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COCCINELLID DIVERSITY OF THE GARHWAL REGION OF UTTARAKHAND, INDIA – I

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ABSTRACT

Coccinellid diversity of the Garhwal region of Uttarakhand, India have been studied from hilly, terai and plain areas. We explored a small portion of area between Dehradun, and Rishikesh of Garhwal, Uttarakhand and found thirteen coccinellid species in the first part of an extensive survey. These coccinellid species are *Coccinella septempunctata, Menochilus sexmaculatus, Hippodamia variegata, Harmonia eucharis, Coccinella transversalis, Oenopia sauzeti, Oenopia kirbyi, Oenopia mimica, Propylea luteopustulata, Platynaspis saundersi, Anegleis cardoni, Coelophora saucia* and *Illeis confusa*. Amongst these, only *I. confusa* is mycophagous, while the rest of coccinellids are aphidophagous and important biocontrol agents of aphids. Garhwal is known for the rich insect diversity. However, little is known regarding its coccinellid diversity. Thus, we also reviewed the ecology and prey-predator interactions with an objective to discuss their biocontrol potential. We also described their taxonomy, morphology, and distribution.

Keywords: Biodiversity, Coccinellidae, Garhwal region.

INTRODUCTION

Ladybird beetles, part of the Coccinellidae family within the Coleoptera order, are typically small to medium-sized insects with oval or semi-spherical bodies (Pervez et al., 2020a). Their body length ranges from 0.8 mm to 18.0 mm (0.03 to 0.71 inches) (Seago et al. 2011). Bouchard et al. (2017) estimated that there are more than 6000 global coccinellid species with 350 genera (Ślipiński and Tomaszewska 2010), which encompass both predatory and plant-feeding (phytophagous) varieties and are divided into six subfamilies: Coccidulinae, Coccinellinae, Scymninae, Chilocorinae, Sticholotidinae, and Epilachninae (Poorani 2002; Hodek and Evans 2012). About 1,100 species were found in the Neotropical region (de Paula Malheiros et al. 2025). Ladybirds play a vital role as predators of various economically significant herbivorous insects, acting as key biological agents against several phytophagous pests like aphids, whiteflies, scales, buds, moth larvae, and specific mites (Hodek et al. 2012; Omkar and Pervez 2016; Pervez 2023). Notably, aphid predators are increasingly recognized for their crucial contributions to pest management. Certain ladybird species may feed on pollen, nectar, fungal spores, and plant tissues, and they may even resort to cannibalism when food is limited, depending on the seasonal availability (Escalona et al. 2017). In addition, many coccinellids also consume other arthropods, fungi, and plant materials like nectar and pollen. (Weber and Lundgren 2009, Hodek and Evans 2012, Ugine et al. 2019).

In various regions globally, ladybird beetles have been introduced as natural predators to control pest populations. In Mexico, predaceous ladybirds are considered vital biocontrol agents (Rodríguez et al. 2023). Rondoni et al. (2021) explored the impact of non-native lady beetles on managing insect pests, showcasing case studies of two most famous coccinellids, *Coccinella septempunctata* Linnaeus and *Harmonia axyridis* (Pallas) in North America, *H. axyridis* in Europe, and *H. axyridis* and *Hippodamia variegata* (Goeze) in South America. In Ecuador, González and Escalona (2022) identified 38 species, including six new species, in the Napo province. Thirteen species from 10 genera and three tribes with a total of 402 individuals were recorded across different habitats in three sampling areas of Nangkor Gewog, Zhemgang District, Bhutan. The Coccinellini tribe was the most prevalent with 378

individuals (RA = 94.03%), while the Chilocorini tribe was the least abundant, with only one individual (RA = 1.00%) among the three coccinellid subfamilies (Wangchuk et al., 2024).

Coccinellid beetles play a crucial role in agricultural systems due to their efficiency in controlling numerous harmful insects (Agarwala et al., 1988; Satpathi, 2009; Gokul et al., 2024). However, the presence and diversity of ladybird species in North India have been documented in only a few studies (Omkar and Pervez 1999, 2000, 2002a). Poorani (2002) identified 400 species across 79 genera of coccinellid beetles on the Indian subcontinent. The ecological aspects, prey-predator dynamics, and dietary relationships of ladybird beetles have been extensively researched previously (Hodek et al. 2012; Omkar and Pervez 2004a, b). Furthermore, Singh and Malik (2018) performed a taxonomic study on the Coccinellini tribe in Haryana, offering detailed descriptions of seven species.

In a similar vein, Sharma et al. (2021) examined the richness and abundance of coccinellids in agricultural fields of the Shambhal district, Uttar Pradesh. Similarly, Neethu et al. (2022) explored the morpho-taxonomic characteristics of ladybird beetles in southern Telangana, identifying 12 species from four subfamilies. Gautam et al. (2023) offered an illustrated overview of the tribe Coccinellini throughout the Indian subcontinent, documenting 119 species across 30 genera. In the state of Uttarakhand, Joshi and Sharma (2008) identified 19 new species in Haridwar. Giorgi et al. (2009) performed a phylogenetic analysis of feeding behavior evolution in coccinellids through molecular data. Likewise, Seago et al. (2011) explored the phylogeny of true ladybird beetles, focusing on the Coccinellini tribe within the Coccinellidae family, also utilizing molecular evidence. Sharma and Joshi (2013) researched the coccinellid fauna in the Haridwar district and recorded 17 species. A study on ladybird beetle diversity in rice fields indicated high diversity indices in Almora (Shanker et al. 2018). Subsequently, Sharma and Joshi (2019) explored the distribution and morpho-taxonomic characteristics of *Micraspis discolor* (Fabricius) and *Micraspis vincta* (Gorham) in Haridwar district. Ślipiński et al. (2019) pointed out that the genus *Coccinella* includes around 50 species, primarily located in the Holoarctic region. In their research, Sharma et al. (2021) identified nine species of coccinellids across four sites in the Mothrowala area of Dehradun. These species are categorized into three subfamilies and four tribes: *Brumoides suturalis* (Fabricius), *Coccinella septempunctata* (Linn.), *Coccinella transversalis* (Fab.), *Hippodamia variegata* (Goeze), *Illeis confusa* (Fabr.), *Micraspis discolor* (Fabr.), *Oenopia sauzeti* (Mulsant), *Psyllobora* spp., and *Henosepilachna vigintioctopunctata* (Fabr.) (Khanduri and Sharma 2023). Siddique et al. (2023) conducted a focused study in two locations within Pauri district, specifically Kandoliya and Paurigaon, where they identified 14 species of Coccinellidae. Khanduri and Sharma (2024) provided insights on the genus *Illeis*, noting *Illeis koebelei* (Timberlake) as a new record in the Doon Valley. Despite Uttarakhand's rich and diverse coccinellid fauna, it is still largely underexplored compared to other states in India. The present study aims to explore the coccinellid diversity between small zone of Garhwal, Uttarakhand, India along with reviewing the morphological and taxonomical characteristics of the sampled coccinellids.

MATERIALS AND METHODS

We conducted extensive surveys to sample and collect predaceous coccinellids ladybirds from terai and plain regions of Garhwal, *viz.* Dehradun and Rishikesh during March 2025 to May, 2025. The adult coccinellids were further identified in Biological Laboratory, Rishikesh Campus, India. These coccinellids were characterized by carefully examining their morphology under stereoscopic trinocular (*Lyzer*) attached to personal computer. The species where further identified in the light of keys and literature. A few specimens in sealed vials containing 70% alcohol were sent for identification to Dr J. Poorani, Scientist, ICAR-National Research Centre for Banana, Tiruchirapalli - 620 102, Tamil Nadu, India.

RESULTS AND DISCUSSION

Thirteen species of coccinellids were sampled and collected. The details of which are as follow:

1) Coccinella septempunctata (Linnaeus, 1758)
Common name: Seven-spot ladybird or C-7 ladybeetle
Altitude of species distribution: 1600-3400m asl
Global Distribution: Bangladesh, China, Japan, and Sri Lanka (Poorani 2002, 2004; Rahatulla et al. 2011).
Distribution in India: The states of Sikkim, Darjeeling, Meghalaya, Uttar Pradesh, Arunachal Pradesh, and Uttarakhand are noted in the literature (Omkar and

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Pervez 2002b; Mishra and Yousaf 2019; Joshi et al. 2012).

Materials examined: Rishikesh, 12♂ 13♀, PT.LMSC, 21.iii.2025, A Pervez leg./ *B. campestris-L. erysimi*/

Diagnostic Characters: The adults of *Coccinella septempunctata* measure approximately 8-10 mm in length and 6-8 mm in width, with seven spots found on a shiny red coloration. Its body is typically smooth, oval, and moderately convex. The elytra is smooth and features seven distinct spots, including one sutural spot, which consists of three and a half spots on each elytron. The head is transverse in section, black in colour, characterized by a pair of yellow spots located on the frontal region near the eyes.
Ecology and Habitat: This cosmopolitan, eurytopic, polymorphic coccinellid is predominantly located in croplands, forests, fruit orchards, and wild vegetation throughout Dehradun and Rishikesh. It dominates the local coccinellid fauna and can be observed on leaves, stems, and flowers in backyard gardens, crop fields, and meadows. This species preys on various species of aphids, psyllids, and whiteflies in the agroforestry fields. Its population was at peak during March, 2025.

(2) Menochilus sexmaculatus: *Menochilus* (*Cheilomenes*) *sexmaculatus* (Fabricius 1801/1781)
Common name: zigzag beetle or six-spotted ladybird beetle
Global Distribution: Afghanistan, Indonesia, Russia, Bangladesh, and Pakistan (Ahmed et al. 2017), China (Wu et al. 2011)
Distribution in Uttarakhand: Almora, Chamoli, Nainital, Udham Singh Nagar, Uttarkashi, Haridwar, and Dehradun (Joshi and Sharma, 2008).

Materials examined: Rishikesh, 5♂ 5♀, PT.LMSC, 22.iii.2025, A Pervez leg./ *Calotropis procera – Aphis nerii*/

Diagnostic Characters: It is an Oriental, polymorphic species with body sizes range from 5.4 - 6.3 mm to 5.5 - 6.2 mm and are oval or nearly round, slightly convex, and glossy. The colour varies from yellow, orange, and pink to a light red. The head is yellow-brown and concealed within the pronotum. A T-shaped median band on the front of the pronotum connects to a broad band in the posterior marginal area. The scutellum is brownish-black. There are six black patches of various shapes on the elytra, including two zig-zag lines and a black spot at the posterior end. A broad black line runs longitudinally along the junction of the elytra and scutellum. The patches on the elytra vary: V-shaped on the first pair, W-shaped on the second, and somewhat rounded on the third pair.
Prey range: Highly predatory towards aphids (Omkar and Pervez 2004a), this species consumes adelgids sp., the whitefly, *Bemisia tabaci* (Gennadius), *Pyrilla perpusillai* Walker (Rahatullah et al. 2011), as well as psyllids and mites. It also targets the tea aphid, *Toxoptera aurantii* Boyer (Roy and Rahman 2014). The host plants include *Helianthus annuus* L., *Zea mays* L., and the tea plant *Camellia sinensis* (L.).
Ecological importance: Commonly found in flat areas and sometimes on foothills: crops of *Brassica* and *Zea mays*.

***(3) Hippodamia variegata* (Goeze, 1777)**
Common name: Spotted amber ladybeetles/ variegated ladybeetle
Altitude of species distribution: 1600-3400m asl.
Distribution: This species is found globally in Afghanistan, Europe, South Africa, Kenya, China, India, Canada, the USA, Chile, Australia, Pakistan, and Scotland (Weddle 2025). In India, it occurs in Arunachal Pradesh, Himachal Pradesh, Jammu and Kashmir, Maharashtra, Uttar Pradesh, and Uttarakhand.

Materials examined: Rishikesh, 1♂ 1♀, PT. LMSC, 29.iii.2025, A Pervez leg./ *Lagenaria siceraria* (Molina) Standl. – *Aphis gossypii*

Diagnostic Character: *Hippodamia variegata* measures between 3.0 and 5.5 mm in length and from 3.0 to 3.5 mm in width. Its pronotum features two small white spots, while its body is slightly semi-hemispherical. The adult has 12 black spots on its elytra, which are dull yellow or red in color.
Ecology and Habitat: This species is prevalent on leaves, stems, and flowers in backyard gardens, agricultural fields, meadows, and wooded areas. It is

commonly found in cultivated crops, forage plants, fruit trees, and wild flora. *H. variegata* primarily feeds on weedy plants in sandy, open soil. These are predominantly observed during the summer in warm environments.

***(4) Harmonia eucharis* (Mulsant, 1850)**
Common name: Asian lady beetle
Altitude of species distribution: 1200-3100m asl.
Global Distribution: China, Myanmar, Nepal, Bhutan, and Pakistan (Poorani 2004; Wu et al. 2011)
Distribution in India: Arunachal Pradesh, Jammu and Kashmir, Himachal Pradesh, Manipur, Sikkim, Uttarakhand, and Uttar Pradesh (Sharma et al., 2017)

Materials examined: Dehradun, 1♀, FRI, 26.iii.2025, A Pervez leg./ *Lablab purpureus* (L.) Sweet– *Aphis craccivora*

Diagnostic Characters*: H. eucharis* measures 10.5 - 12 mm in length and 6-7 mm in width, featuring a broad, oval, and moderately convex shape. Its body displays reddish-brown elytra adorned with black spots and bars that connect in patchy formations. The antennae consist of 11 segments and are slightly shorter than the head. The last three segments of the antennae are thickened at the ends, forming a club-like structure.
Ecology and Habitat: *Harmonia eucharis* is a predatory polymorphic ladybird that feeds on a variety of insects, particularly aphids (Pervez et al. 2025). It has two generations per year, being active in spring and summer, and hibernates during autumn and winter. This species is commonly found on aphids infesting apples, peaches, plums, quinces, apricots, almonds, cherries, and more. It prefers warmer climates, avoiding extreme heat.

***5) Coccinella transversalis* (Fabricius 1781)**
Common name: Transverse ladybird
Altitude of species distribution: 200-1900m asl.
Global Distribution: Cosmopolitan, polymorphic species with worldwide distribution. (Poorani 2004)
Distribution in India: Uttarakhand, Sikkim, Meghalaya, Tripura, Manipur, West Bengal, Andhra Pradesh, Kerala, Goa, and the Andaman Islands. (Poorani 2002 , 2004).

Materials examined: Rishikesh, 2♂ 2♀, PT.LMSC, 21.iii.2025, A Pervez leg./ *B. campestris-L. erysimi*/

Diagnostic Characters: This coccinellid measures on average between 3.8 and 6.7mm in length and 3.3 to 5.4mm in width, displaying an elongated oval shape with a convex profile. The head is dark in color, featuring a pair of yellow subtriangular spots near the inner margin of the eye. The pronotum is black with the anterolateral corners being a light cream hue, while the scutellum is also black. The elytra are vibrant carmine red, orange, or yellow, adorned with an oval substellar spot, a prominent trilobed mark on the humeral callus, as well as a transverse band.

Ecology and Habitat: *Coccinella transversalis*, a polyphagous coccinellid species, is commonly found on small herbaceous vegetation, shrubs, and trees across diverse environments, such as open fields, grasslands, marshes, farming regions, urban gardens, and parks. Three specimens were seen actively feeding on aphids from various host plants. The peak population of this species was noted in April, 2025.

***(6) Oenopia sauzeti* (Mulsant 1846)**
Subfamily – Coccinellinae
Tribe – Coccinellini
Distribution: India: Himachal Pradesh (Sharma et al. 2017); Uttarakhand—Almora, Chamoli, Nainital, Uttarkashi (Pervez et al. 2020b), Nainital (Joshi et al., 2012), and Haridwar (Joshi and Sharma, 2008; Sharma and Joshi, 2020).
Globally: Pakistan (Inayatullah et al. 2005; Rahatullah et al. 2011; Hayat et al. 2017); Thailand (Poorani 2004); China (Wu et al. 2011); Nepal, Bhutan, and Myanmar.

Materials examined: Rishikesh, 1♂ 1♀, PT.LMSC, 30.iii.2025, A Pervez leg./ *B. campestris-L. erysimi*/

Distinctive characters: a round and distinctly convex shape; the pronotum is black with yellow spots, loosely connected to the body; the elytra are light yellowish to white, adorned with large, round brownish-black spots; there are a total of six spots—two on each elytron, two on the mid-dorsal line where the elytra meet, and two central spots that are linked by a band.
Prey range: *A. fabae*, *A. gossypii*, *Aphis kurosawaii* (Takahashi), *Aphis longisetosa* Basu, B. *brassicae*, *Formosartemisiae aegopodii B. helichrysi* (Takahashi), (Scopoli), *Capitophorus*, *Cavariella*, *Clethrobius* .
Ecological importance: Primarily feeding on aphids, it may be utilized for the biological control of *A. gossypii.*

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Hayat et al. (2017) noted the active period from April to October, though we observed activity extending into October and November.

(7) Oenopia kirbyi Mulsant, 1850

Distribution in India: Arunachal Pradesh, Meghalaya, Mizoram, Sikkim, and West Bengal (Das et al. 2020). Global distribution: Bhutan, China, Myanmar, Nepal, and Thailand (Poorani 2002a, 2002b, 2004; Kovář 2007).

Materials examined: Rishikesh 1♀ 1♂, PT.LMSC, 30.iii.2025, A Pervez leg./ Parthenium bushes/

(8) Oenopia mimica Weise, 1902

Global distribution: Bhutan, China, Myanmar, Nepal, and Thailand (Poorani, 2002a, 2002b, 2004).

Distribution in India: Arunachal Pradesh, Meghalaya, Mizoram, Sikkim, and West Bengal (Das et al., 2020).

Materials examined: Rishikesh 2♀, 1♂, PT.LMSC, 30.iii.2025, A Pervez leg./ Parthenium bushes/

Distinctive characters: length is 3.0mm to 4.3mm. The basic color scheme is similar to that of O. *sauzeti*, with the ground color of the head and pronotum being creamy yellow and the elytra ranging from bright lemon yellow to creamy yellow. The head is black in females and yellow in males.

Prey range: *Oenopia mimica* is known to feed on *Adelges* spp. On silver fir, spruce, and other coniferous vegetation: *Taoia indica*.

(9) Propylea luteopustulata (Mulsant, 1850)

Subfamily – Coccinellinae

Tribe – Coccinellini

Distribution Globally : Pakistan (Khan et al. 1999; Hayat et al. 2017); Vietnam (Canepari 1997); Bhutan, Nepal, and Sri Lanka.

Distribution in India: Himachal Pradesh (Sharma et al. 2017); Kashmir (Khan et al. 2009; Bhat 2017); Uttarakhand—Almora, Chamoli, Nainital (Pervez et al. 2020b).

Materials examined: Rishikesh 1♀, PT.LMSC, 3.iv.2025, A Pervez leg./ *B. campestris-L. erysimi*/

Distinctive characters: Unique features: medium-sized body; the anterior side of the pronotum is pale while the posterior side is black; the scutellum is small and black; the anterior margin of the elytra is straight, glabrous, and pale yellow, each featuring five black spots. Range of prey: Includes aphids such as A. craccivora, A. *gossypii*, *L. erysimi*, and *B. brassicae*, as well as psyllids and whiteflies (Rahatullah et al. 2011).

Host plant: apple, radish, peach, eggplant (Sharma et al. 2017) Ecological importance: An important predator of A. *gossypii* in North India.

(10) Platynaspis saundersi Crotch

Subfamily: Chilocorinae

Tribe: Platynaspidini

Distribution Globally: Afghanistan, Nepal, Pakistan (Hayat et al. 2014); Sri Lanka

Distribution in India: Kashmir (Khan et al. 2009; Bhat 2017), Himachal Pradesh (Sharma et al. 2017); Uttarakhand (as per present study). —Chamoli

Materials examined: Rishikesh 1♀, PT.LMSC, 30.iii.2025, A Pervez leg./ Parthenium bushes/

Distinctive characters: The insect is brown with fine, silky hair and a rounded body. The elytra are covered in hair and feature 10 black asymmetrical spots; both the pronotum and scutellum are black, with one large spot along the mid-dorsal line at the junction of the elytra and five spots on each elytron. Adults have been observed on apple, pear, and wild apple trees. According to Agarwala and Ghosh (1988), it has been noted as an accidental predator of some unidentified aphids.

Prey range: unidentified aphids on Solanum nigrum L. (Poorani 2002a; Sharma et al. 2017). Unidentified aphids were observed on host plants such as *Holoptelea integrifolia* (Roxb.), *Toona ciliata* M. Roem, *Mallotus philippensis* Muell., *Pongamia pinnata* L., and *Bauhinia variegata* L. in Uttarakhand (Mishra and Yousuf, 2019).

Ecological significance: The adult specimens were noted to be feeding on unidentified aphids that infest apple, pear, and wild apple trees (Khan et al. 2009). These insects are more commonly found in forested regions.

11) Anegleis cardoni (Weise)

Distribution: India, Pakistan, Sri Lanka (Poorani, 2002)

Materials examined: Rishikesh 1♀, PT.LMSC, 30.iii.2025, A Pervez leg./ Parthenium bushes/

Diagnosis: It is round in shape, measuring 3.50-3.75 mm in length and 3.25-3.50 mm in width. The pronotum features two black spots and a pair of prominent eyes. The body is light yellow with a hint of a median black line connecting the elytra. The elytra display a pattern of black stripes with two black markings at posterior side.
Prey: this ladybird beetle feeding on aphids like *Lipaphis erysimi* (Omkar et al., 2009). It is obtained from the inner side of the leaves *of Hygroryza aristata* and *Ficus benghalensis*.

(12) Coelophora saucia **(Mulsant 1850)**
Subfamily- Coccinellinae
Tribe Coccinellini.

Coelophora saucia (Mulsant) is a significant natural enemy of aphids and mealybugs that infest a variety of economically important agricultural, horticultural, and ornamental crops (Pathak, 2008). Its larvae and adults are highly effective at controlling the green apple aphid, *Aphis pomi* De Geer, in Himachal Pradesh. Since *Aphis*
Materials examined: Rishikesh 4♀, PT.LMSC, 27.iii.2025, A Pervez leg./ Parthenium bushes/

pomi De Geer damages apple orchards and nurseries, biological control is crucial. Therefore, large-scale rearing of this predator could be advisable. (Kumari et al 2024).

(13) Illeis confusa (Fabricius) Timberlake, 1943
Distribution Globally: Pakistan (Rafi et al. 2005; Rahatullah et al. 2011; Hayat et al. 2017), Thailand, Nepal, China (Poorani 2004).
Distribution in Uttarakhand: Almora, Chamoli, Udham Singh Nagar (Pervez et al. 2020b).

Materials examined: Rishikesh 1♀, PT.LMSC, 30.iii.2025, A Pervez leg./ Parthenium bushes/

Distinctive characters: The body is medium-sized, oval, and slightly raised in shape; the pronotum is creamy with two black central spots; the elytra are creamy and without any spots. Its prey includes aphids (Rahatullah et al. 2011). While it mainly feeds on fungi, this ladybird may occasionally consume aphids.

Abbreviation
PT.LMSC = Pt. Lalit Mohan Sharma Campus Rishikesh

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Coccinella septempunctata

Menochilus sexmaculatus

Hippodamia variegata

Harmonia eucharis

Coccinella transversalis

Oenopia sauzeti

Oenopia kirbyi

Oenopia mimica

Propylea luteopustulata

Platynaspis saundersi

Anegleis cardoni

Coelophora saucia

Illeis confusa

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