinellid fauna of Jammu and Kashmir. Further investigations incorporating systematic seasonal sampling, standardized survey protocols, detailed morphological documentation, photographic records, and molecular identification techniques are recommended to obtain a more comprehensive assessment of coccinellid diversity and distribution patterns in the region.

**Table 1:** List of Coccinellidae species recorded from study area of district Udhampur, Jammu and Kashmir (UT), India

| S. No                        | Common Name                 | Zoological Name                                             | Host Plant                                                                                                    |
|------------------------------|-----------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>Family: Coccinellidae</b> |                             |                                                             |                                                                                                               |
| 1                            | Black-spotted Lady Beetle   | <i>Anegleis cardoni</i> (Weise, 1892)                       | <i>Polyalthia longifolia</i>                                                                                  |
| 2                            | Three-striped Lady Beetle   | <i>Brumoides suturalis</i> (Fabricius, 1789)                | <i>Leucaena leucocephala</i> , <i>Coriandrum sativum</i>                                                      |
| 3                            | Six-spotted zigzag ladybird | <i>Cheilomenes sexmaculata</i> (Fabricius, 1781)            | <i>Prunus persica</i> , <i>Leucaena leucocephala</i> , <i>Coriandrum sativum</i> , <i>Phyllanthus emblica</i> |
| 4                            | Red Cholicorus              | <i>Chilocorus circumdatus</i> (Gyllenhal, 1808)             | <i>Citrus limon</i>                                                                                           |
| 5                            | Seven-spotted ladybird      | <i>Coccinella septempunctata</i> (Linnaeus, 1758)           | <i>Coriandrum sativum</i> , <i>Prunus persica</i> , <i>Ageratum conyzoides</i>                                |
| 6                            | Transverse ladybird         | <i>Coccinella transversalis</i> (Fabricius, 1781)           | <i>Prunus persica</i> , <i>Coriandrum sativum</i> , <i>Solanum melongena</i> , <i>Brassica juncea</i>         |
| 7                            | Fifteen-spotted ladybird    | <i>Harmonia dimidiata</i> (Fabricius, 1781)                 | <i>Leucaena leucocephala</i>                                                                                  |
| 8                            | 28-spotted potato ladybird  | <i>Henosepilachna vigintioctopunctata</i> (Fabricius, 1775) | <i>Solanum melongena</i> , <i>Solanum villosum</i>                                                            |
| 9                            | Black-spotted lady beetle   | <i>Micraspis allardi</i> (Mulsant, 1866)                    | <i>Solanum melongena</i>                                                                                      |
| 10                           | Mimic Lady beetle           | <i>Oenopia mimica</i> (Mulsant, 1866)                       | <i>Hibiscus</i> , <i>Brassica juncea</i>                                                                      |
| 11                           | Ladybird beetle             | <i>Propylea dissecta</i> (Mulsant, 1850)                    | <i>Brassica juncea</i> , <i>Coriandrum sativum</i>                                                            |
| 12                           | Turtle vein ladybeetle      | <i>Propylea japonica</i> (Thunberg, 1781)                   | <i>Coriandrum sativum</i>                                                                                     |
| 13                           | Yellow Ladybird beetle      | <i>Illeis koebele</i> (Timberlake, 1943)                    | <i>Solanum melongena</i>                                                                                      |
| 14                           | Ladybird beetle             | <i>Novius sp.</i>                                           | <i>Psidium guajava</i>                                                                                        |

**Table 2:** Shannon-Weiner diversity indices recorded in the study area.

| Shannon-Weiner diversity Index (H) | Pielou's Evenness Index (J) | Menhinick's Index (S) |
|------------------------------------|-----------------------------|-----------------------|
| 2.15                               | 0.83                        | 0.96                  |



**Fig 4:** Rank-abundance curve showing the relative abundance and dominance of coccinellidae species in study area of district Udhampur.

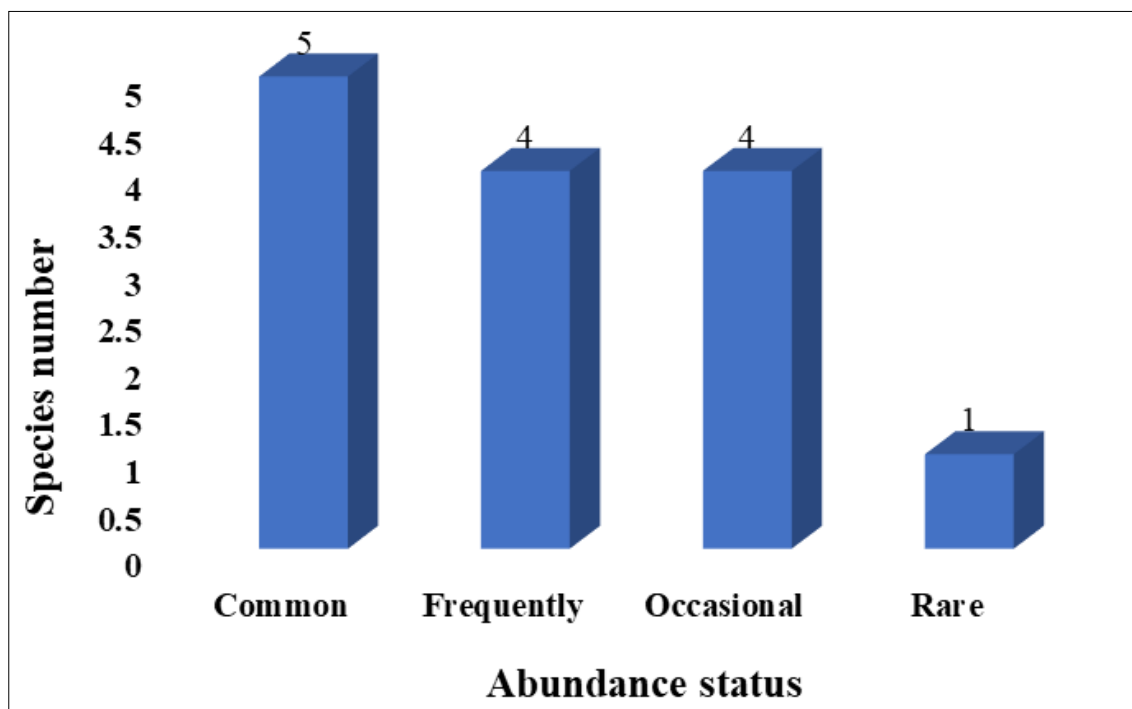


Fig 5: Bar chart representing the abundance status of coccinellidae species in study area.

## Conclusion

The present study documented 14 coccinellid taxa belonging to 12 genera and 13 species from district Udhampur, providing important reference data on the diversity and composition of the local Coccinellidae fauna. The relatively high Shannon–Wiener diversity (2.15), Pielou’s evenness (0.83), and Menhinick’s richness (0.96) indicate a diverse and comparatively well-distributed coccinellid assemblage. *Coccinella septempunctata* was the most abundant and dominant species, while *C. septempunctata* and *Cheilomenes sexmaculata* exhibited notable elytral polymorphism. The findings highlight the ecological importance of coccinellids as natural predators and potential biological-control agents in the region. Overall, the study adds valuable district-level distribution records and provides a baseline for future investigations on the diversity, ecology and conservation of Coccinellidae in Udhampur and the wider Himalayan region.

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**Conflict of Interest:** Author declare no conflict of interest.

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