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Studies on Insect Pollinators of *Vinca major* (L.) in Shimla Hills, Western Himalaya, India

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ABSTRACT: *Pollinators are essential for sustaining the pollination services, because of variation in pollinator community. Therefore, the present investigation were conducted on taxonomy of insect pollinators of medicinally important plant Vinca major (L.) in Shimla Hills. The collections of insect pollinators were made during flowering season i.e. April-May. During this study period a total 11 insect pollinators were recorded, collected and indentified on Vinca major, and their taxonomic studies were made on the basis of their morphological characters and genitalic attributes. Of these 11 species 08 belonged to sub-order Rhoplaocera (Celastrina huegelii, Celastrina lavendularis, Lampides boeticus, Aglais cashmirensis, Pieris brassicae, Pieris canidia, Gonepteryx rhamni neplensis & Hyarotis adrastus), of Order Lepidoptera and 01 each to Hymenoptera (Xylocopa* sp.*), Coleoptera (Coccinella septumpunctata) and Diptera (Macroglossum pyrrhosticta).*

KEYWORDS: taxonomy, insect pollinators, *Vinca major*

INTRODUCTION

Pollinators provide pollination services for many crops species, medicinal plants and wild plants. Therefore, pollination is a well known social service provided by insects for free to humans but take reward from flowers in the form of nectar and pollen for food and feed. Pollination is essential for the process of fertilization and production of fruit and seeds. Pollination can't be depending only on one insect species or one type of insect species. Many groups of insects are known as pollinators of various plants. Bees, butterflies, moths, beetles, wasps and flies are reported as pollinators of plants. Bees are the most important and effective pollinator than other group of insects Tylianakis *et al.* (2007). Other insects, in particular, beetle, flies, butterflies and moths may transmit pollen incidentally during their quest for nectar of floral tissues. Many species of butterflies are nectar feeders and thus, frequently visit flowers and move from one flower to another. They undoubtedly perform beneficial role in assisting plant pollination. Pollinators strongly influence ecological relationships, ecosystem conservation and stability, genetic variation in plant community, floral diversity, specialization and evolution. In present study, taxonomic attributes of insect pollinators of *Vinca major* (L.) were examined. Besides studying morphological characters, their male and female genitalia have also been described in detail.

MATERIAL AND METHODS

The insect pollinators of *Vinca major* (L.) were collected from Shimla hills, Himachal Pradesh (altitude350-2206 meters and extends between 31^0-6^0 N latitude and 77^0-10^0). For collection of different insect pollinators aerial netting method was used. The collected insect pollinators were killed by using benzene after that they were stretched on the stretching board and preserved as dried specimen into air tight wooden insect cabinets containing powdered naphthalene. For the examination of genitalia, first of all the abdomen of specimens were separated from the rest of body. The detached abdomen was then put in 10% KOH solution. For dissection, different processes were followed for removal of male and female genitalia (Martin, 1996). The material was washed in distilled water. After proper washing, material was dissected in 10% alcohol and genitalia were removed with the help of fine needles and forceps. It was then gradually upgraded and dehydrated in various grades of alcohol cleared in clove oil and mounted in Canada balsam. After this specimen was oriented on the slide, the cover glass was placed and observed under Nikon stereomicroscope (SMZ800N/SMZ1270/SMZ1270i).

RESULT

ORDER: Coleoptera

FAMILY: Coccinellidae

Coccinella septumpunctata Linnaeus- The Seven-Spot Ladybird **(Fig. 1)**

Diagnostic Features: Body is roundly oval, convex, nearly hemispherical and densely punctuate with seven spot. Three spots on each elytra and one spot being spread over the junction of two elytra. The size of the spots is black in colour. Head is transverse black with pair of yellow spots on frons near eyes. Triangular head with yellow hairs except on eye. Antennae 11 segmented with longer basal segment. Small eyes with minute facets. Elytra without hairs and finely pitted.

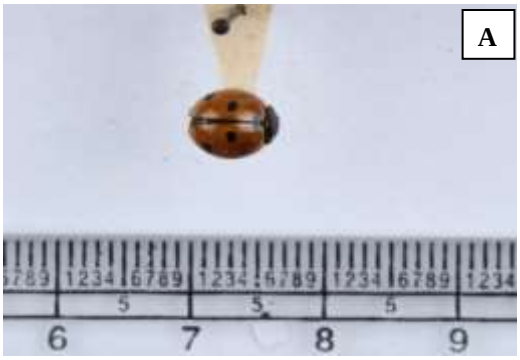
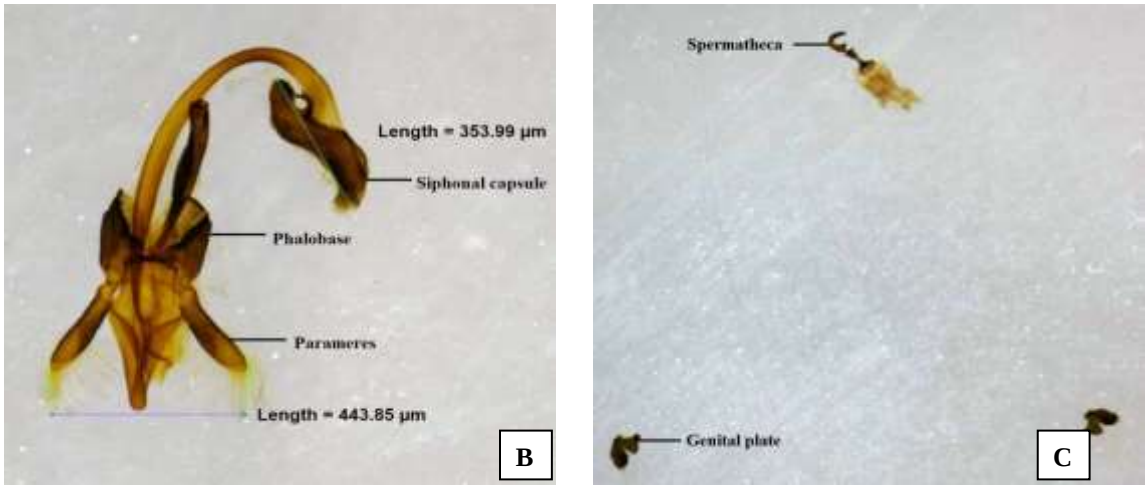


FIG. 1

Male Genitalia: Phalobase: Short trabes with more or less uniform in thickness. Parameres thick, cylindrical, broader at tips, bulb shaped, with densely covered hairs. Short median lobe with broad base tapering gradually beyond middle to apex, form triangle like structure. Siphon: Siphonal capsule is asymmetrical somewhat Y shaped. Outer arm is thick and straight and inner arm is thin. Siphonal tube is long, bent at base, almost straight for most of its length and the distal end carries more or less sac like structure.

Female Genitalia: Hemisternite bears a stylus. Hemisternite is elongate, transverse oval in shape. Anterior portion of hemisternite is bifid and the basal part is sparsely hairy. Spermetheca strongly hooked nodules and ramus and clearly demarcated with elongated infundibulum.



Male genitalia **Female genitalia**

***Coccinella septumpunctata* (Linnaeus)**

FIG. 1

ORDER: Hymenoptera

FAMILY: Apidae

Xylocopa sp.- The Carpenter Bee **(Fig. 2)**

Diagnostic Features: Head transverse, rounded ocelli in a triangle just below the vertex, eyes larger in the male and more closely approximate at vertex than in the female. Antennae geniculate. Maxillary palpi 6 jointed. Labial palpi 4-jointed. Thorax short, forewing with elongated radial cell, acute at apex. Three cubital cells, the 3rd longest, 2nd sub-triangular, the inner angle produced the 1st recurrent nervure interstitial with the 2nd transverse cubital nervure; the 3rd cubital cell receives the 2nd recurrent nervure about the middle. Posterior tibiae and tarsi always densely pubescent, the former with two simple spines at apex. Legs of male generally elongate. Abdomen either elongate or broad and flat, fringed with long hairs on the sides of the segments.

Male Genitalia: Genital capsule is wide, gonobase (cardo) reduced, gonocoxite (stipes) strongly developed, broad at base, narrower toward apex, inwardly curved gonostylus with dense hairs, apex simple, penis valve (sagitta) arcuate, incurved at apex, with narrow, well developed basal

projection (lateral carina), spatha reduced, transversely elongate, gonocoxite is with ventro-apical plate, medial apical lobe reduced.

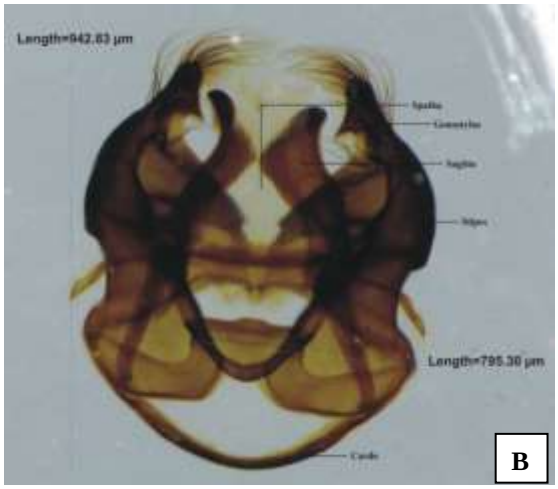


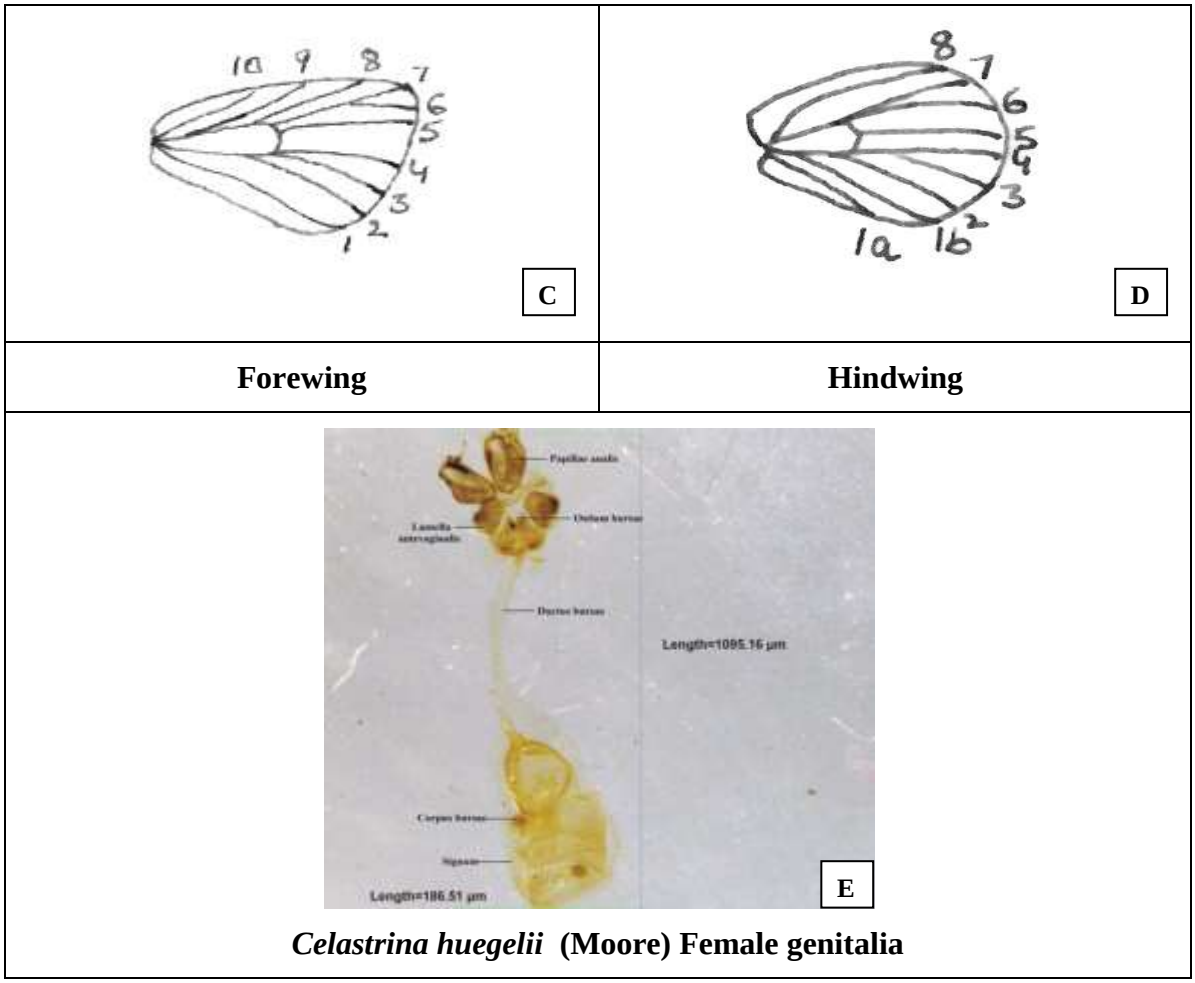
FIG. 2

***Xylocopa* sp.** **Male genitalia**

ORDER: Lepidoptera
FAMILY: Lycaenidae
Celastrina huegelii Moore- The Large Hedge Blue **(Fig. 3)**
Diagnostic Features: Female: More dusky throughout. Upperside: Forewing with broader blackish marginal border with well-defined inner pale dentate marks, the veins are also dusky black. Underside: Grey. Both wings with similar but more distinct markings, the discal series of spots on the hindwing are linear in shape, the marginal spots and sub-marginal lunular band are much more prominent.
Wing Expanse: 34-40 mm.

Upperside **Underside**

Female Genitalia: Genital plates well sclerotized, semicircular notch at the middle of posterior margin called ostium bursae which leads into long, slender ductus bursae. Corpus bursa is obovate, papillae analis is trapezoidal, pilose and two signum are present.



Celastrina huegelii **(Moore) Female genitalia**

FIG. 3

Celastrina lavendularis Moore- The Plain Hedge Blue **(Fig. 4)**

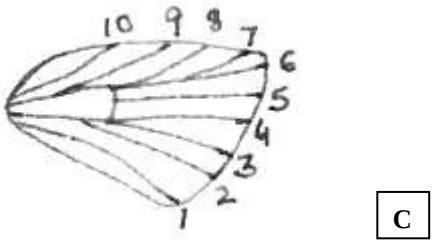
Diagnostic Features: Male: Upperside: dark lavender-blue, with an extremely narrow black outer marginal border. Underside: grayish-white. Forewing with dusky-black streak at end of the cell, a discal series of oblique spots and marginal row of small spots enclosed by a dentated line. Hindwing with three black subbasal spots, some specimens with a smaller spot at base of subcostal and another at base of lower median vein, a curved series of seven discal spots and a marginal row of spots enclosed by a dentate line.

Wing Expanse: 28-34mm.

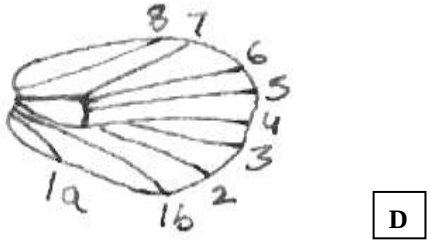
Male Genitalia: Uncus pilose, valva long, aedeagus short, thick, club shaped. Tegumen broad with prominent more sclerotized central fold.

Upperside

Underside



Forewing



Hindwing

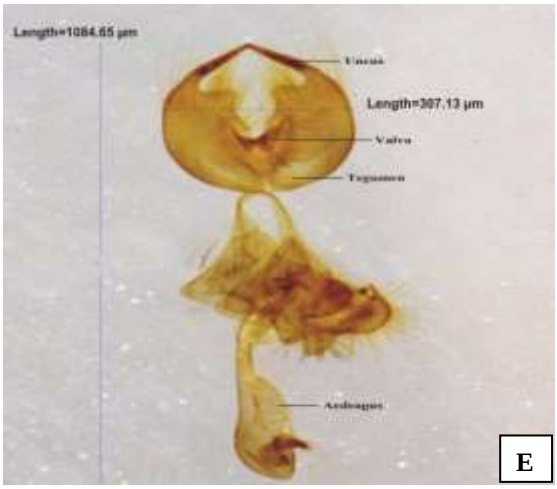
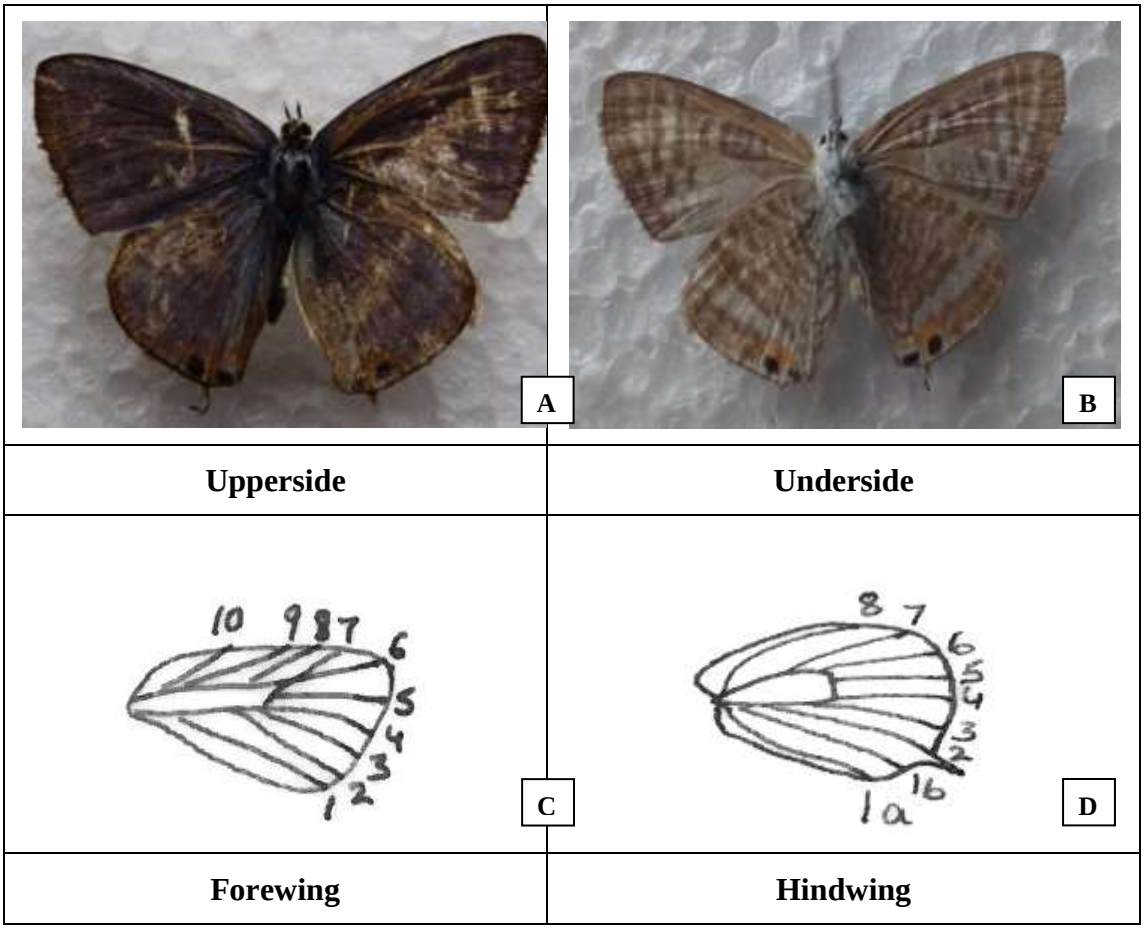


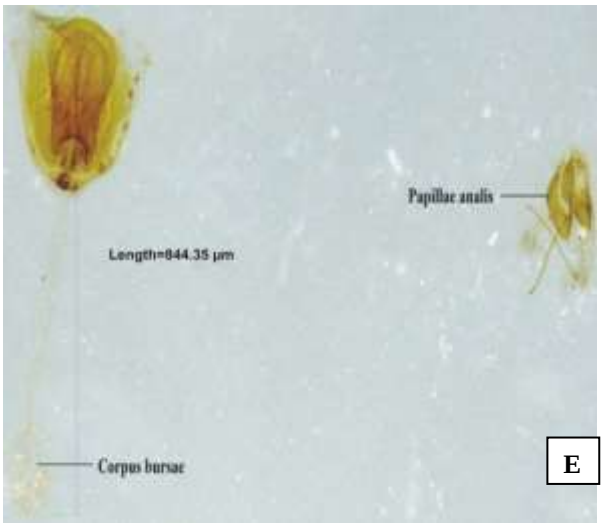
FIG.4 ***Celastrina lavendularis*** **(Moore) Male genitalia**

Lampides boeticus Linnaeus- The Pea Blue **(Fig. 5)**

Diagnostic Features: Female: Upperside: both wings dark brownish with blue scaling at the bases; generally with obscure white marginal crescent. Forewing with a discal bluish patch. Hindwing has a slightly long, white tipped tail, two outer greyish sub-marginal bands, and black anal angular spots as in males. Underside: both wings pale brown or whitish with narrow brown bands. Hindwing with two orange crowned tornal black spots. In between the brown bands a broad whitish discal band.

Wing Expanse: 24-36 mm.





***Lampides boeticus* (Linnaeus) Female genitalia**

FIG.5

Female Genitalia: Small triangular papillae analis, which is covered with small hairs. Anterior apophysis is not well developed whereas posterior apophysis is large hair-like. Ductus bursae very long, curved and corpus bursa rod-shaped without cornuti.

FAMILY: Nymphalidae

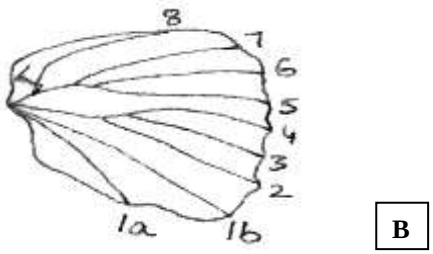
Aglais cashmirensis Kollar- The Indian Tortoise-shell **(Fig. 6)**

Diagnostic Features: Male and female: Upperside: both wings coloured rich chestnut. Forewing with a quadrate black bar across the middle of the cell, then a pale yellow bar, then another much larger black bar, with another narrower pale yellow bar beyond it, with a small bluish-white, costal spot placed outwardly against it. Apex cut off at the tip and produced and angulated at vein 6. Hindwing with a basal area blackish, inner margin paler in basal half, outer margin black, bearing-prominent bluish lunules, followed by two paler lines and margin toothed at vein 4. Underside: Both wings brown at bases, paler beyond and thickened striated with black, a sub-marginal lunulated black line. Forewing with a narrow oval black spot with pale center at the base of the cell, two fine black zig-zag lines enclosing a black space across the middle of cell. Hindwing with prominent ochraceous spot at the lower end of the cell and two fine black lines enclosing a blackish space across its middle.

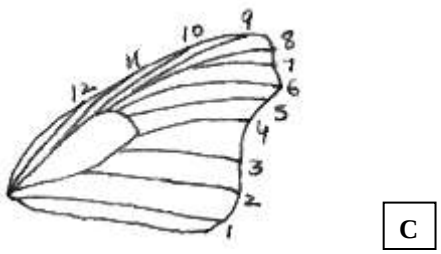
Wing Expanse: 52-65 mm.

Female Genitalia: Ductus bursae broad, indistinguishable from corpus bursae, apical portion membranous, straight, sclerotized, basal portion near ostium bursae highly sclerotized, ductus

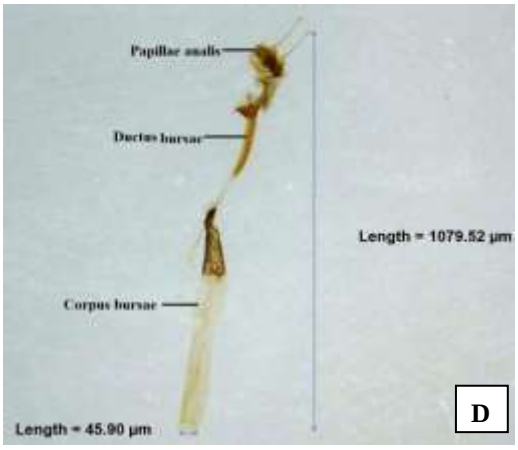
seminalis enters at a junction of membranous and sclerotized portion, corpus bursae very elongated, narrow, apophyses anterioris not developed, posterior apophysis rod like, weakly sclerotized, apices swollen, papillae analis subovate, anterior half well sclerotized, posterior half nearly membranous.



Forewing



Hindwing



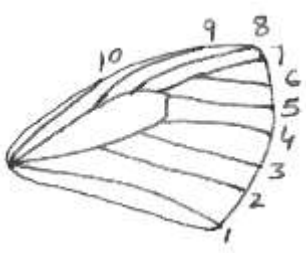
***Aglais cashmirensis* (Kollar) Female genitalia**

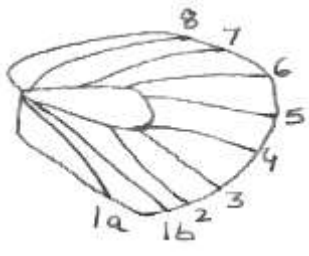
FIG.6

FAMILY: Pieridae

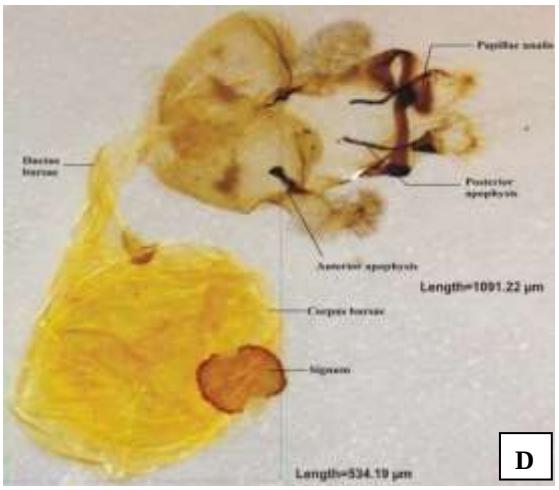
Pieris brassicae Linnaeus- Large Cabbage White **(Fig. 7)**

Diagnostic Features: Female upperside: similar to that of the male but the irroration of black scales at the base of the wings more extended, the black area on apex and termen of forewing broader, its inner margin less evenly curved, a conspicuous large black spot in outer half of interspace 1 and another near base of interspace 3. On the hind wing the sub coastal black spot before apex much larger and more prominent. Underside: white, slightly irrorated with black scales at the base of cell and along costa but the apex of the forewing and the whole surface of the hind wing light ochraceous yellow, the black discal spots on forewing is much larger. Antennae black, white at apex, head, thorax and abdomen black, with some white hairs, beneath: whitish.
Wing Expanse: 62-78 mm.
Female Genitalia: Corpus bursae rounded, gradually narrow towards appendix bursae, signum bifid by shallow suture, outer margins more sclerotized. Appendix bursae globular, moderately large, membranous, clearly separated from corpus bursae. Ductus bursae long, well sclerotized, papilla analis rounded and setosed, posterior apophysis long, thin, sclerotized with blunt tips, anterior apophysis smaller and broad.





Forewing	Hindwing



***Pieris brassicae* (Linnaeus) Female genitalia**

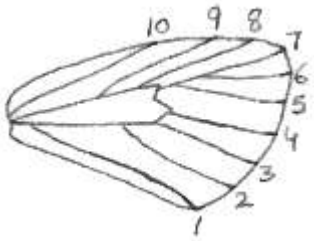
FIG.7

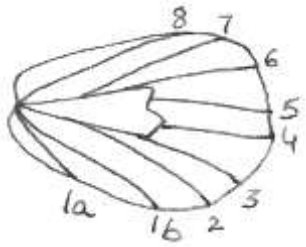
Pieris canidia Sparrman- The Indian Cabbage White **(Fig. 8)**

Diagnostic Features: Male: Upperside: white to pale cream-colour. Forewing: base and basal portion of costa and base and upper margin of cell are irrorated with black scales; apex and terminal margin is decreasingly black to the middle, a round black spot in interspace 3. Hindwing: a subcostal black spot as in *Pieris rape*, but generally larger and more conspicuous and a series of 4 or 5 terminal black spots that vary in size at the apices of the veins. Underside: forewing white, cell and costa lightly irrorated with black scales, apex somewhat broadly tinged with ochraceous yellow, interspaces 1,3 and 5 with conspicuous subquardrate black spots, the spot in interspace 1 sometimes extended into interspace 1 a. Hindwing: pale, almost white, to dark ochraceous, thickly irrorated all over with black scales, costa above vein 8 chrome- yellow. Antennae black with minute white specks, the long hairs on head and thorax greenish-grey, abdomen black, beneath: head, thorax and abdomen are white.

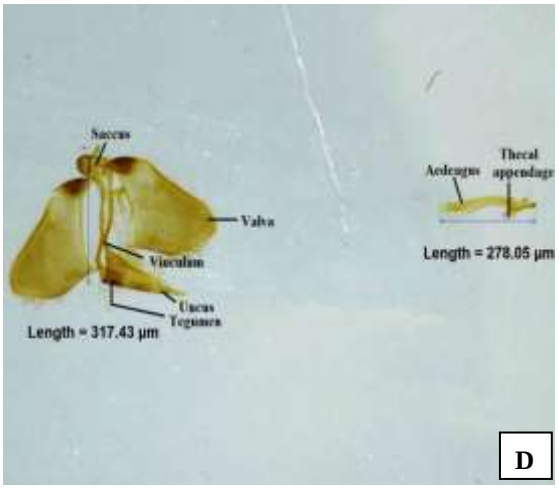
Wing Expanse: 42-60 mm.

Male Genitalia: Narrow uncus, slightly sinuous, distal tip pointed and curved downward. Broad tegumen longer than uncus. Vinculum thin, heavily sclerotized. Broad saccus with rounded distal end, juxta reduced cone-shaped with thin sclerotized long arm. Valva broad proximally with sclerotized marginal area, apex narrow and blunt. Costa and lateral margins sinuous. Aedeagus robust slightly curved. Moderately broad ventral thecal appendage and ductus ejaculatorious enters dorsally.





Forewing | **Hindwing**



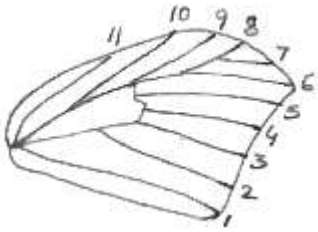
***Pieris canidia* (Sparrman) Male genitalia**

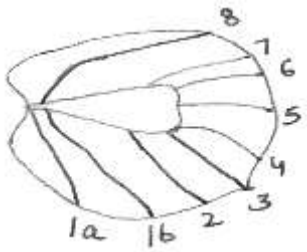
FIG.8

Gonepteryx rhamni neplensis Doubleday - The Common Brimestone **(Fig. 9)**

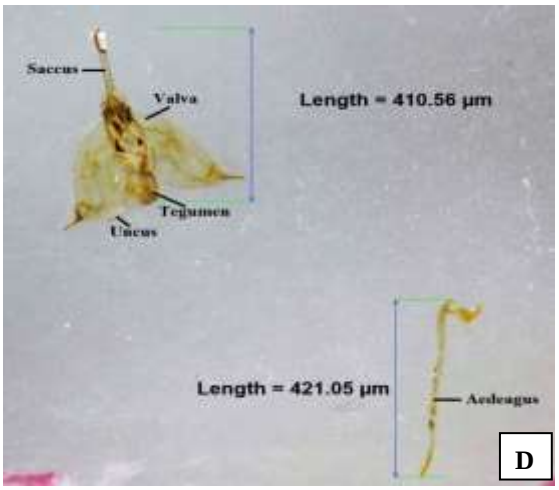
Diagnostic Features: Male: Upperside: wings sulphur yellow, an orange disco-cellular spot on both wings. Forewing with apex more falcate. Underside: Pale yellowish green. Female: Upperside: creamy white. Forewing with apex sharply falcate, marginal dots more distinct, disco-cellular spots on both wings larger and brighter. Hindwing toothed at vein 3. A dark orange spot present at the end of cell in each wing. Underside: Pale yellowish-white or greenish.

Wing Expanse: 60-70 mm.
Male Genitalia: The valvae, vinculum, saccus and aedeagus are well developed. The apex of valva is long and pointed. The dorsal part of genitalia has tegumen and uncus.





Forewing	Hindwing



***Gonepteryx rhamni neplensis* (Doubleday) Male genitalia**

FIG.9

FAMILY: Hesperiidae

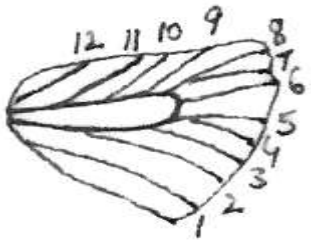
Hyarotis adrastus Cramer- The Tree Flitter **(Fig. 10)**

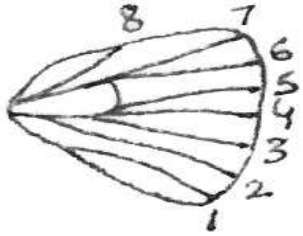
Diagnostic Features: Male and female dark
chocolate-brown. Upperside: forewing with three small conjugated subapical semi-transparent white spots, three similar and larger discal spots and a fourth above them within the cell. Underside darker brown basally, paler exteriorly, forewing with spots as above bordered externally by a suffused dark brown streak, hindwing with a double series of white dark brown-outer-bordered lunules crossing the middle of the wing beyond which is a submarginal series of suffused dark brown spots. Palpi, thorax and
abdomen beneath pale greyish-brown.

Wing Expanse: 38-48mm.

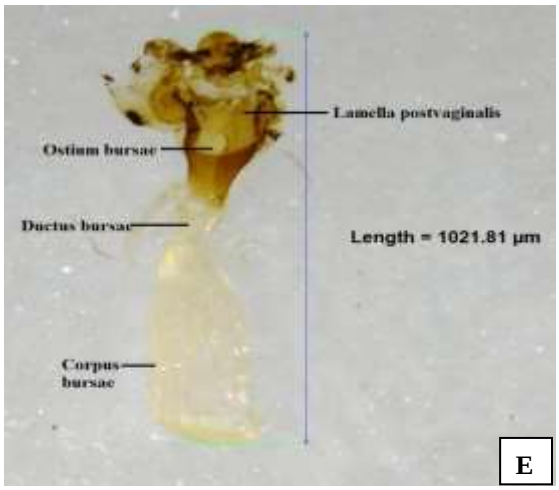
Female Genitalia: Lamella postvaginalis is broader with rounded apex, ostium bursae opens into short ductus bursae and corpus bursae is without signa.

Upperside | **Underside**





Forewing | **Hindwing**



***Hyarotis adrastus* (Cramer) Female genitalia**

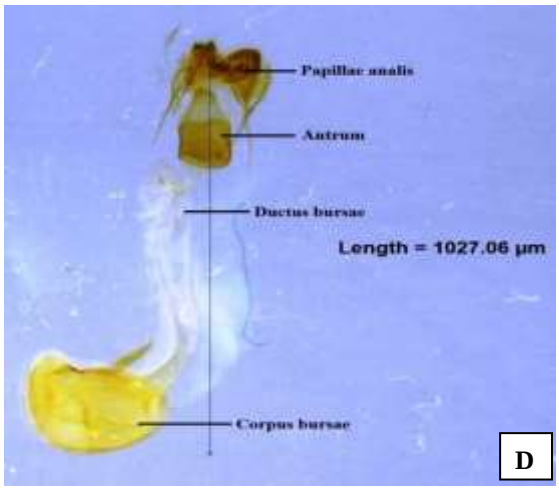
FIG.10

FAMILY: Sphingidae

Macroglossum pyrrhosticta Butler- The Burnt-Spot Hummingbird Hawkmoth **(Fig. 11)**

Diagnostic Features: Male and Female: very like *troglodytus* but larger, antemedian band and first discal line of forewing wider apart, all the grey interspaces more olivaceous, duller and not so prominent as in *troglodytes*. The wings appearing less variegated, though the number of lines and interspaces is the same in both species. Underside: as bright ferruginous as in *troglodytes,* abdomen often with two rows of blackish patches as in many specimens of *troglodytus*. Underside of palpus and middle of breast are variable in tint.

Forewing	Hindwing



***Macroglossum pyrrhosticta* (Butler) Female genitalia**

FIG.11

Wing Expanse: 42-56 mm.

Female Genitalia: Antrum is heavily sclerotized, entrance open, ductus bursae very short, broadly connecting antrum to corpus bursae, corpus bursae broadly rounded, signum is also present. Corpus bursae membranous pleats running longitudinally from ductus bursae and curving around signum anteriorly.

DISCUSSION AND CONCLUSION

In present investigation genitalia of 11 species has been studied taxonomically in Shimla hills, Himachal Pradesh i.e (*Celastrina huegelii, Celastrina lavendularis, Lampides boeticus, Aglais cashmirensis, Pieris brassicae, Pieris canidia, Gonepteryx rhamni neplensis & Hyarotis adrastus*), of Order Lepidoptera and 01 each to Hymenoptera (*Xylocopa* sp.), Coleoptera (*Coccinella septumpunctata)* and Diptera (*Macroglossum pyrrhosticta*). Simialr studies has been conducted by different workers but not as a pollinators of medicinal plants. Some of these are genitalia of *C. septempunctata* were by Kundoo *et al*. (2018). Studies on genital capsule of *Xylocopa* sp. was conducted by Lucia *et al*. (2010) and Prashantha *et al*. (2016). *Pieris brassicae* (L.) female genitalia and *Pieris canidia* **(**Sparrman) male genitalia have also been studied by Kirti *et al*. (2020). The studies on male genitalia of *Gonepteryx rhamni neplensis* **(**Doubleday) was done by Olivier *et al*. (1994) and studies on female genitalia of different species of *Macroglossum* was by Yen *et al*. (2003).

Acknowledgement
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References

Kirti, J.S., Kaur, M., Sidhu, A.K. & Singh, N. (2020) Taxonomic revision of the Genus Pieris Schrank (Lepidoptera: Pieridae) from India. *Journal of Applied and Natural Science*, **12**(3), 328-343.

Kundoo, A.A., Khan, A.A., Ahad, I., Chatoo, M.A., Bhat, N.A. & Rasool, K. (2018) Taxonomic redescription of the species of Genus *Coccinella* (Coleoptera: Coccinellidae) from Jammu and Kashmir, India. *Journal of Pharmacognosy and Phytochemistry*, **7**(5), 79-82.

Lucia, M. & Abrahamovich, A.H. (2010) A new species of Large Carpenter Bee, *Xylocopa* (Hymenoptera: Apidae), from Argentina. *Entomological News*, **121**(3), 243-248.

Martin, R.H. (1996) The procedure for the preparation of microscope slides of the genitalia apparatus of lepidoptera with special reference to the eversion of the verica of aedegus. British Museum (NH), London.

Olivier, A., Poorten, D.V.D. & Prins, W.D. (1994) Conspicuous aberrations and gynandromorphs of some Greek and Turkish butterflies (Lepidoptera: Pieridae, Lycaenidae). *Phegea*, **22**(3).

Prashantha, C. & Belavadi, V.V. (2016) Large carpenter bees, Xylocopa from central western ghats of India: taxonomic notes on subgenus Koptortosoma (Hymenoptera: Apidae: Xylocopinae). *Oriental Insects*, 1-19.

Tylianakis, JM., Tscharntke, T. & Lewis, O.T. (2007) Habitat modification alters the structure of tropical host-parasitoid food webs. *Nature*, **445**, 202-5.

Yen, S.H., Kitching, I.J. & Tzen, C.S. (2003) A new subspecies of hawkmoth from Lanyu, Taiwan, with a revised and annotated checklist of the Taiwanese Sphingidae (Lepidoptera). *Zoological Studies*, **42**(2), 296-306.