

GEOMETRIDAE (ENNOMINAE) LEPIDOPTERA FROM MIZORAM, INDIA

PART-I

**B. LALNGHAHPUII¹, LALRUATTHARA HMAR² & ESTHER
LAHMINGLIANI^{3*}**

^{1,2,3}Systematics and Toxicology Laboratory, Department of Zoology, Mizoram University, Aizawl, 796004, Mizoram, India.

**Corresponding author*

Email: lalnanaui@gmail.com, ruatthara@gmail.com, es_ralte@yahoo.in

Reviewer: Peter Smetacek

INTRODUCTION

In terms of species richness, the family Geometridae is second largest of the Order Lepidoptera with an estimated 23,002 species referable to 2,002 genera under 9 subfamilies worldwide (Scoble & Hausmann, 2007). They are distinguished by the planiform resting position of their wings as well as their delicate and slender bodies. Several species show specificity to certain habitats, particularly at high altitudes (Holloway, 1985). Adults are characterized by the presence of a basal fork between veins 2A and 3A in the forewing, vein 1A is always absent (Kirti *et al.*, 2019).

Mizoram, covering a geographical area of 21,087 square kilometers is situated in the North-Eastern part of India. It represents an important part of the Indo-Myanmar biodiversity hotspot and is rich in flora and fauna. The elevation ranges from 21 m at Tlabung to 2,157 m at Phawngpui. Despite its tropical location, it enjoys a moderate climate throughout the year (Pachauau,

2009). Though attempts have been made by other taxonomists (Ghosh *et al.*, 2007; Kirti *et al.*, 2012, 2014, 2019; Saxena, 2014; Smetacek, 2019) the Geometrid fauna of Mizoram is still very poorly documented. The primary objective of this paper is to document Geometrid moths under the subfamily Ennominae from Mizoram based on all preceding reports as well as current studies.

MATERIAL AND METHODS

Specimens were collected using a 160 W mercury vapour lamp with a Honda EP1000 portable generator as a power source reflected off a 1.5 m x 2 m white sheet hung between two vertical poles. The light source was placed in such a way that the whole sheet was brightly illuminated. Geometer moths that came to light were hand sampled and photographs were taken. The collected specimens were killed in a killing jar containing petroleum ether which were then removed and placed in butter paper packets with the wings folded vertically. Pinning, setting and labelling of specimens was done in laboratory.

Identification and distribution records were based on relevant literature (Hampson, 1895, 1896; Holloway, 1994; Kirti *et al.*, 2012, 2014, 2019; Shubhalaxmi, 2018). Wingspan measurements provided in the paper are based on the specimens examined in the current study. Genitalia dissection following Lee and Brown (2009) protocol was performed on all reported species, serving as differentiation and identification key between species. Specimens were deposited in the Entomological Collections of the Systematics and Toxicology Laboratory, Mizoram University, Aizawl, Mizoram, India (MZUEC).

RESULTS

This paper reports 30 species from 23 genera, all belonging to Ennominae subfamily with their original references, and diagnostic characters with a short remarks for each species. The reported species are usually slightly smaller in wingspan as compared to those from Fauna of British India.

Subfamily Ennominae

Subfamily Ennominae is the largest subfamily of Geometridae. It was first described by Hampson (1895) as Boarmiinae which was followed by Prout (1912, 1933) and Paclt (1975). Scoble (1999) changed the subfamily name to Ennominae, which is followed till today. Ennominae is the most species rich subfamily of Geometridae with 858 species reported from India (Kirti *et al.*, 2019).

Systematic account:

The absence of vein M2 on the hindwing is a diagnostic character for species belonging to the subfamily. The commonest features found in this

subfamily include a transversal setal comb on the third abdomen sternite of males and a prominent signum in bursa of females (Holloway *et al.*, 2001). The presence of a fovea or hyaline membrane on the underside of the forewing acting as tympanum in males of many species is rare in other groups of Lepidoptera (Hampson, 1895). Following are the list of reported species:

I. Genus *Achrosis* Guenee in Boisduval & Guenee, 1857

Guenee, 1857. *Hist. nat. Ins., Spec. gen. Lepid.* 10: 539

1. *Achrosis incitata* (Walker, 1862)

Omiza incitata Walker, 1862, *List Specimens Lepid. Insects Colln. Br. Mus.*, 24:1085

Forewing: Male 34 mm; Female 38 mm

Material examined: 1♂: 27.x.2019, Hmuifang, Aizawl district, 1619 m; 1♀: 13.x.2020, Tamdil, Saitual district, 767 m

Distribution: West Bengal (Darjeeling) (Walker, 1862), Assam, Mizoram (Kirti *et al.*, 2019)

Distinctive features: Forewing groundcolour olive green suffused with fuscous; a slightly curved ante- medial band; post- medial running out to an acute angle near middle of outer margin, recurved at vein 2 and with purplish fuscous beyond it on inner area. Hindwing bright luteous with olive green tint along the interior border, indistinct speck at cell end.

Remarks: Hampson, (1895) synonymized the genus with *Prionia* Hubner, and reported 9 species from India. This species resembles *A. pallida* but differs in genitalia (Kirti *et al.*, 2019). Saxena (2014) in his

unpublished thesis reported 5 males and 3 females of *A. incitata* from 3 sites (Mamit, Hmuifang, Hrangchawkawn) in Mizoram, within an elevation range of 500-1200m in September.

2. *Achrosis lithosiaria* Walker, 1862

Omiza lithosiaria Walker, 1862, *List Specimens Lepid. Insects Colln. Br. Mus.* 24: 1085.

Forewing: Male 24 mm

Material examined: 1 ♂: 8.iv.2021, MZU Campus, Aizawl district, 839 m.

Distribution: Borneo, Peninsular Malaysia, Sumatra (Holloway, 1994), Sikkim, Nagas, Khasis (Hampson, 1895)

Distinctive features: Forewing cinereous fawn colour with two distinct olive green triangular patches on costa; marginal line acute and angled; short lunulate line on postmedial; marginal line rufous just below apex. Hindwing luteous yellow; cinereous fawn on inner margin with a small transversal olive rufous patch. Underside plain suffused with luteous.

Remarks: This species is reported here for the first time from Mizoram. Holloway (1994) stated that this species frequented lowland and lower montane forest zones. The current study reported a single specimen from MZU Campus at an elevation of 839 m.

II. Genus *Antipercnia* Inoue, 1992

Inoue, 1992, *Bull. Otsuma Wom. Univ.* 28:127

3. *Antipercnia belluaria* (Guenee, [1858])

Percnia belluaria Guenee, [1858], in Boisdual & Guenee, *Hist. nat. Insects. (Spec. gen. Lepid.)* 1:217

Forewing: Male 68 mm

Material examined: 1 ♂: 25.xi.2020, Hmuifang, Aizawl district, 1619 m.

Distribution: Sikkim, Arunachal Pradesh, Meghalaya (Khasis) (Kirti & Saxena, 2012), Indo- Oriental region (Inoue, 1992), Mizoram (Saxena, 2014 unpublished thesis).

Distinctive features: Wings whitish suffused with grey, numerous black specks span both wings. This species closely resembles *Percnia felinaria* but is paler with the spots smaller (Hampson, 1895).

Remarks: Saxena (2014) in his unpublished thesis reported 4 males of this species from three sites Hmuifang, Hrangchawkawn and Sangau, within an elevation of 1200 m -1700 m.

III. Genus *Arichanna* Moore, [1868]

Arichanna Moore, [1868]. *Proc. zool. Soc. Lond.* 1867:658

4. *Arichanna transfasciata* Warren, 1893

Arichanna transfasciata Warren, 1893. *Proc. zool. Soc. Lond.* 1893 (2): 425

Forewing: Male 46 mm

Material examined: 1 ♂: 13.xi.2019, MZU Campus, Aizawl district, 839 m.

Distribution: Sikkim (Warren, 1893), Khasis, Nagas (Hampson, 1895).

Distinctive features: Forewing ground colour brown striated with black; whitish oblique antemedial and postmedial lines

edged with black; a horizontal whitish streak from base on median nervure to outer margin, a short oblique line from apex intersecting post-medial, a sinuous sub-marginal line bent towards outer angle. Hindwing orange yellow irrorated with black; an indistinct dark cell spot with post-medial line with traces of whitish band on its outer edge.

Remarks: Hampson (1895) reported 19 species from India and the current report is the first report of this species from Mizoram.

IV. Genus *Biston* Leach [1815] 1830

Biston Leach, [1815]; in Brewster, *Edinburgh Ency.* 9: 134

5. *Biston bengaliaria* (Guenee, [1858]).

Amphidasys bengaliaria Guenee, 1857. *Hist. nat. Ins. Spec. gen. Lepid.* 9: 210, *Atlas (Uranides & Phalénides)*: pl. 4, f. 2

Forewing: Male 62 mm

Material examined: 1 ♂: 29.vii.2020, North Hlimes, Kolasib district, 670 m

Distribution: Bengal (Guenee, 1858), Sikkim, Khasi, Shillong (Hampson, 1895)

Distinctive features: Wings ground colour white, suffused with ochreous; irrorated with black specks. Forewing with oblique ante-medial line slightly angled on median nervure, encompassing ochreous bands; indistinct traces of medial line; black specks on costa; post-medial black line highly angled at vein 5 of both wings; a diffuse ochreous band beyond it; traces of a waved sub-marginal line with some waved black marks on each side of it near vein 4; Hindwing similar to forewing with a distinct black speck on cell.

Remarks: The specimen was first reported from Bengal and hence the name. The current study reported this species from North Hlimes, Mizoram at an elevation of 670 m and is the first report from Mizoram.

6. *Biston contectaria* Walker, 1863

Amphidasys contectaria Walker, 1863, *List Specimens lepid. Insects Colln. Br. Mus.* 26: 1529

Forewing: Male: 70 mm

Material examined: 1 ♂: 29.x.2019, Hmuifang, Aizawl district, 1619 m.

Distribution: Nepal, Sikkim, Meghalaya, Nagaland (Subhalaxmi, 2018), China (Jiang *et al.*, 2011).

Description: Wings ground colour white irrorated with greyish specks. The prominent black lines on ante-medial and post-medial line are diagnostic for this species. Hindwing ante-medial line obsolete; post-medial line with curved projection towards outer margin. Underside whitish, irrorated with black specks; upperside faciae clearly distinct.

Remarks: This species closely resembles *B. mediolata* but differs in the prominent discal spot on underside of the wings. Kirti *et al.* (2014) reported *B. mediolata* from Thingsul, Mizoram (890 m) but *B. contectaria* is reported here for the first time from Mizoram.

7. *Biston suppressaria* (Guenee, 1858)

Amphidasys suppressaria Guenee, 1857; *Hist. nat. Ins., Spec. gen. Lepid.* 9: 210

Forewing: Female: 76 mm

Material examined: 1♀: 10.viii.2020, Palak dil, Siaha district, 290 m.

Distribution: Assam, Kangra, Sikkim, Calcutta, Ceylon, (Hampson, 1895).

Distinctive features: Groundcolour white suffused with ochreous and irrorated with black specks. Forewing ante-medial indistinct, both wings with irregularly sinuous indistinct yellow medial line excurved beyond cell of forewing; post-medial with ill defined maculate bands angled at vein 5 on both wings, with some yellowish specks and blackish suffusion at middle of outer margin; marginal series of yellow spots. Hindwing same as forewing. Underside with prominent dark discal patch on both wings.

Remarks: Kirti *et al.* (2012) reported one male specimen from Thingsul (890 m) during the month of September. The current study reports a single female specimen which is much larger in size than that of the male counterpart at a low elevation of 290 m.

V. Genus *Borbacha* Moore, [1887]

Borbacha Moore, [1887]. *Lepid. Ceylon* 3 (4): 446

8. *Borbacha pardaria* (Guenée, 1857)

Anisodes pardaria Guenée, 1857, *Hist. nat. Ins. Spec. Gen. Lep.* 9: 420.

Forewing: Female: 48 mm

Material examined: 1♀: 26.vii.2021, West Phaileng, Mamit district, 603 m.

Distribution: Western Ghats, N.E. Himalaya, Sundaland, Sulawesi (Holloway, 1994), Khasis (Hampson, 1895)

Distinctive features: Wings somewhat similar to *B. punctipardaria* but with more minute specks on both wings. Both wings with small black speck in discal cell; post-medial band greyish with yellow suffusion beyond. Hindwing ante-medial fuscous; crenulated sub-marginal area.

Remarks: This is the first report from Mizoram. Hampson (1895) synonymized the genus with *Synegia* Guenée. Scoble (1999) listed 11 species from India, Japan, China, Sri Lanka, Singapore and Borneo. Two species, *B. pardaria* and *B. punctipardaria*, have been reported from India.

9. *Borbacha punctipardaria* Holloway, 1982

Borbacha punctipardaria Holloway, 1982; in Barlow, *Intr. Moths of South East Asia. Taxonomic app.*: 251

Forewing: Male 42 mm; Female 40 mm

Material examined: 1♂: 28.vii.2020, North Hlimen, Kolasib district, 670 m; 1♀: 26.vii.2021, West Phaileng, Mamit district, 603 m.

Distribution: China, Vietnam Borneo, Sumatra, Nias, Java (Holloway, 1994), Mizoram (Kirti *et al.*, 2014)

Distinctive features: Wings orange yellow with grey faciae. The prominent black discal spot on both wings is diagnostic for this species. Both wings with irregularly arranged bands. Underside pale, markings on dorsal side more distinct, immaculate medial and post-medial wavy lines.

Remarks: Kirti *et al.* (2014) reported 1 male and 1 female of this species from New Serchhip (940 m) and Hmuifang (1619 m) during the month of September.

VI. Genus *Celenna* Walker, 1861

Celenna Walker, 1861. *List Spec. Lepid. Insects Colln. Br. Mus.* 22: 519

10. *Celenna festivarior* (Fabricius, 1794)

Phalaena festivarior Fabricius, 1794, *Ent. Syst.*, 3(2): 152

Forewing: Male 32 mm; Female 34 mm

Material examined: 1♂: 29.x.2019, Hmuifang, Aizawl district, 1619 m; 1♀: 26.vii.2021, West Phaileng, Mamit district, 778 m.

Distribution: Burma, Borneo, Java, Taiwan (ssp. *formosensis* Inoue), Ryukyu Island (ssp. *manifesta* Inoue), Luzon (ssp. *Temperate* Prout) (Holloway, 1994), Hongkong, Sikkim, Bhutan, Khasis, Sibsagar, Nagas, Ceylon, Andamans (Hampson, 1895), Arunachal Pradesh (Kirti & Saxena, 2012).

Distinctive features: Wings groundcolour purplish grey with bright green blotches. Forewing with a large green patch on medial area except costa; a similar rounded sub-apical patch beyond it; costa slightly arched towards apex. Hindwing with similar green patch on whole area except costa, widest towards inner margin. Underside reddish orange with fuscous patch on forewing below end of cell. This species closely resembles *C. centraria* (Hampson, 1994) but differ in the bright green blotch present on forewing which is divided into two in case of *C. festivarior*. The hindwing interior angle is prominent and green patch also shows variation to that of *C. centraria* in being less rounded than the latter.

Remarks: Saxena (2014) in his unpublished thesis reported this species from Thingsul (890m) during the month of September. Hampson (1895) synonymized the genus with *Hypochrosis* Guenee, Holloway (1993) resurrected *Celenna*

Walker. Two species from this genus are found in India (Scoble, 1999).

VII. Genus *Dalima* Moore [1868]

Dalima Moore [1868]. *Proc. zool. Soc. Lond.*, 1867: 614

11. *Dalima patularia* (Walker, 1860)

Omiza patularia Walker, 1860, *List Specimens Lepid. Insects Colln. Br. Mus.* 20: 247.

Forewing: Male 56 mm

Material examined: 1 ♂: 2.xi.2019, Hmuifang, Aizawl district, 1619 m.

Distribution: North Hindostan (Walker, 1860); Himalaya, N. Thailand, W. China, Borneo, Sumatra, Sulawesi (Holloway, 1994); N.W. Himalaya, Sikkim, Khasis (Hampson, 1895)

Distinctive features: Wings groundcolour chocolate brown with diagnostic array of immaculate rich brown faciae. Forewing with oblique parallel ante-medial and medial rufous lines, the latter black at inner margin; medial line joined by indistinct brown line from near costa to apex; traces of sub-marginal line. Hindwing groundcolour ochreous, oblique rufous slightly curved medial line; curved rufous and reddish post-medial line; sub-marginal line studded with a series of rufous specks.

Remarks: Ghosh *et al.*, (2007) reported a male specimen from Aibawk (784 m), Mizoram during November. The current study reported this species from Hmuifang, Aizawl district with an elevation range of 1619 m.

VII. Genus *Eutoea* Walker, 1860

Eutoea Walker, 1860. *List. Spec. Lepid. Insects. Colln. Br. Mus.* 20:68, 217

12. *Eutoea heteroneurata* (Guenée, (1858))

Cassyma heteroneurata Guenée, [1858]; *Hist. nat. Ins., Spec. gen. Lepid.* 10:19

Forewing: Male 44 mm

Material examined: 2♂♂: 14.iv.2021, Parsenchhip, Kolasib district, 120 m; 1♂: 28.vii.2020 North Hlimen, Kolasib district, 675 m.

Distribution: Sikkim, Sylhet, Java, Borneo (Hampson, 1895), Arunachal Pradesh, Sylhet (Kirti & Saxena, 2012), Indo Australian tropics to Bismarck Island, Java, Borneo (Holloway, 1994)

Distinctive features: Groundcolour ochreous irrorated with brown. Forewing with three indistinct dark specks on costa; a crescent shaped oblique line from below apex which doubles towards middle of inner margin. Hindwing with black speck at end of cell; a prominent oblique medial line and traces of sinuous sub-marginal line. Males with forewing apex produced and with an enlarged dorsal zone on hindwing. Females differ from males as they lack the strong discal crescent on forewing which is a diagnostic character for males.

Remarks: This species shows striking sexual dimorphism in facies. It was collected during April and June within an elevation range of 120-700 m. This is the first report from Mizoram. Out of the three species of *Eutoea* reported worldwide, *E. heteroneurata* is the only species reported from India (Scoble, 1999).

IX. Genus *Fascellina* Walker, 1860

Fascellina Walker, 1860. *List Spec. Lepid. Insects Colln. Br. Mus.* 20:67, 215

13. *Fascellina plagiata* (Walker, 1866)

Geometra plagiata Walker, 1866; *List Spec. Lepid. Insects Colln. Br. Mus.* 35: 1601

Forewing length: Female 36 mm

Material examined: 2♀♀: 2.x.2019, Hmuifang, Aizawl district, 1619 m

Distribution: Himalaya, W. China, Taiwan, Peninsular Malaysia, Borneo. (Holloway, 1994), Himachal Pradesh, Sikkim, Assam (Kirti *et al.*, 2012)

Distinctive features: Wings groundcolour greenish yellow. Forewing acute, a discontinuous oblique dentate line near base; a distinctive rectangular dark patch below apex. Hindwing double medial line rusty followed by a curved line ending in a dark patch on inner margin.

Remarks: Saxena (2014) in his unpublished thesis reported 1 female of this species from Mamit (500m), Mizoram. The present study reported two females from Hmuifang (1619 m).

X. Genus: *Heterostegane* Hampson, 1893

Heterostegane Hampson, 1893. *Ill typical Spec. Lep. Het. Colln. Br. Mus.* 9:35, 142

14. *Heterostegane subtessellata* (Walker, [1863])

Macaria subtessellata Walker, [1863]; *List Spec. Lepid. Insects Colln. Br. Mus.* 26: 1648

Forewing: Male 26 mm

Material examined: 1♂: 7.viii.2021 West Phaileng, Mamit district, 603 m

Distribution: Canara (Walker, 1863); Dharamsala, Khasis, Nilgiris, Borneo (Hampson, 1895); Nepal, Burma, Sundaland (Holloway, 1994).

Distinctive features: Wings groundcolour yellow, irrorated with rust red. Forewing with oblique ante-medial rust red lines, medial sinuous rust red line, post-medial line lunulate; sub-marginal line angled outwards to the margin, terminating in a rounded patch at outer angle; marginal line with series of spots. Hindwing ante-medial straight, medial and post-medial lines wavy; sub-marginal lines with dentate spot between veins M2 and M3.

Remarks: Kirti *et al.* (2012) reported this species from New Serchhip (940 m) and Thingsul (890 m) during the month of October 2009. The present specimen was collected from West Phaileng at an elevation of 603m. Out of a total of 45 species in the genus, 8 species have been reported from India (Scoble, 1999).

XI. Genus *Hyperythra* Guenée in Boisduval & Guenée, 1857

Hyperythra Guenée, 1857. *Hist. nat. Ins. Spec. gen. Lepid.* 9: 99

15. *Hyperythra lutea* (Stoll, 1787)

Phalaena lutea Stoll, 1787, *Uitl. Kapellen.*, 4: 157

Forewing: Male 34 mm; Female 46 mm

Material examined: 1 ♂: 28.vii.2020, North Hlimen, Kolasib district, 675 m; 1 ♂: 31. vii.2020, North Hlimen, Kolasib district, 675 m; 1♀: 29.iv.2020, MZU campus, Aizawl district, 839 m.

Distribution: China, Ceylon, Burma, Andamans, Sumatra, Java, New Guinea, throughout India (Hampson, 1895), Indian Subregion, S.E. Asia, Sundaland (Holloway, 1994)

Distinctive features: This species is sexually dimorphic. Wings ground colour yellow, in females, forewing with medial and post-medial indistinct, slightly curved pinkish bands. Hindwing with similar narrow ante- and post-medial bands, the latter with black marks below costa. The underside is bright yellow. Males with wings yellow, densely striated with red and brown stronger in ante- and post-medial zones, particularly at forewing costa. Underside brighter, more intense orange yellow with whitish zone at the margin just posterior to forewing apex.

Remarks: This species is reported here for the first time from Mizoram and North-Eastern India. Hampson (1895) reported 3 species from India.

XII. Genus *Hypochrosis* Guenée in Boisduval & Guenée, 1857

Hypochrosis Guenée, 1857; *Hist. nat. Ins. Spec. gen. Lepid.* 10: 536

16. *Hypochrosis hyadaria* Guenée, 1857

Hypochrosis hyadaria Guenée, 1857; *Hist. nat. Ins. Spec. gen. Lepid.* 10: 537

Forewing: Male 32 mm; Female 40 mm

Material examined: 2 ♂♂: 30.iii.2019, Hmuifang, Aizawl district, 1619 m; 1♀: 25.xi.2020, Hmuifang, Aizawl district, 1619 m.

Distribution: Sikkim, Assam, Khasis, Nilgiris, (Hampson, 1895), Borneo, Sumatra, Java, Philippines, Sulawesi (Holloway, 1994)

Distinctive features: Wing's ground colour is pale green with a purplish tinge. Forewing ante-medial line oblique originating from a rufous patch on costa; a small annulus at end of cell; a highly angled oblique post-medial line enclosing a greyish lunule at the apex running to the middle of inner margin of the hindwing. Underside luteous, an outer area slightly rufous.

Remarks: Ghosh *et al.*, (2007) reported 2 males and one female from Aibawk (784 m) during November.

XIII. Genus *Hyposidra* Guenee, [1858]

Guenee [1858], *Hist. nat. Ins. (Spec. gen. Lepid.)*, 10: 150

17. *Hyposidra talaca* (Walker, 1860)

Lagyrta talaca Walker, 1860, *List Specimens Lepid. Insects Colln. Br. Mus.*, 20: 59.

Forewing: Male 40 mm

Material examined: 1♂: 13.x.2020 Tamdil, Saitual district, 767 m.

Distribution: Sri Lanka, Myanmar, Java, Borneo, Celebes, Philippines (Kirti *et al.*, 2012), Indo-Australian tropics from N.E. Himalaya to Queensland and Solomons (Holloway, 1994)

Distinctive features: Wings ground colour blackish-grey, antennae bipectinate; both wings more or less irrorated and suffused with grey; faint traces of medial and crenulate post-medial lines. Forewing apex slightly produced and falcate; indistinct traces of ante-medial line; Underside simple with less distinct crenulate post-medial lines.

Remarks: Ghosh *et al.*, 2007 reported 1 male of this species from Aibawk (784 m) in November.

XIV. Genus: *Lomographa* Hubner, [1825]

Hubner, [1825], 1816, *Verz. Bekannter Schmett.* 1816: 311

18. *Lomographa inamata* (Walker, 1860)

Lomographa inamata Walker, 1861, *List Spec. Lepid. Insects Colln. Br. Mus.* 22: 755

Forewing: Male 32 mm

Material examined: 2♂♂: 30.x.2019, Hmuifang, Aizawl district, 1619 m; 1♀: 2.xi.2019, Hmuifang, Aizawl district, 1619 m.

Distribution: Sylhet, Nilgiris, Ceylon, Borneo, Sumatra (Holloway, 1994), Mizoram (Kirti *et al.*, 2012)

Distinctive features: Wings ground colour satiny white, ochreous transverse fascia from below apex of forewing till the middle of hindwing; black discal spots on both wings. The underside is simple, satiny white.

Remarks: Kirti *et al.* (2012) reported 3 males and two females of this species from Thingsul (890m) during September. The currently reported specimen is larger in wingspan.

XV. Genus *Luxiaria* Walker, 1860

Luxiaria Walker, 1860; *List Spec. Lepid. Insects Colln. Br. Mus.* 20: 231

19. *Luxiaria mitorrhapes* Prout, 1925

Luxiaria mitorrhapes Prout, 1925, *Novit. zool.*, 32: 64

Forewing: Female 40 mm

Material examined: 1♀: 25.xi.2019, Hmuifang, Aizawl district, 1619 m.

Distribution: Himalaya, Japan, Taiwan, Burma, Borneo, Java (Holloway, 1994)

Distinctive features: Ground colour fawn with dull faciae. Forewing with apex acute, post-medial band broad and slightly darker. Numerous inconspicuous dark speckles on the entire wing.

Remarks: This species is reported from Naga Hills between an elevation of 1524 m -1830 m. It is a rare species, and the current record is believed to be the second report of this species from the northeast, reported at an elevation of 1619 m at Hmuifang, Aizawl district, Mizoram.

20. *Luxiaria phyllosaria* (Walker, 1860)

Drepanode sphyllsaria Walker, 1860, *List Spec. Lepid. Insects Colln. Br. Mus.* 20: 82

Forewing: Male 56 mm

Material examined: 1 ♂: 19.x.2019, Lawngtlai, Lawngtlai district, 715 m; 1♂: 13.x.2020, Tamdil, Saitual district, 767 m.

Distribution: Khasis, Borneo, Java (Hampson, 1895), N.E. Himalaya, Sumatra, Borneo, Sri Lanka, (Holloway, 1994)

Distinctive features: Ground colour yellowish with dark brown fringes on the margin of both wings. Forewing with apex produced, an indistinct ante-medial and medial dark speck on costa; a dark brown bar with grey distad marks on the short coastal section of the forewing post-medial. The hindwing is simple, with a

broad sub-marginal band. Underside with the marginal band on both wings rich chocolate brown with two indistinct crenulated lines on it.

Remarks: Hampson (1895) reported this species from Khasis. This is the second time report of this species from the Northeast. The wingspan of a specimen from Mizoram is much larger as compared to previously reported specimens.

XVI. Genus *Metapercnia* Wehrli, 1939

Wehrli, 1939, *Gross-Schmett. Erde*, 4 (Suppl.): 264

21. *Metapercnia ductaria* (Walker, 1862)

Rhyparia ductaria Walker, 1862, *List Specimens Lepid. Insects Colln. Br. Mus.* 24: 1111

Forewing: Female 66 mm

Material examined: 1♀: 9.xi.2019, MZU Campus, Aizawl District, 839 m.

Distribution: Sikkim, Arunachal Pradesh (Kirti *et al.*, 2014)

Distinctive features: Wings ground colour white, irregular yellowish suffusion; irrorated with fuscous; series of small black specks on entire wing.

Remarks: The genus *Metapercnia* Wehrli was originally proposed as a subgenus of genus *Percnia* Guenee, 1857 for its type species, *Rhymparia ductaria* from India. It has a distribution only in India. Ghosh *et al.* (2007) reported this species from Mizoram as *Percnia ductaria* from Lawngtlai (850 m) during April. In India, the known distribution is restricted to the northeast based on a literature survey.

XVII. Genus *Mimomiza* Warren, 1894

Mimomiza Warren, 1894. *Novit. Zool.* 1 (2): 444

22. *Mimomiza cruentaria* (Moore, 1868)

Cimicodes cruentaria Moore, [1868]; *Proc. zool. Soc. Lond.* 1867: 616

Forewing: Male 30 mm

Material examined: 3♂♂: 30.x.2019, Hmuifang, Aizawl district, 1619 m.

Distribution: West Bengal (Darjeeling), Nepal (Stunting, 2000), Dalhousie, Dharamsala, Khasis (Hampson, 1895)

Distinctive features: Wing's ground colour is yellow irrorated with reddish-brown. Forewing apex produced; a double oblique line from apex to inner margin, an area beyond suffused with rufous and grey; a prominent rufous blotch with white hyaline spot on apex. Hindwing with medial double oblique line suffused with rufous; a sub-marginal area with series of pinkish spots.

Remarks: Hampson (1895) synonymized the genus with *Heteromiza* Warren. Scoble (1999) treated it as a monotypic genus distributed in India and China. This species is reported here for the first time from Mizoram.

XVIII. Genus *Omiza* Walker, 1860

Omiza Walker, 1860. *List Spec. Lepid. Insects Colln. Br. Mus.* 20:246

23. *Omiza miliaria* Swinhoe, 1889

Omiza miliaria Swinhoe, 1889. *Proc. Zool. Soc. Lond.* (4): 425

Forewing: Male 56 mm

Material examined: 2 ♂♂: 13.x.2020 Tamdil, Saitual district, 767 m; 29. x.2019, Hmuifang, Aizawl district, 1619 m.

Distribution: West Bengal, Borneo, Sulawesi, Seram, New Guinea (Holloway, 1994)

Distinctive features: Ground colour luteous yellow. Forewing with a strong dark sub-marginal patch and a whitish speck at apex; a straight oblique sub-marginal line which extends from forewing apex to three-fourths of the length of the interior border of the hindwing. Underside with numerous ochreous speckles, more prominent than on the upper side.

Remarks: Hampson (1895) synonymized the genus with *Hypochrosis* Guenee and reported 10 species under the genus. This species shows a close resemblance to *Omiza herois* but differs in genitalia, also, the forewing of *O. miliaria* is more rounded than falcate as compared to that of *O. herois*. This species is reported here for the first time from Mizoram.

XIX. Genus *Orthocabera* Butler, 1879

Orthocabera Butler, 1879. *Ann. Mag. Nat. Hist.* (5) 4 (24): 439

24. *Orthocabera ocernaria* (Swinhoe, 1877)

Microniodes ocernaria Swinhoe, 1877. *Ann. Mag. Nat. Hist.* (6) 12 (68): 152

Forewing: Female 38 mm

Material examined: 1♀: 28.vii.2020, North Hlimen, Kolasib district, 670 m; 1 ♀: 18.x.2019, Lawngtlai, Lawngtlai district, 715 m.

Distribution: N.E Himalaya, Sundaland, Sulawesi (Holloway, 1994), Khasis,

PuloLaut, Borneo (Hampson, 1895), Mizoram (Ghosh *et al.*, 2007)

Distinctive features: Wings ground colour white with three distinctive fulvous streaks. The marginal line on both wings is rusty brown; forewing with ante-medial running to the discal spot, a transverse oblique line from apex to middle of inner margin; a sub-marginal line reduced to specks towards the apex. Hindwing with basal and medial oblique lines; postmedial line crenulate. Underside white, less fasciated than upperside.

Remarks: Hampson (1895) placed this species under *Myrteta* Walker. Five species are known from India (Scoble, 1999). This species closely resembles *O. similaria* but is distinguished by slight variations in wing fascies (Holloway, 1994). It is found between 600-800 m elevation. Ghosh *et al.*, 2007 reported one male and female from Teirei (150 m) and Aibawk (784 m), Mizoram in November 1995.

25. *Orthocabera sericea* Butler, 1879

Orthocabera sericea Butler, 1879. *Ann. Mag. Nat. Hist.* (5) 4 (24): 440

Forewing: Female 38 mm

Material examined: 1♀: 11. iv.2019 Ngopa, Champhai district, 1184 m

Distribution: Sikkim, Khasis (Hampson, 1895), Arunachal Pradesh (Kirti *et al.*, 2019), Himalaya to Taiwan and Japan (Holloway, 1993)

Distinctive features: Wings white, forewing with fulvous streak above the medial vein to discocellulars where it doubles and slightly wavy running to the base of inner margin; a double slightly waved line from below apex to middle of dorsum; a similar sub-marginal line with a

single line beyond it. Hindwing with a single sub-basal line, double medial line, single sub-marginal line and a marginal line. Underside white.

Remarks: Saxena (2014) in his unpublished thesis reported a single male specimen from Hrangchawkawn (1200 m) during September.

XX. Genus *Percnia* Guenee in Boisduval & Guenee, 1857

Percnia Guenée, 1857; *Hist. nat. Ins. Spec. gen. Lepid.* 10: 216

26. *Percnia felinaria* Guenee, 1857

Forewing: Male 82 mm; Female 88 mm

Material examined: 1♂ 15.vii.2020, 1♀: 15. vii. 2020, Hmuifang, Aizawl district, 1619 m

Distribution: Sikkim, Khasis, Nagas (Hampson, 1895)

Distinctive features: Wings ground colour greyish white with numerous black specks; thorax and base ochreous with two distinct spots on vertex of the thorax. Forewing costa with a series of black specks, only one series on post-medial. Hindwing with only the cell spot of the three medial spots; a single post-medial series.

Remarks: The present study reported this species for the first time from Mizoram.

XXI. Genus *Tanaoctenia* Warren, 1894

Tanaoctenia Warren, 1894. *Novit. Zool.* 1 (2): 464

27. *Tanaoctenia haliaria* (Walker, 1861)

Geometra haliaria Walker, 1861; *List Spec. Lepid. Insects Colln. Br. Mus.* 22: 518

Forewing: Male 48 mm; Female 50 mm

Material examined: 5 exs.: 2.xi.2019, 2♂♂: 15.vii.2020, 1 ♂: 25.xii.2020, Hmuifang, Aizawl district, 1619 m; 1 ♂: 6.vi.2019, Mamit, Mamit district, 718 m; 1 ♀: 2.xi.2019, Hmuifang, Aizawl district, 1619 m

Distribution: Sikkim, Khasis (Hampson, 1895), Arunachal Pradesh, Meghalaya (Kirti & Saxena, 2012)

Distinctive features: Wings ground colour green, an indistinct white oblique ante-medial line on forewing; a prominent inwardly oblique white line extending from forewing apex to hindwing; a rufous speck at end of the cell. Males with a rufous patch adjacent to the white medial line which is absent in females. The underside is whitish with few or no faciae.

Remarks: Hampson (1895) reported 2 species under the genus *Metrocampa*, synonymized it with the genus *Tanaoctenia*. Fletcher (1979) resurrected the genus *Tanaoctenia* Warren. Scoble (1999) recorded two species from China and India. *T. haliaria* is the only species reported from India. The current study reports this species for the first time from Mizoram.

XXII. Genus *Thinopteryx* Butler, 1883

Thinopteryx Butler, 1883J. *Linn. Soc. Zool. Lond.* 17: 197, 202, pl.9, f. 13-14

28. *Thinopteryx crocoptera* (Kollar, [1844])

Urapteryx crocoptera Kollar, [1844], in Hugel, *Kaschmir und das Reich der Siek*, 4(2): 483.

Forewing: Male 60 mm

Material examined: 1♂: 18.ix.2020, MZU Campus, Aizawl district, 839 m.

Distribution: China, throughout India and Ceylon, Andamans, Java (Hampson, 1895), India to Korea, Japan and Sundaland (Holloway, 1994), Arunachal Pradesh, (Kirti *et al.*, 2014)

Distinctive features: Wings ground colour orange-yellow with numerous orange striae. Forewing costa white, ante- and post-medial oblique lines, fuscous line on discocellulars, sub-marginal line lunulate reduced to series of specks towards costa. Hindwing fuscous line on disco-cellulars; a double sub-marginal line angled at base of the tail, tail with a patch of fuscous.

Remarks: Saxena (2014) in his unpublished thesis reported this species from Mizoram (Hrangchawkawn and Thingsul) at an elevation ranging from 890 m-1200 m during September. The current species under study shows a slight variation in wingspan as compared to the other recorded wingspan.

29. *Thinopteryx nebulosa* Butler, 1883

Thinopteryx nebulosa Butler, 1883; *J. Linn. Soc. Zool. Lond.* 17: 203

Forewing: Female 58 mm

Material examined: 1♀: 30.x.2019 Hmuifang, Aizawl district, Mizoram, 1619 m.

Distribution: Indian subregion, Sumatra, Java, Borneo (Holloway, 1994), Garhwal (Sondhi & Sondhi, 2016)

Distinctive features: Wings heavily irrorated with grey, external borders mottled with orange. A rather indistinct

oblique line on ante and post-medial; forewing apex slightly produced. Hindwing with a blackish patch extending to the tail.

Remarks: This species was found to be closely similar in facies to *T. crocopterata* (Holloway, 1994) but differs in the greyish suffusion on wings as *T. nebulosa* is almost entirely suffused with grey. This species is reported here for the first time from Mizoram. Holloway (1994) reported this species at an elevation ranging from 1620 m-1790 m.

XXIII. Genus *Vindusara* Moore, 1868

Vindusara Moore, 1868 *Proc. Zool. Soc. Lond.*, 1867: 653

30. *Vindusara moorei* (Thierry-Mieg, 1899)

Erebomorpha moorei Thierry-Mieg 1899. *Annls. Soc. ent. Belg.* 43:20

Forewing: Male 48 mm; Female 80 mm

Material examined: 2♀♀: 2.x.2019, Hmuifang, Aizawl district, 1619 m; 10.vii.2020, Palak Dil, Siaha district, 290 m; 1♂: 13.x.2021 Parsenchhip, Kolasib district, 120 m.

Distribution: Arunachal, Sikkim, Nagaland (Kirti & Saxena, 2012), Thailand (Kocak & Kemel, 2010)

Distinctive features: Wings groundcolour white irrorated with grey patches. Forewing costal area grey, with a whitish speck near apex; medial band running out to an angle at tornus and black and yellow spot to inner margin forming a Y-shaped fascia; Hindwing less irrorated; sub-marginal band with spots and yellow patches.

Remarks: The male is relatively smaller than the female but shares the same morphological attributes. The present study recorded this species within an elevation range of 100m -1700m during the summer season. This species is reported here for the first time from Mizoram.

ACKNOWLEDGEMENT

We are deeply grateful to Isaac Zosangliana and K. Lalhmangaiha for their help in field work; the Chief Wildlife Warden, Environment, Forest and Climate Change Department, Government of Mizoram for issuing research and collection permit for entomofauna in Mizoram (A.33011/5/2011-CWLW/Vol-II/2). We thank the Science and Engineering Research Board (SERB), Department of Science & Technology, Government of India for providing financial assistance and fellowship to BL carry out this research under EEQ (North Eastern Region Empowerment and Equity Opportunities for Excellence in Science) number EEQ/2017/000805. EL thank the Department of Biotechnology, Government of India, New Delhi, for providing financial assistance for laboratory facilities and fellowship to LR under NER-BPMC (North Eastern Region-Biotechnology Programme Management Cell) number DBT-NER/AAB/64/2017.

REFERENCES

- Cook, M. A. & M. J. Scoble. 1992. Tympanal organs of Geometrid moths, A review of their morphology, function and systematic importance. *Systematic Entomology* 17: 219-232.
- Fiedler, K. 2003. Faunal composition of geometrid moths changes with altitude in Andean montane rain forest *Journal of Biogeography* 30: 431-440.

Ghosh, S. K. 2007. Lepidoptera: Geometridae. *Fauna of Mizoram, State Fauna Series*, No.14: 389-398. Zoological Survey of India, Kolkata.

Hampson, G.F. 1895. *Fauna of British India, including Ceylon and Burma*. Moths Vol. 3. Taylor and Francis, London. 546 pp.

Hampson, G.F. 1896. *Fauna of British India, Moths including Ceylon and Burma*. Moths Vol. 4. Taylor and Francis, London. 594 pp.

Holloway, J.D. 1982. Taxonomic Appendix, In Barlow, H.S. An introduction to the Moths of South-East Asia. Southdene Sdn. Bht., Kuala Lumpur. 176-271 pp.

Holloway, J. D. 1985. Moths as indicator organisms for categorizing rain forest and monitoring changes and regenerating processes. *Tropical Rain-Forest* 235-242.

Holloway, J.D. 1994. *The Moths of Borneo*: Family Geometridae, Subfamily Ennominae. *Malayan Nature Journal* 47: 1-309.

Holloway, J. D. 2001. *The Moths of Borneo*: family Arctiidae, subfamily Lithosiinae. *Malay. Nat. J.* 55: 279-458.

Jiang, N., D. Y. Xue & H. Han. 2011. A review of *Biston* Leach, 1815 (Lepidoptera, Geometridae, Ennominae) from China, with description of new species. *Zookeys* 139: 45-96.

Kirti, J. S. & A. Saxena. 2012. An inventory of family Geometridae (Lepidoptera) from North-East India. *Journal of Applied Biosciences* 38(1):28-43.

Kirti, J. S., N. Singh & A. Saxena. 2014. Seven new records of Geometrid moths

(Lepidoptera: Geometridae) from India *J. Appl. Biosci.* 40(2): 113-116.

Kirti, J. S., K. Chandra, A. Saxena & N. Singh. 2019. *Geometrid Moths of India*. Nature Books India, New Delhi. 296 pp.

Pachau, R. 2009. Mizoram. A study in comprehensive geography. Northern Book Centre, New Delhi. pp. 41-54.

Paclt, J. 1975. The nomenclature of Lepidoptera in the second edition of 'Kloet and Hincks' Part 1. Family group names *Arch. Sci.*,28(2): 177-181

Prout, L.B. 1912 Lepidoptera, Heterocera. Family Geometridae, Subfamily Hemiteinae, Genera insect., 129:274

Prout, L.B. 1933. Geometridae. In Seitz Gross Schmett.,12: 77-116

Saxena, A. 2014. Taxonomic Studies on family Geometridae Lepidoptera from north east India (Unpublished thesis). <http://hdl.handle.net/10603/77638>.

Scoble, M. J. & A. Hausmann. (updated2007). Online list of valid and available names of the Geometridae of the world. *Lepidoptera Barcode of Life. IBOL*. Available from: http://www.lepbarcoding.org/geometridae/species_checklists.php.

Sanyal, A.K., P. Dey, V.P. Uniyal, K. Chandra & A. Raha. 2017. Geometridae Stephens, 1829 from different altitudes in Western Himalayan Protected Areas of Uttarakhand, India (Lepidoptera: Geometridae) *SHILAP Revta. lepid.* 45 (177): 143-163.

Scoble, M. J. 1999. *Geometrid Moths of the World - A catalogue (Lepidoptera: Geometridae)*. CSIRO Publishing, Collingwood, 1: 5-482; 2: 485-1016.

Sondhi, Y. & S. Sondhi. 2016. A partial checklist of moths (Lepidoptera) of Dehradun, Mussoorie and Devalsari in Garhwal, Uttarakhand, India. *Journal of Threatened Taxa* 8(5): 8756-8776;

<http://dx.doi.org/10.11609/jott.2814.8.5.8756-87756>.

Shubhalaxmi, V. 2018. *Field Guide to Indian Moths*. Birdwing Publishers, Navi Mumbai.. vi + 461 pp.

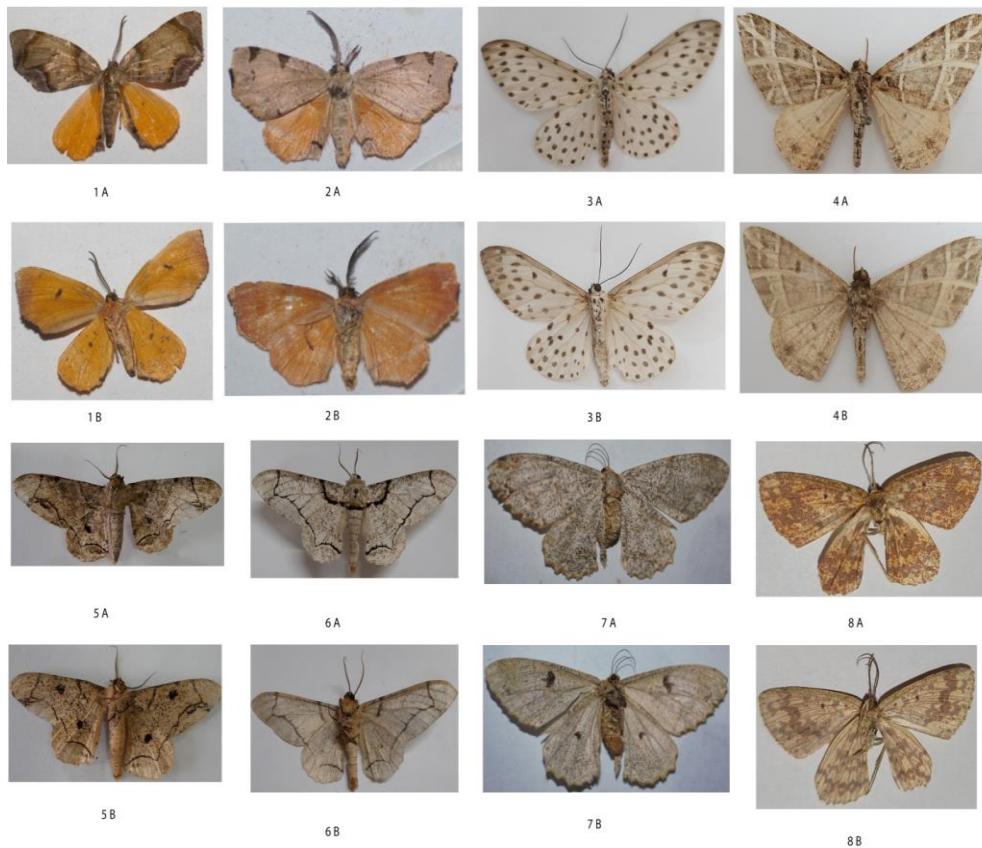
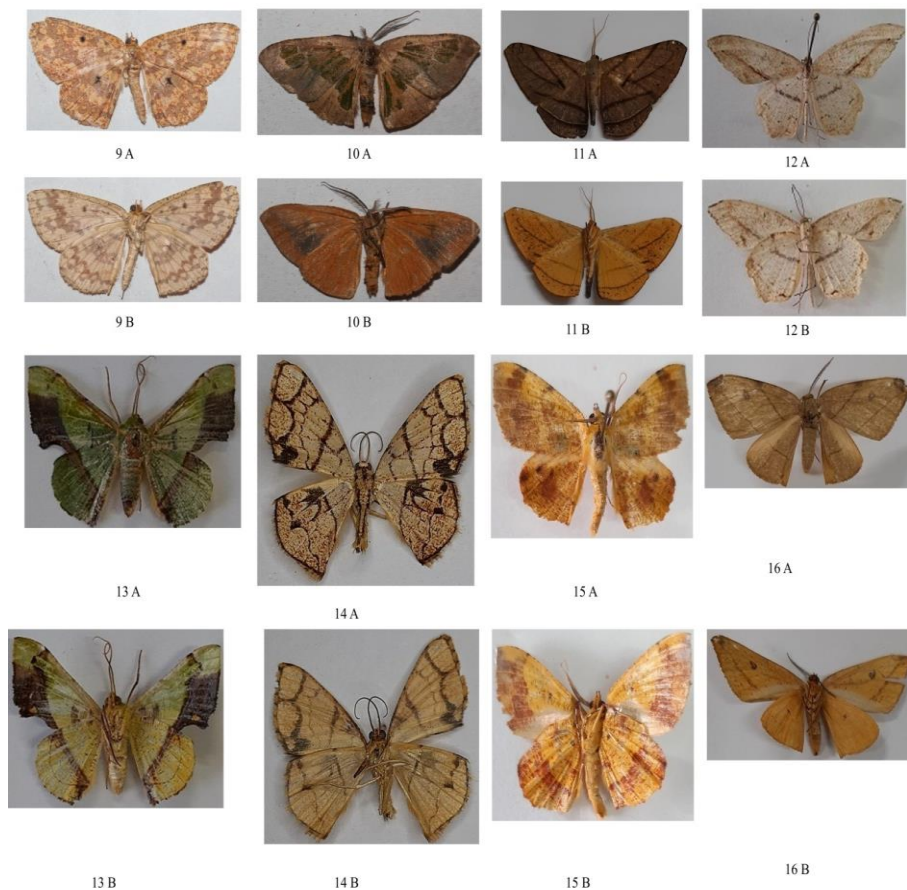
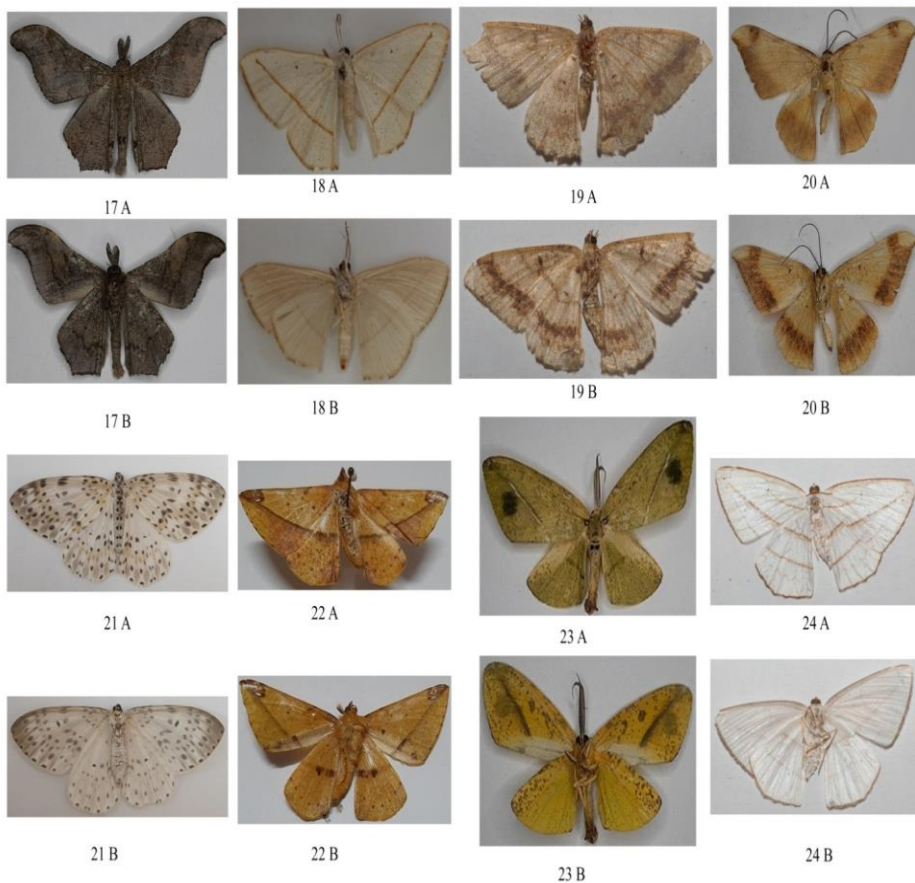


Fig1-8: Geometridae (Ennominae), A-Upperside; B- Underside. 1. *Achrosis incitata* ; 2. *Achrosis lithosiaria*; 3. *Antipercnia belluaria*; 4. *Arichanna transfasciata*; 5. *Biston bengalaria*; 6. *Biston contectaria*; 7. *Biston suppressaria*; 8. *Borbacha pardaria*



Figs 9-16: Geometridae, A- Upperside; B- Underside. 9. *Borbacha punctipardaria*; 10. *Celemma festiviaria*; 11. *Dalima patularia*; 12. *Eutoea heteroneurata*; 13. *Fascellina plagiata*; 14. *Heterostegane subtessellata*; 15. *Hyperythra lutea*; 16. *Hypochrosis hyadaria*



Figs. 17-24: Geometridae, A-Upperside; B- Underside. 17. *Hyposidra talaca*; 18. *Lomographa inamata*; 19. *Luxiaria mitorrhapes*; 20. *Luxiaria phyllosaria*; 21. *Metaperania ductaria*; 22. *Mimomiza cruentaria*; 23. *Omiza miliaria*; 24. *Orthocabera ocernaria*



25 A



26 A



27 A



28 A



25 B



26 B



27 B



28 B



29 A



30 A



29 B



30 B

Figs. 25-30: Geometridae, A-Upperside; B- Underside. 25. *Orthocabera sericea*; 26. *Percnia felinaria*; 27. *Tanaoctenia haliaria*; 28. *Thinopteryx crocoptera*; 29. *Thinopteryx nebulosa*; 30. *Vindusara moorei*

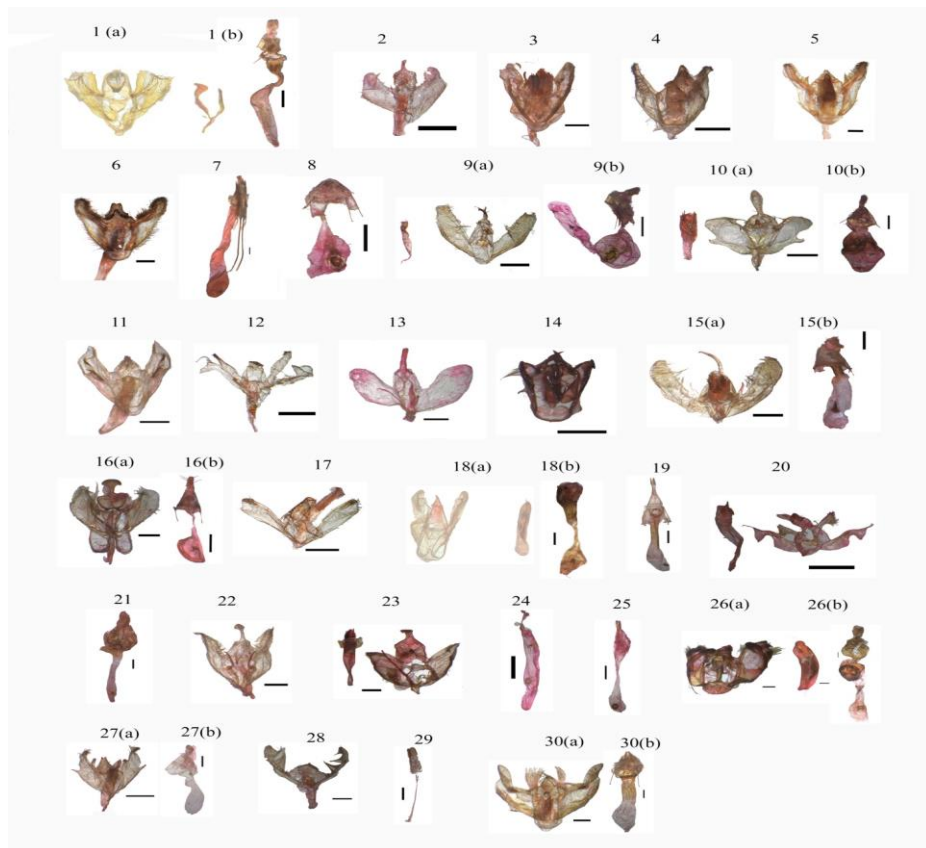


Fig: Genitalia of reported specimens, one scale bar = 0.1 mm: 1. *Achrosis incitata* (a, male; b, female); 2. *Achrosis lithosiaria* (male); 3. *Antipercnia belluaria* (male); 4. *Arichanna transfasciata* (male); 5. *Biston bengalaria* (male); 6. *Biston contectaria* (male); 7. *Biston suppressaria* (female); 8. *Borbacha pardaria* (female); 9. *Borbacha punctipardaria* (a, male; b, female); 10. *Celenna festivarua* (a, male; b, female); 11. *Dalima patularia* (male); 12. *Eutoea heteroneurata* (male); 13. *Fascellina plagiata* (female); 14. *Heterostegane subtessellata* (male); 15. *Hyperythra lutea* (a, male; b, female); 16. *Hypochrosis hyadaria* (a, male; b, female); 17. *Hyposidra talaca* (male); 18. *Lomographa inamata* (a, male; b, female); 19. *Luxiaria mitorrhapes* (female); 20. *Luxiaria phyllosaria* (male); 21. *Metapercnia ductaria* (female); 22. *Mimomiza cruentaria* (male); 23. *Omiza miliaria* (male); 24. *Orthocabera ocernaria* (female); 25. *Orthocabera sericea* (female); 26. *Percnia felinaria* (a, male; b, female); 27. *Tanaoctenia haliaria* (a, male; b, female); 28. *Thinopteryx crocoptera* (male); 29. *Thinopteryx nebulosa* (female); 30. *Vindusara moorei* (a, male; b, female) amplification