



New host records of Lepidoptera, defoliating Himalayan silver oak, *Quercus leucotrichophora* A.Camus and ring-cupped oak, *Q. glauca* Thunb. (Fagaceae) in Uttarakhand, Western Himalayas, India

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ABSTRACT: Survey on the lepidopteran insects attacking oak trees *Quercus leucotrichophora* and *Q. glauca* in forest areas revealed 65 species which are mostly polyphagous in habit. The study reports 13 species of lepidopteran belonging to Limacodidae, Erebidae, Geometridae, Pyralidae and Limacodidae as new host for *Q. leucotrichophora* and four species belonging to Arctiidae and Limacodidae on *Q. glauca* from both Garhwal and Kumaon regions of Uttarakhand state, India.

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KEY WORDS: Oak, Ban, Phaliyant, Garhwal, Kumaon, larval host plants, feeding pattern, distribution

Oaks (*Quercus* spp.) are the dominant tree species of temperate forests of the Indian Himalayan region and about 35 species of them are extensively distributed in this region between 1000-3500m elevations. There are about ten oak species in Eastern Himalayas and five in Western Himalayas, out of which the Himalayan silver oak or ban oak, *Q. leucotrichophora* is the most important species in Western Himalayas (Troup, 1921). Five species of evergreen oaks namely *Q. glauca* (Ring-cupped oak or phaliyant or harinj), *Q. leucotrichophora* (ban), *Q. lanuginosa* (rianj oak), *Q. floribunda* (tilonj or moru oak) and *Q. semecarpifolia* (brown or kharsu oak) grow naturally in the western Himalaya (Bargali *et al.*, 2013). Oaks have an important place in the Himalayan region because

of their significant contribution in soil and water conservation, sustaining rural ecosystems, maintaining biodiversity and other ecosystem services (Bhatt *et al.*, 2015). Ban oak is a multipurpose tree. The oak forests are source of fuel wood, fodder and can be correlated with natural springs and wildlife (Singh, 1981). The leaves are used as fodder during lean period and bedding for livestock (Kala, 2004). Many oaks are keystone species without which the complex web of the ecosystem would soon unravel (Shrestha, 2006). The galls that develop on the leaves are a natural source of gallic acid, a potential antitumoral/pro-oxidant agent. The gum from old trees is used in ethno-medicine for treating colds and as an analgesic (Ambu *et al.*, 2020).

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As many as 51 species of Lepidoptera are known to defoliate Ban oak, *Q. leucotrichophora* trees in the Western Himalaya forests (Beeson, 1941; Mathur and Singh, 1959; Verma *et al.*, 1979; Smetacek and Smetacek, 2011; Thakur *et al.*, 2015; Singh *et al.*, 2019). Field surveys were conducted on the lepidopteran insects attacking oak trees *Q. leucotrichophora* and *Q. glauca* in forest areas of the Western Himalayas during 2018-2020. The studies revealed 64 species and identified 13 species on *Q. leucotrichophora* and four species on *Q. glauca* as new host records from both Garhwal and Kumaon regions of Uttarakhand state, India. Information pertaining to 17 species belonging to five families reported on *Q. leucotrichophora* and *Q. glauca*, as new hosts for first time, are presented.

a. Defoliators of Himalayan silver oak, *Quercus leucotrichophora* A.Camus (syn. *Q. incana* Bartram, 1791).

1. Name: *Cheromettia apicata* (Moore, 1879), Family: Limacodidae

Distribution: The species is distributed in the Oriental tropics (India and Sri Lanka).

Host range: *Camellia sinensis* (L.) Kuntze, *Ceiba pentandra* (L.) Gaertn, *Cocos nucifera* L., *Gliricidia sepium* (Jacq.) Steud., *Schleichera oleosa* (Lour.) Oken, *Schleichera trijuga* Willd, *Vernicia fordii* (Hemsl.) Airy Shaw, *Aleurites fordii* (Hemsl.) Airy Shaw, *Butea monosperma* (Lam.) Taub., *Coffea arabica* L., *Derris elliptica* (Wall.) Benth, *Juglans regia* L., *Pyrus communis* L., *Theobroma cacao* L., *Toona ciliata* M. Roem. and *Malus pumila* Mil.

(https://en.wikipedia.org/w/index.php?title=Arctornis_submarginata&oldid=983434738;
https://en.wikipedia.org/w/index.php?title=Perina_nuda&oldid=932677322).

Habit: Larva defoliates by feeding on leaf tips and margins.

Life-history: Larva (18 mm and width 9 mm) is a slug like watery caterpillar (Fig. 1a)

enclosed in smooth oval shaped shape and having a dotted pattern of minute yellow spots scattered at equal intervals all over the dorsal surface. According to Subhalaxmi (2018) caterpillar is nearly oval, dull bluish green with longitudinal rows of small yellow spots. Two sluggish-watery caterpillars were recorded defoliating *Q. leucotrichophora* trees in the New Forest Campus (30.3333N & 78.0166E; 670m) of the Forest Research Institute, Dehradun. Larvae pupated (length 25 mm) is enclosed in hard, white-spherical cocoon amongst 2-3 green leaves folded together on the tree itself. Moth (Wing span: 30mm) emerged on 09.ix.2020, from the cocoons by an opening of the lid like operculum at one end of the cocoon (personal observation). Male is chestnut brown; forewing is red-brown, (wing span: 30mm; Fig.1 b & c) basal area darker, boundary by wavy central line, dark mark beyond cell end, indistinct wavy line towards outer margin, black patches on wings with grey specks. Hindwing is black-brown with outer margin straight (Subhalaxmi, 2018).

Pest status: Minor pest in Uttarakhand.

Remarks: Uncommon in oak ban forests.

2. *Suana concolor* Walker, 1855, Family: Lasiocampidae

Distribution: The species is distributed in India, and Sri Lanka to S. China, Java, Borneo and the Philippines.

Host Range: Other host plants are *Careya*, *Ceiba*, *Canarium*, *Shorea*, *Castanea*, *Cinnamomum*, *Litsea*, *Persea*, *Albizia*, *Cassia*, *Gossypium*, *Hibiscus*, *Emblica*, *Eucalyptus*, *Psidium*, *Syzygium*, *Citrus*, *Sonneratia*, *Theobroma*, *Camellia*, *Schima* and *Tectona* (Holloway, 1987; Robinson *et al.*, 2010); *Acacia mangium* Willd. (Chey, 2004) and *Acacia farnesiana* (L.) Wight et Arn. (Ahmad and Ho, 1980).

Habit: Larva defoliates by consuming the entire foliage.

Life-history: A larva (85 mm; Fig. 2a) of this lappet moth was recorded feeding on the leaves of oak plantation in New Forest campus, Dehradun. There are seven larval instars and larval development usually lasts 60–80 days for the males and 85–100 days for the females (Pugaev and Skrobotov, 2011). Shiny, brown, elongated, bean shaped pupa (length 100mm) inside a cocoon was formed on 20.vi.2020. Female moth (Fig. 2c & d) emerged on 03.vii.2020 in the laboratory at FRI, Dehradun. According to Browne (1968), the adult female could produce about 2000 eggs, which she places in clusters on the twigs of the host tree.

Pest status: Minor pest.

Remarks: Locally widespread in lower reaches of Uttarakhand.

3. *Pida decolorata* (Walker, 1869), Family: Erebidae

Distribution: The species is known to be distributed in India from Himachal Pradesh, Uttar Pradesh, Uttarakhand, West Bengal and Khasi Hills and in China (Swinhoe, 1923; Shah *et al.*, 2018; Kaleka and Kaur, 2019) and Taiwan (www.nic.funet.fi).

Hosts: The larval food plants are not known however the food plant of an allied species, *Pida nipponis* which occurs in Japan is *Fagus crenata* Blume (Robinson *et al.*, 2010).

Habit: Larva defoliates by feeding on leaf margins and finally consuming the entire leaf.

Life-history: Three 2nd instar larvae (Fig. 3a) were recorded feeding the leaves of *Q. leucotrichophora* in an Oak forest in Chakrata hills (Chakrata Forest Division: 30.7246 N & 77.8610E; 2100m), Garhwal, Uttarakhand, India. Life history on *Q. leucotrichophora* was studied (Table 1). Another individual (male moth: wing span 50 mm) of the same species was also captured on from Ban oak tree in Chakrata Forest Division, Uttarakhand.

The insect is whitish, head and fore parts of the thorax are pale fawns in colour. Palpi erect, slender, fringed in front, rising higher than the vertex; third joint is elongate conical, less than one fourth of the length of second. Antennae are moderately pectinated. Abdomen is brown from above, whitish at base, pale ochraceous at the tips. Legs are slender; fore femora and fore tibia with pale ochraceous fringe. Fore wings are acute, partly suffused with very pale ochraceous, thinly and minutely black speckled; a large divide pale fawn coloured thickly black speckled apical patch. Hindwings are without markings. Length of body is 12 lines; of the wing 38 lines.

Pest Status: Minor pest

Remarks: Occasional in ban oak forests

4. *Clearwing Tussock Moth, Perina nuda* Fabricius, 1787, Family: Erebidae

Distribution: The species occurs in the Indian sub-region, Sri Lanka up to southern China, Hong Kong, Thailand and Sundaland (https://en.wikipedia.org/wiki/Perina_nuda).

Host Range: Other host plants are *Ficus benghalensis* L., *F. benjamina* L., *F. carica* L., *F. elastic* Roxb., *F. microcarpa* L., *F. pumila* L., *F. racemosa* L., *F. religiosa* L., *Mangifera indica* L., *Artocarpus integer* Merr., *A. integrifolia* Lam. (Robinson *et al.*, 2010). Cheanban *et al.* (2017) described the life history on fig trees.

Habit: Larva feeds on leaves

Life-history: Eruciform larva with grey head and dark brownish dorsum was collected from *Q. leucotrichophora* plantation in New Forest campus, Dehradun. The total larval period was 28 days before pupation.

Pupa (17mm; Fig. 4a) is yellowish green colour covered with orange hairy setae and two brown spots. Emergence of moth took place in the laboratory on 29.i.2019 (Wing Span:

Table 1. Life history stages of *Pida decolorata* (Walker, 1869) on Ban oak, *Quercus leucotrichophora*

Stages	Duration	Description	Feeding pattern
2 nd instar	5 days	Length of larva is 10-11 mm, head black and body brown in colour and having orange coloured tuft of hairs on the middle abdominal region of the body.	Larva was found feeding on the margins of ban oak leaves.
3 rd instar (Fig. 3a)	6 days	Length of larva is 20 mm, head enlarged in size and body colour changes from brown to dark brown and long white hairs all over the body	Feeding takes place on the leaf margins.
4 th instar	8 days	Length of larva is 23 mm, head enlarged in size and whole body is covered with brown and black hairs and larva possess black band behind the head region.	Feeding takes place on the leaf tips
5 th instar	21 days	Full grown larval length is 30 mm, body colour changes from dark brown to light brown with brown and white hairs all over the body.	Feeding takes place on the leaf tips and margins.
Pupa (Fig. 3c)	16 days	Length of pupa is 35 mm, brown in colour	Attaches itself to folded oak leaves inside the cocoon made of larval hairs.
Adult (Fig. 3b & c)	2 days	Male (Wingspan: 46 mm) active inside the breeding cage.	Emergence took place at dusk

40mm; Fig. 4b & c). Cheanban *et al.* (2017) observed that males have very small proboscis, bipectinate antenna, body length is 10-14 mm, transparent forewing, one large brown frenulum at the anterior of the hind wing whereas female have pale yellow head and labial palp, bipectinate antenna, body length ranges 11.0-12.50 mm, abdomen covered with white hairs and 2-3 smaller frenulum on the hind wing.

Pest Status: Minor pest

Remarks: Rare in Ban oak forests

5. *Olene inclusa* Walker, 1856, Family: Erebididae

Distribution: *Olene inclusa* Walker, 1856 occurs in the N.W. Himalayas, Poona

(Maharashtra, India), Java (Hampson, 1892), West Malaysia, Indonesia, Hong Kong, New Guinea, Java, South East Asia, Thailand and Andaman Islands (Robinson *et al.*, 2010).

Host Range: Larval host plants recorded for this moth are *Annona*, *Averrhoa*, *Durio*, *Ricinus*, *Leea*, *Pelagonium*, *Acer*, *Arachis*, *Crotalaria*, *Derris*, *Erythrina*, *Mucuna*, *Ficus*, *Musa*, *Calyptanthus*, *Eugenia*, *Rosa*, *Citrus*, *Theobroma*, *Muntingia*, *Conggea* (Holloway, 1999); *Octomeles sumatrana* Miq. (Chung *et al.*, 2008); *Solanum melongena* L., *Casuarina* sp. (Robinson *et al.*, 2010).

Life-history: Larva of male are dark brown in colour, with lateral tufts of long hair; head red-brown; two white dorsal lines on 4th somite

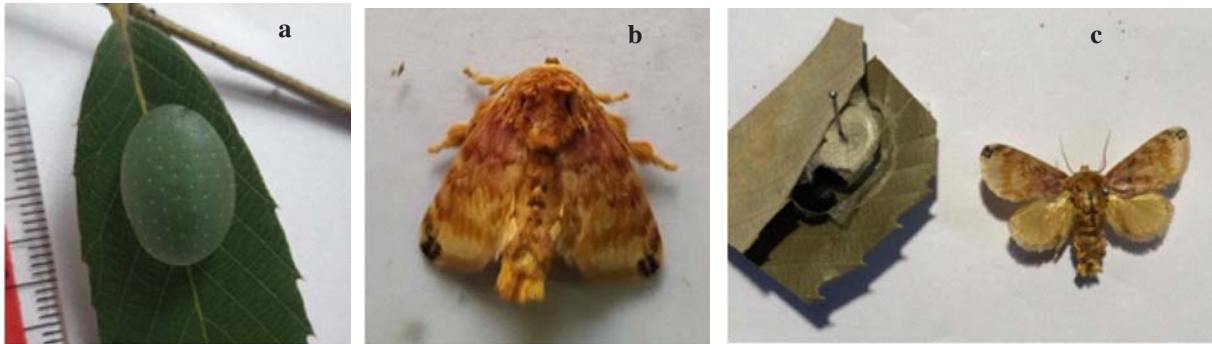


Fig.1. Life history stages of *Cheromettia apicata* (Moore,1879) on Ban oak-
a) Larva, b) Moth, c) Cocoon and pinned moth (upperside)



Fig. 2. Life history stages of *Suana concolor* Walker,1855 on Ban oak, *Quercus leucotrichophora*-
a) Larva, b) Cocoon, c) Moth, d) Pinned moth (upperside)

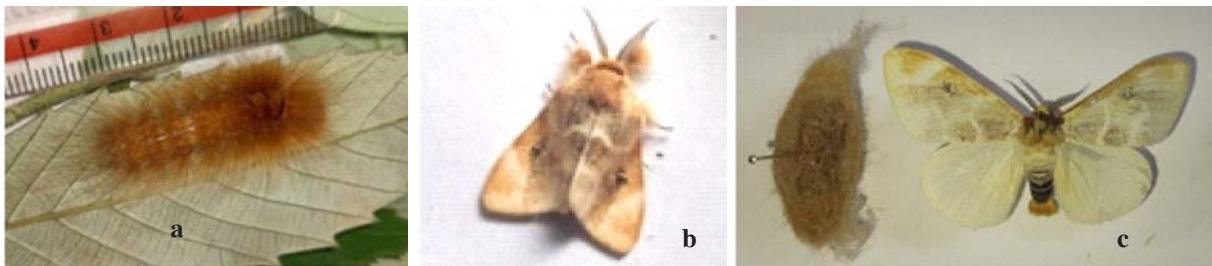


Fig. 3. Life history stages of *Pida decolorata* (Walker,1869) on Ban oak, *Quercus leucotrichophora*-
a) Larva, b) Moth (male), c) Cocoon and pinned moth (upperside)

and dorsal tufts of silky reddish hair from 4th to 7th somite. While the larva of female has dorsal tufts dark brown; a subdorsal white stripe and crimson dorsal spots on 9th and 10th somites (Fig. 5a). *O. inclusa* was recorded on young plantation in New Forest campus, Dehradun, Uttarakhand, India during 2018-2020. Its incidence was observed from June to November. A full grown fifth instar larva measured 30 mm in length (Fig. 5a). The larval period varied from 14 to 17 days. Pupa (24mm) was formed inside a tightly woven cocoon (30mm; Fig. 5c) in the laboratory. Pupal period

varied from 5 to 6 days in July. Both male (wingspan: 36-38 mm; Fig. 5b) and female (wingspan: 50mm; Fig. 5c) moths emerged in the laboratory during July. Male moth had a wingspan of 40 mm and was dark brown with indistinct lines and waved brown band beyond the post-medial line and hind wing brownish fuscous while the female is larger with 52mm wingspan and has a indistinct pale brown sub-basal mark on the upper forewing (Hampson, 1892).

Pest Status: Minor pest.



Fig. 4. Life history stages of *Perina nuda* Fabricius, 1787 on Ban oak, *Quercus leucotrichophora*- a) Pupa, b) Pupal case and emergent moth, c) moth pinned (upperside)



Fig. 5. Life history stages of *Olene inclusa* Walker, 1856 on Ban oak, *Quercus leucotrichophora*- a) Larva, b) Moth (male), c) Cocoon and moth pinned (female upperside)

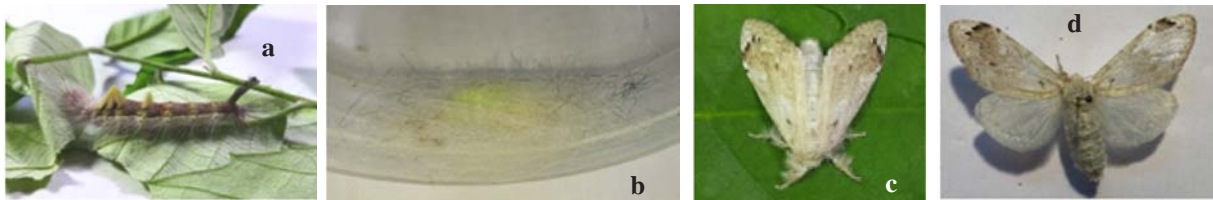


Fig. 6. Life history stages of *Olene dudgeoni* Swinhoe, 1907 on Ban oak, *Quercus leucotrichophora*- a) Larva, b) Cocoon with pupa, c) Emergent moth (female) and d) pinned moth (female) upperside

Remarks: Common in Ban oak forests at lower elevation.

6. *Olene dudgeoni* Swinhoe, 1907, Family: Erebidae.

Distribution: This moth is distributed from N.E. Himalaya to Taiwan and Sundaland (Holloway, 1999); China (Lui *et al.*, 2012). It has also been recorded from Godavari village near Kathmandu in Nepal (Central Himalaya).

Host range: Other host plants are *Camellia oleifera* C. Abel (Lui *et al.*, 2012); *Camellia sinensis*(L.) Kuntze (Theaceae).

Habit: Larva feeds on the leaf margin and then entire leaf leaving only behind the midrib.

Life cycle: Larva (Fig. 6a) of this moth were recorded defoliating *Q. leucotrichophora* tree in Chaubati village (29.81294N & 80.21558E; 1838 m) in Pithoragarh district, Uttarakhand. Length of full grown larva was 43 mm. Body is ashy black from the dorsal region with yellow patches on the lateral side and white coloured from ventral surface from which white hair like setae are rising laterally and head in pinkish in colour; four yellow tuft of hairs lies on the dorsal surface of the body



Fig. 7. Life history stages of *Ischyja manila* (Cramer, [1776]) on Ban oak, *Quercus leucotrichophora* - a) 5th instar larva, b) larva in folding position on being threatened, c) Cocoon in folded leaves, d) pupa, e) emergent moth, f) pinned moth (female)



Fig. 8. Life history stages of *Arctornis submarginata* (Walker, 1855) on Ban oak, *Quercus leucotrichophora* - a) 5th instar larva with feeding pattern, b) Pupa, c) Emergent moth (upperside) with pupal shell, d) pinned moth (female)

and one black tuft of hairs lies at the last segments of the body and white hair like setae are present near the head region and black setae lies at the last abdominal segment of the body longitudinally. Pupa was formed after 16 days of larval feeding. Pupa (30 mm; Fig. 6b) is yellowish-green in colour and enclosed in cocoon whose length is 40 mm attached to the surface. Pupal period was 11 days. Moth female wingspan was 46 mm (Fig. 6c & d). According to Holloway (1999), this species resembles *O. mendosa* Hubner, to some extent but the forewings are a darker, more leaden grey, with the transverse, black anti medial in a more basal position, without a pale blotch basal to it.

Pest Status: Minor pest.

Remarks: Sporadic infestation in Ban oak forests in mid elevations.

7. *Ischyja manila* (Cramer, 1776), Family: Erebiidae

Distribution: The species has distribution in Philippines, Ceylon and Burma; Andamans; Java (Hampson, 1894), Palau (Fukushima, 1947), Australia (Nielsen *et al.*, 1996), Burma (Myanmar), Thailand, China, Okinawa (Japan), Sundaland (Thailand), Sulawesi (Indonesia); S. Moluccas (ssp. *amboinensis*) (Holloway, 2005) and in the Indian sub-region, Arunachal

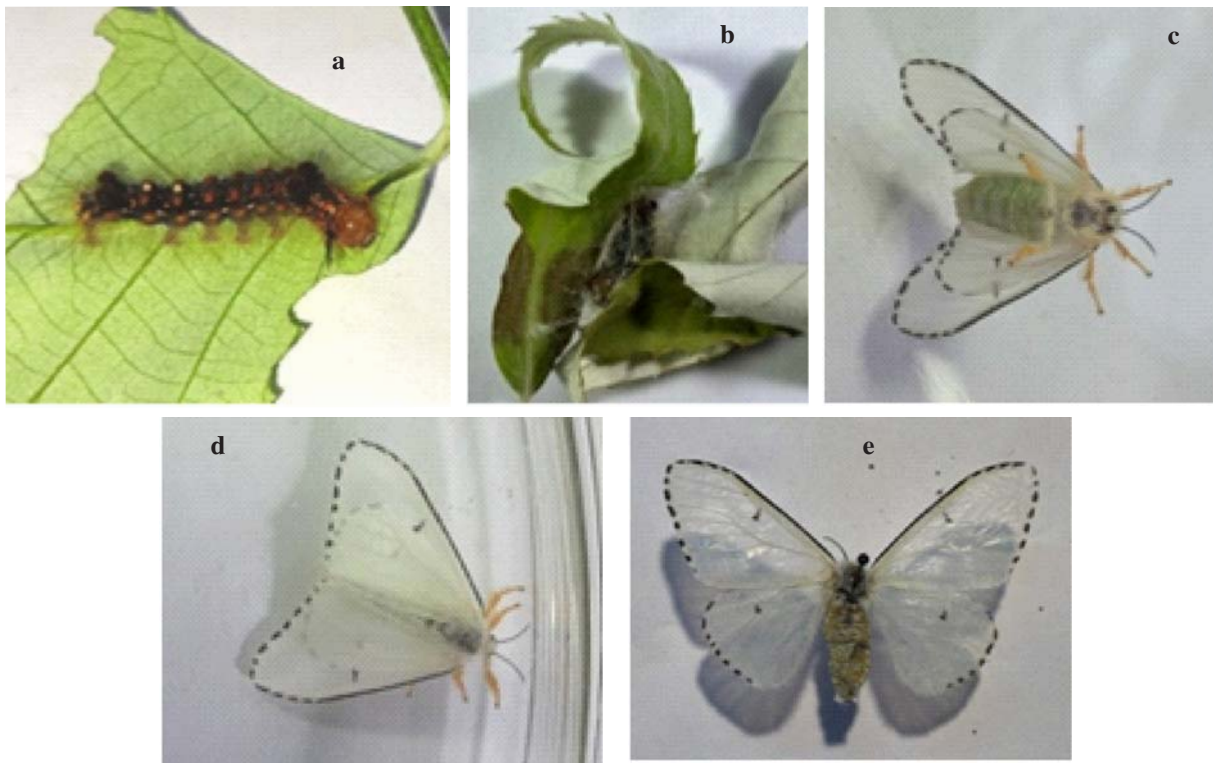


Fig. 9. Life history stages of *Swannia marmarea* Prout 1926 on Ban oak, *Quercus leucotrichophora*- a) v instar larva, b) Cocoon in folded leaves, c) Emergent moth (underside), d) Emergent moth (upperside), e) pinned moth (female).



Fig. 10. Life history stages *Alcis variegata* Moore, 1888 on Ban oak, *Quercus leucotrichophora*- a) Vth instar larva, b) feeding pattern, c) Emergent moth (upperside) with pupa, d) Emergent moth pinned (female upperside).

Pradesh, Uttarakhand, Assam and Karnataka (Sondhi *et al.*, 2019).

Host Range: Larvae are known to feed on *Schima* (Theaceae) (Holloway, 2005); *Aglaialawii* (Wight) Saldanha *ex* Ramamoorthy (Meliaceae), *Cupaniopsis nacardioides* (A. Rich.) Radlk (Sapindaceae), *Dalbergia monetaria* L.f. Moneybush, *Xylia xylocarpa* Roxb. Taub. (Fabaceae), *Terminalia paniculata* Roth (Combretaceae) (Robinson *et al.*, 2010).

Habit: Larvae feed on the frontal half of the leaf by cutting it into half (40 mm; Fig. 7a & b).

Life-history: Hampson (1894) described pupa and Holloway (2005) described larva and adult. Pupa 35 mm in length, efflorescent, ashy black in colour and enclosed in cocoon whose length is 50 mm which is enclosed inside 3-4 ban oak leaves wrapped together around it from all the sides (Fig. 7c). Emerged female moth had a wingspan of 90mm (Fig. 7e & f).

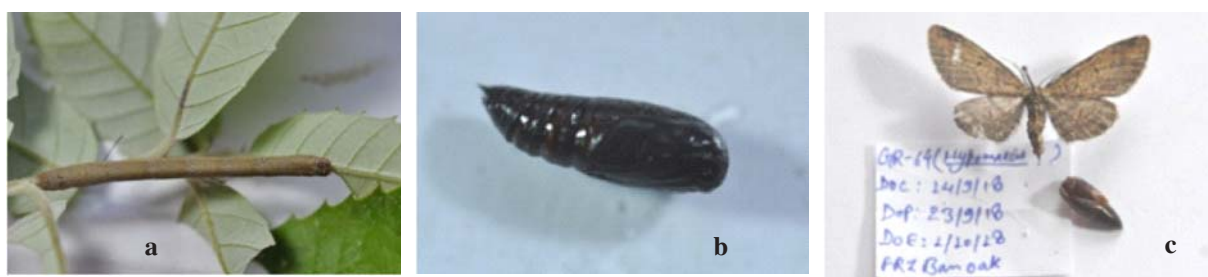


Fig. 11. Life history stages of *Eupithecia maculosa* (Vojnits,1981)-
a) vth instar larva, b) pupa, c) Emergent Moth



Fig. 12. Life history stage of *Salma* sp. (Walker,1863) of Ban oak, *Quercus leucotrichophora*-
a) V instar larva, b) pupa, c) emergent moth (Upperside), d) Pinned moth (upperside)



Fig. 13. Larva of *Mahanta* sp. feeding on Ban oak, *Quercus leucotrichophora*

Pest Status: Minor pest.

Remarks: Sporadic infestation in ban oak forests in lower elevations.

8. *Arctornis submarginata* (Walker, 1855),
Family: Erebidae

Distribution: China

Host Range: Other host plants are *Camellia oleifera* C. Abel (Lui *et al.*, 2012); *Camellia sinensis* (L.) Kuntze (Theaceae).

Habit: Larva feed on leaf margins by eating part of it but never the entire leaf.

Life-history: Larvae (Fig. 8a) were collected from oak tree on 23.ix.2020 in Dhauli-Ghauri village (29.843N & 80.165E; 1027m), Pithoragarh district, Uttarakhand, India. Larvae preferred to rest on the midrib of the leaf on the under surface thus hiding by camouflaging. The length of full grown larva is 28 mm. Larval period was more than two weeks in September. Pupa (Fig. 8b) was plain green in colour and

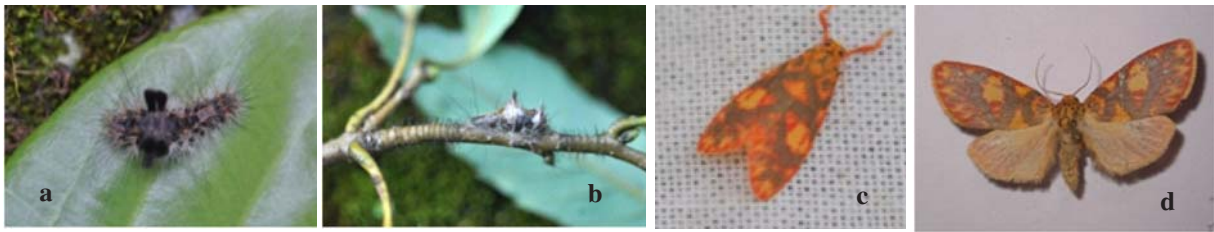


Fig. 14. Life history stages of *Floridasura tricolor* (Wileman, 1910) on ring-cupped oak, *Quercus glauca* - a) 5th instar larva, b) Pupa on twig covered with rings of spine like hairs, c) Emergent moth (underside), d) pinned moth (female).

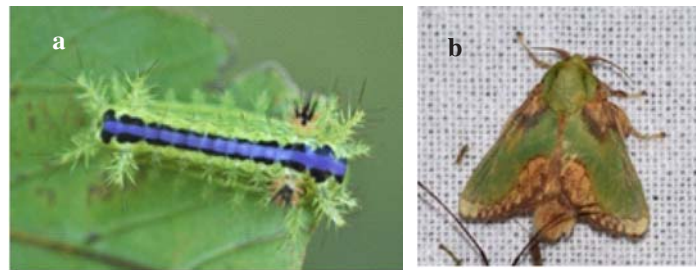


Fig. 15. Life history stages of *Parasa pastoralis* Butler, 1885 on ring-cupped oak, *Quercus glauca* - a) 5th instar larva, b) cocoon, c) Emergent moth



Fig. 16. Life history stages of *Demonarosa rufotessellata* Moore, 1879 on ring-cupped oak, *Quercus glauca* - a) Final instar larva (dorsal view), b) Final instar larva (lateral view), c) Final instar larva before cocoon formation, d) cocoon inside folded leaf

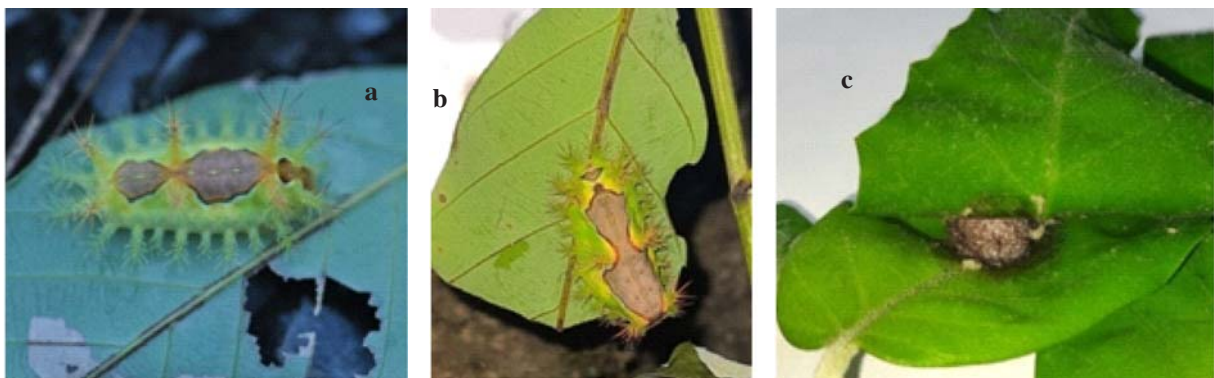


Fig. 17. Life history stages of *Adoneta* sp. on ring-cupped oak, *Quercus glauca* - a) Final instar larva (Dorsal view), b) Final instar larva with half eaten leaf, c) Cocoon ball inside folded leaf

having small, yellow colour dots on the dorsal side was formed. Length of pupa was 17 mm. Pupal period was of seven days (27 September - 2 October 2020). Emergence of white male moth (Fig. 8 c & d; wing span: 40mm) with green abdomen and having a black spot near the middle of each forewing was noted on 2.x.2020. The mature 5th instar larva move to lower leaves and combine two complete leaves by spinning silk into a ridge shaped cocoon and then pupate inside it.

Pest Status: Minor pest.

Remarks: Common in Ban oak forests.

9. *Swannia marmarea* (Prout,1926), Family: Geometridae

Distribution: This species was described by Prout (1926) from Myanmar also been recorded in Central Himalaya i.e. Nepal (Godavari village near Kathmandu) (Haruta, 1993). The present record of this species is from Chaubati village in Pithoragarh district in Uttarakhand and is 500 km west of Godavari village in Nepal, its known western most limit in the Himalayas.

Host Range: Data deficient.

Habit: Larvae feed on leaf margins.

Life-history: Larva (Fig. 9a) was collected from Ban oak on 25.ix.2020 in Chaubati village near Didihat (29.81294N & 80.21558E; 1838 m) in Pithoragarh district, Uttarakhand. Length of larvae ranged from 20 to 28 mm, body is black and head in brown in colour; a pair of dark brown tuft of hairs lies in the metathorax region and at the last few segments of dorsal surface of the body and pairs of raised brick-red spots on their dorsal and lateral side of the body and white hair like setae are present all over the body. Pupa was formed on 13.x.2020. The pupa is yellowish in colour (length is 10 mm; Fig. 9b), and enclosed in a cocoon (measures 22mm) attached in 2-3 ban oak leaves together. Pupal period was of 7 days. Emerged female moth (Fig. 9c - e) is white

with sharp black wing margins that are chequered along the outer margin (termen), with a wingspan of 42 mm and legs yellow in colour.

Pest Status: Minor pest.

Remarks: Sporadic infestation in ban oak forests in mid elevations.

10. *Alcis variegata* Moore,1888, Family: Geometridae

Distribution: This species is found in India, Sikkim, Nepal, Myanmar, Laos, southern China, northern Vietnam, Thailand, Peninsular Malaysia and Sumatra (https://en.wikipedia.org/wiki/Alcis_variegata).

Host Range: In Japan another species of the same genus i.e. *A. angulifera* Butler,1878 feeds on *Acer palmatum* Thunb., *Camellia japonica* L., *Castanea crenata* Siebold & Zucc., *Malus pumila* Mil., *Quercus acutissima* Carruth., *Q. mongolica* Fisch.ex. Ledeb., *Q. serrata* Murray, *Q. variabilis* Blume. While in Finland *A. repandata* Linnaeus,1758 feeds on *Alnus incana* (L.) Moench, *Betula pendula* Roth, *Salix aurita* L., *Tilia cordata* Mill. (Robinson *et al.*, 2010).

Habit: Larva defoliates

Life-history: One larva (12 mm; Fig. 10a & b) was recorded on 03.iv.2019. Dark brown pupa (12m; Fig. 10c) was formed on 16.iv.2019 Emergence of moth (Wingspan: 26mm) took place on 26.iv.2019 in the laboratory (Fig.10c & d).

Pest Status: Minor pest.

Remarks: Uncommon in Ban oak forests in lower elevations.

11. *Eupithecia maculosa* (Vojnits,1981), Family: Geometridae

Distribution: It is found in north eastern India and Pakistan (Mironov *et al.*, 2008, 2010).

Host plants: Other species of the same genus i.e. *Eupithecia abbreviata* are known to feed on *Crataegus* spp., in Iran, *Quercus* spp., in British Isles. *E. abietaria* feeds on *Abies procera*, *A. concolor*, *Picea abies*, *Pinus cembra*, *P. sylvestris* in Nearctic and Holarctic realm. One more species of same genus *Eupithecia interrubescens* is known to feed on *Pinus* spp. in India (Robinson *et al.*, 2010).

Habit: Larvae feed on the leaf tips and margins of tender leaves

Life-history: A green coloured larva (24mm) feeding on foliage (Fig 11a) was collected on 14.ix.2018 and it pupated on 23.ix.2018. Pupa (20 mm length, 4 mm width) is dark brown in colour (Fig. 11b). Adult moth emergence noted on 01.x.2018 (Fig. 11c).

Pest Status: Minor pest.

Remarks: Rarely seen in Ban oak forests at lower elevations

12. *Salma* sp. (Walker, 1863), Family: Pyralidae

Distribution: Oriental region

Host Range: The host plants for genus *Salma* in this region are mainly of the family Combretaceae - (*Terminalia* and *Anogeissus*) i.e. *Salma carbonifera* found in Oriental region feeds on *Terminalia tomentosa* Roxb, *T. bellirica* (Gaertn.) Roxb., *T. paniculata* Roth, *Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill. & Perr., *Diospyrus melanoxylon* Roxb., *Garuga pinnata* Roxb., *Lagerstroemia parviflora* Roxb., *Mangifera indica* L., *S. plicatalis* found in India and Burma feeds on *Tectona grandis* L. and *Terminalia tomentosa* Roxb. (<https://www.nhm.ac.uk>).

Habit: Larva defoliates

Life-history: One larva (10mm) was collected on 27.vi.2018 while feeding on oak leaves (Fig. 12a). Moulting into fifth instar larva took place on 05.vii.2018 (Fig. 12a & b). Full grown fifth instar larva measured 35mm in length. Shiny

brown pupa (Fig. 12b; 15 mm) formed on 16.vii.2018. Emergence of moth (wing span 25mm; Fig. 12c & d) noted on 27.vii.2018 in the laboratory.

Pest Status: Minor pest.

Remarks: Rarely seen in Ban oak forests at lower elevations

13. *Mahanta* sp., Family: Limacodidae

Distribution: *Mahanta quadrilinea* Moore, 1879 is distributed in India and Bhutan and Taiwan (http://www.wikiwand.com/en/Mahanta_quadrilinea).

Host Range: Not known

Habit: Larva defoliates feeding on both young and mature leaves

Life-history: Larva (12mm) was recorded defoliating at Chakrata hills (Chakrata Forest Division: 30°72'46" N & 77°86'10" E; 2100m), Garhwal, Uttarakhand, India on 28.viii.2019 (Fig. 13). Pupa is like brownish hardened ball.

Pest Status: Minor pest.

Remarks: Uncommon in Ban oak forests.

b. Defoliators of Ring-cupped oak or Phaliant, *Quercus glauca* Thunb., 1784

14. *Floridasura tricolor* (Wileman, 1910), Family: Arctiidae

Distribution: The genus is widespread from Assam (Strand, 1922); north-eastern India through Myanmar, Thailand, Laos, Cambodia and southern Mainland China to Vietnam, Hainan and Taiwan Island (Hampson, 1914; Volynkin *et al.*, 2019).

Host Range: Not known

Habit: Larva defoliates by feeding on the lateral surface of the leaf

Life-history: Larvae were recorded defoliating *Q. glauca* trees in moist temperate forest at Oglā, between Didihat and Thal

(29.84339N & 80.16503E; 1560-1800m), Pitthoragarh district of Kumaon region of Uttarakhand (Western Himalaya) on 23.ix.2020. Full grown larva measured 20 mm in length (Fig. 14a), greyish in colour having long spiny hairs spread all over the body and two pairs of thick black hair tufts on the dorsal surface of the 4-5 segments of the body spread laterally. Up to 2-4 larvae were recorded defoliating a single twig. Larval period ranged from 3 to 4 weeks in September. Pupa (Fig. 14 b) is 15 mm (male) and 17 mm (female) in length, dark brown in colour and was formed attached to the twig longitudinally near the area of feeding with new foliage. Spines like setae are woven all around the twig in such a way that pupa lies in between and spine like barbs are present on anterior and posterior of pupa and all around in order to protect it from natural enemies. Pupa period is of 5-6 days in September. Moths (Fig.14 c & d) wing span 30mm (male) and 34mm (female)], emerged in during late September: three numbers on 30.ix.2020 and two on 05.x.2020. Fore wings are crimson colour with yellow patches on the centre and outer areas and four dark grey transverse bands; sub-basal and anti-medial bands are curved towards each other, touching about middle. Hind wings are pale ochreous, suffused with reddish (Wileman, 1910). According to Volynkin *et al.* (2019) antennae of both sexes are ciliate.

Pest Status: Minor pest.

Remarks: Moths are attracted to light in subtropical and moist temperate forests in the state.

15. *Parasa pastoralis* Butler, 1885, Family: Limacodidae

Distribution: This species is widespread in the Oriental tropics from N.E. Himalaya to Sundaland and in south-east Asia including India, Pakistan, Bhutan, Nepal, Myanmar, Southern China, Taiwan, Thailand, Vietnam, Borneo, Sumatra, Java and Bali (Holloway, 2005).

Host Range: Other host plants are *Musa* sp. (Musaceae), *Aleurites cordata* (Thunb.)

Staud. (Euphorbiaceae), *Tectona grandis* L. (Verbenaceae), *Triadica sebifera* (L.) *Stillingia sebifera* (L.) Michx (Euphorbiaceae) (Joannis, 1929); *Camellia sinensis* (L.) Kuntze (Theaceae) India (Robinson *et al.*, 2010).

Life-history: Larva (17mm) was recorded on *Q. glauca* tree in moist temperate forest at Oglia, between Didihat and Thal (29.84339N & 80.16503E; 1560-1800m), Pitthoragarh district of Kumaon region of Uttarakhand (Western Himalaya) on 23.ix.2020 (Fig. 15a). Rounded brownish ball like pupa was formed on 06.x.2020. Emergence of greenish moth with brown markings took place on 18.x.2020 (Fig. 15b; female; wingspan: 38mm).

Habit: Larva defoliates by feeding on tender leaves.

Pest Status: Minor pest.

Remarks: Uncommon in *Q. glauca* forests.

16. *Demonarosa rufotessellata* Moore, 1879, Family: Limacodidae

Distribution: This species is found in Borneo as well as in India, Nepal, Myanmar, Thailand, Laos, Vietnam, the Philippines, Taiwan and Japan. (https://en.wikipedia.org/wiki/Demonarosa_rufotessellata).

Host Range: Rock Oak, *Lithocarpus konishii*, *Litchi* spp. and *Liquidambar* spp. (James, 2017).

Habit: Larva defoliates

Life-history: A tent shaped greenish larva (Fig. 16a & b) was recorded defoliating *Q. glauca* tree in moist temperate forest at Oglia, between Didihat and Thal (29.84339N & 80.16503E; 1560-1800m), Pitthoragarh district of Kumaon region of Uttarakhand (Western Himalaya) on 23.ix.2020. Caterpillar 16mm in length moves slowly in a smooth, slug like fashion and does not travel far and, before moving on, will consume the same leaf until there is nothing left. It is green, with the dorsal

peaks outlined in brown and intricate, armour-plating markings across its top and sides (James, 2017). The larva only feed on the leaf margin and turned brownish just before pupation (Fig. 16c). Pupa, a hardened ball cocoon (Fig. 16d) is placed between two leaves tied together (10mm length), was formed on 25.ix.2020. The moth failed to emerge.

Pest Status: Minor pest.

Remarks: Locally common in *Q. glauca* forests

17. *Adoneta* sp., Family: Limacodidae

Distribution: The genus is distributed in the Neartic and Palaearctic region.

Host Range: One species of the same genus i.e. *Adoneta spinuloides* feeds on the *Malus*, *Prunus* (Rosaceae) and *Quercus* (Fagaceae) in the Neartic region (<https://www.nhm.ac.uk>) whereas *A. gemina* feeds on *Ebenopsis ebanob* (Berland.) Barneby & J.W. Grimes (Fabaceae) at Texas North America (<https://bugguide.net/node/view/1034734>).

Habit: Larva defoliates by feeding on the leaf margins before consuming the entire leaf.

Life-history: Larva (23mm) was recorded feeding leaves of *Q. glauca* trees in moist temperate forest at Oglia, between Didihat and Thal (29.84339N & 80.16503E; 1560-1800m), Pitthoragarh district of Kumaon region of Uttarakhand (Western Himalaya) on 23.ix.2020 (Fig. 17a & b). A hard balled pupa (Fig. 17c) was formed on 08.x.2020 between a folded leaf and leaves.

Pest Status: Minor pest.

Remarks: Locally common at lower elevations.

With the current findings the total number of leaf eating caterpillars infesting *Q. leucotrichophora* and *Q. glauca* known till date is 68 species in the Western Himalayas and are mostly polyphagous in habit and distributed across the Himalayan region

extending to south-east Asia. The study reports for the first time *Q. leucotrichophora* as new host for 13 species of lepidopteran belonging to Limacodidae, Erebidae, Geometridae, Pyralidae and Limacodidae and four species belonging to Arctiidae and Limacodidae on *Q. glauca* from both Garhwal and Kumaon regions of Uttarakhand state, India.

REFERENCES

- Ahmad Y. and Ho T.H. (1980) List of economic pests, host plants, parasites and predators in West Malaysia (1920-1978). Bulletin No. 153. Ministry of Agriculture, Malaysia.
- Ambu G., Chaudhary R.P, Mariotti M. and Cornara L. (2020) Traditional Uses of Medicinal Plants by Ethnic People in the Kavrepalanchok District, Central Nepal. *Plants* 9: 759.
- Bargali K., Bisht P, Khan A. and Rawat Y.S. (2013) Diversity and regeneration status of tree species at Nainital Catchment, Uttarakhand, India. *Int J of Biodiversity and Conservation* 5 (5): 270-280.
- Beeson C. F. C. (1941) Ecology and control of the forest insects of India and the neighbouring countries. Govt of India. 532 pp.
- Bhatt J., Tewari A. and Mittal A. (2015) Regeneration Problem in *Quercus leucotrichophora* A. Camus in Nainital Forest Division of Kumaun Himalaya. *International journal of pure & applied bioscience* 3 (3): 284-290 (2015).
- Browne F.G. (1968) Pests and diseases of forest plantation trees. Oxford University Press. 1330 pp.
- Cheanban, S., S. Bumroongsook & S. Tigvattananont (2017) *Perina nuda* F. (Lepidoptera: Lymantriidae): An Important Leaf Eating Caterpillar of Fig Trees. *International Journal of Agricultural Technology* 13(4): 485-492.
- Chey V.K. (2004) *Suana concolor*-Giant defoliator of *Acacia mangium*. *Sepilok Bulletin* 1: 63-65.
- Chung A.Y.C., Ajik M., Nilus R., Hastie A., Ong R. and Chey V.K. (2008) Insect pests of binuang (*Octomeles sumatrana*) in Sabah. *Sepilok Bulletin* 9: 31-52.
- Fukushima I. (1947) Noctuidae of Micronesia (Lepidoptera). *Mushi* 18: 1-22.
- Hampson G.F. (1892) The Fauna of British India including Ceylon and Burma. Moths, Vol. 1. Taylor & Francis, London. pp. 452.

- Hampson G.F. (1894) The Fauna of British India including Ceylon and Burma. Moths, Vol. 2. Taylor & Francis, London. Arctiidae, Agrostidae, Noctuidae. pp. 537.
- Hampson G.F. (1914) Catalogue of the Amatidae and Arctiidae (Nolinae, Lithosianae) in the collection of the British Museum. Catalogue of Lepidoptera Phalaenae in the British Museum I (Suppl.):1:768.
- Haruta T. (1993) Moths of Nepal Part-2. Tinea (Supplement 3). The Japan Heterocerists Society. Vol.13 . pp. 207.
- Holloway J.D. (1987) The Moths of Borneo: Superfamily Bombycoidea: families Lasiocampidae, Eupterotidae, Bombycidae, Brahmaeidae, Saturniidae, Sphingidae. 199 pp. Kuala Lumpur: Southdene.
- Holloway J.D. (1999) The moths of Borneo (part 5): family Lymantriidae. Malayan Nature Journal 53: 1–188 (www.mothsofborneo.com/part-5/orgyiini/orgyiini_3_2.php).
- Holloway J.D. (2005) *The Moths of Borneo*. Part 15/16. Noctuidae, Catocalini. http://www.mothsofborneo.com/part-15-16/miscellaneous_i/miscellaneousi_3_6.php [accessed 14 January 2016]
- http://www.wikiwand.com/en/Mahanta_quadri-linea
- <https://bugguide.net/node/view/1034734>
- https://en.wikipedia.org/w/index.php?title=Arctornis_submarginata&oldid=983434738.
- https://en.wikipedia.org/w/index.php?title=Perina_nuda&oldid=932677322.
- https://en.wikipedia.org/wiki/Alcis_variegata
- https://en.wikipedia.org/wiki/Demonarosa_rufotessellata
- <https://www.nhm.ac.uk>
- James D.G (2017) The books of Caterpillars. A life size guide to six hundred species from around the world. University of Chicago Press, Chicago. P 656.
- Joannis J.D. (1929) Lepidopteres Heteroceres du Tonkin. III part. Annals Society of Entomology, France 48: 559-569.
- Kala C.P.(2004) Studies on the Indigenous Knowledge, Practices and Traditional Uses of Forest Products by Human Societies in Uttaranchal State of India. Almora: GB Pant Institute of Himalayan Environment and Development.
- Kaleka A.S. and Kaur N. (2019) Studies on internal male and female genitalic features of *Pida decolorata* (Walker) (Lymantriidae: Lepidoptera) from India. Annals of Entomology, 37(01): 61-65.
- Liu J., Shu J., Hua Z., Xu T. and Wang, H. (2012) Preliminary report of biological characteristics of *Dasychira dudgeoni*. Forest Research, Beijing 25(4): 535-539.
- Mathur R.N. and Singh B (1959) A list of insect pests of forest plants in India and adjacent countries-Part-8-List of insect pests of plant genera 'P' to 'R'. (Paederia and Rumex). Govt. of India Press, Faridabad, Delhi. 130 pp.
- Mironov V.G. and Galsworthy A. C. (2010). "Further notes on *Eupithecia* (Lepidoptera: Geometridae) from Nepal and the Indian subcontinent". Transactions of the Lepidopterological Society of Japan 61 (2): 137-172.
- Mironov, V.G., A.C. Galsworthy & U. Ratzel (2008). "A survey of the *Eupithecia* fauna (Lepidoptera: Geometridae) of the Western Himalayas: Part I". Transactions of the Lepidopterological Society of Japan 59 (1): 55-77.
- Nielsen E.S., Edwards E.D. and Rangsi T.V. (eds) (1996) Checklist of the Lepidoptera of Australia. CSIRO, Australia. XIV: 529p.
- Prout L.B. (1926) On a collection of moths of the family Geometridae from upper Burma made by Captain A.E. Swann. Journal of Bombay Natural History Society 31:129-146.
- Pugaev S.N. and Skrobotoy A.A. (2011) Contribution to the knowledge of the preimaginal stages of *Suanaconcolor* Walker, 1855. Neue Entomologische Nachrichten 67: 23-26.
- Robinson G.S., Ackery P.R., Kitching I.J., Beccaloni G.W. and Hernandez L.M. (2010) HOSTS - A Database of the World's Lepidopteran Hostplants. Natural History Museum, London. <http://www.nhm.ac.uk/hosts>. (Accessed: 01 October 2020).
- Shah S.K.R., Das A., Dutta R. and Mishra B (2018) A current list of moths (Lepidoptera) of West Bengal. Bionotes 20(1): 24-29.
- Shrestha B.B. (2006) *Quercus semecarpifolia* Sm. in the Himalayan region: Ecology, exploitation and threats. Himalayan Journal of Sciences, September DOI: 10.3126/hjs.v1i2.212.
- Singh A.P., Bahuguna K. and Ramola G.C. (2019) New host records of polyphagous Lepidoptera on Ban Oak *Quercus leucotrichophora* A. Camus (Fabaceae) in the Garhwal Himalaya, India. Journal of Threatened Taxa 11(5): 13579–13591. <https://doi.org/10.11609/jott.4624.11.5.13579-13591>.

- Singh S.P. (1981) Rural ecosystem and development in the Himalaya. In: J.S. Singh, S.P.Singh, C. Shastri (eds.) Science and Rural development in Mountains, Gyanodaya Prakashan, Nainital, India, pp. 74-78.
- Smetacek P. and Smetacek R. (2011) Additions to the known larval host plants of Indian Lepidoptera, *Journal of Threatened Taxa* 3(12):2272-2276.
- Sondhi S., Sondhi Y., Roy P. and Kunte K. (2019) Moths of India, v. 2.00. Retrieved December 31, 2019. url: <https://www.mothsofindia.org/>.
- Strand E. (1922) Arctiidae :Lithosiinae. *Lepidopterorum Catalogous* 26 : 501-825.
- Subhalaxami V. (2018) Birding Field Guide to Indian Moths. Birdwing Publishers. pp. 175.
- Swinhoe C. (1923) *Annals and Magazine of Natural History* (9) 11 (61):81.
- Thakur B., Chakrabarti S. and Kumar M. (2015) American *Applied & Natural Sciences* 10(1): 31-34.
- Troup R.S. (1921) *The Silviculture of Indian Trees*. Vol.3. Clarendon Press. Oxford. 1144 pp.
- Verma T. D., Thakur J.R. and Dogra G.S. (1979) Outbreak of Indian Gypsy moth *Lymantria obfuscata* Wlk., on oak in Himachal Pradesh, *Indian Forester* 105: 594-597.
- Volynkin A. V., Huang S.Y. and Ivanova M.S. (2019) An overview of genera and subgenera of the *Asura/Miltochrista* generic complex (Lepidoptera, Erebidae, Arctiinae). Part 1. Barsine.
- Walker, 1854 sensulato, *Asura* Walker, 1854 and related genera, with descriptions of twenty new genera, ten new subgenera and a check list of taxa of the *Asura/Miltochrista* generic complex. *Ecologica Montenegrina* 26: 34.
- Wileman A.E. (1910) New Lepidoptera-Heterocera from Formosa. *Entomologist* 43 (568): 244. www.nic.funet.fi/

(Received February 11, 2021; revised ms accepted March 20, 2021; printed March 31,2021)