An Update on the Systematic Checklist and Biodiversity of Caterpillars of Butterfly-Fauna on Food /Host Plant Species of Jammu & Kashmir State (India) - Papilionoidea: Hesperiidae, Lycaenidae and Pieridae

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Abstract
This paper deals with 23 species, under 15 genera of butterfly caterpillars, belonging to family Hesperiidae, Lycaenidae and Pieridae, associated with 33 species of food / host plant species (agricultural crops and economically important plant species), covering 14 families. The highest number of caterpillar species i.e. 8 (Lycaenids, Pierids) has been found on medicinal plants, followed by 6 spp. (Hesperiids, Pierids) on vegetable crop species. The food crops, fruit crops and ornamental plant species, served as food / host plants for 4 spp. each, pertaining to family Hesperiidae, Lycaenidae and Pieridae. The lowest number of caterpillar species i.e. 2 (Lycaenid, Pierid), is known to be on forest / timber trees. An-up-to-date systematic checklist of butterfly caterpillar species, with food/host plant species, have been provided. Besides, species diversity of caterpillar-fauna on host plant species has been discussed.

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Introduction
In Jammu and Kashmir State, 23 species of butterfly caterpillars, under family Hesperiidae, Lycaenidae and Pieridae, are found to be associated with 33 species of agricultural crops and other economically important plant species, belonging to 14 families. The adult butterflies can obtain nectar as food from suitable flowers of the plant species in this region. The adult butterfly species lay eggs on the food plant species on which the larvae, known as caterpillar feed. The survival of butterfly population actually depends on food for its caterpillar stage, by feeding on specific plant species, referred to as butterfly host plant. Most species accept one or few species of plants that provide necessary food for caterpillar (larval stages).

In case of Lycaenids, the caterpillars are flattened in appearance and may be green, blue, orange or dull brown in colour, with gland that may produce secretion to attract or subdue ants. The Hesperid caterpillars are cylindrical, with large head. They are usually green or transparent green and sometimes conspicuously marked. These caterpillars feed within cells made, out of rotted leaves of the host plant. The caterpillars of Pierids are generally green, with hairs or spine and mostly feed on the plants belonging to the family Brassicaceae and...
Materials and methods

The database provided in this paper pertains to 23 species of butterfly caterpillars of 3 families, feeding on diverse food/host plant species under 14 families, including agricultural crops and economically important plant species, occurring in vast areas and localities of Jammu and Kashmir State. This State is located in the northern part of Indian sub-continent, in the vicinity of Karakorum and the Western Himalayan ranges. Jammu and Kashmir (J & K) State is divided into three geographically and climatically different Provinces, viz. Ladakh (cold desert), Kashmir (temperate) and Jammu (sub-tropical). This State is of paramount zoo-geographical significance as well as rich in biodiversity.

In the present paper, a first attempt has been made to consolidate the scattered data on butterfly caterpillar species with reference to their host/food plant species and is being given in the form of updated annotated checklist. The data pertaining to the taxa as well as host/food plant species, has been updated in the light of the latest nomenclatural/systematic changes.

For the purpose of updating of faunal taxa and diversity, relevant published works (national and international), besides online information on taxonomic surveys and latest systematic checklist/catalogue of the world, have been consulted. For the changes in nomenclature/systematics of faunal taxa, the important monographs and online databases followed are: Anonymous (2017a, 2017b), Beccaloni et al. (2016), Greishuber and Lama (2007), Varshney and Smetacek (2015) and Ziegler (2017).

The faunal records of valid butterfly caterpillar species, with their host/food plant species are given in the Systematic Checklist. The synonymies of the taxa are listed under the valid species, given in the parentheses and in case of food plant species, the synonymies are given in front of valid species, also in parentheses. The checklist provides the references pertaining to authors recording and describing taxa from different regions and localities, in the form of code numbers, given in the long brackets in front of each listed species. The keys to the code numbers, are cited at the end of systematic checklist.

Results and discussion

Systematic Checklist

Superfamily: Papilionoidea
Family: Hesperiidae
Subfamily 1: Hesperiinae
Tribe 1: Baorini
1. Parnara guttatus Bremer & Gray (Common Straight Swift) [12]
Caterpillar Food / Host plants: Vigna unguiculata (Cow pea), Phaseolus vulgaris (French beans) and Oryza sativa (Rice).
2. Pelopidas methias (Fabricius) (Variable Swift) [3, 28]
Caterpillar Food / Host plants: Brassica spp., Raphanus sativus
Tribe 2: Hesperini
3. Hesperia comma (Linnaeus) (Chequered Deter) [23]
Caterpillar Food / Host plant: Oryza sativa

Subfamily 2: Pyrginae
Tribe: Celaenorrhini
4. Celaenorrhinus leucocera (Kollar) (Common Spotted flat) [11, 14, 39]
Caterpillar Food / Host plants: Eranthemum roseum (=Daedalaneathus roseum), Epilobium, Strobilanthes

Family 2: Lycaenidae
Subfamily 1: Polyommatinae
Tribe: Polyommatini
5. Celastrina huegelii hugelii Huegel (Large Hedge Blue) (=Lycenopsis huegelii Huegel) [11, 39]
Caterpillar food / host plant: Cylista scariosa, Xyilia dalabriformis

Subfamily 2: Thecalinae
Tribe 1: Theclini
6. Chaetoprocta odata (Hewitson) (Walnut Blue)
Caterpillar Food / host plant: Juglans regia (Walnut)
Tribe 2: Deudoriginii
7. Deudorix epijarbas (Moore) (The common Cornelian) [21, 26, 37, 39, 40]
Caterpillar Food / host plants: Aesculus indica (Indian horse chestnut), Citrus sinensis (Sweet orange), Punica granatum (Pomegranate)
8. Rapala nissa (Kollar) (Common Flash )[11,14]
Caterpillar Food / host plant: Astilberivularis
9. Rapala varuna Horsfield (Indigo Flash) [12, 22]
Caterpillar host plant: Psidium guajava (Guava)
10. Virachola isocrates (Fabricius) (Pomegranate, Guava butterfly [6, 12, 15, 31]
Caterpillar food / host plants: Emblica officinalis (Aonla), Punica gara nutum, Citrus sinensis, Citrus reticulata (Mandarin orange), Psidium guajava

Family 3: Pieridae
Subfamily 1: Coliadinae
11. Catopsilia pomona (Lemon emigrant) (= Catopsilia crocale (Cramer) [29]
Caterpillar food / host plants: Senna siamea (= Cassia siamea)
12. Colias fieldii (Meneties) (Dark Clouded Yellow) (= Colias electro fieldii) [16, 28, 38, 39]
Caterpillar food / host plants: Indigofera heterantha, Medicago spp., Robinia pseudoacacia, Trifolium spp. and Vicia (Vetch)
13. Colias erate (Esper) (Pale Clouded Yellow) [7]
Caterpillar food / host plant: Melilotus alba
14. Colias hyale glica Linnaeus (Pale-clouded yellow) [7]
Caterpillar food / host plants: Medicago spp., Melilotus sp., Trifolium sp., Vicia cracca (Vetch)
Subfamily 2: Pierinae
Tribe 1: Pierini
15. Aporia leucodice (Eversmann) (Arrow head black vein) [11, 39]
 (= Metaporia leucodice Eversmann) [38]
Caterpillar food / host plant: Berberis lycium
16. Aporia nabellica nabellica (Boisduval) (Kashmir Dusky Black vein) [35, 38]
Caterpillar food plant: Plant species of Umbelliferae and Rosaceae
17. Pieris brassicae (Linnaeus) (Large cabbage butterfly) [5, 9, 19, 24, 25]
Caterpillar food plants: Brassica oleracea var. acephala (Haa k), B. o. botyris (Cauliflower); B. o. capitata (Cabbage); B. rapa (Turnip), Lepidium latifolium (Pepper grass), Raphanus sativus (Radish)
18. Pieris brassicae kashmirensis Rishi (Large cabbage butterfly) [32]
Caterpillar food / host plants: Brassicas spp. and its varities and Brassica juncea (Mustard)
19. Pieris canidia (Linnaeus) (Indian Cabbage White) [4, 7, 27]
Caterpillar food/plants: Brassica o. var. capitata, B. o. botyris,B.o.gongylodes, Raphanus stavius (Raddish)
20. Pieris rapae (Linnaeus) (Small white butterfly) [5, 24, 32, 38]
Caterpillar food / host plants: Brassica.o. var. capitata., B.o. botyris, B.o.gongylodes, Brassicarapa, R. stavius
21. Pontia daplidice (Linnaeus) (Bath White) [5, 7, 17, 28, 38, 39]
Caterpillar food / host plants: B. o. acephala, B. o. botyris, B. o. gongylodes, B. rapa, R.stavius
Tribe: Teracolini
22. Ixias marianne (Cramer) (White orange tip) [4]
Caterpillar food plant: Capparis grandis
23. Ixias pyrene (Linnaeus) (Yellow orange tip) [4]
Caterpillar food plant: Capparis

Key to numerical in the long brackets [, cited in the above checklist

The above cited Systematic Checklist incorporated a total of 23 species, belonging to 15 genera of butterfly caterpillar-fauna, under family Hesperiidae, Lycaenidae and Pieridae of Superfamily Papilionoidea. The caterpillar taxa under these families are associated with 33 species of agricultural crops (food, fodder, fruits, vegetables) and economically important plants (medicinal plants and timber/ forest trees, ornamental plants), distributed over 14 families. A total of 4 species under 4 genera of Hesperiid caterpillars are known to have their food/ host plants as food and vegetable crops, besides ornamental plants. In case of Lycaenidae family, 6 spp. (5 genn.), have their food / host plants as fruit crops, medicinal plants and forest trees. The family Pieridae incorporated as many as 13 spp. (6 genn.) and their caterpillars are known to thrive on agricultural crops (food, fodder and vegetables), medicinal and ornamental plants, forest trees (see Checklist and Table 1).

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Table 1. Species diversity of Hesperiids, Lycaenids and Pierids caterpillars, infesting agricultural crops and economically important plants of various families in Jammu and Kashmir State.

<table>
<thead>
<tr>
<th>Caterpillar host crops and plants (Family)</th>
<th>Caterpillar families and genus (no. of species)</th>
<th>Total no. of species</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food crops</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peppergrass (BR)</td>
<td>-</td>
<td>Pieris (1)</td>
</tr>
<tr>
<td>Paddy/Rice (PO)</td>
<td>Hesperia (1), Parnara (1)</td>
<td>02</td>
</tr>
<tr>
<td>Vetch (FA)</td>
<td>-</td>
<td>Colias (1)</td>
</tr>
<tr>
<td><strong>Fodder crops</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicago spp. (FA)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Food crops</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aonla (EL)</td>
<td>-</td>
<td>Virachola (1)</td>
</tr>
<tr>
<td>Guava (MY)</td>
<td>-</td>
<td>Rapala (1), Virachola (1)</td>
</tr>
<tr>
<td>Mandarin orange (RU)</td>
<td>-</td>
<td>Virachola (1)</td>
</tr>
<tr>
<td>Pomegranate (PU)</td>
<td>-</td>
<td>Deudorix (1), Virahcoela-(1)</td>
</tr>
<tr>
<td>Sweat orange (RU)</td>
<td>-</td>
<td>Deudorix (1), Virachola (1)</td>
</tr>
<tr>
<td>Walnut (JU)</td>
<td>-</td>
<td>Chaetoprocta (1)</td>
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<tr>
<td><strong>Medicinal plants</strong></td>
<td></td>
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<tr>
<td>Aesculus (SA)</td>
<td>-</td>
<td>Deudorix (1)</td>
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<tr>
<td>Astibe (SX)</td>
<td>-</td>
<td>Rapala (1)</td>
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<tr>
<td>Berberis (BE)</td>
<td>-</td>
<td>Aporia (1)</td>
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<tr>
<td>Capparis (CA)</td>
<td>-</td>
<td>Ixias (2)</td>
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<tr>
<td>Cylista (FA)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Melilotus (FA)</td>
<td>-</td>
<td>Colias (2)</td>
</tr>
<tr>
<td><strong>Ornamental plants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arabis (BR)</td>
<td>-</td>
<td>Pieris (1)</td>
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<tr>
<td>Ecbolium (AC)</td>
<td>Celaenorrhinus (1)</td>
<td></td>
</tr>
<tr>
<td>Eranthemum (AC)</td>
<td>Celaenorrhinus (1)</td>
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<tr>
<td>Indigofera (FA)</td>
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<tr>
<td>Rorippa (BR)</td>
<td>-</td>
<td>Pieris (1)</td>
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<tr>
<td>Senna (FA)</td>
<td>-</td>
<td>Catopsilia (1)</td>
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<td>Strobilanthes (AC)</td>
<td>Celaenorrhinus (1)</td>
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<tr>
<td><strong>Timber/forest trees</strong></td>
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<tr>
<td>Robinia (FA)</td>
<td>-</td>
<td>Colias (1)</td>
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<tr>
<td>Xylia (FA)</td>
<td>Celastrina (1)</td>
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<tr>
<td><strong>Vegetable and oil crops</strong></td>
<td></td>
<td></td>
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<tr>
<td>Brassicas vegetables and oil crop (mustard) (BR)</td>
<td>Peleopidas (1)</td>
<td>Pieris (4), Pontia (1)</td>
</tr>
<tr>
<td>Cowpea (FA)</td>
<td>Parnara (1)</td>
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<tr>
<td>French beans (FA)</td>
<td>Parnara (1)</td>
<td></td>
</tr>
<tr>
<td>Yam (DI)</td>
<td>Parnara (1)</td>
<td></td>
</tr>
</tbody>
</table>

AC= Acanthaceae; BR= Brassicaceae; BE= Berberidaceae; CA= Capparaceae; DI= Dioscoraceae; EU=Euphorbiaceae; FA= Fabaceae; JU=Juglandaceae; PO = Poaceae; MY= Myrtaceae; PU= Punicaceae; RU=Rutaceae; SP= Spindaceae; SX= Saxifragaceae

**Species Diversity of caterpillar-fauna on agricultural crops and economically important plant species**

**Medicinal plants**: The highest number of caterpillar species i.e. 8, belonging to the family Lycaenidae and Pieridae (5 spp.) have found on 6 species of medicinal plants. The medicinal plants are: *Aesculus, Berberis* and *Cylista*, each serving as food plant for single species each of caterpillar; *Capparis* and *Melilotus*, serve as food plants for 2 spp. each of caterpillar (Pierid), belonging to genus *Ixias* and *Colias* respectively (see Table 1).

**Vegetable crops**: 6 species of caterpillars (Hesperiid, Pierid) are known to be associated with 7 species of vegetables (brassicas, radish, cowpea, beans, and yam)
and oil crop (mustard). The highest number of species \textit{i.e.} 5, belonging to genus \textit{Pieris} and \textit{Pontia}, feed on brassicas vegetables (\textit{Brassica oleoracea} and its varities), \textit{Brassica rapa}, mustard (oil crop), radish. Besides, Hesperiid, \textit{Parnara guttata} caterpillar is potential pest of vegetables like cow pea, French beans and yam (see Table 1).

**Food and fruit crops:** 4 species each of caterpillar, belonging to family Hesperiidae, Lycaenidae and Pieridae, have been found to be associated with food crops (peppergrass, paddy and vetch). Hesperiids- \textit{Hesperia comma} and \textit{Parnara guttata} feed on food crop, viz. Paddy (Rice), whereas, peppergrass and vetach serve as food for the caterpillars of butterfly species, viz. \textit{Pieris brassicae} and \textit{Colias fieldi}, respectively. 4 species of butterfly caterpillars (Lycaenidae) feed on 6 species of fruit crops such as aonla, guava, mandarin orange, pomegranate, sweet orange and walnut. The caterpillars of \textit{Virachola isocrates} feed on all these kinds of fruits, excepting walnut. The caterpillars of \textit{Deudorix epijarbas} devour fruit crops- pomegranate and sweet orange. The walnut crop serves as food for the caterpillars of butterfly, viz. \textit{Chaetoprocta odata} (see Table 1).

**Ornamental plants, fodder crops and forest trees:** 4 species of butterfly caterpillars also feed on 7 species of ornamental plants such as \textit{Arabis, Ecbolium, Eranthemum, Indigofera, Rorippa, Senna} and \textit{Strobilanthes}. The caterpillar of butterfly, viz., \textit{Celaenorrhinus leucocera} has three three species of ornamental plants as host/ food plants. The lowest number of caterpillar species \textit{i.e.} 2 (Pierid), are noticed to be infesting host species, belonging to 2 genera of fodder crop, viz., \textit{Medicago} and \textit{Trifolium}. The caterpillars \textit{Lycaenids- Colias} and \textit{Celaenorrhinus}, feed on forest tree, \textit{Robinia} and \textit{Xylia} respectively (see Table 1).

**Conflict of interest statement**

Authors declare that they have no conflict of interest.

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