

Studies on butterfly diversity (Lepidoptera: Papilionoidea) from Punjab Agricultural University Campus, Ludhiana, Punjab, India

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Abstract

Thirty-three species referable to twenty-four genera belonging to five families, namely, Hesperidae (1), Lycaenidae (6), Nymphalidae (14), Papilionidae (3) and Pieridae (9) from different localities of University campus were collected and identified. The details on their synonymy, material examined, and host distribution along with plants are provided. The photographs of the adults are also given.

Keywords: Butterfly, Diversity, Lepidoptera, Papilionoidea

Introduction

Biological diversity is the base for upholding the ecosystems and the functional aspects of the species that provide goods and services for human well-being (Wilson, 1997). Insects are the most dominant group of invertebrates with distinct three body parts (head, thorax and abdomen), three pairs of legs, compound eyes and body covered with chitinous exoskeleton. Butterflies belong to order Lepidoptera and distributed globally wherever the flowering plants are found (Khan *et al.*, 2004). Butterflies are taxonomically well studied group, which have received reasonable amount of attention through the world (Ghazoul, 2002). The total number of butterfly species in the world range from 7700 (Kirby, 1872) to 20,000 (Landing, 1984). India hosts 1501 species of butterfly (Gaonker, 1996) out of 19,238 species described globally (Heppner, 1998). They are very delicate, beautiful and attractive due to their colorful scaly wings, considered as the symbol of beauty and grace (Rafi *et al.*, 2000). They are diurnal (active at daytime) in habitats and easily recognized by their beautiful colour,

shape and stylish flight that give pleasure to everyone (Javed, 1978). Butterflies have always attracted the attention of naturalists, amateurs, environmentalists, biodiversity discoverers and conservationists (Rose and Walia, 2003). Butterflies are important pollinators for many varieties of plant because they fly over long distance, but at the same time, some of them are very serious pest of many crops and fruits. Caterpillars of most Pierid butterflies feed on various varieties of mustards (family *Brassicaceae*), legume and cabbage (Mal *et al.*, 2013). The study of biological diversity encompasses both the intrinsic and anthropocentric values associated with it. The values of the biological elements are recognized in correspondence to the perceived importance by the human being, which is realized in terms of the ecosystem services (Daily, 1997). Biological diversity is the base for upholding the ecosystems and the functional aspects of the species that provide goods and services for human well-being. Monitoring of species diversity of a region enables estimation of the prospective functional roles of the species. Therefore, monitoring species diversity acts as an enormous source of information of Super families

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Papilionoidea from Punjab Agricultural University, Ludhiana. Furthermore, this checklist will be helpful for researchers to identify the species of butterfly.

Material and Methods

Study area: The present study was undertaken at Punjab Agricultural University (PAU), Ludhiana, established in 1962 and is the nation's third-oldest agricultural university. It lies at 30.90°N and 75.85°E of Punjab in north-west India with an average elevation of 244mASL. The university covers an area of 1,510 acres (6.1 km²) on its main campus. The temperature ranges from 1°C (in December/ January) to 45-46°C (in June) with the average annual precipitation of 730mm.

Localities: For study purpose, campus was divided into seven localities according to general landscape attributes (Figure 1). These were

1. Open fields
2. Orchards
3. Herbal and botanical gardens
4. Plant nursery
5. CIPHET, The Central Institute of Post-Harvest Engineering and Technology
6. Residential area
7. GADVASU complex

Methodology Used

The adults of the butterflies were collected with the help of insect collection net (circumference 93 cm, handle length 87cm and bag depth 77cm) sweeping method while exploring different localities of the campus. The collected adult specimens were killed with the killing agent like ethyl acetate, charged in the killing bottle. After killing, the dead specimens were kept in the relaxing jar for making the specimens soft. They were pinned using different size entomological pins (38mm×40mm; 38mm×55mm), and then stretching of dead specimens were done in the spreading board boxes (40cm×30cm×10cm). The stretched specimens were tagged with the labels carrying information such as name of collector, locality, altitude, date of collection, and then placed in the well fumigated (with naphthalene balls) air tight wooden showcases placed in the movable racks for storage. For wings slide preparation, the method proposed by Common (1970) and advocated by Zimmerman (1978) has been followed. The taxonomic procedures involves an examination of various morphological characters such as head, labial palpus, legs, wing shape, wing maculation and wing venation. Except wing venation, the rest of the characters have been directly examined from the dried specimens. The photographs of the adults belonging to different species were taken with the help of digital camera.



Figure 1. Study area.

Observations

During different survey-cum-collection tours from the above said areas, the entire collection is sorted and identified. 33 species belonging to 24 genera of 10 subfamilies under 05 families of butterflies have been collected and identified. Genera such as genus *Pelopidas* Walker (Hesperiinae), *Euchrysops* Fabricius, *Chilades* Moore, *Tarucus* Moore, *Catochrysops* Boisduval, *Talica* Moore (Polyommatainae), *Rapala* Moore (Lycaeninae), *Phalanta* Doubleday (Heliconiinae), *Vanessa* Fabricius, *Hypolimnas* Hübner, *Junonia* Hübner (Nymphalinae), *Danaus* Linnaeus, *Euploea* Fabricius, *Tirumala* Moore (Danainae), *Melanitis* Fabricius (Satyrinae), *Papilio* Linnaeus, *Graphium* Scopoli, (Papilioninae), *Belonoides* Hubner, *Cepora* Billberg, *Ixias* Hübner, *Pieris* Schrank (Pierinae), *Catopsilia* Hübner, *Colias* Fabricius, *Eurema* Hübner (Coliadinae) are represented in the respective subfamilies. Status of abundance is shown as- VC: Very common, C: Common, LC: Less Common, R: Rare, VR: Very Rare (Table 1, Photos 1-34, a-upperside, b-lowerside).

Order LEPIDOPTERA

Superfamily PAPILIONOIDEA

Family HESPERIIDAE

Subfamily HESPERIINAE

I. Genus *Pelopidas* Walker, 1870

1. *Pelopidas mathias* Fabricius (Photo 1a, b)

Hesperia mathias Fabricius, 1798; *Ent. Syst. (Suppl.):* 433, no. 289-90; TL: Tranquebar, S.India

Material examined: (17♂♂ 9♀♀). India: Punjab: PAU 5.xii.2012, Sunita, Kritika and Pathania (2♂ 2♀), PAU,

2.xi.2013, Kumar and Pathania (4♂ 3♀), PAU, 14.viii.2015, Sachin and Pathania (5♂ 3♀), GADVASU, 17.viii.2015, Sachin and Pathania (6♂ 1♀).

Distribution: India (Chandrasekharan, 2017)

Hostplant: Arecaceae and Poaceae (Kunte, 2000)

Family LYCAENIDAE

Subfamily POLYOMMATINAE

II. Genus *Tarucus* Moore

2. *Tarucus callinara* Butler (Photo 2a, b)

Tarucus callinara Butler, 1886, *Ann.N.H. (5)* 18: 185

Material examined: (7♂♂ 3♀♀). India: Punjab: PAU, 04.v.2009, Katewa, A. Seni and P.C. Pathania (4♂ 2♀), PAU 18.viii.2012, Sunita, Kritika and Pathania (3♂ 1♀).

Distribution: It ranges from North West Himalayas to Kumaun, the plains of northern India, central and Western India, Ceylon, Assam, Burma, Tenasserim (Bingham, 1907).

Host plant: Plants of the legume family, Plumbaginaceae and some of the citrus family Rutaceae (Kunte, 2006).

III. Genus: *Euchrysops* Butler

3. *Euchrysops cnejus* Fabricius (Photo 3a, b)

Hesperia cnejus Fabricius, (1798), *Ent. Syst. Suppl.* 430.

Material examined: (24♂♂ 19♀♀). India: Punjab: PAU, 6.v.2009, Amit Katewa and P.C. Pathania (8♂ 4♀), PAU, 1.ix.2010, Vijay and P.C. Pathania (5♂ 3♀), PAU, 20.xi.2012, Sunita, Kritika and P.C. Pathania (6♂ 1♀), popen fields 30.xi.2012, Sunita, Kritika and P.C. Pathania (1♂ 4♀), PAU, 13.viii.2013, Avi Kumar and P.C. Pathania (1♂ 2♀), PAU, 11.viii.2015, Sachin and P.C. Pathania (1♂), GADVASU, 17.viii.2015, Sachin and P.C. Pathania

Table 1. Superfamilies, families, number of subfamilies, genera and species of butterflies recorded in PAU campus, Ludhiana (as per Van Nieukerken *et al.*, 2011)

SSr. No.	Superfamily	Families	No. of sub-families	No. of genera	No. of species
1	Papilionoidea	Pieridae	2	7	9
		Papilionidae	1	2	3
		Nymphalidae	4	8	14
		Lycaenidae	2	6	6
		Hesperiidae	1	1	1
Total	01	05	10	24	33

Table 2. List of species with common names and along with their distribution

Sr. no.	Family/ Subfamily	Scientific Name	Common name	Remarks
Hesperiidae				
1	Hesperiinae	<i>Pelopidas mathias</i> Fabricius	Small branded swift	Common
Lycaenidae				
2	Polyommatainae	<i>Tarucus callinara</i> Butler	The spotted pierrot	Rare
3	Polyommatainae	<i>Euchrysops cnejus</i> Fabricius	The gram blue	Very common
4	Polyommatainae	<i>Chilades pandava</i> Horsfield	The plains cupid	Common
5	Polyommatainae	<i>Catochrysops strabo</i> Faricius	The forget-me-not	Common
6	Polycnemoideae	<i>Talicauda nyseus</i> Guerin Meneville	The red pierrot	Rare
7	Lycaeninae	<i>Rapala iarbus</i> Fabricius	Common red flash	Very rare
Nymphalidae				
8	Heliconiinae	<i>Phalanta phalantha</i> Drury	Common leopard	Very common
9	Nymphalinae	<i>Vanessa cardui</i> Linnaeus	Painted lady	Common
10	Nymphalinae	<i>Hypolimnas missipus</i> Linnaeus	Danaid eggfly	Less common
11	Nymphalinae	<i>Hypolimnas bolina</i> Linnaeus	The great egg-fly	Common
12	Nymphalinae	<i>Junonia almana</i> Linnaeus	Peacock pansy	Less common
13	Nymphalinae	<i>Junonia atlites</i> Linnaeus	Grey pansy	Very rare
14	Nymphalinae	<i>Junonia lemonias</i> Linnaeus	Lemon pansy	Very rare
15	Nymphalinae	<i>Junonia orithya</i> Linnaeus	Blue pansy	Common
16	Nymphalinae	<i>Junonia hierta</i> Fabricius	The yellow pansy	Less common
17	Danainae	<i>Danaus chrysippus</i> Linnaeus	The plain tiger	Very common
18	Danainae	<i>Danaus genutia</i> Cramer	The common tiger	Very Common
19	Danainae	<i>Euploea core</i> Cramer	Common crow	Rare
20	Danainae	<i>Tirumala limniace</i> Cramer	-	Very rare
21	Satyrinae	<i>Melanitis leda</i> Cramer	Common evening brown	Less common
Papilionidae				
22	Papilioninae	<i>Papilio demoleus</i> Linnaeus	Lime butterfly	Very common
23	Papilioninae	<i>Papilio polytes romulus</i> Cramer	Indian common mormon	Very common
24	Papilioninae	<i>Graphium doson</i> Felder	Common jay	Less common
Pieridae				
25	Pierinae	<i>Belonoides aurota</i> Fabricius	The pioneer white	Less common
26	Pierinae	<i>Cepora nerissa</i> Fabricius	Common gull	Less common
27	Pierinae	<i>Ixias mariane</i> Cramer	White orange tip	Rare
28	Pierinae	<i>Ixias pyrene</i> Linnaeus	Yellow orange tip	Rare
29	Pierinae	<i>Pieris brassicae</i> Linnaeus	Large Cabbage White	Very common
30	Coliadinae	<i>Catopsilia pomona</i> Fabricius	Lemon emigrant	Less common
31	Coliadinae	<i>Catopsilia pyranthe</i> Linnaeus	Mottled emigrant	Less common
32	Coliadinae	<i>Colias fieldii</i> Ménétriés	The Dark clouded yellow	Less common
33	Coliadinae	<i>Eurema hecabe</i> Linnaeus	One-spot grass yellow	Common

(1♂ 1♀), Floriculture garden, 14.viii.2015, Sachin and P.C. Pathania (4♀), CIPHET, 11.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: Species is spread throughout India except at very high elevations and is widely distributed in the Malayan subregion; extending to Australia and the South Sea Islands (Bingham, 1907).

Host plant: Fabaceae (Kunte, 2000).

IV. Genus: **Chilades** Moore

4. **Chilades pandava** Horsfield (Photo 4a, b)

Lycaena pandava Horsfield, [1829], *Descr. Cat. lepid. Ins.* (2): 84 (*Lycaena*).

Material examined: (17♂♂ 13♀♀). India: Punjab: Orchard (PAU) 12.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: It is found in Peninsular India south of the outer ranges of the Himalayas, Ceylon, Assam, Burma and extending into the Malayan Subregion (Talbot, 1939).

Host plant: Cycadaceae, Fabaceae and Ulmaceae (Saji *et al.*, 2017).

V. Genus: **Catochrysops** Boisduval

5. **Catochrysops strabo** Fabricius (Photo 5a, b)

Hesperia strabo Fabricius (1793), *Ent. Sys.* 3.1:287 (*Hesperia*).

Material examined: (17♂♂ 19♀♀). India: Punjab: PAU, 12.v.2008, Katewa, A. Seni and P.C. Pathania (7♂ 9♀), PAU, 23.viii.2009, S. Chandel and P.C. Pathania (2♂ 4♀), PAU, 21.x.2010, Vijay and P. C. Pathania (1♂ 1♀), PAU 16.viii.2012, Sunita, Kritika and P.C. Pathania (2♂ 3♀), PAU, 8.ix.2013, Avi Kumar and P.C. Pathania (2♂), PAU, 4.vii.2015, Sachin and P.C. Pathania (3♂2♀).

Distribution: Europe, Africa, South and Southeast Asia, and Australia (Bingham, 1907).

Host plant: Fabaceae (Kunte, 2000).

VI. Genus: **Talicada** Moore

6. **Talicada nyseus** Guérin Meneville (Photo 6a, b)

Polyommatus nyseus Guérin-Ménéville (1843), *Deless Sour. Inde:* 78.t.22.f.i (*Polyommatus*)

Material examined: (6♂♂ 4♀♀). India: Punjab: PAU, 04.xii.2009, Katewa, A. Seni and P.C. Pathania (4♂ 2♀),

PAU 24.viii.2012, Sunita, Kritika and P.C. Pathania (2♂ 2♀).

Distribution: It found in Central, Western and Southern India, Assam, Ceylon and Burma (Bingham, 1907).

Host plant: Crassulaceae (Saji *et al.*, 2017).

Subfamily LYCAENINAE

VII. Genus **Rapala** Moore

7. **Rapala iarbus** Moore (Photo 7a, b)

Rapala jarbas Fabricius (1787), *Mant. Ins.* 2:68.

Material examined: (1♂). India: Punjab: PAU, 08.v.2009, Katewa, A. Seni and P.C. Pathania (1♂).

Distribution: South-east Asia from India to the Fiji, including the Philippines, and also the tropical coast of Queensland in Australia (Bingham, 1907).

Host plant: Connaraceae and Sapindaceae (Saji *et al.*, 2017).

Family NYMPHALIDAE

Subfamily HELICONIINAE Rafinesque, 1815

VIII. Genus: **Phalanta** Doubleday

8. **Phalanta phalanta** (Horsfield) (Photo 8a,b)

Papilio phalantha Horsfield, 1829, *Cat. Lep.E.Ind.Comp pl.* 7 (*Papilio*).

Material examined: (23♂♂ 17♀♀). India: Punjab: PAU, 11.viii.2011, Birpal, Amit and P.C. Pathania (12♂ 9♀), PAU 27.ix.2012, Sunita, Kritika and P.C. Pathania (7♂ 7♀), Forest field, 14.viii.2015, Sachin and P.C. Pathania (2♂ 1♀), Floriculture garden, 14.viii.2015, Sachin and P.C. Pathania (1♂), GADVASU, 17.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: It occurs nearly throughout Continental India, Ceylon, Assam, Burma, Tenasserim; extending to China, Japan and the Malayan Subregion (Bingham, 1905).

Host plant: Flacourtia species (Bingham, 1905).

Subfamily NYMPHALINAE

VIX. Genus **Vanessa** Fabricius

9. **Vanessa cardui** (Linnaeus) (Photo 9a,b)

Papilio cardui Linnaeus, 1758, *Syst. Nat.* 475 (*Papilio*).

Material examined: (18♂♂ 14♀♀). India: Punjab: PAU, 17.iv.2009, Katewa, Seni and P.C. Pathania (3♂ 5♀),

PAU, 8.xi.2009, Vijay and P.C. Pathania (8♂ 4♀), PAU, 05.ix.2010, S. Kumar, Vijay and P.C. Pathania (4♂ 3♀), PAU, 13.iii.2011, Birpal, Amit and P.C. Pathania (3♂ 2♀).
Distribution: The painted Lady is distributed over the whole world, it occurs in and is recorded from all parts of India, Ceylon, Burma and Tenasserim, more plentifully in the hills (Bingham, 1907).

Host plant: Asteraceae, Fabaceae, Papaveraceae and Utricaceae (Kunte, 2000).

X. Genus *Hypolimnas* Hübner

10. *Hypolimnas missipus* (Linnaeus) (Photo 10a,b)

Papilio misippus Linnaeus, 1764, *Verz. Bek. Schmett.*: 45.

Material examined: (5♂♂ 7♀♀). India: Punjab: PAU, 25.viii.2010, Vijay and P.C. Pathania (1♂ 3♀), PAU 3.xi.2012, Sunita, Kritika and P.C. Pathania (2♀), PAU, 14.viii.2015, Sachin and P.C. Pathania (1♂ 1♀), GADVASU, 17.viii.2015, Sachin and P.C. Pathania (2♂), Orchard, 12.viii.2015, Sachin and P.C. Pathania (1♂ 1♀).

Distribution: It is found in the Himalayas up to 6000 feet; extending to the Malayan Subregion and China (Bingham, 1905).

Host plant: *Portulaco oleracea* (Bingham, 1905).

11. *Hypolimnas bolina* (Linnaeus) (Photo 11a,b)

Papilio bolina Linnaeus, 1758, *Syst. Nat.*: 479.

Material examined: (6♂♂ 8♀♀). India: Punjab: PAU, 25.viii.2010, Vijay and P.C. Pathania (2♂ 3♀), PAU 3.xi.2012, Sunita, Kritika and P.C. Pathania (3♀), PAU, 14.viii.2015, Sachin and P.C. Pathania (1♂ 1♀), GADVASU, 17.viii.2015, Sachin and P.C. Pathania (2♂), Orchard, 12.viii.2015, Sachin and P.C. Pathania (1♂ 1♀).

Distribution: It is found in the Himalayas up to 6000 feet; extending to the Malayan Subregion and China (Bingham, 1905).

Host plant: *Portulaco oleracea* (Bingham, 1905).

XI. Genus *Junonia* Hubner

12. *Junonia almana* Linnaeus (Photo 12a,b)

Papilio almana Linnaeus, 1758, *Syst. Nat.*: 472.

Material examined: (8♂♂ 5♀♀). India: Punjab: PAU 8.viii.2012, Sunita, Kritika and P.C. Pathania (2♂ 2♀),

PAU 30.ix.2012, Sunita, Kritika and P.C. Pathania (2♂ 2♀), PAU, 14.viii.2013, Avi Kumar and P.C. Pathania (4♂), Orchard, 12.viii.2015, Sachin and P.C. Pathania (1♀).

Distribution: Throughout our limits; abundant, in some districts found also in the Malayan Sub region, and in China and Japan (Bingham, 1905).

Host plant: *Mimulis gracilis*, Rice crop (Bingham, 1905).

13. *Junonia atlites* (Linnaeus) (Photo 13a,b)

Papilio atlites Linnaeus, 1763, *Amoen Acad.*: 6: 407, n.72.

Material examined: (1♂ 1♀). India: Punjab: PAU, 11.viii.2011, Birpal, Amit and P.C. Pathania (1♂ 1♀).

Distribution: It is found in Terai, at the foot of the Himalayas from Kumaun Sikkim; Eastern Bengal, Central Provinces, Kanara, Ceylon, Burma, extending to the Malaya sub region (Bingham, 1907).

Host plant: Acanthaceae (Saji *et al.*, 2017).

14. *Junonia lemonias* (Linnaeus) (Photo 14a,b)

Papilio lemonias Linnaeus 1758, *Syst. Nat.*: 473.

Material examined: (1♀). India: Punjab: PAU, 26.x.2010, Vijay and P.C. Pathania (1♀).

Distribution: It occurs in North West Himalayas as far as Kumaun; Punjab, Bengal, Western and Southern India, Ceylon (Bingham, 1907).

Host plant: Acanthaceae and Cannabaceae (Saji *et al.*, 2017).

15. *Junonia orithya* Linnaeus (Photo 15a,b)

Junonia orithya Linnaeus, 1764, *Mus. Ulr.*: 278.

Material examined: (16♂♂ 10♀♀). India: Punjab: PAU, 18.vi.2008, Amit Katewa and P.C. Pathania (4♂ 3♀), PAU, 3.iii.2010, Vijay and P.C. Pathania (6♂ 2♀), PAU, 26.x.2010, Vijay and P.C. Pathania (5♂ 2♀), PAU 13.vii.2012, Sunita, Kritika and P.C. Pathania (3♀), Floriculture garden, 14.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: It occurs nearly throughout our limits, extending to China (Bingham, 1905).

Host plant: *Amaranthus*, Sweet Potato (Bingham, 1905).

16. *Junonia hierta* Fabricius (Photo 16a,b)

Junonia hierta Fabricius, 1798, *Ent. Syst. Suppl.*: 424.

Material examined: (15♂♂ 9♀♀). India: Punjab: PAU, 18.vi.2008, Amit Katewa and P.C. Pathania (4♂ 3♀), PAU, 3.iii.2010, Vijay and P.C. Pathania (6♂ 2♀), PAU, 26.x.2010, Vijay and P.C. Pathania (5♂ 1♀), PAU 13.vii.2012, Sunita, Kritika and P.C. Pathania (3♀), Floriculture garden, 14.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: It occurs nearly throughout our limits, extending to China (Bingham, 1905).

Host plant: Amaranthus, Sweet Potato (Bingham, 1905).

Subfamily DANAINAE

XII. Genus *Danaus* Linnaeus

17. *Danaus chrysippus* (Linnaeus) (Photo 17a,b)

Papilio chrysippus Linnaeus, 1758, *Syst. Nat. (ed.x)*: 471, n.81.

Material examined: (49♂♂ 39♀♀). India: Punjab: PAU, 14.iv.2009, Amit Katewa and P.C. Pathania (15♂ 12♀), PAU, 8.ii.2010, Vijay and P.C. Pathania (19♂ 15♀), PAU, 30.ix.2010, Sanjeev Chandel and P.C. Pathania, (12♂ 10♀), PAU, 14.viii.2015, Sachin and P.C. Pathania (1♂ 1♀), GADVASU, 17.viii.2015, Sachin and P.C. Pathania (1♂), Orchard, 12.viii.2015, Sachin and P.C. Pathania (1♂ 1♀).

Distribution: Found in Southern Europe, Syria, over a great part of the Ethiopian Region, through Arabia, Persia, and Afghanistan. Eastwards it extends to China and through the Malayan Subregion to Sulu and the Celebes (Bingham, 1905).

Host plant: Apocynaceae (Saji *et al.*, 2017).

18. *Danaus genutia* (Cramer) (Photo 18a,b)

Papilio genutia Cramer, 1779, *Pap. Exot.* 3: 23, t.206.

Material examined: (46♂♂ 35♀♀). India: Punjab: PAU, 14.iv.2009, Amit Katewa and P.C. Pathania (12♂ 10♀), PAU, 8.ii.2010, Vijay and P.C. Pathania (21♂ 20♀), PAU, 30.ix.2010, Sanjeev Chandel and P.C. Pathania, (6♂ 3♀), PAU, 14.viii.2015, Sachin and P.C. Pathania (4♂ 1♀), GADVASU, 17.viii.2015, Sachin and P.C. Pathania (2♂), Orchard, 12.viii.2015, Sachin and P.C. Pathania (1♂ 1♀).

Distribution: British India (Bingham 1905).

Host plant: Apocynaceae (Saji *et al.*, 2017).

XIII. Genus *Euploea* Fabricius

19. *Euploea core* (Cramer) (Photo 19a,b)

Papilio core Cramer, 1780, *Pap. Exot.* 3: 133, t. 267.

Material examined: (5♂♂ 2♀♀). India: Punjab: PAU, 16.v.2008, Katewa, A. Seni and P.C. Pathania (1♂ 1♀), PAU, 15.ix.2009, Vijay and P. C. Pathania (2♂ 1♀), PAU 09.vii.2012, Sunita, Kritika and P.C. Pathania (2♂).

Distribution: Throughout continental India (Bingham, 1907).

Host plant: Apocynaceae, Moraceae and Sapotaceae (Saji *et al.*, 2017).

XIV. Genus *Tirumala* Moore

20. *Tirumala limniace* Cramer (Photo 20a,b)

Papilio limniace Cramer, (1775), *Pap. Exot.* 1: 92, t. 59.

Material examined: (1♂). India: Punjab: Orchard, 12.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: China, India, Sri Lanka, Pakistan, Bangladesh, Myanmar, and Thailand (Ambrose and Raj, 2005).

Host plant: Poaceae (Saji *et al.*, 2017).

Subfamily SATYRINAE

XV. Genus *Melanitis* Fabricius

21. *Melanitis leda* Cramer (Photo 21a,b)

Melanitis lela Moore, 1758, *Syst. Nat. (ed. 10)*: 474.

Material examined: (7♂♂ 4♀♀). India: Punjab: PAU, 12.v.2008, Katewa, A. Seni and P.C. Pathania (1♂ 1♀), PAU, 23.viii.2009, S. Chandel and P.C. Pathania (2♂ 1♀), PAU, 21.x.2010, Vijay and P. C. Pathania (1♂ 1♀), PAU 16.viii.2012, Sunita, Kritika and P.C. Pathania (1♂ 1♀), PAU, 8.ix.2013, Avi Kumar and P.C. Pathania (1♂), PAU, 4.vii.2015, Sachin and P.C. Pathania (1♂).

Distribution: It ranges from Indo-Malayan Region down to Australia, Burma, Ceylon (Bingham, 1907).

Host plant: *Apluda* spp., *Cyrtococcum* spp., *Eleusine* spp., *Oplismenus composites*, *Oryza sativa*, *Panicum* spp., *Sorghum* spp., *Zea* spp., (Kunte, 2000).

Family PAPILIONIDAE

Subfamily PAPILIONINAE

XVI. Genus *Papilio* Linnaeus

22. *Papilio demoleus* Linnaeus (Photo 22a,b)

Papilio demoleus, Linnaeus, 1758, *Syst. Nat. (ed.10)*: 464. N. 35.

Material examined: (29♂♂ 16♀♀). India: Punjab: PAU, 26.iii.2010, Vijay and P.C. Pathania (8♂ 6♀), PAU,

25.viii.2010, Vijay and P.C. Pathania (5♂ 2♀), PAU 13.vii.2012, Sunita, Kritika and P.C. Pathania (8♂ 4♀), PAU, 5.xii.2012, Sunita, Kritika and P.C. Pathania (3♂ 1♀), PAU, 11.viii.2015, Sachin and P.C. Pathania (2♂ 1♀), GADVASU, 17.viii.2015, Sachin and P.C. Pathania (3♂ 1♀), CIPHET, 11.viii.2015, Sachin and P.C. Pathania (1♀).

Distribution: Kashmir to Ceylon; Assam to upper Burma, up to a moderate elevation; extending to Persia and eastwards to China and Formosa (Talbot, 1939).

Host plant: *Aegle marmelos*, *Chloroxylon swietenia*, *Citrus aurantifolia*, *Citrus grandis*, *Citrus limon*, *Citrus sinensis*, *Glycosmis arborea*, *Murreaya koenigii*, *Ruta graveolens* (Kunte, 2000).

23. *Papilio polytes romulus* Cramer (Photo 23a,b & 24a, b)

Papilio polytes romulus Cramer, 1758, *Pap. Exot.* 1: 67, t.43.

Material examined: (37♂♂ 26♀♀). India: Punjab: PAU, 17.iv.2009, Amit Katewa and P.C. Pathania (3♂ 2♀), PAU, 6.v.2009, Amit Katewa and P.C. Pathania (7♂ 4♀), PAU, 1.ix.2010, Vijay and P.C. Pathania (5♂ 2♀), PAU, 11.viii.2011, Birpal, Amit and P.C. Pathania (1♂ 2♀), PAU 27.ix.2012, Sunita, Kritika and P.C. Pathania (3♂ 2♀), PAU, 20.xi.2012, Sunita, Kritika and P.C. Pathania (4♂ 3♀), PAU 30.xi.2012, Sunita, Kritika and P.C. Pathania (2♂ 4♀), PAU, 13.viii.2013, Avi Kumar and P.C. Pathania (5♂ 5♀), PAU, 11.viii.2015, Sachin and P.C. Pathania (4♂). GADVASU, 17.viii.2015, Sachin and P.C. Pathania (1♂ 1♀), Floriculture garden, 14.viii.2015, Sachin and P.C. Pathania (1♂ 1♀), CIPHET, 11.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: Throughout Asia, Pakistan and southern Asia, including India and all regions east of it, Malaysia and Indonesia, and on the coast of southern China, the Philippine islands, and the southwestern islands of Japan (Suwarno, 2010).

Host plant: *Atalantia racemosa*, *Aegle marmelos*, *Citrus aurantifolia*, *Citrus grandis*, *Citrus limon*, *Citrus medica*, *Citrus sinensis*, *Glycosmis arborea*, *Murraya koenigii*, *Murraya paniculata*, *Tripahsia* sp., *Zanthoxylum rhetsa* (Kunte, 2000).

Distribution: Nicobar Islands (Talbot, 1939).

Host plant: Citrus, *Murraya*, *Triphasia*, *Xanthoxylon* (Talbot, 1939)

XVII. Genus *Graphium* Scopoli

24. *Graphium doson* (Felder) (Photo 25a, b)

Papilio doson Felder, 1864, *Verh. zool. bot. Ges. Wien.*: 305.

Material examined: (13♂♂ 7♀♀). India: Punjab: PAU, 26.ix.2011, Birpal, Amit and P.C. Pathania (4♂ 2♀), PAU 27.ix.2012, Sunita, Kritika and P.C. Pathania (3♂ 2♀), PAU, 1.xi.2013, Avi Kumar and P.C. Pathania (4♂ 2♀), Forest field, 14.viii.2015, Sachin and P.C. Pathania (2♂ 1♀), CIPHET, 11.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: South Japan to South China and Ceylon, southwards and eastwards to the Sunda Islands. Several subspecies are known, of which three occur in the Indian area (Talbot, 1939).

Host plant: *Annona lawii*, *Cinnamomum macrocarpum*, *Magnolia grandiflora*, *Michelia champaca*, *Milium tomentosum*, *Polyalthia longifolia*, Annonaceae, Lauraceae, Magnoliaceae (Kunte, 2000).

Family PIERIDAE

Subfamily PIERINAE

XVIII. Genus *Belonois* Hubner

25. *Belonois aurota* Fabricius (Photo 26a, b)

Belonois aurota Fabricius, 1793, *Ent. Syst.* 3, 1: 197.

Material examined: (8♂♂ 5♀♀). India: Punjab: PAU, 6.v.2009, Amit Katewa and P.C. Pathania (3♂ 1♀), PAU, 8.x.2010, Vijay and P.C. Pathania (2♂ 2♀), PAU 3.xi.2012, Sunita, Kritika and P.C. Pathania (2♂ 2♀), CIPHET, 11.viii.2015, Sachin and P.C. Pathania (1♂).

Distribution: It found in all India except Assam and Burma. A straggler is recorded from Great Nicobar. The subspecies also extends to Palestine and Africa (Talbot, 1939).

Host Plant: *Cadaba fruticosa*, *Capparis decidua*, *Capparis pyrifolia*, *Capparis rheedii*, *Capparis sepiaria*, *Capparis spinosa*, *Capparis zeylanica*, *Maerua oblongifolia* (Kunte, 2000).

XIX. Genus *Cepora* Billberg

26. *Cepora nerissa* Fabricius (Photo 27a, b)

Cepora Nerissa Fabricius, 1775. *Syst. Ent.*: 441.

Material examined: (13♂♂ 9♀♀). India: Punjab: PAU 5.xii.2012, Sunita, Kritika and P.C. Pathania (2♂ 2♀), PAU,

2.xi.2013, Avi Kumar and P.C. Pathania (4♂ 3♀), PAU, 14.viii.2015, Sachin and P.C. Pathania (5♂ 3♀), GADVASU, 17.viii.2015, Sachin and Pathania (2♂ 1♀).

Distribution: It found in Ceylon, India, Burma, and Andaman Islands, north to Formosa, south to Sumbawa (Bingham, 1907).

Host plant: *Cadaba fruticosa*, *Capparis decidua*, *Capparis rheedii*, *Capparis sepiaria*, *Capparis zeylanica*, *Maerua oblongifolia* (Kunte, 2000).

XX. Genus *Ixias* Hubner

27. *Ixias mariane* Cramer (Photo 28a, b)

Ixias marianae Cramer, 1779. *Exot. III.* : 41.

Material examined: (5♂♂ 3♀♀). India: Punjab: PAU 13.xii.2012, Sunita, Kritika and P.C. Pathania (2♂ 2♀), PAU 17.xii.2012, Sunita, Kritika and P.C. Pathania (2♂ 1♀), PAU, 18.ix.2013, Avi Kumar and P.C. Pathania (1♂).

Distribution: It occurs in North West Himalayas as far as Kumaun; Punjab, Bengal, Western and Southern India, Ceylon (Bingham, 1907).

Host plant: *Capparis deciduas*, *Capparis divaricata*, *Capparis grandis*, *Capparis sepiaria* (Kunte, 2000).

28. *Ixias pyrene* Linnaeus (Photo 29a, b)

Ixias pyrene Linnaeus, 1764. *Mus. Ulr.* : 241.

Material examined: (4♂♂ 3♀♀). India: Punjab: PAU 5.xii.2012, Sunita, Kritika and P.C. Pathania (2♂ 2♀), PAU, 2.xi.2013, Avi Kumar and P.C. Pathania (2♂ 1♀).

Distribution: It is the commonest and most widespread member of the genus. It is distributed in India, Pakistan to Taiwan, Malaysia, Borneo and the Philippines (Bingham, 1907).

Host plant: *Capparis sepiaria* (Kunte, 2000).

XXI. Genus *Pieris* Schrank

29. *Pieris brassicae* Linnaeus (Photo 30a, b)

Papilio brassicae Linnaeus, 1758. *Syst. Nat. ed. X:* 467.

Material examined: (41♂♂ 24♀♀). India: Punjab: PAU, 6.v.2009, Amit Katewa and P.C. Pathania (9♂ 5♀), PAU, 6.iv.2010, Vijay and P.C. Pathania (14♂ 6♀), PAU

4.viii.2012, Sunita, Kritika and P.C. Pathania (10♂ 8♀), PAU, 16.ix.2013, Avi Kumar and P.C. Pathania (8♂ 5♀).

Distribution: Baluchistan and Chitral (Pakistan) eastwards to Assam, very common in Himalayas and plains adjoining Himalayas, ascending to about 12,000 feet in Himalayas (Kumar, 2008).

Host plant: Brassicaceae (Kunte and Soman, 2017).

Subfamily COLIADINAE

XXII. Genus *Catopsila* Hubner

30. *Catopsila Pomona* Fabricius (Photo 31a, b)

Catopsila pomona Fabricius, 1775. *Syst. Ent.* : 479.

Material examined: (11♂♂7♀♀). India: Punjab: PAU, 8.viii.2009, Katewa, Seni and P.C. Pathania (3♂ 2♀), PAU, 12.x.2009, S. Chandel and P.C. Pathania (2♂ 1♀), PAU, 6.iv.2010, Vijay and S. Kumar (2♂ 2♀), PAU, 11.viii.2011, Birpal, Amit and P.C. Pathania (1♂ 1♀), PAU 4.vii.2012, Sunita, Kritika and P.C. Pathania (2♂ 1♀), PAU, 16.x.2013, Avi Kumar and P.C. Pathania (1♂).

Distribution: It found in Ceylon, India, Burma, Andaman Islands and Nicobar Islands; South China to Solomon Islands and Austerlia. (Bingham, 1907).

Host plant: *Cassia fistula* (Talbot, 1939)

31. *Catopsila pyranthe* Linnaeus (Photo 32a, b)

Papilio pyranthe Linnaeus, 1758. *Syst. Nat. I.1:* 469.

Material examined: (16♂♂ 9♀♀). India: Punjab: PAU, 28.vii.2010, Vijay and P.C. Pathania (3♂ 3♀), PAU, 12.ix.2012, Sunita, Kritika and P.C. Pathania (2♂ 2♀), PAU, 30.xi.2012, Sunita, Kritika and P.C. Pathania (3♂ 1♀), PAU, 11.viii.2015, Sachin and P.C. Pathania (2♂ 1♀), GADVASU, 17.viii.2015, Sachin and P.C. Pathania (1♂ 2♀), Floriculture garden, 14.viii.2015, Sachin and P.C. Pathania (3♂), CIPHET, 11.viii.2015, Sachin and P.C. Pathania (2♂).

Distribution: It found throughout India; Assam; Burma; Tenasserim; not ascending the Himalayas to above 7000 ft. It extends to China on the east and as far as Australia southwards (Bingham, 1907).

Host plant: *Cassia auriculata*, *Cassia fistula*, *Cassia occidentalis*, *Cassia tora*, *Gnidia glauca*, *Sesbania bispinosa* (Kunte, 2000).

XXIII. Genus: *Colias* Fabricius

32. *Colias electo fieldi* Ménériés (Photo 33a, b)

Colias fieldi fieldi Ménériés, 1855. *Cat. Mus. Petr. Lep.* I: 79.

Material examined: (9♂♂ 4♀♀). India: PAU, 20.viii.2010, Vijay and P. C. Pathania (5♂ 2♀), PAU 04.xii.2012, Sunita, Kritika and P.C. Pathania (3♂ 1♀), PAU 13.xii.2012, Sunita, Kritika and P.C. Pathania (1♂ 1♀).

Distribution: Baluchistan to North Punjab, Sikkim, northern Burma, more common in the Western Himalaya. (Bingham, 1907).

Host plant: Caterpillars feed on Fabaceae, for example vetches (*Vicia*). While most are thus beneficial by keeping weeds at bay, some occasionally become nuisance pests on crops like alfalfa (Kunte, 2000).

XXIV. Genus *Eurema* Hubner

33. *Eurema hecabe* Linnaeus (Photo 34a,b)

Papilio hecabe Linnaeus, 1758. *Syst. Nat. ed.* X: 470.

Material examined: (17♂♂ 14♀♀). India: Punjab: PAU, 8.viii.2009, Katewa, Seni and P.C. Pathania (3♂ 2♀), PAU,

12.x.2009, S. Chandel and P.C. Pathania (2♂ 1♀), PAU, 6.iv.2010, Vijay and S. Kumar (2♂ 2♀), PAU, 11.viii.2011, Birpal, Amit and P.C. Pathania (1♂ 1♀), PAU 4.vii.2012, Sunita, Kritika and P.C. Pathania (2♂ 1♀), PAU, 16.x.2013, Avi Kumar and P.C. Pathania (1♂).

Distribution: British India (Bingham, 1905).

Host plant: The early stages of Common Grass Yellow are polyphagous with most of its host plants belonging to the Fabaceae family. The caterpillars feed on the young and tender leaves of the host plants. Eggs are laid on *Abrus precatorius*, *Acacia* spp., *Aeschynomene* spp., *Albizia* spp. and numerous other Leguminosae, Euphorbiaceae and Cucurbitaceae species (Kunte, 2000).

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PLATE 1

Family: Hesperidae



1a

1b

Figure 1. 1-*Pelopidas mathias*

Family: Lycaenidae



2a

2b

3a

3b

4a

4b

5a

5b

6a

6b

7a

7b

Figure 2-8. 2-*Tarucus callinara*; 3-*Euchrysops cnejus*; 4-*Chilades pandava*; 5-*Catochrysops strabo*; 6- *Talicauda nyseus*; 7- *Rapala airbus* (a: Upper side, b: Lower side).

Family: Nymphalidae



8a



8b



9a



9b



10a



10b



11a



11b



12a



12b



13a



13b



14a



14b



15a



15b

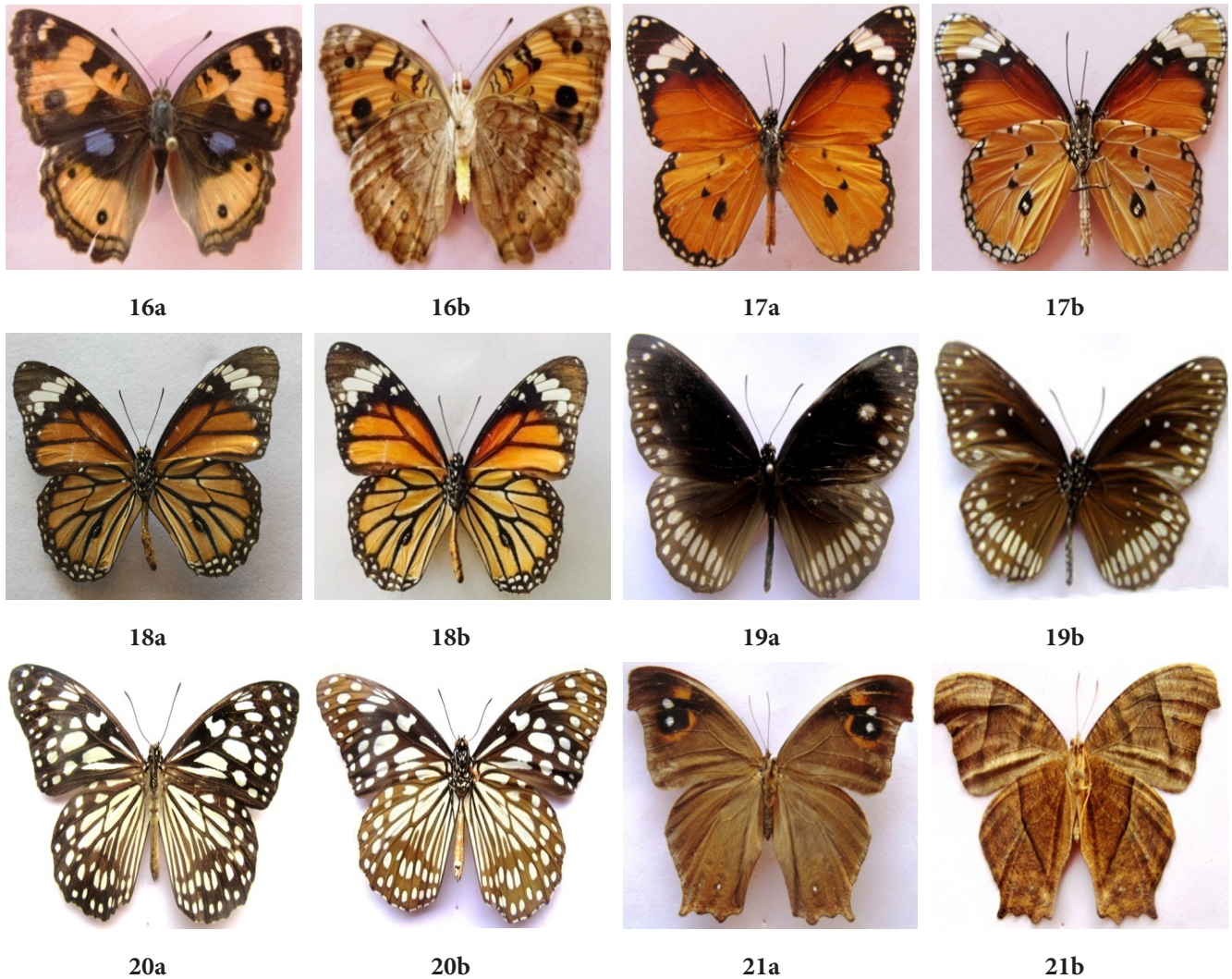


Figure 8-21. 8- *Phalanta phalantha*; 9- *Vanessa cardui*; 10- *Hypolimnas missipus*; 11- *Hypolimnas bolina*; 12- *Junonia almana*; 13- *Junonia atlites*; 14- *Junonia lemonias*; 15- *Junonia orithya*; 16- *Junonia hierta* 17- *Danaus chrysippus*; 18- *Danaus genutia*; 19- *Euploea core*; 20- *Tirumala limniace*; 21- *Melanitis leda*.

Family: Papilionidae



22a



22b



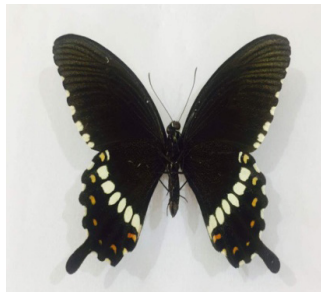
23a



23b



24a



24b



25a



25b

Figure 22-25. 22- *Papilio demoleus*; 23-24 *Papilio polytes romolus*; 25- *Graphium doson* (a: Upper side, b: Lower side).

Family: Pieridae



26a



26b



27a



27b



28a



28b



29a



29b

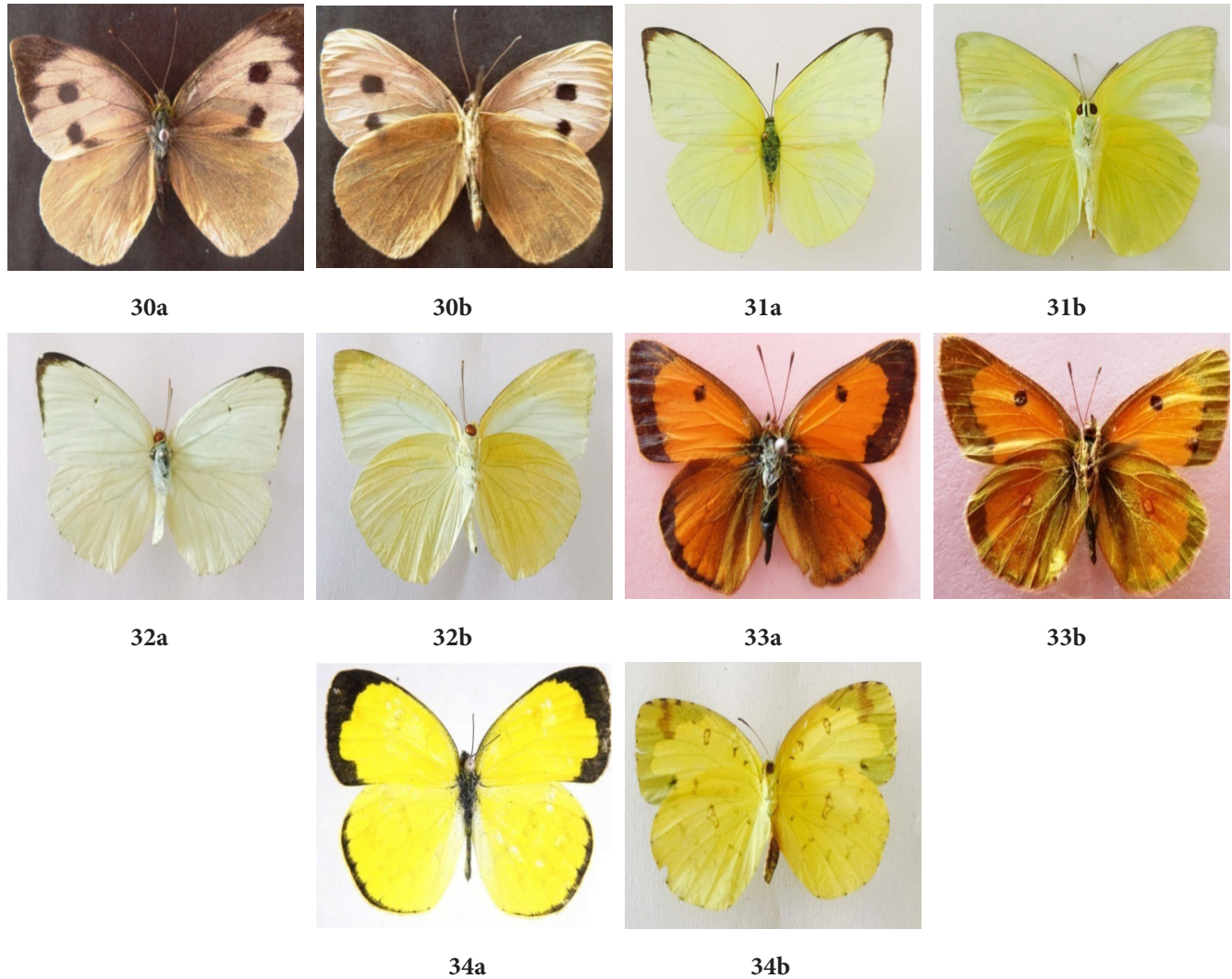


Figure 26-34. 26-*Belonoides aurota*; 27- *Cepora nerissa*; 28- *Ixias marianne*; 29- *Ixias pyrene*; 30- *Pieris brassicae*; 31- *Catopsilia pomona*; 32- *Catopsilia pyranthe*; 33- *Colias fieldii* 34- *Eurema hecabe* (a: Upper side, b: Lower side).