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Biodiversity of Neuroptera associated with aphids of Western Himalaya

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ABSTRACT: In the western Himalayan region 26 species of Neuroptera are associated with aphids. They are distributed under 4 families and 13 genera. The species diversity of Chrysopa was the maximum. Many of the free living larvae of the Neuroptera and adult of some species predate on aphids. Information is given on the altitudinal distribution and the period of occurrence of neuropteran species.

KEYWORDS: Neuroptera, aphid predator, biodiversity, distribution, occurrence

INTRODUCTION

Aphids (Homoptera: Aphididae) are more or less cosmopolitan in distribution and are found in abundance in temperate climate. They attack a wide variety of plants, both cultivated and wild and may feed on roots, stem, leaves, inflorescence, fruits and seeds. The larvae of many species of Neuroptera and adults of some of the species predate on aphids. Because of this, they are often known as 'aphid lion'. The importance of Neuroptera as predators has been overshadowed by greater attention paid to other predators like syrphids and coccinellids (Bodenheimer and Swirski, 1957). Although Neuroptera account for only 5.3% of the total natural enemies used for biological control world wide (Chatterjee, 1997), they have the potential to be more significant in reducing aphid numbers and may become important when other predators are absent or inactive.

Extensive work on the predator-prey relationship of the Neuroptera and aphids has been done abroad while limited work has been reported from India. Some information on this aspect is available from the works of Chatterjee (1934), Ghosh and Sen (1977), Rahman and Khan (1941), Rao (1969), Raychaudhuri *et al.* (1981), Balasubramani and Swamiappan (1994), Bhaktavatsalam *et al.* (1994) and Ghosh (1998). Publications pertaining to Western Himalayan region include Ghosh (1985), Debnath *et al.* (1988), Chakrabarti *et al.* (1991) and Dey and Bhattacharya (1997) and Bhatacharya (2000).

Western Himalaya include the Garhwal and Kumaon range of Uttranchal, India. Collection of Neuroptera specimens were made at different locations of Western Himalaya, from different altitudes. The climatic condition of Western Himalaya is varied. It has a low annual rainfall (100–205 cm) with a considerable variation in outer and inner valleys; high temperature variation, both seasonal and diurnal; strong winds and heavy snowfall. Fluctuation in temperature, humidity, altitudinal zonation, temperature stratification, wind and rainfall determine the flora and fauna of the area. The present study was made during the period from 1994 to 1997 and gives a

comprehensive account of Neuroptera associated with aphids in the Western Himalayan region. Information is also given on their altitudinal distribution and seasonal occurrence.

RESULTS AND DISCUSSION

Members of the three families of the order Neuroptera *viz.*, Chrysopidae (the green lacewings), Coniopteygidae (the dusty wings) and Hemerobiidae (the brown lace wings) and Dilaridae are found to remain closely associated with aphids and prey upon them. The larval instars of three families of Neuroptera (Chysopidae, Coniopterygidae, Hemerobiidae) are found to be active predators, as are some of the adults. Adults of Hemerobiidae are active predator of aphids. Adults of Chrysopidae feed on honeydew and pollen and sometimes on aphids (as seen from gut content examination). They are generally collected from the vicinity of the aphids.

Table 1 gives a list of species of Neuroptera along with their prey aphid and aphid host plants in the Western Himalayan region. Of the 26 species of Neuroptera belonging to four families, majority belong to family Chrysopidae (20 species under 10 genera) followed by Hemerobiidae (four species under two genera). Coniopterygidae and Dilaridae each are represented by single species under single genus. These 26 Neuroptera species predate on 25 aphids which infest 24 plant species comprising of herbs, shrubs and trees. Most of these plants are of economic importance.

TABLE 1. Neuroptera species associated with aphids in Western Himalaya

Neuroptera species	Associated prey aphid	Aphid host plant	Place of occurrence	Altitude (m)	Month of occurrence
Family: Chrysopidae					
Ankylopteryx octopunctata (Fabricius)	*Eriosoma ulmi*	*Ulmus* sp	Almora	1650	May
Chrysopa septempunctata Wesmael	*Pemphigus mordvilkoi* (Cholodkovsky)	*Populous ciliate*	Chowrangikhal	2310	June
	Chaitophorous kapuri Hille Ris Lambers	*Populus ciliata*	Harsil	2620	August
Chrysoperla carnea (Stephens)	*Rhopalosiphum padi* (Linnaeus)	*Triticum aestivum*	Uttarkashi	1158	July
	Betacallis sikkimensis Basu, Ghosh and RayChaudhuri	*Betula alnoides*	Chowrangikhal	2310	August
	Capitophorus formosartemisiae (Takahashi)	*Artemisia vulgaris*	Joshimath	1975	March July–August
	Eriosoma lanigerum (Hausmann)	*Pyrus malus*	Lambagarh	2300	June
	Chaitophorus kapuri Hille Ris Lambers	*Populus ciliata*	Kalimath	1250	July
	Macrosiphoniella kikungshana Takahashi	*Artemisia* sp.	Joshimath	1975	March July–August
	Macrosiphoniella pseudoartemisiae	*Artemisia vulgaris*	Joshimath	1975	March July–August

Neuroptera species	Associated prey aphid	Aphid host plant	Place of occurrence	Altitude (m)	Month of occurrence
	Shinji				
	Macrosiphum miscanthi Takahashi	*Triticum aestivum*	Uttarkashi	1158	April
	Pemphigus siphunculatus Hille Ris Lambers	*Populus ciliata*	Kalimath	1250	July
	Rhopalosiphum maidis (Fitch)	*Triticum aestivum*	Uttarkashi	1158	April
C. gujaratensis Ghosh	*Rhopalosiphum padi* (Linnaeus)	*Triticum vulgaris*	Rishikesh	356	March
C. orestes Banks	*Myzus mumecola* (Matsumura)	*Prunus sp.*	Lanka	2850	May
C. himalayana Ghosh	*Chromaphis hirsutustibis* Kumar and Lavigine	*Juglans regia*	Gobindghat	1829	September
Chrysopidia albolineata (Killington)	*Brevicoryne brassicae* (Linnaeus)	*Brassica campestris*	Bhatwari	1200	April
	Rhopalosiphum padi (Linnaeus)	*Triticum vulgaris*	Joshimath	1975	March July–August
Italochrysa sp.	*Greenidia (Paragreenidia) parthenocissi* Saha and Chakrabarti	*Perthenosisus semicondata*	Osla	2755	June
Mallada alcestes (Banks)	*Betacallis sikkimensis* Basu, Ghosh and RayChaudhuri	*Betula alnoides*	Jangalchatti	3300	August
M. boninensis (Okamotao)	*Greenidea (Trichosiphum) formosana* (Maki)	*Psidium guajava*	Kapkot	660	August
M. sp.	*Chaitophorous kapuri* Hille Ris Lambers	*Populus ciliata*	Dodital	3307	March
M. garhwalensis Ghosh	*Lachnus sp.*	*Cedrus deodara*	Gangotri	3140	October
M. kinnaurensis Ghosh	*Rhopalosiphum maidis* (Fitch)	*Triticum aestivum*	Barkot	1450	March–April
M. murrensis (Tjeder)	*Lachnus sp.*	*Cedrus deodara*	Gongotri	3140	October
M. obvia Hölzel	*Rhopalosiphum maidis* (Fitch)	Wild grass	Joshimath	1975	April
Nothochrysa indigena Needham	*Pemphigus mordvilkoi* (Cholodkovsky)	*Populus ciliata*	Sankri	1800	September
N. lefroyi Needham	*Pemphigus mordvilkoi*	*Populus ciliata*	Nainital	1940	April

Neuroptera species	Associated prey aphid	Aphid host plant	Place of occurrence	Altitude (m)	Month of occurrence
	(Cholodkovsky)				
Retipenna dasyphlebia (McLachlan)	*Betacallis sikkimensis* Basu, Ghosh and RayChaudhuri	*Betula alnoides*	Khati	2210	June
	Eumyzus pruni Chakrabarti and Bhattacharya	*Prunus cornuata*	Lanka	2850	May
R. jubingensis (Hölzel)	*Aphis kuroswai* Takahashi	*Artemisia vulgaris*	Joshimath	1975	June September
	Brevicoryne brassicae (Linnaeus)	*Brassica campestris*	Gobindghat	1829	July
	Chaitophorus kapuri Hille Ris Lambers	*Populus ciliata*	Lambagarh	2300	June–August
	Greenidia (*Trichosiphum*) *formosana* (Maki)	*Psidium guajava*	Kapkot	660	August
	Mollitrichosiphum sp.	*Alnus nepalensis*	Almora	1650	May
	Pmephigus mordvilkoi (Cholodkovsky)	*Populus ciliata*	Kalimath	1250	July
Tumeochrysa indica Needham	*Chaitophorus kapuri* Hille Ris Lambers	*Populus ciliata*	Hanumanchatti	1870	May
Family: Coniopterygidae					
Coniocompsa indica Withycombe	*Chromaphis hirsutastibis* Kumar and Lavigine	*Berberis* sp.	Harsil	2620	September
Family: Dilaridae					
Dilar indicus Kimmins	*Prociphilus himalayensis* Chakrabarti	*Lonicera quinqulolocularis*	Harsil	2620	April–May
	Eirosoma ulmi (Linnaeus)	*Ulmus* sp.	Harsil	2620	April–May
Family: Hemerobiidae					
Hemerobius indicus Kimmins	*Prociphilus himalayensis* Chakrabarti	*Lonicera* sp	Harsil	2620	April
Micromus sp. A	*Rhopalosiphum padi* (Linnaeus)	*Triticum aestivum*	Gongotri	3140	October
	Rhopalosiphum rufiabdominalis (Sasaki)	Helianthus *tuberosus*	Uttarkashi	1158	April
Micromus sp. B	*Betacallis sikkimensis* Basu, Ghosh and RayChaudhuri	*Betulla alnoides*	Chowrangikhal	2310	April

Neuroptera species	Associated prey aphid	Aphid host plant	Place of occurrence	Altitude (m)	Month of occurrence
M. timidus Hagen	*Lipaphis erysimi* (Kaltenbach)	*Raphanus* sp.	Bhatwari	1200	March
	Aphis craccivora Koch	*Cajanus cajan*	Kalimath	1250	June
	Brevicoryne brassicae (Linnaeus)	*Brassica campestris*	Joshimath	1975	June

Altogether, these 26 species of Neuroptera fall under 13 genera. The species diversity of *Mallada* was the maximum (7 species), followed by *Chrysoperla* (4 species) and *Micromus* (3 species). The genera *Nothochrysa*, *Retipenna*, contain two species each, while *Ankylopteryx*, *Chrysopa*, *Italochrysa*, *Coniocompsa*, *Dilar* and *Hemerobius*, *Chrysopidia*, *Cunctochrysa* contain single species each.

Table 1 also provides the list of aphid associated Neuroptera species with their altitudinal distribution and period of occurence in the Western Himalayan region. *Chrysoperla carnea* (Stephens) was found early in the year at Joshimath (1975 msl) during March and at Uttarkashi (1158 msl) during April. At higher altitudes *viz*., Lambagarh (2300 msl) and Chowrangikhal (2310 msl) the same species was found during June and August respectively. *Micromus timidus* Hagen was found in April from Chowrangikhal, situated at a height of 2310 msl. In places of comparatively lower altitude it was found during March from Bhatwari (1200 msl) and during October from Uttarkashi (1158 msl). *Retipenna jubingensis* (Hölzel) was found during the middle of the year from places of both lower and higher altitudes *viz*., from Joshimath (1975 msl) during June–September and from Lambagarh (2300 msl) during June–September. *Hemerobius indicus* Kimmins was found at Harsil (2620 msl) during the month of April whereas *Chrysopa septempunctata* Wesmael was found at Harsil in August. In Uttarkashi (1158 msl) *Micromus sp.* A and *Chrysoperla carnea* (Stephens) were found in April. *Micromus sp.* B was found in Chowrangikhal (2310 msl) during April but *Chrysoperla carnea* (Stephens) was found in the same place during August. Exception to the above pattern of distribution were *Mallada murrensis* (Tjeder) found at Gongotri (3140 msl) in October, *Chrysoperla orestes* Banks found at Trijuginarayan (2215 msl) in April and *Mallada sp.* found at Gongotri (3140 msl) during October.

In the present study it was noted that in general the Hemerobiidae were prevalent during early summer at high altitude but Chrysopidae were scant. As summer progressed the number of chrysopids increased. In low altitude, where temperature was comparatively higher, both families were found during early summer. The results indicate that the distribution of Neuroptera species at different altitudes depends on the temperature and season.

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