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Research Article

Notes on coccinellid beetles (Coleoptera: Coccinellidae) from forest ecosystem of Uttarakhand, India

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ABSTRACT: Present study on diversity of coccinellid beetles comprises a significant group of predatory beetles which are being utilized in biological control of insect pests from more than one hundred years ago throughout the world. An extensive survey and collection of coccinellid beetles was carried out by following the sweep net and handpicking method during a period of two years, June 2016 to May2018, in Uttarakhand, India. Collection of beetles was also made at different altitudes. All the collected beetles have been identified up to species level. In total, fifteen species of coccinellid beetles were identified as *Aiolocaria hexaspilota* (Hope), *Anegleis cardoni* (Weise), *Brumoides suturalis* (Fabricius), *Coccinella septempunctata* Linnaeus, *C. transversalis* Fabricius, *Harmonia dimidiata* (Fabricius), *Henosepilachna vigintioctopunctata* (Fabricius), *Hippodamia variegata* (Goeze), *Illeis confusa* Timberlake, *Menochilus sexmaculatus* (Fabricius), *Micraspis allardi* (Mulsant), *Micraspis univittata* (Hope), *Oenopia sexareata* (Mulsant), *Platynaspidius saundersi* (Crotch) and *Propylea dissecta* (Mulsant). *H. vigintioctopunctata* is phytophagous while *I. confusa* is mycophagous; all other species are predatory feeding on mealy bugs and aphids occurring on forest tree species. Out of all identified species, four species *A. hexaspilota*, *I. confusa*, *O. sexareata* and *P. saundersi* have been recorded for the first time from Uttarakhand.

KEY WORDS: Biological control, Coccinellidae, Coleoptera, first record, forest, predatory beetles

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INTRODUCTION

Ladybird beetles (Coleoptera: Coccinellidae) are mainly predatory in nature and feed upon the phytophagous insects of agricultural, horticultural and forestry species like coccids, pseudococcids, white flies, thrips, aphids, mites, etc (Evans, 2009). Phytophagous and mycophagous beetles among the coccinellids (Sutherland and Parrella, 2009) also occur and are important. There are more than 6000 species of coccinellids, recorded world over, of which about more than 400 species have been recorded from India (Sharma *et al.*, 2015).

Ladybird beetles are mostly considered as beneficial because of their predatory behaviour as they keep the population of several insect pests under check in the field. Mostly they prey and consume the pest populations of soft and small bodied insects like aphids, jassids, coccids and pseudococcids, whiteflies, mites, etc (Agarwala and Ghosh, 1988). A ladybird may eat aphids as much as equal to its body weight every day. They are active throughout year but at the early winter and late summer their population is observed maximum. Most of the coccinellids are predatory in nature while some are phytophagous and mycophagous (Tomaszewska and Szawaryn, 2016). These beetles have proved as significant tools for biological control of insect pests. Coccinellid beetles are being utilized for controlling insect pests of agricultural crops, commercial cash crops, vegetables, flowers, orchards and insect pests of forest tree species as well. Coccinellids diversity and abundance have been reported from this region (Joshi and Sharma, 2008) and also from other parts of India (Poorani and Thangjam, 2019). However In this study coccinellid beetles were collected from forestry and agro-forestry areas of different districts of Uttarakhand.

MATERIALS AND METHODS

Coccinellid beetles were collected from forestry and agro-forestry areas of different districts of Uttarakhand during a period of June 2016 to May 2018, at monthly

intervals. Beetles were collected during day time mostly, in early morning and occasionally in late evening.

Study area

The current study on coccinellid beetles has been carried out in thirteen different districts, Almora, Bageshwar, Chamoli, Champawat, Dehradun, Haridwar, Nainital, Pauri Garhwal, Pithoragarh, Rudraprayag, Tehri Garhwal, Udham Singh Nagar and Uttarkashi of Uttarakhand, India. Collection of beetles and larvae were made from different landscapes including orchards, nurseries, flowers beds, agro-forestry and forestry areas during summer, winter and rainy seasons.

Collection methods

Collection of lady bird beetles was done by mainly three methods: (i) Hand picking method for picking and collection of adult beetles with the help of brush and forceps (ii) Sweep net method of beetles as given by (Gadagkar *et al.,* 1990) and (iii) Collection of larvae from field for rearing and emergence of adult beetles in the laboratory.

Preservation and taxonomic identification of coccinellids

Beetles were killed in killing-bottle or Jars using ethyl acetate. Sweeping net collections were kept in 70% alcohol for screening of coccinellids and dissection of beetles for further taxonomic studies. Beetles were then dried; their legs and antennae were stretched, pinned and kept into airtight wooden insect collection boxes. These boxes were fumigated with naphthalene balls for long time preservation. Specimens labelled with their collection data locality, date of collection, collector, host plants etc. These preserved coccinellids were examined under stereoscopic zoom binocular microscope (Aark International) for identification of their morphological characters. Dissection of specimens was carried out to study their genitalia (Afroze and Shafee, 1991a, b & c). These beetles were identified using different taxonomic keys and descriptions by coccinellids taxonomist (Kapur, 1955, 1972, Poorani, 2002).

RESULTS AND DISCUSSION

The collected specimens from different habitats were identified into fifteen species, four of which are being recorded for the first time from Uttarakhand. Detailed descriptions of these fifteen species are given below:

1. *Aiolocaria hexaspilota* (Hope) (Plate 1.1)

The body size measured 10 mm long and 9 mm wide. Beetle somewhat round, slightly convex and broadly oval in shape. The colour of head and mouth parts black or partly dark brown. Antennae dark black, shorter than head width. Pronotum black with white round large spots at sides. Elytra ground colour orange, brick red, with red or orange spots at sides. Pronotum deeply excavated at anterior margins, angles rounded, lateral margins strongly convex; punctuation fine, sparse, homogeneous, surface shiny. Elytra with equal length and width. Elytral punctuation very fine, heterogeneous.

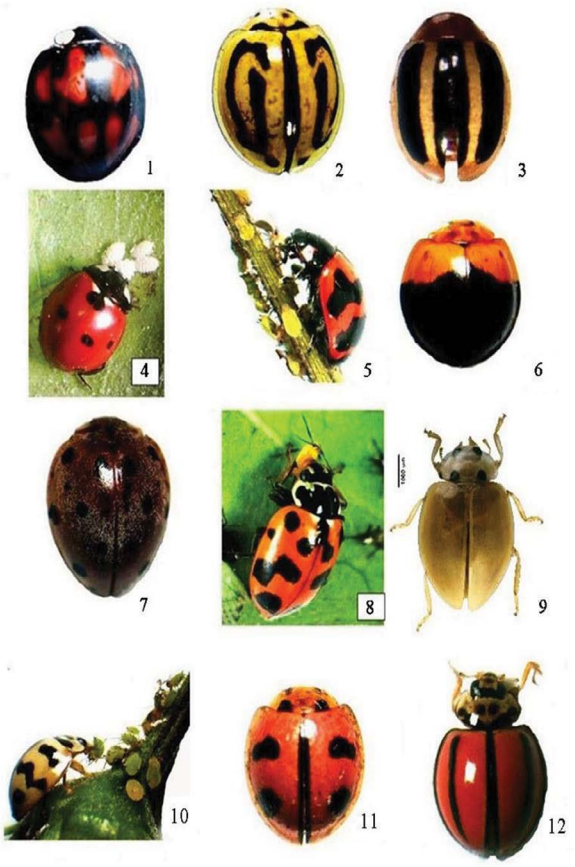

Plate1. Coccinellid beetles from forest ecosystem of Uttarakhand: 1-*Aiolocaria hexaspilota* (Hope), 2-*Anegleis cardoni* (Weise), 3-*Brumoides suturalis* (Fabricius), 4-*Coccinellla septempunctata* Linnaeus, 5-*Coccinella transversalis* Fabricius, 6-*Harmonia dimidiata* (Fabricius), 7-*Henosepilachna vigintioctopunctata* (Fabricius), 8-*Hippodamia variegata* (Goeze), 9-*Illeis confusa* Timberlake, 10-*Menochilus sexmaculatus* (Fabricius), 11-*Micraspis allardi* (Mulsant), 12-*Micraspis univittata* (Hope) continued in plate 2

Habit and habitat: Predatory in nature and observed feeding on aphids on *Quercus leucotrichophora* tree.

2. *Anegleis cardoni* (Weise) (Plate 1.2)

The body size of the beetle 3.50-3.75 mm in length and 3.25-3.50 mm wide. The body shape of beetle rounded, highly convex and ground colour is whitish cream to yellow. Pronotum

contains a pair of triangular dark black markings on posterior border and a pair of small, transverse markings in the middle. A unique morphological characteristic appearance on each elytron with a pair of thin black stripes, outer one anteriorly bent inwards and inner one posteriorly bent out wards and a small circular spot near apex and sutural line with a black stripe, outer margins of elytra very narrowly black, scutellum triangular shape, small and black in colour.

Plate 2. Coccinellid beetles from forest ecosystem of Uttarakhand (Continue): 13-*Oenopia sexareata* (Mulsant), 14-*Platynaspidius saundersi* (Crotch) and 15-*Propylea dissecta* (Mulsant).

Habit and habitat: Predacious on aphids, mealybugs, scale insects, coccids, mites and whiteflies in agro-forestry fields, orchards (*Psidium guajava*), flowers beds and forestry trees (*Populus deltoides* and *Terminalia arjuna*).

3. *Brumoides suturalis* (Fabricius) (Plate 1.3)

Adult beetle is oval, about 4.0 mm long and 2.6 mm broad across the mid elytra, head brown with a pair of prominent black eyes, slightly covered by pronotum when the head is retracted. Elytra are brownish yellow except at their apical, basal and lateral margins. There is one median longitudinal black stripe and one more on sutural line at each elytron.

Habit and habitat: Predatory on scale insects, aphids, psyllids, mealy bugs white flies, and mites in agro-forestry fields, orchards, nurseries, flower beds, plantations and forestry trees, *Bauhinia variegata* and *Dalbergia sissoo*.

4. *Coccinella septempunctata* Linnaeus (Plate 1.4)

Adult beetle's body smooth, oval, moderately convex. Body size of adult beetle about 6.0 mm in length and 5.0 mm in width. The colour is shiny brown or red with smooth elytra. Adult beetle's head black, eyes brown, mouth parts brown, antennae dark brown, pronotum black with two white spots laterally. Elytra with seven spots including one sutural spot i.e. three and a half spots on each elytron.

Habit and habitat: Feeding on different species of aphids, psyllids, mealy bugs white flies, and mites in agro-forestry fields, orchards, nurseries, flower beds, plantations and forestry trees, *Alstonia scholaris, Eucalyptus sp., Shorea robusta, Pinus roxburghii* and *Quercus leucotrichophora.*

5. *Coccinella transversalis* Fabricius (Plate 1.5)

Body size of adult beetle's about 5.5 mm in length and 4.5 mm in width. Females body size comparatively larger than males. Adult's body oval, moderately convex, elytra with one sutural and two triangular sub-humeral spots and four black transverse bands uniting with a black sutural margin. Head broad with a pair of prominent black compound eyes. Pronotum wide and finely punctate.

Habit and habitat: Predatory on aphids, mealy bugs and white flies in agro-forestry areas, orchards, flowers beds and forestry trees, *Populus deltoides, Dillenia indica, Elaeocarpus ganitrus, Eucalyptus sp.* and *Alstonia scholaris.*

6. *Harmonia dimidiata* (Fabricius) (Plate1.6)

The body length of the beetle's measuring 6.0-7.0 mm and width 5.0-6.0 mm. The shape of the beetle's round and broad, strongly convex. The colour of the head was yellow. Elytral pattern variable, posterior two-thirds of elytra black and anterior portion yellowish, with or without humeral black spots.

Habit and habitat: Predatory on aphids, psyllids and small insects in agriculture fields, orchards, flowers beds and forestry trees, *Sapindus mukorossi, Saraca asoca* and *Populus deltoides.*

7. *Henosepilachna vigintioctopunctata* (Fabricius) (Plate 1.7)

Body hemispherical and convex, pubescence whitish, grey except black spots, head reddish brown, eyes black, pronotum reddish brown except for yellowish brown antero–lateral margins, antennae 11 segmented. Females were bigger than males. Adult body size in males 5.5-6.5 mm long and 4.0-5.0 mm wide and female's body size slightly larger, measuring 6.5-7.5 mm long and 4.5-5.5 mm wide.

Habit and habitat: Phytophagous on the plants of family solanaceae. In forestry areas, it has been collected from *Populus deltoides.*

8. *Hippodamia variegata* (Goeze) (Plate1.8)

Body of the adult beetles is smooth oblong, weakly

convex in shape, measuring about 4.0-4.5 mm in length and 2.5-3.0 mm wide. Adult beetle's body reddish brown and head bears a pair of prominent black eyes. Two spots are present towards the anterior portion of the elytra.

Habit and habitat: Predatory on aphids, small insects in agroforestry and forestry areas. Host trees recorded were Dalbergia sissoo, Shorea robusta and Tectona grandis found and feeding on aphids.

9. *Illeis confusa* Timberlake (Plate 1.9)

The body length of the beetle is 4.0-4.5 mm and width 3.0-3.50 mm. Body elongate oval, moderately convex. Head pale to creamy yellow. Eyes separated by a distance of more than one eye width. Pronotum with a pair of median black spots on posterior margin; Anterior and lateral margins transparent, lateral margins slightly upturned. Elytra bright lemon yellow with transparent lateral margins, ventral parts more or less uniformly yellowish.

Habit and habitat: Beetles are usually feeding on various powdery mildews in agro-forestry areas, orchards, flowers bed and also on forestry areas tree species, *Dalbergia sissoo*, *Populus deltoids* and *Ficus benghalensis*.

10. *Menochilus sexmaculatus* (Fabricius) (Plate 1.10)

Adult beetles are about 4.5 mm long and 3.5 mm wide across the middle elytra, head dark brown with a pair of black eyes and brown antennae. Elytra colour of beetle's yellowish with two blank transverse wavy lines and one small round black spot. Polymorphic elytral ground colour varies within species.

Habit and habitat: Predatory on aphids, coccids, scale insects and mealy bugs in agro-forestry, orchards and forestry areas on tree species *Dalbergia sissoo, Tectona grandis, Mangifera indica* and *Morus alba.*

11. *Micraspis allardi* (Mulsant) (Plate 1.11)

The body size of the adult beetles measuring about 4.0-5.0 mm in length and 3.5-4.0 mm in width. Body oval, moderately convex, yellowish white pronotum bear distinct black patches; two small round dot shaped patches towards the proximal end and two almost triangular towards the distal end. There was a curved black line, almost across the mid-dorsal line on each reddish coloured elytron, starting approximately from the proximal end and continuing up to the distal end. A pair of parallel carinae, first abdominal sternite with femoral line incomplete and without an oblique line at each lateral part.

Habit and Habitat: Predatory on aphids and small insects in agro-forestry and forestry areas, recorded on *Populus deltoides, Terminalia arjuna, Bauhinia variegata, Dalbergia sissoo* and *Terminalia chebula.*

12. *Micraspis univittata* (Hope) (Plate1.12)

The beetle rounded shaped medium sized, measuring about 4.5-5.0 mm long and 3.4- 3.8 mm width respectively. The pronotum of the beetle creamish yellow, two dark black spots are visible in the middle of pronotum. Head bears two prominent eyes and a pair of antennae. Elytra with deep reddish in colour with two black lines originated from the posterior end of thorax region and continue as marginal lining along the inner part of each elytron. The whole margin is black in colour. One black horizontal strip is present at central junction in each elytron.

Habit and Habitat: Predatory on small insects in agro-forestry and forestry areas; recorded on *Shorea robusta,Toona ciliata* and *Mallotus philippensis.*

13. *Oenopia sexareata* (Mulsant) (Plate 2.13)

The body size of the adult beetles measuring about 5.5-6.5 mm in length and 5.0-5.5 mm in width. Adult's body oval, moderately convex. The colour of the adult beetle was yellowish red and black with six cells on elytra. The cells divided into two as upper half of with two cells and lower half just one on each elytron, which are diagnostic characteristics of the species.

Habit and habitat: Predatory on aphids and Adelges on forestry trees, *Cedrus deodara* and *Quercus leucotrichophora*.

14. *Platynaspidius saundersi* (Crotch) (Plate 2.14)

The body of the beetle slightly rounded, dark brown in colour and with thin whitish hairs throughout the whole body. The colour of the pronotum and scutellum was black covered with white hairs. Pronotum and elytra contains numerous white dense hairs and elytra contains ten irregular dark black spots, five spots on each elytron and one large on mid dorsal line at junction of elytra.

Habit and habitat: Predatory on aphids and small insects in agro-forestry and forestry areas. Feeding aphids on forest tree species, *Holoptelea integrifolia,Toona ciliata, Mallotus philippensis, Pongamia pinnata* and *Bauhinia variegata.*

15. *Propylea dissecta* (Mulsant) (Plate 2.15)

The body of the beetle oval in shape and weakly convex,

measuring about 4.8-5.2 mm long and 4.2-4.4 mm wide. Prosternum with a pair of parallel carinae. Elytra contain two white patches at proximal end. Adults were bright red colour and elytral ground colour varies within species.

Habit and Habitat: Predatory in nature, aphidophagous, feeding on aphids and other small insects in forest nurseries, orchards, vegetable fields, flower beds and agro-forestry fields on forest tree species *Butea monosperma* and *Mallotus philippensis.*

After field survey, collection, preservation, taxonomic key study, all fifteen coccinellids species were identified as *A. hexaspilota, A. cardoni, B. suturalis, C. septempunctata, C. transversalis, H. dimidiata, H. vigintioctopunctata, H. variegata, I. confusa, M. sexmaculatus, M. allardi, M. univittata, O. sexareata, P. saundersi and P. dissecta.* These coccinellids were collected from Uttarakhand and recorded as biological control agents of insect pests. The coccinellids were mainly recorded from agro-forestry and forestry areas. *H. vigintioctopunctata*, phytophagous, was collected from forest tree, *Populus deltoides* and *I. confusa*, mycophagous in nature was found feeding on powdery mildews occurring on leaves of different forestry trees (Ahmad *et al*., 2001). All other coccinellids are predatory in nature and feeding on white flies, coccids, pseudococcids, soft body insects, jassids, thrips, and aphids on forest tree species, orchards, flowers beds and forest nurseries. Four species: *A. hexaspilota, I. confusa, O. sexareata* and *P. saundersi* have been recorded for the first time from Uttarakhand, India.

CONCLUSION

Collection and identification of coccinellids has been carried out in this study from all districts of Uttarakhand. The results indicated that the species from the family Coccinellidae was abundant and diversified. Almost all the coccinellid species recorded are highly beneficial to forestry ecosystem due to their predatory potential, except one species i.e. *Henosepilachna vigintioctopunctata* which is phytophagous. The feeding nature varies in different species and were documented as either aphidophagous, phytophagous or mycophagous. Various insect pests can cause great loss to plant growth and development and the role of lady bird beetles in insect pest control has been recognized as important component of integrated pest management. After evaluation of predatory potential of coccinellid beetles they may be utilized as biocontrol agents. The diversity of coccinellids in Uttarakhand is rich and conservation of these beetles is also important for their use in future as a natural tool for control of aphids, mealy bugs and others small insect pests, especially in forestry and agro-forestry system.

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