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CHECKLIST OF APHIDOPHAGOUS NEUROPTERA (INSECTA: ORTHOPTERA) IN INDIA

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Abstract: The article deals with the record of aphidophagous lacewings (Neuroptera) in India. Data reveals 32 species of lacewings are aphidophagous in India belonging to 4 families, Chrysopidae being the largest one comprising 24 species under 11 genera followed by Hemerobiidae (6 species in 2 genera) and Dilaridae and Coniopterygidae (one species each) preying on 68 species of aphids belonging to 37 genera associated with 107 species of plants distributed in 23 states/union territories of India. A maximum of 24 species were recorded from Uttarakhand followed by 9 species each from Karnataka and West Bengal, 6 species from Himachal Pradesh, 5 species from Maharashtra, and less than 5 species were recorded from other states/union territories. Out of 32 species of aphidophagous lacewings recorded from India, only *Chrysoperla zastrowi sillemi* (Esben-Petersen, 1935) is considerably widely distributed in 21 states/union territories preying on 42 species of aphids infesting 76 species of plants, mostly crops followed by *Micromus timidus* Hagen, 1853 which preys on 17 species of aphids infesting 23 food plants distributed in 11 states/union territories of India. Hence, extensive surveys for these lacewings are required throughout the country particularly in agroecosystem to establish their relationship with aphid preys on different crops.

Keywords: Aphid, Aphidophagous lacewings, Biocontrol, Chrysopidae, Neuroptera.

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INTRODUCTION

The aphids (Hemiptera: Aphididae) are soft-bodied plant sap-sucking insects infesting almost all parts of several species of plants. Globally, more than 250 species of aphids are notorious pests of both agricultural and horticultural crops (Singh and Singh, 2016). Sometimes, the damage in some crops is to the extent that nothing remains to harvest, particularly in the case of some cereals, potatoes and mustard. There are a number of unique features that contribute to their success such as polyphagy, peculiar mode of reproduction, development, and polymorphism. According to the climatic conditions and availability of food plants, they may reproduce either by parthenogenesis, zygogenesis, or

pedogenesis. They may either be oviparous or viviparous or both (Singh and Singh, 2022).

Neuroptera is an order of holometabolous insects comprising lacewings, mantidflies, antlions and their relatives. Class Insecta is the largest class of Animals that occupy all the three types of habitats (Verma and Prakash, 2020). They are globally distributed and in general, mostly are carnivorous feeding on soft-bodied insects, however, excessive anthropogenic activities and pollution badly affect the disrtribution (Prakash and Verma, 2022; Singh *et al.,* 2023). The larvae of four families of Neuroptera are aphidophagous in India include (1) Chrysopidae (the green lacewings, commonly known as aphid-lion), (2) Coniopterygidae (the dusty wings), (3) Dilaridae (pleasing lacewings) and (4) Hemerobiidae (the brown lacewings). Members of some Neuroptera are also parasitic parasitising the egg capsules of some spiders. The elongated mandibles of the aphidophagous neuropteran larvae are adapted to pierce and suck the body fluid of the aphids so that the aphids die. Because of this, Neuroptera, especially the green and brown lacewings, are generally considered as major components of beneficial insect fauna in agroecosystems (Devetak and Klokočovnik, 2016). Among these, several species of two orders, Chrysopidae (larvae) and Hemerobiidae (larvae and adult both) are aphidophagous. However, the importance of Chrysopidae and Hemerobiidae as predators of aphids has been overshadowed by greater attention paid to more abundant aphid predators such as syrphids (hover flies) and coccinellids (ladybird beetles). Moreover, green lacewings, particularly members of the genera *Chrysoperla*, and *Mallada* (Chrysopidae), and brown lacewings, particularly *Micromus* (Hemerobiidae) are major biocontrol agents of aphids among Neuroptera and have been used against aphids and other soft-bodied insect pests in several parts of the world (Abd-Rabou, 2008; Pappas *et al*., 2011; Nair *et al*., 2020).

For the proper sustainable management and conservation of biodiversity of the animal species of any region of the world, their proper documentation is vital as it helps in monitoring their conservation (Ashok, 2016). Preparation of checklist of species is an essential component of systematic documentation. Hence, in view of increasing intensity of anthropogenic threats to the biodiversity, a cataloguing and appropriate documentation of biodiversity is desirable. So far, no complete checklist of the aphidophagous fauna of Neuroptera along with their aphid prey, food plants and distribution is available in India, hence, this checklist is prepared.

MATRIALS AND METHODS

The present checklist is based on the published literature on aphidophagous Neuroptera, e.g. books, book chapters, journals, proceedings of conferences, Records and Fauna Series of the Zoological Survey of India, Kolkata, and a few authentic theses up to May 31, 2024. In most of the recent past literature, there are several errors in the scientific names of the insects both predatory (Neuroptera), as well as prey (aphids) and food plants because of their modified status and other nomenclatural decisions and clarification. The names of aphids, as well as plants that were misspelt in the original records have been corrected where we logically ascertain the intended species. In the present checklist, attempts have been made to provide the valid scientific names of the predators following GBIF (2024), aphids following Favret (2024), and of the plants, following (WFO, 2024). For synonymy of valid species, above references should be consulted.

RESULTS AND DISCUSSION

The data demonstrates that a total of 32 species of Neuroptera are aphidophagous in India belonging to 4 families, Chrysopidae being the largest one comprising 24 species under 11 genera followed by Hemerobiidae (6 species in 2 genera) and Dilaridae and Coniopterygidae (one species each) preying on 68 species of aphids belonging to 37 genera associated with 107 species of plants belonging to 80 genera in 23 states of India (Figure 1).

In India, the aphidophagous Neuroptera are distributed only in 23 states/union territories. A maximum of 24 species were recorded from Uttarakhand followed by 9 species each from Karnataka and West Bengal, 6 species from

Himachal Pradesh, 5 species from Maharashtra, and less than 5 species were recorded from other states/union territories (Figure 1). No species of these lacewings is recorded from Arunachal Pradesh, Bihar, Chhattisgarh, Jharkhand, Ladakh, Meghalaya, Mizoram, Sikkim and Tripura. Indeed, no survey was conducted in these regions and hence, it requires an extensive survey in these areas. Most of the surveys were conducted in Uttarakhand, West Bengal, Karnataka and Himachal Pradesh.

Out of 32 species of aphidophagous lacewings recorded from India, only *Chrysoperla zastrowi sillemi* (Esben-Petersen, 1935) is considerably widely distributed in 21 states/union territories. Hence, extensive surveys for these lacewings are required throughout the country particularly in agroecosystem to establish their relationship with aphid preys on different crops. Following is the detailed list of these lacewings along with their aphid preys and food plants recorded from different states/union territories of India.

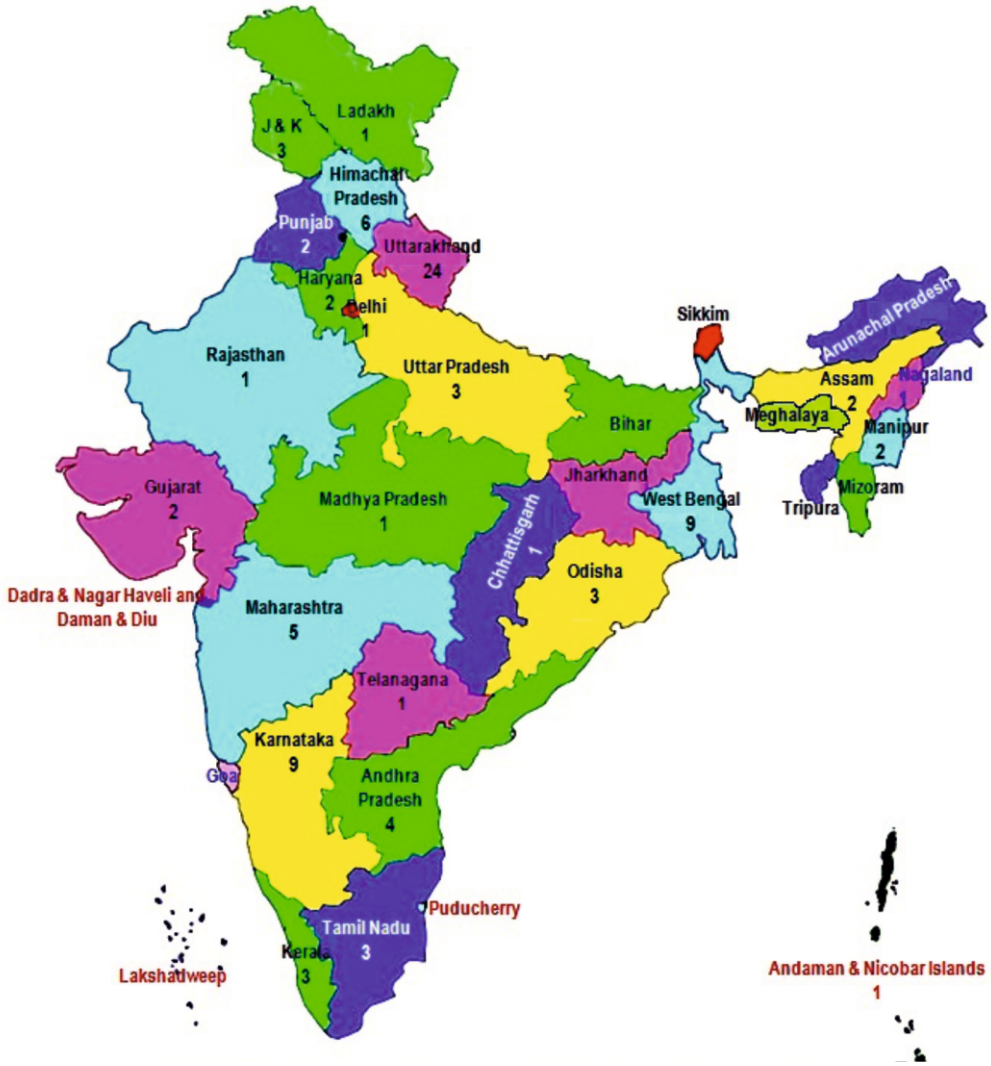

Fig. 1: Map showing the distribution of aphidophagous lacewings (Neuroptera) in India.

Checklist of aphidophagous lacewings along with their prey aphid species infesting food plants in different states of India are as under:

A. Family: Coniopterygidae

The family includes only a single species of aphidophagous species, *Coniocompsa indica* Withycombe, 1925 feeding on two identified and one unidentified species of aphids associated with 4 food plants distributed in 3 Indian states as mentioned below:

1. *Coniocompsa indica* Withycombe, 1925
- *Chromaphis hirsutustibis* Kumar and Lavigne, 1970
  - *Berberis* sp. - Uttarakhand (Dey, 2015)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Himachal Pradesh (Rahman, 1940)
- **Unidentified aphids**
  - *Artocarpus heterophyllus* Lam. - West Bengal (Ghosh and Maulik, 1985)
  - *Mangifera indica* L. - West Bengal (Ghosh and Maulik, 1985)

B. Family: Dilaridae

This family also includes only a single species of aphidophagous species, *Dilar indicus* Monserrat, 1989 feeding on two species of aphids associated with 2 different food plants distributed only in Uttarakhand as mentioned below:

1. *Dilar indicus* Monserrat, 1989
- *Eriosoma ulmi* (Linnaeus, 1758)
  - *Ulmus* sp. - Uttarakhand (Dey, 2015)
- *Prociphilus (Stagona) himalayaensis* Chakrabarti, 1976
  - *Lonicera quinquelocularis* Hardw. - Uttarakhand (Dey, 2015)

C. Family: Chrysopidae

This is the largest family, members are commonly known as green lacewings or aphid lion. In India, it comprises 24 aphidophagous species belonging to 10 genera. All these species prey upon 55 species of aphids infesting 84 species of food plants distributed in 22 states/union territories in India, maximally 48 predator-prey-food plant triplets in Uttarakhand followed by 39 triplets in Jammu & Kashmir as mentioned below:

1. *Ankylopteryx octopunctata* (Fabricius, 1793)
- *Aphis (Aphis) craccivora* Koch, 1854
  - *Psophocarpus tetragonolobus* (L.) DC. - Kerala (Thamilvel, 2009)
  - *Vigna unguiculata* (L.) Walp. (syn. *Vigna catjang* (Burm.f.) Walp.) - Kerala (Thamilvel, 2009)
- ***Aphis (Aphis) gossypii* Glover, 1877**
  - *Abelmoschus esculentus* Moench - Kerala (Thamilvel, 2009)
  - *Capsicum annuum* L. - Kerala (Thamilvel, 2009)
  - *Solanum melongena* L. - Kerala (Thamilvel, 2009)
- ***Eriosoma ulmi* (Linnaeus, 1758)**
  - *Ulmus* sp. - Uttarakhand (Dey, 2015)

2. *Brinckochrysa scelestes* (Banks, 1911)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus sylvestris* (L.) Mill. - Himachal Pradesh (Thakur *et al*., 1988)
- *Myzus (Nectarosiphon) persicae nicotianae* Blackman, 1987
  - *Nicotiana tabacum* L. - Andhra Pradesh (Rao and Chandra, 1984)

3. *Chrysopa himalayana* Ghosh, 1985
- *Chromaphis hirsutustibis* Kumar and Lavigne, 1970
  - *Juglans regia* L.- Uttarakhand (Debnath *et al*., 1988)

4. *Chrysopa pallens* (Rambur, 1838) [syn. *Chrysopa septempunctata* Wesmael, 1841]
- *Aphis (Aphis) craccivora* Koch, 1854
  - *Vicia faba* L. - Himachal Pradesh (Poddar, 1982)
- *Aphis (Aphis) gossypii* Glover, 1877
  - Unidentified - Himachal Pradesh (Das and Raychaudhuri, 1983)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica oleracea* (L.) Czern. - West Bengal (Dey and De, 2018)
- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Dey, 2015)
- *Myzus (Myzus) ornatus* (Laing, 1932)
  - Unidentified - Himachal Pradesh (Das and Raychaudhuri, 1983)
- *Pemphigus (Pemphigus) mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Dey, 2015)

5. *Chrysopa* sp.
- *Aphis (Aphis) gossypii* Glover, 1877
  - *Solanum melongena* L. - West Bengal (Satpathi, 1999)

- *Gossypium hirsutum* L. - Haryana (Butani, 1971) - Telangana (Mallesh and Sravanthy, 2021)

- *Aphis (Aphis) punicae* Passerini, 1863
  - *Punica granatum* L. - Karnataka (Sreedevi, 2003)
- *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843)
  - *Prunus amygdalus* Batsch - Himachal Pradesh (Bhardwaj, 1991)
- *Ceratovacuna lanigera* Zehntner, 1897
  - *Saccharum officinarum* L.- Nagaland (Tripathi, 1995)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus sylvestris* (L.) Mill. - Himachal Pradesh (Thakur & Pawar, 1986)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843)
  - *Brassica nigra* (L.) W.D.J. Koch - West Bengal (Ghosh *et al*., 1981)
- *Sitobion (Sitobion) rosaeiformis* (Das, 1918)
  - *Rosa bourboniana* L. - Himachal Pradesh (Kakar and Sood, 1989)

6. ***Chrysoperla orestes*** **(Banks, 1911) [syn. *Chrysopa orestes* Banks, 1911]**
   - *Aphis (Aphis) gossypii* Glover, 1877
     - *Solanum melongena* L. - Jammu and Kashmir (Bhagat and Masoodi, 1985)
   - *Aphis (Aphis) pomi* De Geer, 1773
     - *Malus domestica* (Suckow) Borkh. - Jammu and Kashmir (Bhagat & Masoodi, 1985)
   - *Melanaphis sacchari* (Zehntner, 1897)
     - *Sorghum bicolor* (L.) Moench - Odisha (Patnaik *et al*., 1977)
     - *Zea mays* L. - Odisha (Patnaik *et al*., 1977)

7. ***Chrysoperla zastrowi sillemi*** **(Esben-Petersen, 1935) [syn. *Chrysopa gujaratensis* Ghosh, 1976; *Chrysopa punensis* Ghosh, 1976; *Chrysopa sanandensis* Ghosh, 1977*; Chrysopa sillemi* Esben-Petersen, 1935; *Chrysoperla carnea* - group (recorded in India); *Chrysoperla gujaratensis* (Ghosh, 1976); *Chrysoperla punensis* (Ghosh, 1976); *Chrysoperla sanandensis* (Ghosh, 1977); *Chrysoperla sillemi* (Esben-Petersen, 1935); *Chrysoperla zastrowi arabica* Henry *et al*., 2006]**
   - *Acyrthosiphon (Acyrthosiphon) pisum* (Harris, 1776)
     - *Medicago sativa* L. - Gujarat (Ingawale and Tambe, 2007); - Maharashtra (Tambe and Kadam, 2015)
     - *Pisum sativum* L. - Jammu and Kashmir (Bhat, 2008)
   - *Acyrthosiphon (Acyrthosiphon) rubi* (Narzikulov, 1957)
     - *Rubus fruticosus* Lour. - Jammu and Kashmir (Khan and Shah, 2017)
   - *Aphis (Aphis) craccivora* Koch, 1854
     - *Arachis hypogaea* L. - Gujarat (Patel *et al*., 1976); - Tamil Nadu (Saminathan *et al*., 1999, 2003)
     - *Cajanus cajan* (L.) Millsp. - Uttar Pradesh (Tiwari *et al*., 2024)
     - *Gossypium hirsutum* L. - Punjab (Kumar *et al*., 2019)
     - *Lablab purpureus* (L.) Sweet ssp. *purpureus* - Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari *et al*., 2024)
     - *Medicago sativa* L. - Maharashtra (Tambe and Kadam, 2015)
     - *Psophocarpus tetragonolobus* (L.) DC. - Kerala (Thamilvel, 2009)
     - *Vicia faba* L. - Gujarat (Chakraborty and Korat, 2010)
     - *Vigna unguiculata* (L.) Walp. - Andhra Pradesh (Sreemohan Reddy *et al*., 2022); - Jammu and Kashmir (Mushtaq and Khan, 2010a); - Kerala (Thamilvel, 2009) - Maharashtra (Mounika *et al*., 2021); - Odisha (Patro and Behera, 2002); -Rajasthan (Naruka and Ameta, 2015); - Tamil Nadu (Saminathan *et al*., 1999, 2003); - Telangana (Sheileja *et al*., 2022); - Uttar Pradesh (Satpathy *et al*., 2012;)
     - Unknown - Uttar Pradesh (Singh *et al*., 2024)
   - *Aphis (Aphis) gossypii* Glover, 1877
     - *Abelmoschus esculentus* (L.) Moench -

Kerala (Thamilvel, 2009); - Madhya Pradesh (Shukla, 2014); - Tamil Nadu (Saminathan *et al*., 1999, 2003)

- *Capsicum annuum* L. – Karnataka (Jambagi *et al*., 2021); - Kerala (Thamilvel, 2009)
- *Catharanthus roseus* (L.) G. Don - Kerala (Thamilvel, 2009)
- *Cucumis sativus* L. - Himachal Pradesh (Kumari *et al*., 2020)
- *Cucurbita maxima* Duchesne - Jammu and Kashmir (Bhat, 2008); - Uttar Pradesh (Tiwari et al., 2024)
- *Fagopyrum esculentum* Moench - Gujarat (Bhat *et al*., 1986)
- *Fagopyrum kashmirianum* Munshi - Gujarat (Bhat *et al*., 1986)
- *Fagopyrum tataricum* (L.) Gaertn. - Gujarat (Bhat *et al*., 1986)
- *Gossypium herbaceum* L. - Gujarat (Butani and Kapadia, 2000)
- *Gossypium hirsutum* L. - Gujarat (Chakraborty and Korat, 2010); - Haryana (Kumar *et al*., 2016); - Karnataka (Manjunatha *et al*., 2018); - Maharashtra (Vennila *et al*., 2007; Mounika *et al*., 2021); - Odisha (Bhattacharyya *et al*., 2019); - Punjab (Kumar *et al*., 2019); - Rajasthan (Dhaka, 2013; Naruka and Ameta, 2015); - Tamil Nadu (Saminathan *et al*., 1999, 2003); - Telangana (Sheileja *et al*., 2022)
- *Luffa aegyptiaca* Mill. - Uttar Pradesh (Chaudhary and Singh, 2012)
- *Momordica charantia* L. - Kerala (Thamilvel, 2009)
- *Psidium guajava* L. - Tamil Nadu (Saminathan *et al*., 1999, 2003)
- *Solanum melongena* L. - Assam (Borkakati *et al*., 2019); -Jammu and Kashmir (Bhat, 2008); - Kerala (Thamilvel, 2009); - Madhya Pradesh (Kumar & Chandra, 2015); - Punjab (Shankar and Tripathi, 2021); - Uttar Pradesh (Singh, 2023; Tiwari *et al*., 2024)
- *Vicia faba* L. - Uttar Pradesh (Tiwari *et al*., 2024)
- Unknown - Uttar Pradesh (Singh *et al*., 2024)

- *Aphis (Aphis) nerii* Boyer de Fonsc., 1841
  - *Calotropis procera* (Aiton) Dryand. - Gujarat (Chakraborty and Korat, 2010); - Rajasthan (Naruka and Ameta, 2015)
- *Aphis (Aphis) pomi* De Geer, 1773
  - *Cissampelos glaberrima* A.St.-Hil. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Lablab purpureus* (L.) Sweet ssp. *purpureus* - Jammu and Kashmir (Khan and Shah, 2017)
  - *Malus domestica* (Suckow) Borkh. - Jammu and Kashmir (Mushtaq and Khan, 2010a; Khan and Shah, 2018)
- *Aphis (Aphis) punicae* Passerini, 1863
  - *Punica granatum* L. - Tamil Nadu (Elango and Sridharan, 2018)
- *Aphis (Aphis) solanella* Theobald, 1914
  - *Euonymus fortunei* (Turcz.) Hand.-Mazz. - Jammu and Kashmir (Khan and Zaki, 2008; Bhagat, 2013)
- *Aphis (Aphis) spiraecola* Patch, 1914
  - *Cosmos bipinnatus* Cav. - Delhi (Halder & Rai, 2016); - Uttar Pradesh (Dubey and Singh, 2011; Tiwari *et al*., 2024)
  - *Cucumis sativus* L. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Malus domestica* (Suckow) Borkh. - Jammu and Kashmir (Khan and Shah, 2017)
- *Betacallis sikkimensis* Basu, Ghosh and Raychaudhuri, 1974
  - *Betula alnoides* Buch.-Ham. - Uttarakhand (Dey, 2015)
- *Brachycaudus (Brachycaudus) helichrysi* (Kaltenbach, 1843)
  - *Brassica oleracea* (L.) Czern. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Erigeron canadensis* L. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Kleinia grandiflora* (Wall. ex DC.) N.Rani - Jammu and Kashmir (Khan and Shah, 2017)

- *Brachycaudus rumexicolens* (Patch, 1917)
  - *Rumex* sp. - Jammu and Kashmir (Khan and Shah, 2017)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Uttarakhand (Verma *et al*., 2023)
  - *Brassica oleracea* L. - Gujarat (Chakraborty and Korat, 2010); - Jammu and Kashmir (Bhat, 2008; Mushtaq and Khan, 2010b); - Himachal Pradesh (Sharma *et al*., 2020; Chandana *et al*., 2023)- Odisha (Mandal and Patnaik, 2006a)
  - *Brassica oleracea* L. var. *capitata* - Gujarat (Chaudhari *et al*., 2022); - Himachal Pradesh (Sree Chandana *et al*., 2020); - Maharashtra (Mounika *et al*., 2021); - Uttar Pradesh (Pal & Singh, 2012; Satpathy *et al*., 2012)
  - *Descurainia* sp. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Malus domestica* (Suckow) Borkh. - Jammu and Kashmir (Khan and Shah, 2017)
  - Unknown - Uttar Pradesh (Singh *et al*., 2024)
- *Capitophorus formosartemisiae* (Takahashi, 1921)
  - *Artemisia vulgaris* L. - Uttarakhand (Dey, 2015)
  - *Artemisia* sp. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Cajanus cajan* (L.) Millsp. - West Bengal (Dey and De, 2018)
- *Ceratovacuna lanigera* Zehntner, 1897
  - *Saccharum officinarum* L. - Assam (Sarma *et al*., 2007)
- *Chromaphis juglandicola* (Kaltenbach, 1843)
  - *Juglans regia* L. - Jammu and Kashmir (Khan and Shah, 2017)
- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Dey, 2015)
- *Ceratovacuna lanigera* Zehntner, 1897
  - *Saccharum officinarum* L.- Maharashtra (Rabindra *et al*., 2002)
- *Dysaphis* sp.
  - *Malus domestica* (Suckow) Borkh. - Ladakh (Pawar and Parry, 1989)
- *Eriosoma lanigerum* (Hausmann, 1802)
  - *Malus domestica* (Suckow) Borkh. - Himachal Pradesh (Thakur *et al*., 1988); -Jammu and Kashmir (Wani and Masoodi, 2001; Rasool *et al*., 2019); - Uttarakhand (Maurya, 2011)
- *Hyadaphis coriandri* (Das, 1918)
  - *Coriandrum sativum* L. - Haryana (Purti *et al*., 2017); - Gujarat (Chaudhari *et al*., 2022); - Punjab (Sagar and Kumar, 1996); - Rajasthan (Kant *et al*., 2019)
- *Hyalopterus gracilis* (Walker, 1852)
  - *Prunus* sp. - Jammu and Kashmir (Bhagat and Masoodi, 1988)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843)
  - *Brassica carinata* A. Braun - Punjab (Kumar, 2015)
  - *Brassica juncea* (L.) Czern. - Assam (Pradhan *et al*., 2020b); - Gujarat (Chakraborty and Korat, 2010); - Haryana (Kalra, 1988); - Punjab (Soni *et al*., 2004; Belagalla *et al*., 2024); - Rajasthan (Naruka and Ameta, 2015); -Uttarakhand (Verma *et al*., 2023); - West Bengal (Ghosh, 1983)
  - *Brassica napus* L. - Punjab (Kumar, 2015)
  - *Brassica nigra* (L.) W.D.J. Koch - Uttar Pradesh (Tiwari *et al*., 2024)
  - *Brassica oleracea* L. - Chhattisgarh (Singh, 2014); - Maharashtra (Shaikh *et* al., 2020); - Odisha (Mandal and Patnaik, 2006b); - Uttar Pradesh (Tiwari *et al*., 2024)
  - *Brassica rapa* L. Delhi (Kaushik and Shankarganesh, 2009); - Gujarat (Chaudhari *et al*., 2022); - Maharashtra (Shaikh *et al*., 2020); - Punjab (Kumar, 2015); - Rajasthan (Singh & Meghwal, 2010); - Uttar Pradesh (Singh and Kumar, 2000; Tiwari *et al*., 2024); - Telangana (Sheileja *et al*., 2022); - Uttarakhand (Joshi & Sharma, 2008)

- *Eruca vesicaria* (L.) Cav. - Punjab (Kumar, 2015)
- *Raphanus sativus* L. - Maharashtra (Shaikh *et al*., 2020)
- Unknown - Uttar Pradesh (Singh *et al*., 2024)

- *Lipaphis (Lipaphis) pseudobrassicae* (Davis, 1914)
  - *Brassica juncea* (L.) Czern. - Jammu and Kashmir (Khan and Shah, 2017)
- *Macrosiphoniella (Macrosiphoniella) formosartemisiae* Takahashi, 1921
  - *Arachis hypogaea* L. - West Bengal (Dey and De, 2018)
- *Macrosiphoniella (Macrosiphoniella) kikungshana* Takahashi, 1937
  - *Artemisia* sp. - Uttarakhand (Dey, 2015)
- *Macrosiphoniella (Macrosiphoniella) pseudoartemisiae* Shinji, 1933
  - *Artemisia vulgaris* L. - Uttarakhand (Dey, 2015)
- *Macrosiphoniella (Macrosiphoniella) yomogifoliae* (Shinji, 1924)
  - *Artemisia* sp. - Jammu and Kashmir (Khan and Shah, 2017)
- *Macrosiphum (Macrosiphum) rosae* (Linnaeus, 1758)
  - *Brassica juncea* (L.) Czern. - Uttarakhand (Verma *et al*., 2023)
- *Myzus (Myzus) mumecola* (Matsumura, 1917)
  - *Prunus* sp. - Uttarakhand (Dey, 2015)
- *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)
  - *Abelmoschus esculentus* (L.) Moench - Jammu and Kashmir (Khan and Shah, 2017)
  - *Brassica juncea* (L.) Czern. - Maharashtra (Bhandare, 2022)
  - *Brassica oleracea* L. - Chhattisgarh (Singh, 2014); - Himachal Pradesh (Sharma *et al*., 2020); - Madhya Pradesh (Kumar & Chandra, 2015); - Maharashtra (Bhandare, 2022); - Odisha (Mandal and Patnaik, 2006a)
  - *Brassica rapa* L. - Maharashtra (Bhandare, 2022); Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari *et al*., 2024)
  - *Capsella bursa-pastoris* (L.) Medik. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Capsicum annuum* L. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Capsicum frutescens* L. - Uttar Pradesh (Tiwari *et al*., 2024)
  - *Raphanus sativus* L. - Maharashtra (Bhandare, 2022)
  - *Sesamum indicum* L. - Odisha (Padhy *et al*., 2020)
  - *Solanum lycopersicum* L. - Jammu and Kashmir (Khan and Shah, 2017); - Punjab (Nair *et al*., 2020)
  - *Solanum melongena* L. - Jammu and Kashmir (Khan and Shah, 2017); - Maharashtra (Bhandare, 2022); - Uttar Pradesh (Tiwari *et al*., 2024)
  - *Solanum nigrum* L. - Jammu and Kashmir (Khan and Shah, 2017) - Maharashtra (Bhandare, 2022);
  - *Solanum tuberosum* L. - Jammu and Kashmir (Khan and Shah, 2017); - Maharashtra (Bhandare, 2022);
  - Unknown - Uttar Pradesh (Singh *et al*., 2024)
- *Myzus (Nectarosiphon) persicae nicotianae* Blackman, 1987
  - *Nicotiana rustica* L. - Andhra Pradesh (Rao *et al*., 2008)
  - *Nicotiana tabacum* L. - Andhra Pradesh (Rao *et al*., 2008); - Karnataka (Jagadish and Jayaramaiah, 2004; Jagadish *et al*., 2010); - Maharashtra (Bhandare, 2022);
- *Panaphis juglandis* (Goeze, 1778)
  - *Juglans regia* L. - Jammu and Kashmir (Khan and Shah, 2017)
- *Pemphigus (Pemphigus) siphunculatus* Hille Ris Lambers, 1973
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Dey, 2015)
- *Pterochloroides persicae* (Cholodkovsky, 1898)

- *Prunus persica* L. - Jammu and Kashmir (Khan and Shah, 2017)

- *Pyrolachnus pyri* (Buckton, 1899)
  - *Malus domestica* (Suckow) Borkh. - Jammu and Kashmir (Khan and Shah, 2017)
  - *Prunus armeniaca* L. - Jammu and Kashmir (Khan and Shah, 2017)

- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Cenchrus americanus* (L.) Morrone - Karnataka (Savithri & Prakash, 2023)
  - *Hordeum vulgare* L. - Rajasthan (Naruka and Ameta, 2015)
  - *Triticum aestivum* L. - Uttarakhand (Dey, 2015); - West Bengal (Dey and De, 2018)
  - *Zea mays* L. - Gujarat (Patel, 1998); - Telangana (Sheileja *et al*., 2022)
  - Unknown - Uttar Pradesh (Singh *et al*., 2024)

- *Rhopalosiphum padi* (Linnaeus, 1758)
  - *Avena sativa* L. - Maharashtra (Gaikwad *et al*., 1921)
  - *Triticum aestivum* L. - Uttarakhand (Dey, 2015); - West Bengal (Dey, 2015; Dey and De, 2018)

- *Sitobion (Sitobion) miscanthi* (Takahashi, 1921)
  - *Lens culinaris* Medik. - West Bengal (Dey and De, 2018)
  - *Triticum aestivum* L. - Uttarakhand (Dey, 2015)
  - *Vigna mungo* (L.) Hepper - West Bengal (Dey and De, 2018)

- *Therioaphis trifolii trifolii* (Monell, 1882)
  - *Medicago sativa* L. - Maharashtra (Tambe and Kadam, 2015)

- *Tinocallis* sp.
  - *Ulmus* sp. - Jammu and Kashmir (Khan and Shah, 2017)

- *Trama (Neotrama) penecaeca* (Stroyan, 1964)
  - *Helianthus tuberosus* L. - Jammu and Kashmir (Khan and Shah, 2017)

- *Uroleucon (Uromelan) compositae* (Theobald, 1915)
  - *Carthamus tinctorius* L. - Gujarat (Chakraborty and Korat, 2010); - Maharashtra (Mounika *et al*., 2021)
  - *Gaillardia pulchella* Foug. - Gujarat (Bhatt *et al*., 2007)

- Unidentified aphid
  - *Moringa oleifera* Lam. - Karnataka (Math *et al*., 2013)

8. *Chrysoperla* sp.

- *Aphis (Aphis) craccivora* Koch, 1854
  - *Vigna unguiculata* (L.) Walp. - Madhya Pradesh (Kumar & Chandra, 2015)

- *Aphis (Aphis) gossypii* Glover, 1877
  - *Gossypium hirsutum* L. - Maharashtra (Kale *et al*., 2020)
  - *Tectona grandis* L.f. - Chhattisgarh (Harinkhere *et al*., 2013)

- *Aphis (Toxoptera) citricidus* (Kirkaldy, 1907)
  - *Citrus* sp. - Maharashtra (Kale *et al*., 2020)

- *Ceratovacuna lanigera* Zehntner, 1897
  - *Saccharum officinarum* L. - Karnataka (Patil *et al*., 2006)

- *Myzus (Nectarosiphon) persicae nicotianae* Blackman, 1987
  - *Nicotiana tabacum* L. - Andhra Pradesh (Sitaramaiah *et al*., 2001)

- *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)
  - *Raphanus sativus* L. - Madhya Pradesh (Kumar & Chandra, 2015)

- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Sorghum bicolor* (L.) Moench - Maharashtra (Kale *et al*., 2020)

- *Uroleucon (Uromelan) compositae* (Theobald, 1915)
  - *Carthamus tinctorius* L. - Maharashtra (Kale *et al*., 2020); - Karnataka (Mallapur *et al*., 2002)

9. *Cunctochrysa albolineata* (Killington, 1935)

- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica rapa* L. -West Bengal (Dey and De, 2018); - Uttarakhand (Dey, 2015)

- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Triticum aestivum* L. - West Bengal (Dey and De, 2018)

- *Rhopalosiphum padi* (Linnaeus, 1758)
  - *Triticum aestivum* L. - Uttarakhand (Dey, 2015)

10. *Cunctochrysa jubingensis* (Hölzel, 1973) [syn. *Retipenna jubingensis* (Hölzel, 1973)]

- *Aphis (Aphis) kurosawai* Takahashi, 1921
  - *Artemisia absinthium* L. - Uttarakhand (Chakrabarti *et al*., 1991)
  - *Artemisia vulgaris* L. - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica oleracea* L. - West Bengal (Dey, 2014)
  - *Brassica rapa* L. - Uttarakhand (Chakrabarti *et al*., 1991; Bhattacharya and Dey, 2002)
- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)
  - *Populus* sp. - Uttarakhand (Chakrabarti *et al*., 1991)
- *Greenidea (Trichosiphum) psidii* van der Goot, 1917
  - *Psidium guajava* L. - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)
- *Mollitrichosiphum* sp.
  - *Alnus nepalensis* D. Don - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)
  - *Alnus* sp. - Uttarakhand (Chakrabarti *et al*., 1990)
- *Pemphigus (Pemphigus) mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)
  - *Populus* sp. - Uttarakhand (Chakrabarti *et al*., 1991)

11. *Italochrysa aequalis* (Walker, 1853)

- *Greenidea (Paragreenidea) parthenocissi* Saha and Chakrabarti, 1988
  - *Parthenocissus semicordata* Planch - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)
- *Greenidea* sp.
  - *Parthenocissus semicordata* Planch - Uttarakhand (Debnath, 1991)

12. *Italochrysa lefroyi* (Needham, 1909) [syn. *Nothochrysa lefroyi* Needham, 1909]

- *Pemphigus (Pemphigus) mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Dey, 2015)

13. *Mallada basalis* (Walker, 1853)

- *Aphis (Aphis) gossypii* Glover, 1877
  - *Solanum melongena* L. - Punjab (Shankar and Tripathi, 2021)

14. *Mallada desjardinsi* (Navás, 1911) [syn. *Anisochrysa boninensis (*Okamoto, 1914); *Mallada boninensis* (Okamoto, 1914)]

- *Aphis (Aphis) craccivora* Koch, 1854
  - *Lablab purpureus* (L.) Sweet ssp. *purpureus* - Gujarat (Nehare *et al*., 2004)
  - *Vigna unguiculata* (L.) Walp. - Maharashtra (Nagamallikadevi *et al*., 2013); - Tamil Nadu (Guntupalli, 2014)
- *Aphis (Aphis) gossypii* Glover, 1877
  - *Cucumis sativus* L. - Himachal Pradesh (Kumari *et al*., 2021)
  - *Gossypium herbaceum* L. - Gujarat (Butani and Kapadia, 2000)
  - *Gossypium hirsutum* L. - Gujarat (Nehare *et al*., 2004) - Maharashtra (Nagamallikadevi *et al*., 2013; George *et al*., 2016); - Tamil Nadu (Guntupalli, 2014)
- *Aphis (Aphis) punicae* Passerini, 1863
  - *Punica granatum* L. - Karnataka (Mani & Krishnamoorthy, 1995)
- *Greenidea (Trichosiphum) psidii* van der Goot, 1917
  - *Psidium guajava* L. - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843)

- *Brassica juncea* (L.) Czern. - Haryana (Kalra, 1988)
- *Brassica oleracea* L. var. *capitata*. - Maharashtra (Gade *et al*., 2010)
- *Brassica rapa* L. - Gujarat (Nehare *et al*., 2004); - Maharashtra (Gade *et al*., 2010)

- *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)
  - *Solanum melongena* L. - West Bengal (Satpathi & Mandal, 2006)
  - *Solanum tuberosum* L. - Uttar Pradesh (Raj, 1989)
- *Myzus (Nectarosiphon) persicae nicotianae* Blackman, 1987
  - *Nicotiana tabacum* L. - Andhra Pradesh (Joshi *et al*., 1979; Rao and Chandra, 1985)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Sorghum bicolor* (L.) Moench - Maharashtra (Nagamallikadevi *et al*., 2013)
- *Uroleucon (Uromelan) compositae* (Theobald, 1915)
  - *Carthamus tinctorius* L. - Gujarat (Nehare *et al*., 2004); - Maharashtra (Gade *et al*., 2010)

15. *Mallada garhwalensis* (Ghosh, 1985) [syn. *Chrysopidia garhwalensis* Ghosh, 1985]

- *Lachnus* sp.
  - *Cedrus deodara* (Lamb.) G. Don - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)

16. *Mallada kinnaurensis* (Ghosh, 1977)

- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Triticum aestivum* L. - Uttarakhand (Dey, 2015)

17. *Mallada murreensis* (Tjeder, 1963) [syn. *Chrysopa murreensis* Tjeder, 1963]

- *Lachnus* sp.
  - *Cedrus deodara* (Lamb.) G. Don - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)

18. *Mallada obvius* (Hölzel, 1973) [syn. *Anisochrysa obvia* Hölzel, 1973]

- *Rhopalosiphum* sp.
  - Grass - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)

19. *Mallada* sp.

- *Aphis (Aphis) gossypii* Glover, 1877
  - *Gossypium hirsutum* L. - Maharashtra (Kale *et al*., 2020)
- *Aphis (Toxoptera) citricidus* (Kirkaldy, 1907)
  - *Citrus* sp. - Maharashtra (Kale *et al*., 2020)
- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Dey, 2015)
- *Eriosoma* sp.
  - *Cotoneaster obtusus* Wall. ex Lindl. - Uttarakhand (Debnath, 1991)
- *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)
  - *Solanum melongena* L. - Andhra Pradesh (Rao *et al*., 1990)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Sorghum bicolor* (L.) Moench - Maharashtra (Kale *et al*., 2020)
  - *Triticum aestivum* L. - Uttarakhand (Debnath, 1991)
- *Sitobion (Sitobion) miscanthi* (Takahashi, 1921)
  - *Triticum aestivum* L. - Uttarakhand (Dey, 2015)
- *Uroleucon (Uromelan) compositae* (Theobald, 1915)
  - *Carthamus tinctorius* L. - Maharashtra (Pranav *et al*., 2021)

20. *Nothochrysa indigena* Needham, 1909

- *Pemphigus (Pemphigus) mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Dey, 2015)

21. *Pseudomallada astur* (Banks, 1937) [syn. *Mallada astur* Banks, 1937]

- *Aphis (Aphis) gossypii* Glover, 1877
  - *Gossypium hirsutum* L. - Karnataka (Jalali and Singh, 1994)

22. *Pseudomallada alcestes* (Banks, 1911) [syn. *Mallada alcestes* (Banks, 1911)]

- *Betacallis sikkimensis* Basu, Ghosh and Raychaudhuri, 1974
  - *Betula alnoides* Buch.-Ham. - Uttarakhand (Dey, 2015)

23. *Retipenna dasyphlebia* (McLachlan, 1894) [syn. *Chrysopa dasyphlebia* McLachlan, 1894]

- *Betacallis sikkimensis* Basu, Ghosh and Raychaudhuri, 1974
  - *Betula alnoides* Buch.-Ham. - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)
- *Eumyzus pruni* Chakrabarti and Bhattacharya, 1985
  - *Prunus cornuta* (Wall. ex Royle) Steud. - Uttarakhand (Debnath *et al*., 1988; Dey, 2015)

24. *Tumeochrysa indica* Needham, 1909

- *Chaitophorus kapuri* Hille Ris Lambers, 1966
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Dey, 2015)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843)
  - *Brassica oleracea* L. - West Bengal (Dey and De, 2018)

D. Family: Hemerobiidae

The members of the family Hemerobiidae are commonly called as brown lacewings and all are voracious predators as both larvae and adults. In India, 6 species (including unidentified species) belonging to 2 genera *Hemerobius* and *Micromus* are recorded preying on 29 aphid species infesting 48 food plants in 14 states/union territories of India as mentuioned below.

1. *Hemerobius indicus* Kimmins, 1938

- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - West Bengal (Dey *et al*., 2016)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) *Prociphilus (Stagona) himalayaensis* Chakrabarti, 1976
  - *Lonicera* sp. - Uttarakhand (Dey and Bhattacharya, 1997; Dey, 2015)

2. *Hemerobius* sp.

- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) *Aphis (Aphis) craccivora* Koch, 1854
  - *Lablab purpureus* (L.) Sweet ssp. *purpureus* - Karnataka (Joshi *et al*., 1997)
  - *Vigna unguiculata* (L.) Walp. - Karnataka (Joshi *et al*., 1997)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) *Aphis (Aphis) pomi* De Geer, 1773
  - *Malus domestica* (Suckow) Borkh. - Jammu and Kashmir (Bhagat *et al*., 1988)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) *Pemphigus (Pemphigus) mordwilkoi* Cholodkovsky, 1912
  - *Populus ciliata* Wall. ex Royle - Uttarakhand (Debnath, 1991)

3. *Micromus australis* Hagen, 1858

- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) *Aphis (Aphis) gossypii* Glover, 1877
  - *Gossypium hirsutum* L. - Karnataka (Mulimani *et al*., 2006; Mulimani *et al*., 2008a)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) *Melanaphis sacchari* (Zehntner, 1897)
  - *Sorghum bicolor* (L.) Moench - Karnataka (Mulimani *et al*., 2006; Mulimani *et al*., 2008b)

4. *Micromus igorotus* Banks, 1920

- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) *Aphis (Aphis) craccivora* Koch, 1854
  - *Vigna unguiculata* (L.) Walp. - Karnataka (Mulimani *et al*., 2007; Joshi *et al*., 2011); - Uttar Pradesh (Tiwari *et al*., 2024)
- *Aphis (Aphis) gossypii* Glover, 1877
  - *Gossypium hirsutum* L. - Karnataka (Mulimani *et al*., 2007; Joshi *et al*., 2011)

- *Aphis (Aphis) spiraecola* Patch, 1914
  - *Arelia* sp. - Karnataka (Joshi *et al*., 2011)
- *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonsc., 1841
  - *Citrus* sp. - Karnataka (Joshi *et al*., 2011)
- *Astegopteryx bambusae* (Buckton, 1893)
  - *Bambusa* sp. - Karnataka (Joshi *et al*., 2011)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica oleracea* L. - Karnataka (Joshi *et al*., 2011); - Uttar Pradesh (Tiwari *et al*., 2024)
- *Ceratovacuna lanigera* Zehntner, 1897
  - *Saccharum officinarum* L. - Karnataka (Lingappa *et al*., 2004; Deshmukh *et al*., 2009); - Maharashtra (Patil and Bhosale, 2007); - Tamil Nadu (Srikanth *et al*., 2015); - Uttar Pradesh (Tripathi *et al*., 2008)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843)
  - *Brassica rapa* L. - Uttar Pradesh (Tiwari *et al*., 2024)
- *Melanaphis sacchari* (Zehntner, 1897)
  - *Cenchrus americanus* (L.) Morrone - Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari *et al*., 2024)
  - *Sorghum bicolor* (L.) Moench - Karnataka (Mulimani *et al*., 2007); - Uttar Pradesh (Tiwari *et al*., 2024)
- *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)
  - *Brassica juncea* L. - Karnataka (Joshi *et al*., 2011)
  - *Brassica rapa* L. - Uttar Pradesh (Tiwari *et al*., 2024)
- *Myzus (Nectarosiphon) persicae nicotianae* Blackman, 1987
  - *Nicotiana tabacum* L. - Karnataka (Mulimani *et al*., 2007); - Maharashtra (Amruta and Chaugale, 2023)
- *Pentalonia nigronervosa* Coquerel, 1859
  - *Alpinia* sp. - Karnataka (Joshi *et al*., 2011)
- *Pseudoregma bambusae* (Chakrabarti and Maity, 1982)
  - *Bambusa* sp. - Karnataka (Joshi *et al*., 2011)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Cenchrus americanus* (L.) Morrone - Uttar Pradesh (Chaudhary and Singh, 2012; Tiwari *et al*., 2024)
- *Sitobion (Sitobion) miscanthi* (Takahashi, 1921)
  - *Cenchrus americanus* (L.) Morrone - Uttar Pradesh (Tiwari *et al*., 2024)
- *Uroleucon (Uromelan) carthami* (Hille Ris Lambers, 1948)
  - *Carthamus tinctorius* L. - Karnataka (Mulimani *et al*., 2006; Joshi *et al*., 2011)
  - *Micromus timidus* Hagen, 1853 [syn. *Micromus sauteri* Esben-Petersen, 1912]

5. *Micromus timidus* Hagen, 1853 [syn. *Micromus sauteri* Esben-Petersen, 1912]

- *Aphis (Aphis) craccivora* Koch, 1854
  - *Cajanus cajan* (L.) Millsp. - Uttarakhand (Dey, 2015)
  - *Lablab purpureus* (L.) Sweet ssp. *purpureus* - West Bengal (Ghosh *et al*., 1981; Poddar, 1982)
  - *Senna tora* (L.) Roxb. - West Bengal (Poddar, 1982)
  - *Solanum melongena* L. - West Bengal (Satpathi and Mandal, 2006); - Uttar Pradesh (Tiwari *et al*., 2024)
  - *Vicia faba* L. - West Bengal (Poddar, 1982)
  - *Vigna unguiculata* (L.) Walp. - Karnataka (Navi *et al*., 2011); - Uttar Pradesh (Tiwari *et al*., 2024)
- *Aphis (Aphis) glycines* Matsumura, 1917
  - *Glycine max* L. - Manipur (Singh and Singh, 2000)
- *Aphis (Aphis) gossypii* Glover, 1877
  - *Brassica oleracea* L. - Manipur (Singh *et al*., 2002)
  - *Gossypium hirsutum* L. - Karnataka (Mulimani *et al*., 2008a; Navi *et al*., 2010)

- *Solanum melongena* L. - Manipur (Shah *et al*., 2013); West Bengal (Satpathi, 1999; Satpathi and Mandal, 2006); - Uttar Pradesh (Tiwari *et al*., 2024)
- Unidentified plant - *Odisha* (Basu and Patro, 2007)

- *Aphis (Aphis) nerii* Boyer de Fonsc., 1841
  - *Calotropis procera* (Aiton) Dryand. - Uttar Pradesh (Tiwari *et al*., 2024)
- *Aphis* (*Toxoptera*) *aurantii* Boyer de Fonsc., 1841
  - *Camellia sinensis* (L.) Kuntze - Assam (Das, 1974; Das and Kakoty, 1992); - Karnataka (Radhakrishnan and Muraaledharan, 1991); - Kerala (Radhakrishnan and Muraaledharan, 1991); - Manipur (Devi *et al*., 2010); - Tamil Nadu (Radhakrishnan and Muraaledharan, 1989)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica oleracea* L. - Manipur (Singh *et al*., 2002); - Uttar Pradesh (Tiwari *et al*., 2024)
  - *Brassica rapa* L. - Uttarakhand (Dey, 2015); - Uttar Pradesh (Tiwari *et al*., 2024)
- *Ceratovacuna lanigera* Zehntner, 1897
  - *Saccharum officinarum* L. - Karnataka (Navi *et al*., 2011); - Maharashtra (Anonnymus, 2003)
- *Cervaphis quercus* Takahashi, 1918
  - *Quercus serrata* Murray - Manipur (Shantibala *et al*., 1994)
- *Cervaphis rappardi indica* Basu, 1961
  - *Cajanus cajan* (L.) Millsp. - Manipur (Shantibala *et al*., 1997)
- *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843)
  - *Brassica juncea* (L.) Czern. - Manipur (Chitra Devi *et al*., 2002); - West Bengal (Ghosh, 1983)
  - *Brassica nigra* (L.) W.D.J. Koch - West Bengal (Ghosh *et al*., 1981)
  - *Brassica oleracea* L. - Manipur (Singh *et al*., 2002)
  - *Brassica rapa* L. - Uttar Pradesh (Tiwari *et al*., 2024)
  - *Raphanus* sp. - Uttarakhand (Dey, 2015)
- *Melanaphis sacchari* (Zehntner, 1897)
  - *Sorghum bicolor* (L.) Moench - Karnataka (Mulimani *et al*., 2008a; Mulimani *et al*., 2009); - Odisha (Patnaik *et al*., 1977)
  - *Zea mays* L. - Odisha (Patnaik *et al*., 1977)
- *Myzus (Nectarosiphon) persicae* (Sulzer, 1776)
  - *Brassica oleracea* L. - Manipur (Singh *et al*., 2002; Bijaya *et al*., 2006)
  - *Brassica rapa* L. - Manipur (Bijaya *et al*., 2001); - Uttar Pradesh (Tiwari *et al*., 2024)
  - *Solanum melongena* L. - Uttar Pradesh (Tiwari *et al*., 2024); - West Bengal (Satpathi and Mandal, 2006)
- *Myzus (Nectarosiphon) persicae nicotianae* Blackman, 1987
  - *Nicotiana tabacum* L. - Andhra Pradesh (Rao *et al*., 1990
- *Pentalonia nigronervosa* Coquerel, 1859
  - *Musa acuminata* Colla (syn. *Musa cavendishii* Lamb.) - Tamil Nadu (Poorani *et al*., 2023)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Cenchrus americanus* (L.) Morrone - Uttar Pradesh (Tiwari *et al*., 2024)
- *Tuberculatus (Orientuberculoides) nervatus* Chakrabarti and Raychaudhuri, 1976
  - *Quercus serrata* Murray - Manipur (Somen Singh *et al*., 1995a)
- *Uroleucon (Uromelan) carthami* (Hille Ris Lambers, 1948)
  - *Carthamus tinctorius* L. - Karnataka (Navi *et al*., 2011)

6. *Micromus* sp.

- *Aphis (Aphis) craccivora* Koch, 1854
  - *Moringa oleifera* Lam. - Kerala (Thamilvel, 2009)
  - *Psophocarpus tetragonolobus* (L.) DC. - Kerala (Thamilvel, 2009)
  - *Vigna unguiculata* (L.) Walp. - Kerala (Thamilvel, 2009)

- *Cucumis* sp. - Uttarakhand (Debnath, 1991)

- *Aphis (Aphis) gossypii* Glover, 1877
  - *Abelmoschus esculentus* (L.) Moench - Kerala (Thamilvel, 2009)
  - *Ageratum conyzoides* L.- Kerala (Thamilvel, 2009)
  - *Ama ranthus tricolor* L. - Kerala (Thamilvel, 2009)
  - *Capsicum annuum* L. - Kerala (Thamilvel, 2009)
  - *Coccinia grandis* (L.) Voigt - Kerala (Thamilvel, 2009)
  - *Momordica charantia* L. - Kerala (Thamilvel, 2009)
  - *Solanum melongena* L. - Kerala (Thamilvel, 2009)
  - *Trichosanthes cucumerina* L. [syn. *Trichosanthes anguina* L.] - Kerala (Thamilvel, 2009)
- *Aphis (Aphis) odinae* (van der Goot, 1917)
  - *Anacardium occidentale* L. - Karnataka (Mulimani and Rajanna, 2014)
- *Aphis (Aphis) spiraecola* Patch, 1914
  - *Chromolaena odorata* (L.) - Kerala (Thamilvel, 2009)
  - *Clerodendrum infortunatum* L. [syn. *Clerodendrum viscosum* Vent.] - Kerala (Thamilvel, 2009)
  - *Coccinia grandis* (L.) Voigt - Kerala (Thamilvel, 2009)
- *Astegopteryx rhapidis* (van der Goot, 1917)
  - *Elaeis guineensis* Jacq. - Andaman (Dhileepan, 1996)
- *Betacallis sikkimensis* Basu , Ghosh and Raychaudhuri, 1974
  - *Betula alnoides* Buch.-Ham. - Uttarakhand (Debnath, 1991; Dey, 2015)
- *Brevicoryne brassicae* (Linnaeus, 1758)
  - *Brassica rapa* L. - Uttarakhand (Debnath, 1991)
- *Rhopalosiphum padi* (Linnaeus, 1758)
  - *Triticum aestivum* L. - Himachal Pradesh (Dixit *et al*., 2019); - Uttarakhand (Dey, 2015)
- *Rhopalosiphum rufiabdominale* (Sasaki, 1899)
  - *Betula alnoides* Buch.-Ham. - Uttarakhand (Dey, 2015)
- *Sitobion (Sitobion) avenae* (Fabricius, 1775)
  - *Triticum aestivum* L. - Himachal Pradesh (Dixit *et al*., 2019)

7. Unidentified Hemerobiidae

- *Aphis (Aphis) craccivora* Koch, 1854
  - *Vigna unguiculata* (L.) Walp. - Karnataka (Chinnu *et al*., 2023)
- *Aphis (Aphis) odinae* (van der Goot, 1917)
  - *Aralia* sp. - Karnataka (Chinnu *et al*., 2023)
- *Aphis (Aphis) gossypii* Glover, 1877
  - *Lantana camara* L. - Karnataka (Chinnu *et al*., 2023)
- *Macrosiphum (Macrosiphum) euphorbiae* (Thomas, 1878)
  - *Rosa* sp. - Karnataka (Chinnu *et al*., 2023)
- *Rhopalosiphum maidis* (Fitch, 1856)
  - *Zea mays* L. - Karnataka (Chinnu *et al*., 2023)

Among the Chrysopidae, *Chrysoperla zastrowi sillemi* (Esben-Petersen, 1935) (all Indian species mentioned in literarure as *Chrysoperla carnea* (Stephens, 1836) belong to this species (Henry *et al*., 2010; Nair *et al*., 2020) is highly polyphagous feeding on 42 species of aphids infesting 76 species of plants in 21 states of India followed by *Micromus timidus* Hagen, 1853 (17 aphid species on 23 plant species distributed in 11 states) and *Micromus igorotus* Banks, 1920 (16 aphid species on 14 plant species distributed in 4 states) (Table 1). *Chrysoperla zastrowi sillemi* (Esben-Petersen, 1935) has been widely used in biocontrol of aphids and other insect pests because of its polyphagous habits and compatibility with selected chemical insecticides, microbial agents, and amenability for mass rearing (Uddin *et al*., 2005). It has been mass-reared and marketed commercially in the world (Tauber *et al*., 2000; Alghamdi *et al*., 2018). Among the Hemerobiidae, *Micromus* and *Hemerobius* species are also

Table 1: The number of species of aphid preys infesting food plants of aphidophagous lacewings and their distribution in different states/union territories of India.

Predator family	Predator species	No. of aphid species	No. of food plant species	No. of states/union territories recorded
Coniopterygidae	*Coniocompsa indica*	3	4	3
Dilaridae	*Dilar indicus*	2	2	1
Chrysopidae	*Ankylopteryx octopunctata*	3	6	2
	Brinckochrysa scelestes	2	2	2
	Chrysopa himalayana	1	1	1
	Chrysopa pallens	6	5	3
	Chrysopa sp.	7	8	6
	Chrysoperla orestes	3	4	2
	Chrysoperla sp.	8	9	3
	Chrysoperla zastrowi sillemi	42	76	21
	Cunctochrysa albolineata	3	2	2
	Cunctochrysa jubingensis	6	9	2
	Italochrysa aequalis	1	1	1
	Italochrysa lefroyi	1	1	1
	Mallada basalis	1	1	1
	Mallada desjardinsi	9	14	9
	Mallada garhwalensis	1	1	1
	Mallada kinnaurensis	1	1	1
	Mallada murreensis	1	1	1
	Mallada obvius	1	1	1
	Mallada sp.	8	8	3
	Nothochrysa indigena	1	1	1
	Pseudomallada alcestes	1	1	1
	Pseudomallada astur	1	1	1
	Retipenna dasyphlebia	2	2	1
	Tumeochrysa indica	2	2	2
Hemerobiidae	*Hemerobius indicus*	2	2	2
	Hemerobius sp.	3	4	3
	Micromus australis	2	2	1
	Micromus igorotus	16	14	2
	Micromus timidus	17	23	11
	Micromus sp.	10	19	5
	Unidentified species	4	4	1

promising biocontrol agents against pest aphids as they possess several desirable attributes for biocontrol programmes (New, 1988).

Among the 68 aphid species serving as prey for aphidophagous lacewings, *Aphis (Aphis) gossypii*

Glover, 1877 is preyed by 13 species of predators on 22 food plants followed by *Aphis (Aphis) craccivora* Koch, 1854 (preyed by 9 species of predators) on 12 food plant species; *Brevicoryne brassicae* (Linnaeus, 1758) and *Rhopalosiphum maidis* (Fitch, 1856) (each preyed by 7 species of predators) on 12 and 5 food plant species, respectively; and *Lipaphis (Lipaphis) erysimi* (Kaltenbach, 1843) and *Myzus (Nectarosiphon) persicae nicotianae* Blackman, 1987 (each preyed by 6 species of predators) on 8 and 3 food plant species, respectively; and other aphid species serve as prey for 5 or less species of predators (Table 2). Though, only 5 species of predators feed on *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) but on 12 food plants of agricultural importance. The population of *Myzus (Nectarosiphon) persicae* (Sulzer, 1776) recorded on tobacco (*Nicotiana tabacum* L.) are considered as *Myzus (Nectarosiphon) persicae nicotianae* Blackman 1987 as proposed by Eastop and Blackman (2005).

In addition to these specis of aphidophagous Neuroptera, there are some more species mentioned in literature feeding on aphids without giving their prey/food plant records.

CONCLUSION

All these 32 species of aphidophagous lacewings recorded in India act as natural bio-control agents of all 68 species of aphids mentioned above mostly infesting agricultural and horticultural crops, and help in reducing the damage caused by them in agroecosystems. Hence, it is important to promote the preservation and conservation of the existing diversity of these aphidophagous lacewings by discriminate use of pesticides and other cultural practices so that efforts of their control programme may be materialised and be successful.

Table 2: Number of aphid species consumed by different number of species of neuropteran predators in India.

Sl. No.	Aphid species	No. of predator species	No. of food plant species	No. of states/ union territories
1.	*Aphis (Aphis) gossypii*	13	22	18
1.	*Acyrthosiphon (Acyrthosiphon) pisum*	1	2	3
2.	*Acyrthosiphon (Acyrthosiphon) rubi*	1	1	1
3.	*Aphis (Aphis) craccivora*	9	12	16
4.	*Aphis (Aphis) glycines*	1	1	1
5.	*Aphis (Aphis) gossypii*	13	22	18
6.	*Aphis (Aphis) kurosawai*	1	2	1
7.	*Aphis (Aphis) nerii*	1	1	2
8.	*Aphis (Aphis) odinae*	1	1	1
9.	*Aphis (Aphis) pomi*	2	3	1
10.	*Aphis (Aphis) punicae*	2	1	2
11.	*Aphis (Aphis) solanella*	1	1	1
12.	*Aphis (Aphis) spiraecola*	3	7	5
13.	*Aphis (Toxoptera) aurantii*	2	2	5
14.	*Aphis (Toxoptera) citricidus*	2	1	1
15.	*Astegopteryx bambusae*	1	1	1
16.	*Astegopteryx rhapidis*	1	1	1
17.	*Betacallis sikkimensis*	4	1	1
18.	*Brachycaudus (Brachycaudus) helichrysi*	2	4	2

19.	*Brachycaudus rumexicolens*	1	1	1
20.	*Brevicoryne brassicae*	7	5	10
21.	*Capitophorus formosartemisiae*	1	3	3
22.	*Ceratovacuna lanigera*	5	1	5
23.	*Cervaphis quercus*	1	1	1
24.	*Cervaphis rappardi indica*	1	1	1
25.	*Chaitophorus kapuri*	5	2	1
26.	*Chromaphis hirsutustibis*	2	2	1
27.	*Chromaphis juglandicola*	1	1	1
28.	*Dyphis* sp.	1	1	1
29.	*Eriosoma lanigerum*	4	2	3
30.	*Eriosoma ulmi*	2	1	1
31.	*Eumyzus pruni*	1	1	1
32.	*Greenidea (Paragreenidea) parthenocissi*	1	1	1
33.	*Greenidea (Trichosiphum) psidii*	2	1	1
34.	*Hyadaphis coriandri*	1	1	4
35.	*Hyalopterus gracilis*	1	1	1
36.	*Lachnus* sp.	2	1	1
37.	*Lipaphis (Lipaphis) erysimi*	6	8	13
38.	*Lipaphis (Lipaphis) pseudobrassicae*	1	1	1
39.	*Macrosiphoniella (Macrosiphoniella) pseudoartemisiae*	1	1	1
40.	*Macrosiphoniella (Macrosiphoniella) yomogifoliae*	1	1	1
41.	*Macrosiphum (Macrosiphum) euphorbiae*	1	1	1
42.	*Macrosiphum (Macrosiphum) rosae*	1	1	1
43.	*Melanaphis sacchari*	4	3	3
44.	*Mollitrichosiphum* sp.	1	2	1
45.	*Myzus (Myzus) mumecola*	1	1	1
46.	*Myzus (Myzus) ornatus*	1	1	1
47.	*Myzus (Nectarosiphon) persicae*	5	12	11
48.	*Myzus (Nectarosiphon) persicae nicotianae*	6	3	3
49.	*Panaphis juglandis*	1	1	1
50.	*Pemphigus (Pemphigus) mordwilkoi*	5	1	1
51.	*Pemphigus (Pemphigus) siphunculatus*	1	1	1
52.	*Pentalonia nigronervosa*	2	2	2
53.	*Prociphilus (Stagona) himalayaensis*	2	1	1
54.	*Pseudoregma bambusae*	1	1	1
55.	*Pterochloroides persicae*	1	1	1
56.	*Pyrolachnus pyri*	1	2	1
57.	*Rhopalosiphum maidis*	7	5	8
58.	*Rhopalosiphum padi*	3	1	3
59.	*Rhopalosiphum rufiabdominale*	1	1	1
60.	*Sitobion (Sitobion) avenae*	1	1	1
61.	*Sitobion (Sitobion) miscanthi*	2	3	2
62.	*Sitobion (Sitobion) rosaeiformis*	1	1	1
63.	*Therioaphis trifolii trifolii*	1	1	1
64.	*Tinocallis* sp.	1	1	1
65.	*Trama (Neotrama) penecaeca*	1	1	1
66.	*Tuberculatus (Orientuberculoides) nervatus*	1	1	1
67.	*Uroleucon (Uromelan) carthami*	2	1	1
68.	*Uroleucon (Uromelan) compositae*	2	2	3

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