Insect Pests of Western Himalayan Oaks in Uttarakhand

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Forest Research Institute
(Indian Council of Forestry Research & Education)
Dehradun

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Written by
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Shri Arun Singh Rawat, IFS
Director General

भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद
(पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार की एक स्वायत्त परिषद्)
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Foreword

The book on "**Insect Pests of Western Himalayan Oaks in Uttarakhand**" produced by Forest Research Institute is a unique compilation of 231 species of insects infesting 5 species of Western Himalayan Oaks occurring across the state, each depicted with colourful photographs of different stages of their life cycle. The book contains vital information on the taxonomy, distribution range, host plant spectrum, habits, life history, extent of damage, pest status of each one of them. This is the first ever compilation of detailed information on insect pests of Oaks in India at one platform. I would like to congratulate the author and his team for their relentless efforts in gathering data for over 3 years and bringing out this work in form of a monograph. It is anticipated that this book will persuade all stakeholders including forest departments, researchers, naturalists, local communities, NGOs, to join hands in better managements of Oak forests against insect pests in the region.

(Arun Singh Rawat) 24/9/21

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Preface

Preface

The Western Himalayan state of Uttarakhand is represented five species of oaks, namely, *Q. leucotrichophora* (Banj), *Q. floribunda* (Moru), *Q. semecarpifolia* (Kharsu), *Q.lanata* (Ryianj) and *Q.glauca* (Phaliant). These oaks assume considerable conservation significance as they are providers of numerous ecosystem services (conservation of soil, water, native flora and fauna) and serve as lifeline for the local communities. Predominantly these oak species are intricately associated not only with agro-ecosystems but also with the life support system of the inhabitants of the hills in this area. The oak forests are source of fuelwood, fodder and can be correlated with natural springs and wildlife. Many oaks are keystone species without which the complex web of the ecosystem would soon unravel. However, due to increasing anthropogenic disturbances, oak forests are today witnessing a steady decline and there are very few large patches of intact oak forests left in the Himalayan region today. Attack by insect pests is known to cause significant damage and sometimes mortality of oak trees. As there was no comprehensive information on the spectrum of insects infesting western Himalayan oaks in the state, this database was created for identification of insects infesting oaks and understanding their life history, distribution range, host plants, altitudinal distribution, habits, seasonality, extent of damage and pest status. The database created is presented in the form of a monograph for researchers, forest managers, NGO's and local communities,and is hoped to improve the understanding about insects infesting oaks in a better way.

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(Arun Pratap Singh)

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Introduction

INTRODUCTION

Forests constitute a very important resource base in the Himalayas, the world's youngest mountain range, which covers over one fifth (18%) of India's geographical area. The temperate broadleaved forests form the most significant ecosystems in the foothills and the mountainous regions of the mighty Himalayas throughout. These forests despite being very rich in their floral composition are, by and large are dominated by a few widely distributed plants genera, essentially and importantly including the species of *Quercus* commonly known as oak. Oaks (*Quercus* spp.) are the dominant, climax tree species of the moist temperate forests of the Indian Himalayan region (Troup,1921). An oak is a tree in the genus *Quercus* (Latin "oak tree") of the beech family, Fagaceae.

The genus *Quercus* is native to the Northern Hemisphere, and includes deciduous and evergreen species extending from cool temperate to tropical latitudes in the America, Asia, Europe, and North Africa (Hogan, 2012). There are approximately 600 species of oaks found worldwide and about 35 species of *Quercus* are distributed between 1000-3500 m elevations either in abundance or somewhat narrowly from the north eastern to the westernmost part of the Himalayas (Singh & Singh,2012). Oak forests occupy approximately 20,000 km^2 areas in the Central Himalaya between 1000-3000m elevations and are considered as a key stone species (Joshi & Juyal,2017). 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). Almost 35 species of oaks are important sources of fodder, fuelwood, charcoal, agricultural tools and bee boxes in Indian Himalaya (Negi and Naithani 1995). Amongst these, five species of evergreen oaks namely *Quercus glauca* (phaliyant or ring-cupped oak), *Q. leucotrichophora* (ban or banj or Himalayan silver oak), *Q.lanata* (syn. *Q. lanuginosa*) (rianj or woolly-leaved oak), *Q. floribunda (*syn.*Q,dilatata*)(moru) and *Q. semecarpifolia* (kharsu) grow naturally in the Western Himalaya sub-region of Uttarakhand (Singh & Rawat, 2012).

In the Western Himalaya, oak species assume considerable conservation significance as they are providers of numerous ecosystem services (conservation of soil, water, native flora and fauna) and serve as lifeline for the local communities. Predominantly three oak species (*Quercus leucotrichophora*, *Q. floribunda* and *Q. semecarpifolia*) are intricately associated not only with agro-ecosystems but also with the life support system of the inhabitants of the hills in this area. The oak forests are source of fuelwood, fodder and can be correlated with natural

springs and wildlife (Singh, 1981). In hill states of India, besides fuelwood and timber, the local people use oak wood for making agricultural implements. The leaves are used as fodder during lean period and bedding for livestock (Kala, 2004). The bark of mature trees supports a luxurious growth of non-vascular as well as vascular epiphytes. Many oaks are keystone species without which the complex web of the ecosystem would soon unravel (Shretha, 2006). Oaks also promote the recharge of mountain springs (Valdia, 1998).Uttarakhand (Singh & Rawat, 2012).

Oak forests are today under threat of extinction in the wild, largely due to land use changes, livestock grazing, unsustainable harvesting and insects attack. There is a continuing threat to these forests from exploitation for timber, fuelwood and charcoal (Kappelle, 2006). In the Himalayan region of India, oak forests are being invaded by pine forests due to the increase in temperature. The associated species of pine forest may cross frontiers and become new elements of the oak forests (Kala, 2012). Pressures on oaks have increased due to the rapid increase and spread of population, increasing land value, the development of practices and machinery for clearing range land, channelizing streams, road building, and urban development. In the Indian Himalayan region, the subsistence economy is dependent on energy and nutrient input from forests. Chronic disturbance caused by biomass removal-lopping of trees for fuel wood and leaf fodder is the dominant disturbance in these forests particularly in the vicinity of villages (Singh and Singh, 1992). According to Singh and Rawat (2010), there are very few patches of intact oak forests left in the Himalayan region today and those that do remain intact are changing rapidly due to alien invasive species such as *Eupatorium adenophorum, Lantana camara* and more aggressive species such as *Pinus roxburghii.*

Insects are the most numerous animals living in a forest, and more than a thousand different insect species feed on oaks across the globe (Metcalf and Flint, 1962). Only a few groups of insects have a significant impact on the oak resource: the leaf feeders (defoliators, skeletonizers and miners); the borers (bark, phloem, wood, root, twig, shoot, and acorn borers; the sucking insects; and those insects that cause indirect damage, such as vectors of disease-inducing organisms. Mathur and Singh (1959) were the first to list 125 species insects infesting these five species of Western Himalayan oaks.

1.Himalayan Silver Oak or Ban Oak- *Quercus leucotrichophora* A.Camus

Ban oak is a moderate to large sized evergreen tree with massive branches and a rounded crown, ordinarily attaining a girth of 120-180 cm and a height of 360-540cm. Leaves are 8-16 cm long, oblong or ovate lanceolate, acuminate, sharply serrate, coriaceous, dull green and glabrous above, densely white or grey tomentose beneath. Bark grey to grayish brown, longitudinally and transversely cracked. The male inflorescences (catkins) are borne on the tips of the branches, while the tiny round female flowers are borne at the base of the leaves. The fruits are orange-tan, marble-sized acorns (Troup,1921).

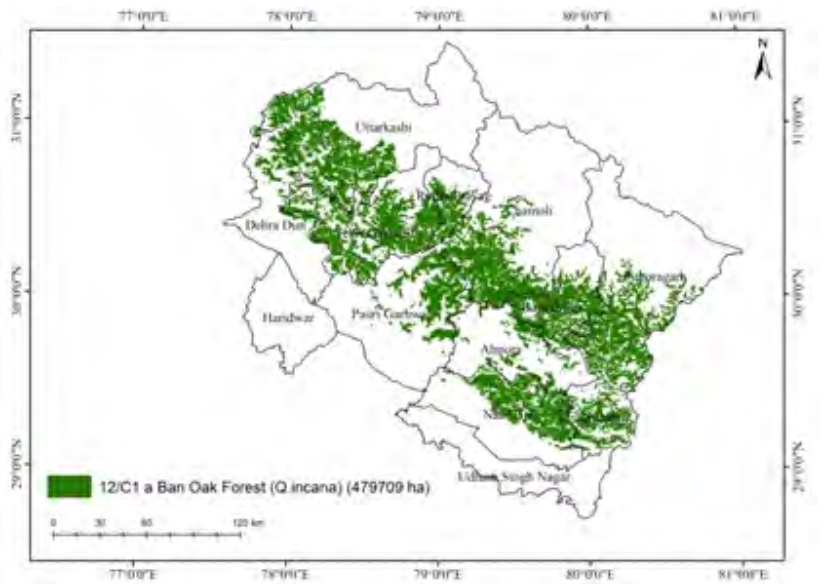


Fig.1.Map showing distribution of Ban oak, *Quercus leucotrichophora* forests in Uttarakhand

Ban oak occurs in the moister and cooler aspects in the Western Himalayas between altitudes 800 m to 2300 on the southern aspects, while the limits are lower by 200 to 300 m on the northern aspects. It is a principal species of oak forests of lower West Himalayan temperate forests as distinguished by Champion and Seth (1968). It is distributed in Northern India, Nepal, Pakistan. In Nepal, it naturally occurs at 1500-2700 m in forested areas in association with *Rhododendron arboretum* in its upper zone, it is usually associated with *Quercus floribunda, Cedrus deodara, Pinus wallichiana,* whereas in its lower zone it occurs with *Pinus roxburghii, Quercus glauca* (Luna, 2005). Based on detailed analysis, the total extent of banj oak forest in the Uttarakhand state comes to 1284.60 km^2 (5.24 % of total forest cover of the state). About 774.93 km^2 of banj oak forest lies within reserved forests while the remaining 509.66 km^2 lies in unclassified and village forests (Singh etal.,2016).

Ban oak is a multipurpose tree. The acorns are edible and can be dried, ground and used to thicken stews or to make bread. The seeds can be roasted to prepare a coffee substitute. The wood is a poor timber but a valuable fuel and is also used for making agricultural implements, and in low-grade construction. 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 ethnomedicine for treating colds and as an analgesic. In the Himalayas, ban oak foliage is a major source of fodder and the trees are lopped from December to June. In the Himalayas, *Quercus leucotrichophora* is lopped for fodder from December to June. The acorns are edible and the seeds can be roasted to make a coffee substitute. *Quercus leucotrichophora* also has uses in ethnomedicine, the gum being used for treating colds and as an analgesic (https://www.feedipedia.org/). It is used by the local inhabitants for fodder, fuel wood, agricultural implement and leaves for animal bedding. These forests are important for inflow and spring recharge of water for drinking and domestic uses of local residents. The future of these forests depends upon the regeneration (Bhatt et al., 2015). Acorns (seeds) make wildlife food for animals like *Macaca mulatta* (Rhesus Macaque), *Semnopithecus schistaceus* (Himalayan Langur), *Petaurista petaurista* (Flying Squirrel), *Ursus thibetanus* (Himalayan Black Bear) and many species of Himalayan forest birds like jays and Himalayan nutcracker. Ban oak forests are the imperative broadleaf forests in the Himalaya. These forests bring been under colossal biotic stress, similarly as they furnished fuel and fodder. Focus of mankind's settlements near the oak forest areas increase the risk of over lopping, felling and furthermore principally fire spreading from pine forest have lessen the region under oak forest (Champion and Seth, 1968). The tree is lopped extensively in the hills of Himachal Pradesh and Uttarakhand (Orwa et al., 2009).

Insects are the most numerous animals living in a forest, and more than a thousand different insect species feed on world oaks (Metcalf and Flint, 1962). The borers cause very serious damage to oaks as they bore through bark, roots, shoots and acorns and also make tunnels in wood and bark. The lepidopteran pests, some of them have very injurious effect on ban-oak as this group of pest defoliates the trees and cause damage to the living trees. Other than those bugs, aphids, leaf miners are minor pests of ban-oak. Mathur and Singh (1959) have listed 54 species of Coleoptera, 37 species of Lepidoptera and 1 species of Hemiptera infesting *Quercus leucotrichophora.*

Fig.2.Panoramic view of Ban oak, *Quercus leucotrichophora* forest in Mussoorie Forest Division, Dehradun District, Uttarakhand.

Fig.3.Ban oak, *Quercus leucotrichophora* tree and forests, acorns, lopped trees and villagers carrying fodder loads of ban oak in Uttarakhand

2. Moru oak- *Quercus floribunda* Lindl. ex A.Camus,1935

Quercus floribunda grows in Western Himalaya from Jammu & Kashmir and Uttarakhand between elevations of about 2000 to 2500m. It descends down to about 1500 m elevation along water streams. Its zone of occurrence is between that of *Quercus leucotrichophora* and *Q. semecarpi folia.* It often forms gregarious stands of varying degree but is also found in mixture with the broadleaved and conifer species (Luna, 2005). According to Champion & Seth (1968) the associated species of *Q. floribunda* are *Q. leucotrichophora, Abies pindrow, Rhododendron arboreum, Pyrus lanata, Lyonia ovalifolia, Fraxinus micrantha, Betula alnoides, Taxus baccata, Celtis australis* and *Acer caesium*. According to Troup (1912), in moru oak forests there is often a rich undergrowth of herbaceous plants and shrubs such as *Vibernum, Lonicera, Rosa, Rubus, daphne cannabina, Indigofera, Desmodium, Strobilanthus* and *various ferns* with the dwarf bamboo *Arundinaria falcator* and *A. spatiflora*.Young shoots and mature leaves of *Quercus floribunda* are glabrous. Leaves are entire, nerves mostly forked. The male catkins and female appear on new shoots in March-April and pollination takes place in April-May. Flowering time coincides with the shedding of old leaves, the new green shoots appear late in March to early in May, depending on the elevation. It flowers in April to May and fruiting occurs in August to October. The new shoots grow rapidly, attaining full size within two months. The new shoots, which bear female spikes, put on no growth until the flowering year. The acorns ripen during August and by October most of the female flower to the ripening of the acorn is thus about 15-17 months (Luna, 2005).

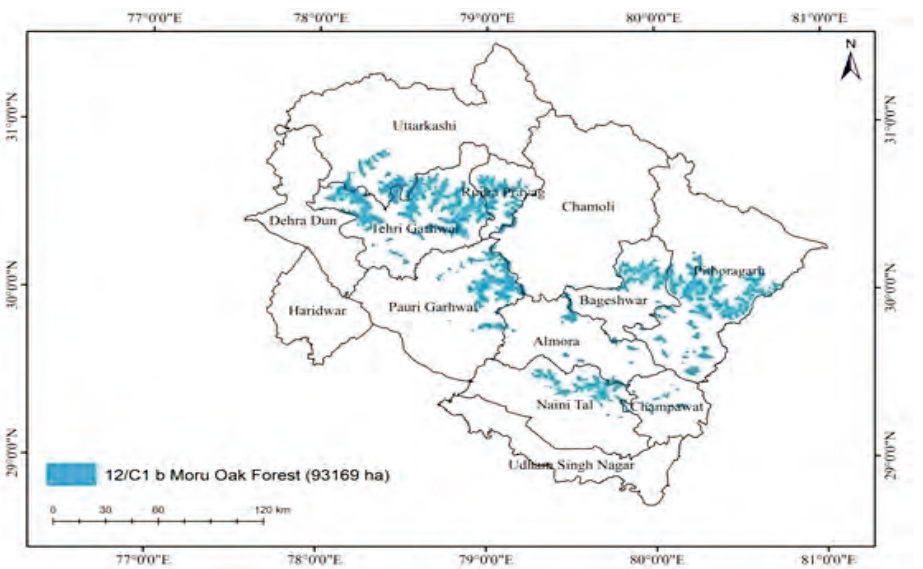


Fig.4 -Map showing distribution of Moru oak, *Quercus floribunda* in Uttarakhand

Fig.5. Mature Moruoak,*Quercus floribunda* tree, foliage and acorn.

Fig.6.Panoramic view of Moru oak forests in Chakrata Forest Division, Dehradun district

Quercus floribunda is lopped for fodder which is the most appreciated among all oaks. Its wood is used for constructional purposes and agricultural implements. It is suitable for tool-handles and has been employed for axe-handles, sledge-runners, carrying poles and walking sticks. (Negi & Naithani,1995). The stem bark is used to clean foul sores. The seeds are used in the treatment of diarrhoea, menorrhagia and gastrointestinal hypertrophy. Moru oak is largely exploited for firewood and charcoal. It is very sensitive to grazing, browsing, lopping and fires and these factors have been responsible for its relatively remote and restricted distribution. Young regeneration, both seedlings and of coppice has to be protected by game proof fencing (Negi & Naithani,1995).

A number of insect have been reported to attack the foliage, branches and wood of moru oak. A large number of insect pests infest the wood of felled trees. Mathur and Singh (1959) listed 33 species of coleoptera, 6 species of Lepidoptera and 2 species of hemiptera infesting moru oak.

3. Kharsu oak- *Quercus semecarpifolia* Smith in Rees,1814

Kharsu oak is is middle to a large gregarious, evergreen to nearly evergreen tree, forming a long clean bole, attaining a girth of 210 cm or more under favourable conditions. It is a characteristic tree of West Himalayan upper oak/fir forest and Kharsu oak forest types, generally predominating on the exposed ridges (Luna,2005). According to Champion and Seth (1968), the associated species of *Q. semecarpifolia* are *Betula alnoides, Pyrus lanata, Quercus floribunda, Acer caesium, Abies pindrow, Rhododendron arboreum, Betula utilis, Picea smithiana* and *Pinus wallichiana.* The old leaves begin to fall in May-June, but do not fall entirely until the new leaves are formed. The male catkins and female spike appear on the new shoots, the male catkins in dense pendulous clusters at the base of the new shoots, the female spikes are axillary in the upper part of the new shoots. There is little or no growth of the young acorns in the first season, however, rapid growth ensures in the second season, the acorns developing fully by June (Orwa et al., 2009). According to Troup (1921), there is often luxuriant herbaceous and shrubby undergrowth in the kharsu oak forests. Among the comer shrubs are *Rosa macrophylla, Rubus niveus* and other species, *Salix elegans, Vibernum stellulatum, V. cotini folium, V. foetens, Lonicera angustifolia* and the dwarf bamboo *Arundinaria spatiflora.*

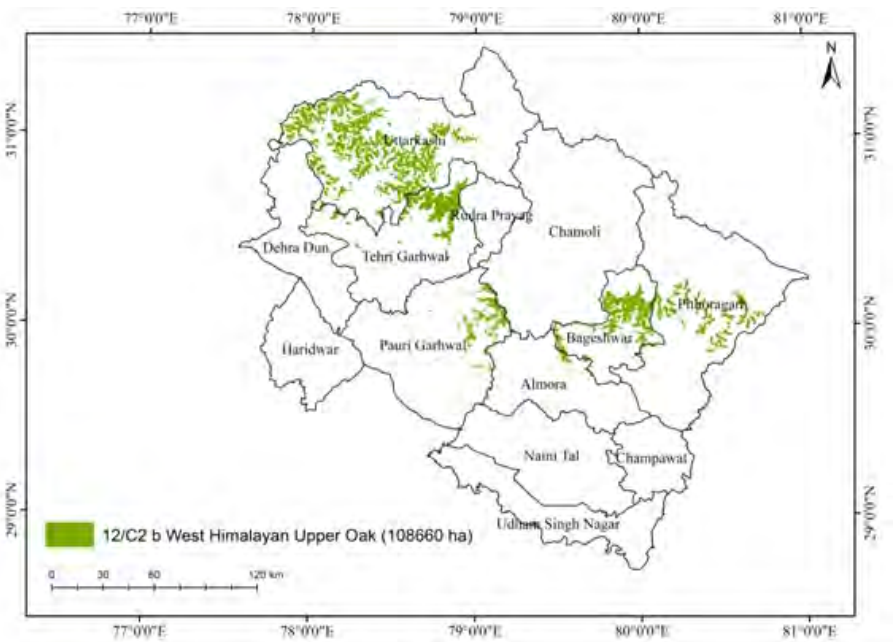


Fig.7.Map showing distribution of Kharsu, *Quercus semecarpifolia* in Uttarakhand

Fig.8.Kharsu oak, *Quercus semecarpifolia* forest stands in Chakrata Forest Division, male catkins and green acrons

Fig.9. Lopped Kharsuoak, *Quercus semecarpifolia* forest stands in Chakrata Forest Division

Fig.10-Lopped Kharsu oak, *Quercus semecarpifolia* tree near Osla in Govind Wildlife Sanctuary, Uttarkashi district, Uttarakhand.

The tree is lopped extensively in the hills of Uttarakhand and Himachal Pradesh. Bears are particularly fond of acorns. Gorrie (1937) suggested rotation lopping cycle of 3-4 year for maintenance of good health of lopped trees as they are capable of living to good old age and remain productive for very long periods. Silkworm of *Antheraea proylei* is widely cultivated on the leaves of oaks, of which the leaves of *Quercus semecarpifolia* are more palatable with little change of condensed tannins. Seeds can be dried, ground into a powder and used as a thickening in stews etc or mixed with cereals for making bread. Either the whole seed can be used or the seed can be dried and ground it into a powder (Orwa et al., 2009). Besides, defoliators, oak decline in the Western Himalaya is caused by the damage done by stem boring beetles, capable of causing oak mortality (Beeson, 1941). Mathur and Singh (1959) listed 13 species of coleopteran and 9 species of Lepidoptera infesting kharsu oak.

4.Woolly-leaved Oak or Riyanj - *Quercus lanata*Smith,1819

A large evergreen tree up to 3 m girth and 24 m in height and is usually branched low down. Bark is pale grey or ashy-brown, lenticellate, rather rough, exfoliating in large irregular thin woody plates which remain long in a semidetached condition. Young parts are densely tawny-woolly or tomentose, persistent on the lower leaf surface. Leaves are 1.5-3.5 inches, oblong-or elliptic-lanceolate, acute or acuminate, cuspidate-serrate, coriaceous, dark glossy green with distinct pale midrib and glabrous from above, with dense pale yellow or greenish-white tomentum and prominent secondary and tertiary nerves beneath; lateral nerves 9-13 pairs, straight, parallel. Stipules are 3-4 inch long, ovate-oblong, broad at the base and caducous. Male catkins are 2-5 inches long, woolly and usually interrupted. Female flowers are solitary or in pairs. Acorns are 8 inch long, one-third to one-half enclosed by the campanulate cup when ripe. Flowering occurs in April with new leaves. (Osmaston,1927). It is an oak native of China, northern Thailand and Vietnam where it grows at an altitude between 800 and 2600 meters (Huang et al.,2012). In India it occurs throughout the hills between 1800 and 2400 m. It is often found pure, but also frequently associated with *Quercus leucotrichophora*(Osmaston,1927. According to Troup (1921) the distribution of this tree is very local. It occurs in patches, sometimes of small extent in the Garhwal and Kumaun Himalaya, extending eastward to Bhutan at 4,000-8000 ft. It is associated with *Q. leucotrichophora* and *Rhododendron arboreum* and its upper and lower elevations with *Q. floribunda* and *Pinus longifolia* respectively. Mathur and Singh (1959) listed only 3 species of coleoptera infesting riyanj oak.

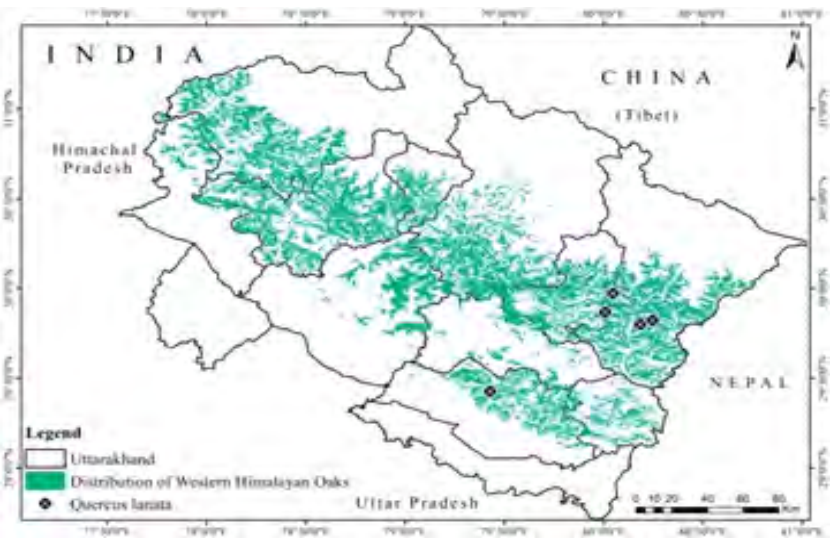


Fig.11 -Map depicting the location of Riyanj oak, *Quercus lanata* sites surveyed in Uttarakhand

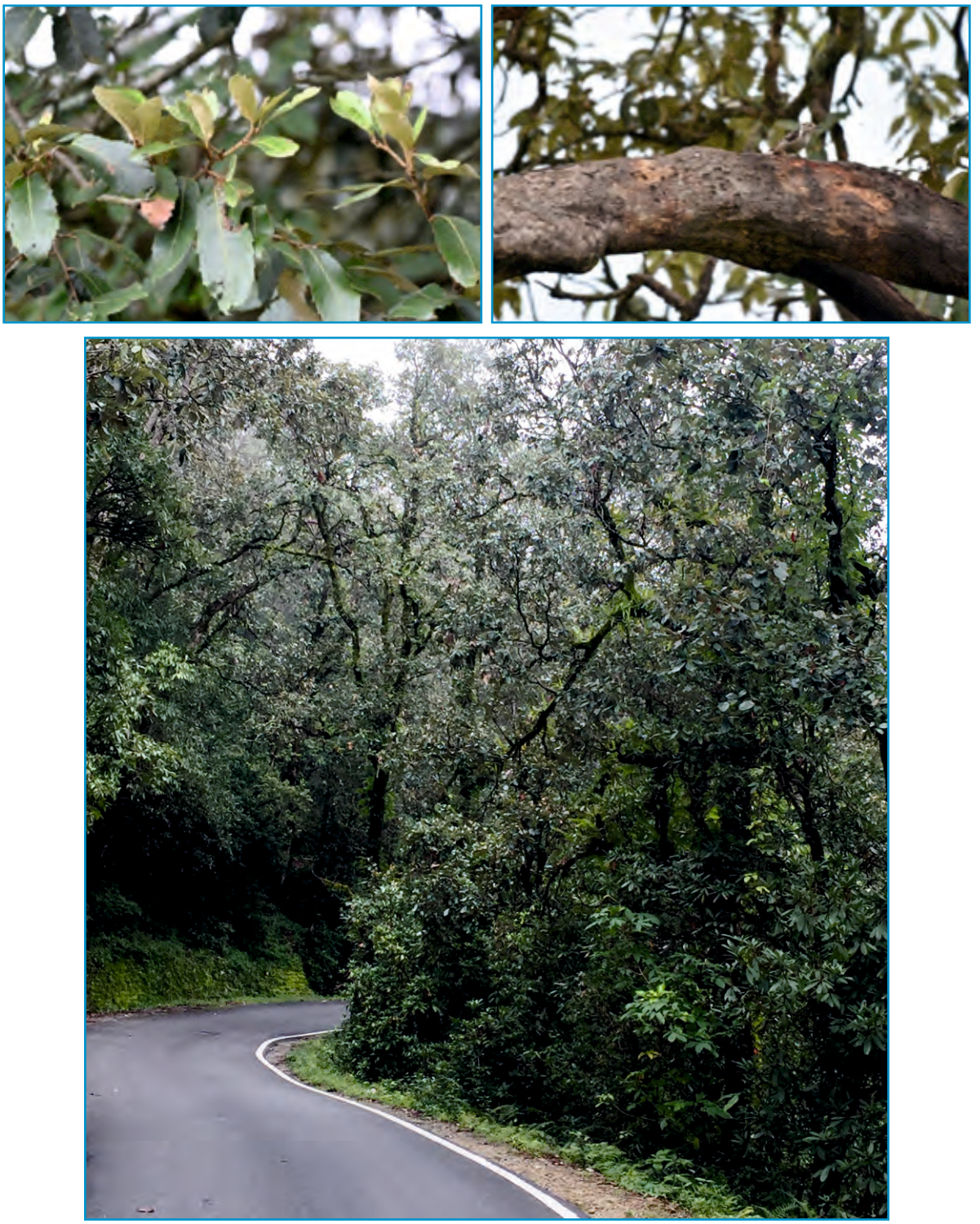


Fig.12 Riyanj oak, *Quercus lanata*- Foliage and pinkish bole and panoramic view of *Q. lanata* forest in Dharamgarh, near Bhageshwar, Kumoan.

5. Ring cupped oak or Phaliant - *Quercus glauca* Thunb.,1784

It is a medium-sized or large evergreen tree up to4 m girth and 25 m height. Bark is dark brown, grey or blackish, roughto the touch but not fissured and lenticellate. Young shoots are glabrous. The young immature leaves are glossy and tinged with shades of pink or purplish-brown. Leaves are 3.5-7 by 1.5-3 inches, oblong-lancelolate or oblanceloate, acuminate, cupsidate-serrate except towards the base, coriacous, glabrous and shining from above and glaucous and pubescent from beneath or ultimately glabrescent. Stipules are 8-6 inch long, linear or linear-oblanceloate and caducous. Male catkins are 2-8 inches long, bracts much longer than the flowers. Female flowers 2-3 together on a short axillary peduncle. Acorns are 6-7 inch long, solitary or in pairs; the cup is sessile and composed of tomentose scales arranged in 5-7 annular belts, covering the base of the nut only. Flowering occurs in March-April and fruiting in October-December. It occurs throughout the hills between 900-2000m. It is common in moist depressions and along the banks of streams, especially in cool shady ravines intersecting chir pine forest and not gregarious (Osmaston,1927). It is native to eastern and southern Asia, where it is found in Afghanistan, Bhutan, China, northern and eastern India, southern Japan, Kashmir, Korea, Myanmar, Nepal, and Vietnam (https://en.wikipedia.org/wiki/Quercus_glauca).

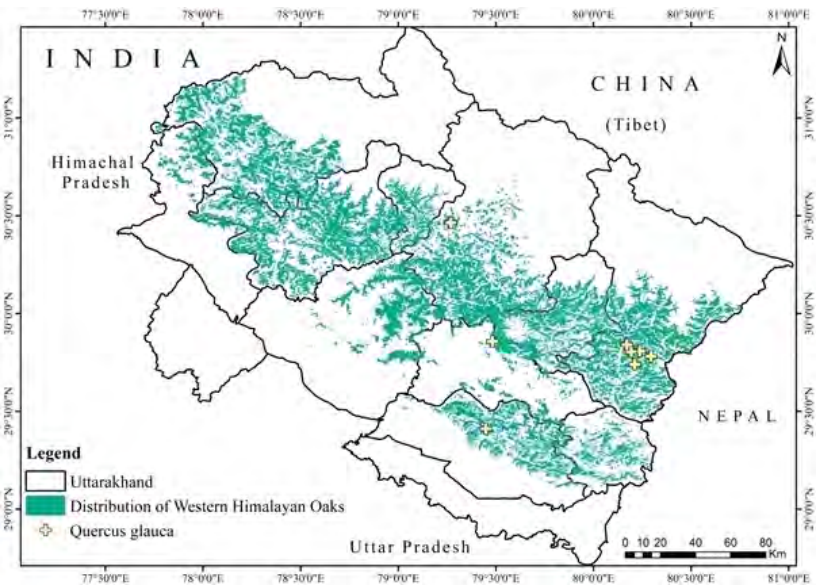


Fig.13- Map depicting the locations of Phaliant or ring-cupped oak, *Quercus glauca* forest sites surveyed for insects in Uttarakhand.

Fig.14. Phaliant or ring-cupped oak, *Quercus glauca* acorns, foliage and tree with male catkins in Didihat, Pithoragarh district, Uttarakhand.

According to Troup (1912) it is generally distributed throughout the outer Himalaya, ascending to 1828m also in the Khasi hills. The tree is found typically in moist situations in valleys, on the sides of ravines and along streams. It also occurs in Kangra valley (Himachal Pradesh) it occurs at 914m near Shahpur, mixed with *Quercus leucotrichophora* and associated with *Albizzia stipulata* and other low-level trees. It is not as gregarious except along the banks of stream; in moist localities in the Western Himalaya it is often associated with *Machilus odoratissima* and other evergreen laurels, while *Q. leucotrichophora* is one of its commonest companions. This oak is more common in eastern part of the state. Its acorns are edible. When dried and ground into powder they can be mixed with cereals and used as flour. The roasted seeds can be used as a coffee substitute. The wood of *Quercus glauca* is used for firewood and charcoal. The tree is lopped for fodder (Negi & Naithani, 1995). Its leaves and stems are relished by deer(https://www.feedipedia.org/). A mulch of the leaves repels slugs, grubs etc, though fresh leaves should not be used as these can inhibit plant growth. Oak galls are excrescences that are sometimes produced in great numbers on the tree and are caused by the activity of the larvae of different insects. The insects live inside these galls, obtaining their nutrient therein. When the insect pupates and leaves, the gall can be used as a rich source of tannin that can also be used as a dyestuff. Its wood is used for general construction and fuel (https://pfaf.org/user/Plant.aspx ? LatinName=Quercus+glauca). Externally, it is used as a mouthwash to treat toothache or gum problems and is applied topically as a wash on cuts, burns, various skin problems, haemorrhoids and oral, genital and anal mucosa inflammation. Extracts of the plant can be added to ointments and used for the healing of cuts (http:// temperate. theferns. info/plant/ Quercus+glauca). Potential insect pests include scale, oak skeletonizer, leaf miner, galls, oak lace bugs, borers, caterpillars and nut weevils (https:// www. missouribotanical garden.org/PlantFinder/PlantFinderDetails.aspx? taxonid=280774 & is profile=0&). Mathur and Singh (1959) had listed only 4 species of coleoptera infesting acrons and dead wood of riyanj oak.

The current study gives an account of 231 species of insects infesting Western Himalayan oaks in Uttarakhand Himalayas[(I18 species of Lepidoptera ii) 100 species Coleoptera iii) 16 species of Hemiptera & iv) 1 species of Diptera]. It includes information for each species on their: i) Classification & taxonomy (ii) specimens records with details in collections iii) distribution range across the globe (iv) host plant range (v) habits & habitat (vi) life cycle duration of different stages with their morphological characters (vii) images on the life history stages -larva, pupa, adults (male & female) and also eggs of some species (viii) extent of damage/status and (ix) references and sources of literature.

Previous Studies on Insect Pests of Western Himalayan Oaks

Insects are the most numerous animals living in a forest, and more than a thousand different insect species feed on oaks across the globe (Metcalf and Flint, 1962). Only a few groups of insects have a significant impact on the oak resource: the leaf feeders (defoliators, skeletonizers and miners); the borers (bark, phloem, wood, root, twig, shoot, and acorn borers); the sucking insects and those insects that cause indirect damage, such as vectors of disease-inducing organisms.

Hampson (1894,1895) in his book "The Fauna of British India including Ceylon and Burma" and "Descriptions of New Heterocera from India" was the pioneer to give morphological and habitat descriptions of families of Lepidoptera i.e. Noctuidae and Arctiidae, many of which have been listed as important defoliators of *Quercus leucotrichophora, Q. floribunda and Q. semecarpifolia* in western Himalayan region.

Gahan (1906) in his book "The Fauna of British India including Ceylon and Burma" gave morphological and habitat descriptions of certain species of Coleoptera i.e. Cerambycidae and *Lamiidae.* Coleopteran species like *Lophosternus hugelli, Macrot oma crenata, Sarmydus subcoriaceus, Tetropium oreinum, Stromatium barbatum, Aeolesthes holosericea, Trinophyllum cribratum, Rosalia lateritia, Purpuricenus montanus, Aphrodisium hardwickanium, Xylotrechus smei,* etc. are major stem wood and dead wood borers which mainly infest the *Q. leucotrichophora, Q.flori dunda* and *Q. semecarpifolia* in the western Himalayan region.

Stebbing (1911) in the "Indian Forest Records" on "Some insect pests of the Himalayan oaks (*Q. floribunda* and *Q. leucotrichophora*)" described the nature of attack, previous record of attack, distribution, general appearance and life history of many species of beetles i.e. *Lophosternus hugelli, Xylotrechus smei, X. stebbingi, Sphnerotrypes querci, Ozopemon hewetti* (*Stebbing*) (*Syn.Dryocoeteshewe tti*),*Diapus impressus, Apoderus incana;* bugs i.e. *Kermes himalayensis,* insects causing twig and leaf galls and some other defoliating caterpillars. Later, Stebbing (1914) described the habits, host plants and life history of certain many species of Coleoptera in his book "Indian Forest Insects of Economic Importance" among which are families Pssalidae, Lucanidae, Scarabidae, Bostrychidae, Buprestidae, Chrysomelidae, Cerambycidae, Curculionidae, Scolytidae and Platypodidae, that infest western Himalayan oaks.

Beeson & Bhatia (1938) in the "Indian Forest Records" described the "Biology of the cerambycidae (Coleoptera)" along with

their host plants, distribution, life-cycle and emergence period of the genus *Xylotrechus* (*X. smei, X. stebbingi* and *X. basifuliginosus* found in north India) which are secondary borers of *Q. leucotrichophora, Q. floribunda* and *Q.semecarpifolia* in the western Himalaya.

Beeson (1941) in his book "The Ecology and Control of the Forest Insects of India and the neighbouring countries" described the 24 insect orders for their distribution, host plants and ecology. Amongst them, Lepidoptera, Coleopteara, Hymenoptera and Diptera are the major orders and many species listed in the book infest western Himalayan oaks. *Aphrodisium hardwichianum* was identified as one of the primary stem borer of *Q. leucotrichophora* in Western Himalayas. According to Khan & Bhatia (1946), Beeson (1941) & Browne (1968), attack of several generations of this borer kills trees by destroying the stem, and even when the host survives its timber is rendered useless for anything but firewood. Its occurrence on *Q. leucotrichophora* have been reported from the Dharamsala, Kangra Forest Division, Himachal Pradesh; Sitoli in Almora and Bhimtal in Nainital district of Uttarakhand (Khan & Bhatia,1946). Later, Mathur and Singh (1959) listed insects pests of forest plants in India & the adjacent countries" with as many as 163 insects species infesting 5 major species of western Himalayan oaks [92 species (55 species of Coleoptera, 36 Lepidoptera and 1 Hemiptera) on *Quercus leucotrichophora;* 41 species (33 Coleoptera, 6 Lepidoptera and 2 Hemiptera) on *Q. floribunda*, 23 species (14 Coleoptera and 9 Lepidoptera) on *Q. semecarpifolia*, 4 Coleoptera on *Q. glauca* and 3 species of Coleoptera on *Q. lanuginosa* that are mainly defoliators (Lepidoptera), wood boring beetles (Coleoptera) and sap suckers (Hemiptera)].

Verma et al.,(1979), described the outbreak of Indian gypsy moth, *Lymantria obfuscata* on oaks in Himachal Pradesh. The insect caused complete defoliation of *Quercus floribunda* and *Q. leucotrichophora* over a large area in Hardipurdhar forest in Rajgarh forest division in Himachal Pradesh in 1976. The attack was so severe that trees in about 30 km^2 area were completely defoliated. Due to defoliation the pest infested area showed characteristic of a burnt forest. These caterpillars are nocturnal, at dusk they ascend the oak trees and feed on the leaves and before dawn they migrate back to the ground where they lie hidden below the fallen leaves, stones, and other protected places. Feeding on the leaf is initiated from the periphery towards the midrib. As many as 200 caterpillars infest a single tree.

Kaushal et al., (1993) reported that 83.7% of *Q. leucotrichophora* acorns and 5.6% of *Q. floribunda* infestation in acorns by weevils *Sitophilus glandium* and *Dicranognathus nebulosus*, in Nainital district of Uttarakhand. The larvae fed on endosperm, completely

reduced it to a yellow-brown granular frass at the end of development.

Rawat et al.,(2003) reported mortality of *Q. leucotrichophora* and *Q. floribunda* in Dangan village, Mori Block in Uttarkashi district of Uttarakhand in which the lopping was carried out during precious year (2000) after which tent like structures appeared on the lopped portion of the trees when new sprout came out and started progressing with thick tent like structure having numerous insects. Such infected trees and leaves were examined and the insect was identified as tent caterpillar *Malacosoma indica*. Few trees of Moru oak were found to be attacked by the stem borer and heap of wood dust was found at the base of trees.

Singh et al., (2007), reported an epidemic defoliation by *Lymantria obfuscata* in ban oak forests in Rajgarh forest division covering area in Solan district of Himachal Pradesh. The trees of 40 to 55 years age group showed up to 80% defoliation while older trees of 60 years and above showed less defoliation compared to young age group. The trees with poor growth characteristics were found heavily infested serving epicenter of the pest as deformed, stunted and water stressed trees were found to be more susceptible to the attack of this insect. The attack was so severe that trees in about 50 km area were completely defoliated. As many as 500 larval skins were collected from near the tree trunk of individual tree. The newly hatched larvae feed gregariously on tender leaves and as they grow up, become more mobile but remain together in large groups and feed voraciously on mature leaves. The pest was found to be active from April to mid of June.

Mishra & Patni (2008) in their study "Anatomical changes and Development of Cecidomyiid leaf gall of *Quercus leucotrichophora*-Himalayan White Oak" observed that ban oak tree is affected with many types of leaf galls caused by different types of insects. The order Diptera has the largest number of galls making insects. According to them, many cecidomyiidae genera like *Asphondylia, Lasioptera* and *Dasineura* are known to cause plant galls.

Smetacek (2008) listed moths recorded from different elevations in Nainital District, Kumaon Himalaya, India amongst which *Demonarosa rufotesselata, Suana concolor, Trabala vishnou, Deroca inconclusa, Mixochlora vittata, Hyposidra talaca, Alcisvariegata, Hypomecis transcissa, H. infixaria, Thyas juno, Ischyja manila, Calliteara grotei, C. strigata, Orgyia postica, Lymantria Mathura,* and *L. obfuscata* have been recorded earlier as defoliators of western Himalayan oaks.

Singh (2011) studied the impact of oak stem borers in Garhwal. *Aphrodisium hardwickianum* was one of the major wood borers of *Quercus leucotrichophora* in disturbed forest tracts in Dehradun, Uttarkashi

and Tehri districts of Uttrakhand. Another longhorn beetle, *Rosalia laterifolia* is also major wood boring beetle of *Quercus floribunda* and *Q. semecarpifolia* in Deoban Reserve forest, Chakrata Forest Division of Dehradun district. Other than primary wood borers, secondary borers like *Crossotarsus fairmeri, Dryocoetes hewetti, Tetropium orienum, Aglaophis fasciatus, Xylotrechus basifuliginosus, Perissus quercus, Demonax albincintus, Demonax nigro-maculatus*, *Margites* sp., *Setenis cribrifrons* and *Rhomborrhina glaberrima* were also *reported* on *Q. leucotrichophora, Q. floribunda* and *Q. semecarpifolia* in Garhwal Himalaya, India.

Singh et al.,(2012) reported the mortality in Ban oak trees in Mussoorie, Uttarakhand due to borer infestation and have pointed out that initiating factors associated with oak decline are drought, frost injury and insect defoliation. Since the year 2000 few trees having more than 150 cm of girth class are shedding their leaves in March–April, which is unusual for an evergreen species. Such infected trees were examined and found to be attacked by a stem borer. The excreta of these beetles was observed around the infected trees in the form of small heaps of wood dust at the base of trees. Penetration of the conductive tissue by the pest resulted in the wilting of leaves and dieback of canopy branches of the trees, which severely affected photosynthesis in these trees (Singh et al.,2012).

Thakur et al.,(2015) carried out a detailed study on biology of Indian gypsy moth *Lymantria obfuscata* Walker on *Quercus leucotrichophora* Roxb. in Shimla, Himachal Pradesh (India). According to them, the pest undergoes complete metamorphosis with six larval instars. The larval stage is the destructive stage as it feeds on the foliage voraciously. The newly hatched larvae rested for some time on the top of their egg-mass. Thereafter, larvae moved to the leaf surface, where they started feeding on the outer soft parenchyma tissue of the leaf and formed minute holes in the leaf surface. The second instar larvae also preferred softer and fresh leaves and formed patches and holes in the epidermis. The third instar larva fed upon the softer leaf tissues along with the softer veins of the leaves. The fourth and fifth instars were found to cause maximum damage to the foliage by feeding upon the harder tissues of the ban oak leaves. Sixth instar larvae had slow rate of feeding and after sometime they stopped feeding and transformed into the next pupal stage.

Current work

A total of 24 field surveys were carried out from August 2017 to November 2020 covering 10 districts of Uttarakhand (table-1) under the ICFRE funded project "Insects pests of Western Himalayan oaks and their control" (FRI-626/FED-43). The surveys were carried out using random sampling in oak different forest sites of the state during every season of the year i.e. Pre-monsoon (March-June), monsoon (July-September) & post-monsoon (October-December) seasons (Fig.15). Samples were collected from: branches foliage i.e. leaves, buds and tender stems for defoliators, gall and sap sucking insects; acorns for seed boring beetles; tree trunks of living trees for primary stem borers; tree trunks and branches of lopped, dying and dead trees for secondary wood borers and bark beetles; decaying wood for rotten wood borers; felled timber was also examined for borer attack besides their parasitoids and predatory insects. Studies were focused on the life history of the following orders: Lepidoptera, Coleoptera, Hemiptera and Diptera. Data was recorded on the feeding habit and pattern, seasonality, morphological characters of each stage in life cycle, distribution range and host plant range of the insect studied.

Table1. Details of oak forest sites surveyed for insect pests in Uttarakhand (2017-20).

Sl no.	Name of District	Surveyed sites	Altitudinal range	Species of oaks	Months of survey
1.	Dehradun (9 surveys)	Chakrata Forest Division (Deoban, Mundali, Kauntlani, Kanasar, Ghodaghati), Mussoorie Forest Division (Benog Wild Life Sanctuary, Woodstock school forest, Hathipaon,Bataghat) & Dehradun Forest Division (Thano range Devli & New Forest Campus FRI.	640-2850m	*Quercus leucotrichophora, Q. floribunda, Q. semecarpifolia*	March to November
2.	Tehri Garhwal (1 survey)	Tehri Forest Division (New Tehri, Vinayak khal; Buddha Kedar, Devalsari), Mussoorie Forest Division (Dhanolti, Kanatal, Rauto ki belli, Suwakholi)	1550-2280m	*Q. leucotrichophora, Q. floribunda*	January-February, September, November
3.	Pauri Garhwal (2 surveys)	Lansdowne Forest Division (Lansdowne), Garhwal Forest Division (Khirsu, Adwani, Bharsar, Chorikhal Rathuadhab)	773-2000m	*Q. leucotrichophora*	July,October, November-December.
4.	Uttarkashi (1 survey)	Govind Wildlife Sanctury Forest Division (Dangan, Naitwar, Sankri, Taluka, Osla, Istragaad)	1944-2543m	*Q. leuctrichophora, Q. semecarpifolia, Q. floribunda*	August
5.	Rudraprayag (1 survey)	Kedarnath Forest Division (Makkumath, Chopta, Deoriatal,Tungnath, Chirbatiya, Dugalbitta, Mohankhal, Trijuginarayan)	2120-3500m	*Q. leuctrichophora, Q. semecarpifolia, Q. floribunda*	November
6.	Chamoli (2 surveys)	Badrinath Forest Division (Gopeshwar), Kedarnath Forest Division (Mandal, Kachulakharak), Nanda Devi National Park Forest ivision (Joshimath, Auli).	1550-2909m	*Q. leucotrichophora, Q. semecarpifolia Q. glauca*	September, November
7.	Pitthoragarh (2 surveys)	Pithoragarh Forest Division (Dharamghar, Thal, Didihat, Chaubati, Munsiyari, Birthi, Lamgharghati, Kamedi Devi)	1449-2620m	*Q. leucotrichophora, Q. lanata, Q. glauca, Q. semecarpifolia*	May September,
8.	Nainital (2 surveys)	Nainital Forest Division (Sattal, Kilbury, Mahesh Khan, Nainital, Pangot, Vinayak, Bhimtal, Naukuchiyataal)	1360-2330m	*Q. leucotrichophora, Q. semecarpifolia, Q. lanata, Q. glauca, Q. floribunda*	May September,
9.	Almora (2 surveys)	Almora Forest Division (Binsar WLS, Siuni, Kausani, Almora, Hichuagaad) Soil Conservation Ranikhet Forest Division (Ranikhet)	1598-2312m	*Q. leucotrichophora,*	May September,
10.	Bageshwar (2 surveys)	Bageshwar Forest Division (Kukkudgaad, Garud, Shama)	940-1330m	*Q. leucotrichophora,*	May September,

Sampling surveys from 2017-2020 recorded 113 species [72 species of lepidoptera, 29 coleoptera, 11 hemiptera & 1 diptera, respectively]. Thus, until now the insect pest spectrum of Western Himalayan oaks in Uttarakhand totals to 231 species of insects hand [118 lepidoptera; 96 coleoptera; 16 hemiptera & 1 diptera, respectively, based on both field surveys and those species recorded earlier in literature. These insects are mostly polyphagus in habit and have distribution across the Himalayan region extending up to

South-East Asia. Most of the insects recorded do not cause outbreaks on oaks in the region so far but are mainly sporadic and cause local infestations. This monograph gives details of all the 231 insect species recorded so far.

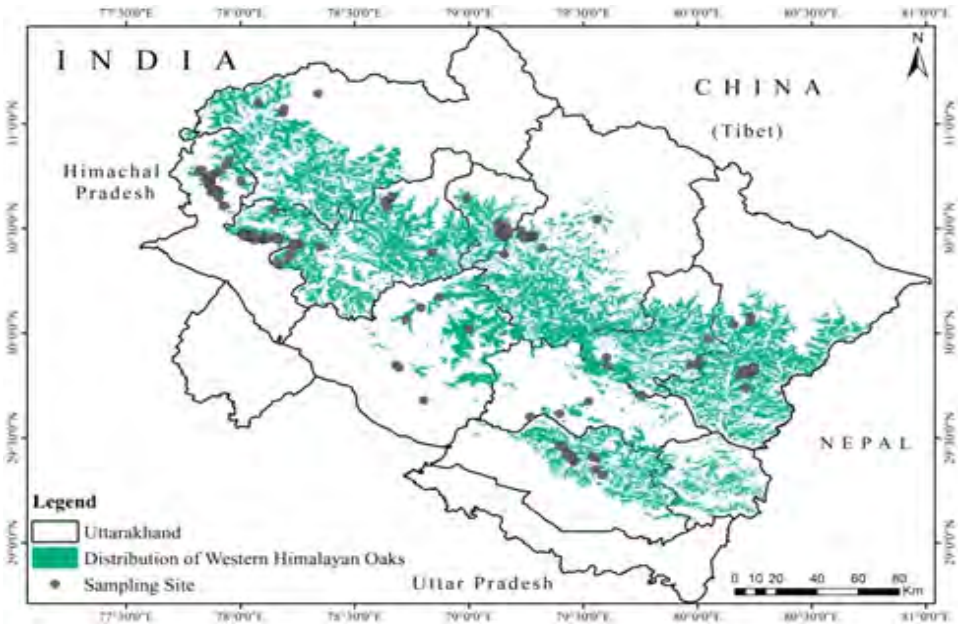


Fig.15. Map depicting the location of sites surveyed for sampling insects infesting western Himalayan oaks in Uttarakhand.

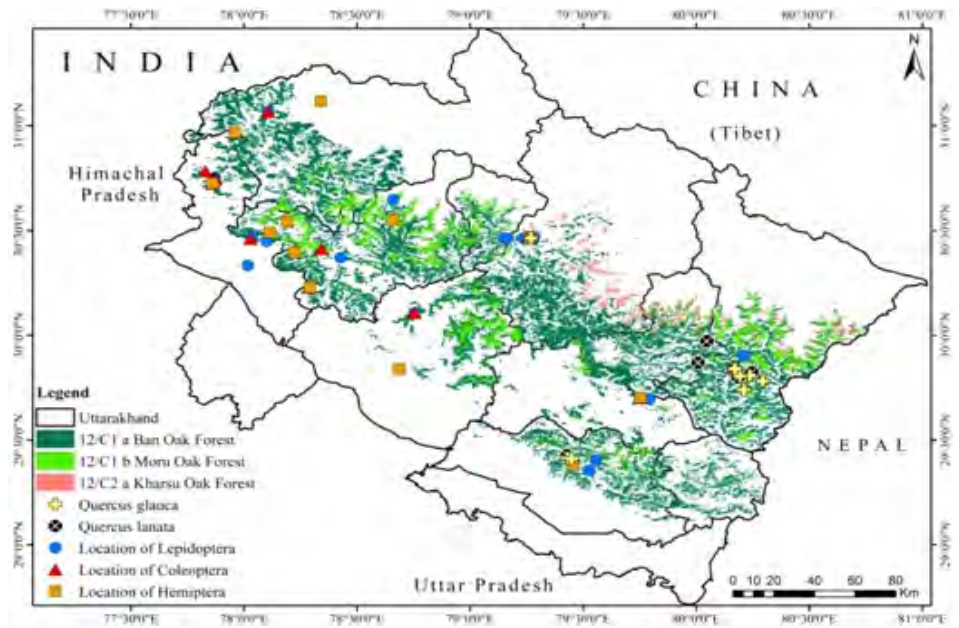


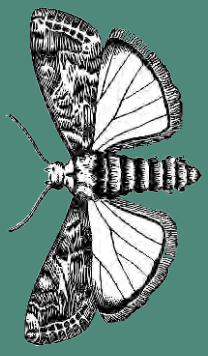
Fig.16. Distribution of 5 species of Western Himalayan oaks and location of insects recorded infesting them, order wise.

a. Lepidoptera [118 species]  27-178

b. Coleoptera [96 species]  178-285

c. Hemiptera [16 species]  286-303

d. Diptera [1 species]  304-306



Lepidoptera

1. LEPIDOPTERA

(moths & butterflies, mainly defoliators): 118 species

Lepidoptera are one of the major species that defoliate western Himalayan oaks. Their feeding habit varies amongst species. Defoliators damage trees by eating leaves removing the photosynthetic tissue critical for plant. A significant loss of leaves results in growth loss, increased susceptibility to attack by other insects and pathogens, and sometimes tree mortality. Oak defoliators generally feed sporadically singly or gregariously. Most of them consume the entire leaf, usually the new flush, and may cause causing complete defoliation. Complete stripping reduces the tree growth by loss in growth increment as a result of repeated defoliation and heavy defoliation may lead to tree mortality. Example: *Malacosoma indica* (Lasiocampidae).

Fig.17. Near complete defoliation by lepidoptera larvae of Ban oak, *Quercus leucotrichophora*

The majority of the leaf feeding insects, however, are whole-leaf feeders, which eat all the leaf tissues. Most of the defoliators initiate feeding of the soft green tissues from the leaf margins and move towards the midrib leaving behind only midrib in the end eg.*Trabala vishnou* (Lasiocampidae), *Alcis variegata* (Geometridae). Larvae of certain species have evolved a unique way of feeding, they consume the soft green tissues between the veins leaving behind the network of major veins attached to the mid rib eg.Mad hatterpillar caterpillar (Nolidae). Some species are leaf skeletonizers that only consumegreen tissues except the vascular portionsi.e. network of veins. Some defoliators prefer to feed by scratching the green part on the upper leaf surface leaving behind the network of veins while the lower portion remains intact, on the other hand a few may hide under the lower surface of the leaf scratching only the green tissues, while the upper surface remains unharmed. In both the cases photosynthesis and the transpiration rates are reduced. While some species may sekeletonise only the central part of the leaf. Larvae of some species of small sized moths spin a web like tents called "leaf tiers" around the new foliage on shoots where they hide, feed and destroy the foliage. Shoot or tip boring insects damage the apical terminal or leader of the tree. The larva tunnels down the main shoot towards the stem by making a gallery and small ejection holes. This causes the new shoot to dry up as a result of wilting resulting in dieback. This results in forking of the main stem eg. *Nycteola revayana* (Nolidae). Some species are leaf miners which feed upon the succulent interior leaf tissues as they tunnel between the upper and lower epidermis of the leaf.

A. Heterocera: 111 species
1. *Meganola nitida* (Hampson,1894)
Superfamily: Noctuoidea
Family: Nolidae
Subfamily: Nolinae
Synonyms:
Selca nitida Hampson,1894
Roeselia nitida

Fig.18-Adult- *Meganola nitida* (Hampson,1894)

Distribution: Himalaya: Occurs from North-West Himalaya (Simla, Dalhousie, Dharmsala) through Nepal up to Northeast India (Manipur and Naga Hills). [Two specimens are kept in National Forest Insect Collection (NFIC), FRI, Dehradun collected from Jakh, Paithani, Garhwal,Uttarakhand on 07.vii.1941 & 15.viii.1941 by Balwant Singh].

Species of Oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959).

Other Host Plants: *Pieris ovalifolia* and *Ilex* sp.(http://archive.org).

Habit: Larva defoliates (Mathur & Singh,1959). The species inhabits the monsoonic forests of medium high elevation (1500 m) (http://archive.org).

Larva: Pale yellow, the 1st and terminal somites are orange; paired black dorsal spots on 3rd somite and single spots on 6^{th}, 10^{th} and 11^{th}somites; a tuft of reddish hair from behind the head, to which are attached the various cast skins of the head, the 1^{st}moult at apex and the others at intervals. The larva feeds on the edges of the leaves from the underside, with the tuft of hair and cast head-skins only projecting beyond the edge (http:// archive.org).

Cocoon: Boat-shaped, spun on a twig and covered with scales of bark, with the tuft of hair and exuviue of head attached to it (http://archive.org).

Adult (Female): Head and thorax silvery white; palpi at sides, antennae, and edges of tegulae blackish: pectus, legs, and abdomen blackish. Forewing are silvery white, the medial and terminal areas tinged with cupreous ; a triangular black patch at base of costa; the tufts of scales small, the 1st and 2nd black; a tine slightly sinuous black antemedial line angled inwards on vein 1; the medial area with blackish patch on costa beyond the antemedial line, some black suffusion below the cell and traces of a medial line; the postmedial line slightly sinuous, strongly recurved at vein 6 to below angle of cell; a blackish patch on costa towards apex; an irregularly dentate black subterminal line retracted to costa and angled outwards to termen a 'nove veins G and 3; a terminal black line; cilia checquered white and black. Hind wing fuscous, with blight discoidal line; veins 3, 4 stalked (http://archive.org). In female head and thorax white, irrorated with brown; palpi and antennae are black. Forewing is silvery white; a black basal patch on the costa; an antemedial angled line with a blackish patch beyond it on the costa and a black spot in the cell; a postmedial line angled beyond the lower angle of cell; a submarginal dentate linestarting from a black patch on the costa; the area between the ante and postmedial lines slightly suffused with brown; a marginal black line; cilia pale, streaked with black at the veins. Abdomen and hind wing are fuscous (Hampson,1894).

Extent of Damage/Status: Data Deficient.

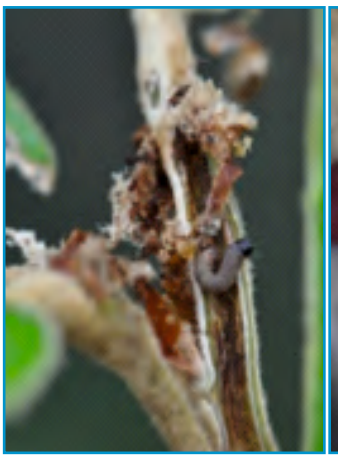
2. *Carea* sp.
Superfamily: Noctuoidea
Family: Nolidae
Subfamily: Nolinae
Distribution: N.W. Himalaya.
Host Plants: *Quercus* sp. (Mathur & Singh,1959).
Habit: Larva defoliates (Mathur & Singh,1959).
Extent of Damage: Data Deficient.

3. *Garella ruficirra*(Hampson,1905)
Superfamily: Noctuoidea
Family: Nolidae
Subfamily: Chloephorinae
Synonyms:
Hypothripa ruficirra Hampson,1905
Characoma ruficirra Hampson

Distribution: Japan, North-East Himalaya, recorded from Kumaon region of Indian Himalaya. Specimens have also been taken mostly from montane forest from 1000m to 1930m and one was taken in dipterocarp forest at 150m in Borneo Island (mothsofborneo.com).

Species of Oak infested: *Quercus lanata* (Singh,2020).
Other Host Plants: Walnut fruit (*Juglans regia*) (Kriti *et al.*, 2014). Mathur (1942) recorded Juglans (Juglandaceae) and *Quercus* as host-plants in India, the larva feeding on the green fruits of the former and defoliating the latter.
Larvae: Larva are stout, light green with black head and light brown anal segment. Caterpillars turn brownish from posterior end to anterior end (Kriti et al.,2014).
Adult: Moths are orange brown with a wing span of 22-28 mm. The fore wings exhibit a wavy pattern of lines (Kriti et al.,2014).
Biology: The larva in Japan is stout, a glossy olive-green with pale yellow speckles. The primary setae are long and set on slightly darker pinacula (Sugi,1987). It bores in green nuts of *Castanea* and *Quercus* (Fagaceae), and the tips of young shoots of *Lithocarpus* in the same family (Sugi,1987 amd Teramoto,1996).

(a)Infested twig



(b) Larva inside gallery

(c) Larva

(d) Emerged moth **(e) Adult Moth**

Fig. 19. Life history stages of *Garella ruficirra*(Hampson,1905)infesting young shoots of *Quercus lanata* Smith,1819

Habitat: Infestation recorded from Dharamghar forest area (Fig.1; 29°52'05.4" N & 80°00'26.9"E; 1989m; Temperature 22°C; Relative Humidity 76 %) in Pithoragarh district of Kumaon bordering Bageshwar district of Uttarakhand, India on 16.ix. 2019. *Q.lanata* trees were observed having distorted terminal tips as well as new shoots, along with defoliation and browning of leaves on shoot tips besides accumulation of frass sticking on to the leaf surface.

Upon close examination, tunneling was noticed from top to bottom inside new shoots, and larval feeding inside. Larva (10 mm) collected on 16.ix.2019 was pale/marbled brown in colour with double row of black dots on the abdominal region and with black head feeding inside the gallery. Pupae formed on 01.x.2019. The length of pupa 10mm, white in colour and enclosed in a white silken cocoon with frass and excreta sticking on the outer surface Infested shoots were collected for life history studies of this shoot borer as given below. Emergence of Moths took place on 04.x.2019. Wingspan:20 mm.

Extent of Damage/Status: Locally common in lopped areas in *Q.glauca* forest, can cause significant damage of leader shoots.

4. Oak Nycteoline Moth, *Nycteola revayana* (Scopoli,1772)

Superfamily: Noctuoidea
Family: Nolidae
Subfamily: Chloephorinae
Synonyms:
Phalaena revayana Scopoli,1772
Pyralis duplana Fabricius,1777
Pyralis ilicana Fabricius,1781
Phalaena lathamiana Swederus,1787
Phalaena afzeliana Swederus,1787
Pyralis riuagana Fabricius,1787
*Tortrix punctana*Hübner, [1799]
*Tortrix undulana*Hübner, [1799]
*Tortrix ramosana*Hübner, [1799]
Phalaena bifasciana Donovan,1801
Sarrothripus stonius Curtis,1829
Sarrothripus undulanus (Hubner)
*Sarrothriparus siana*Duponchel, [1845]
Subrita bilineatella Walker,1866
Sarrothripa fusculana Schmid,1886
Plotheia diplographa Hampson,1905.

Distribution: Western Himalaya. Europe (Karsholt & Razowski,1996). Regions of the Russian Federation: the Volga-Don, East Caucasus, the European North-West, Central European, European south taiga, Western Caucasus, the Volga-Fair (Catalog of Lepidoptera,2008).

Species of Oak Infested: *Quercus leucotrichophora*(Mathur & Singh,1959).

Other Host Plants: In Europe it attacks *Quercus* (http://ukmoth.org.uk) and Pedunculate oak (*Quercus robur*) (http://britishlepidoptera.weebly.com). This species is associated mainly with oak (*Quercus*), poplars (*Populus* spp.) and willows (*Salix* spp.) including amenity trees (Alford,2012).

Habits & Habitat: This species is local in broadleaved woodland throughout Great Britain (britishlepidoptera.weebly.com). It is quite variable, and the adults appear in late autumn, overwintering and appearing again in early spring. The species is locally scattered throughout much of Britain in deciduous woodland, but commoner in the south (ukmoth.org.uk). Caterpillars live in houses made of twisted leaves (Matov & Kononenko,2012).

Life History: Moth occurs from late summer onwards. They hibernate during the winter months and finally deposit eggs in the spring. Larval development continues from May to July. Fully fed individuals then pupating in light green, boat shaped cocoons formed on the twig or underside of leaves (Alford,2012).

a) Defoliated shoots

b) Larva feeding on tender leaves

c) Larva

d) Larva feeding on ban oak leaf

e) Pupa

(f) Emerged moth **(g) Pinned moth**

Fig. 20.Life history stages of *Nycteola revayana* (Scopoli, 1772) infesting *Q. leucotrichophora*

Adult: Adults are extremely variable in appearance, ranging from grayish white, through brownish to blackish. They are relatively small (13-15 mm. wingspan) and superficially similar in appearance to certain member of family Tortricidae (Alford,2012). Antenna are inserted on the crown of the head near to the eyes, long, setaceous, composed of numerous oblong joints, covered with scales above ; first joint rather large, cylindric, curved, second small, Maxillae nearly thrice the length of the Pulpi. Palpi 2, porrected far beyond the head, completely covered with scales resembling hair; first joint short, curved upwards; second joint long, clavate, curved at the base ; third joint as long or longer than the second, nearly filiform, slender. Head with the scales are upon the crown projecting forward in front. Wings rounded at the base, appearing slightly ciliated on the casta. Anterior legs with a long brush of hairy scales on the interior skies of the femur and tibia. Intermediate legs are the longest, posterior legs with 2 moveable siunes in the centre of the tibia, and 2 at the apex. Tarsi 5 are jointed, terminated by small claws. Fuscous: Head, palpi, anterior part of thorax, and a great portion of the upper wings brunneous inclining to chesnut. Superior wings with a dark line branched at the base and on its inferior margin, above which towards the centre is a black spot, a row of dots extend along the posterior margin, and 3 fuscous ocellated spots, with others more obscure, form an irregular transverse line near the same margin (Kurtis,1824).Wingspan 20-25 mm. fw: 11-13mm; Jul-Jun, possibly bivoltine in south, overwinters as adult (ukmoth.orh.uk). Recognized more by its size and shape with a strongly 'shouldered' forewing costa than by the extremely variable forewing pattern (britishlepidop tera.weebly.com).

Infestation: Larvae collected on 10& 23.ix.2017 (10-15 mm) from Vinayak Khal

in Tehri Garhwal from Ban oak. Pupa formed on: 28 &29.ix.2017. Emergence of moths (2.5mm WS) took place on 06 &10.x.2017.Larvae also collected on 31.viii.2018 from the new shoots growing on the terminal tips of lopped small sized oak trees in Chakarata Forest Division.Pupation took place on 05.ix.2018 and emergence took place on 14.ix.2018. Larvae (upto 20 mm. long) is mainly green, marked intersegmentally in yellow and finely clothed in long, whitish hair (Alford,2012). Afinal instar larva (14mm) was collected on 04.xi.2019 feeding on foliage of *Quercus leucotrichophora* in ban oak plantation of New Forest campus,Dehradun. Larva fed on the leaf margins of tender oak leaves and accumulating frass sticks on to the leaf surface and pupated on 06.xi.2019. Paleecoloured pupa measured 10 mm in length. Emergence of moths took place on 20.xi.2019 in the laboratory at FRI, Dehradun.

Extent of Damage/Status: Locally widespread and common. Causes minor damage.

5. Unidentified Nolidae Moth [Mad Hatterpillar caterpillar]
Superfamily: Noctuoidea
Family: Nolidae
Distribution: Garhwal,Uttarakhand.
Species of Oak infested:*Quercus leucotrichophora*

a) Larvae feeding on ban oak leaf

(b) Eaten ban oak leaf

(c)Larva

(d) Pupa

(e) Cocoon

Fig. 21. Life History stages of Mad hatterpillar larvae infesting Quercus leucotrichophora

Habit: Larva defoliates. 12 larvae (10-16 mm) were collected on 28.viii.2019 feeding on the foliage of *Q.leucotrichophora* in Chakrata Forest Division (2,087 m), Uttarakhand. Larvae were light green in colour, black head and have 3 black dots on the abdominal region. One of the peculiar features of these larvae is the head capsule which does not detach from the larvae after moulting into next instar. Every time it sheds the head capsule, the capsule remains attached to the body and the successive capsules keep piling over one another with time, like a stack of hats. Feeding pattern was unique in which one individual start eating from the margin of the oak leaf and eats only the area between two veins leaving behind veins and the mid rib. Up to 12 larvae feed on a single leaf. The larvae pupated on 02.ix.2019. Pupa (10-12 mm) is enclosed in a brown colored cocoon with frass and excreta sticking on the outer surface along with the head capsules attached on the dorsal surface of the cocoon. Moths failed to emergein the laboratory

Extent of Damage/Status: Sporadic. Damage is significant on affected trees.

6. White-underwing Artena, *Artena dotata* (Fabricius,1794)

Superfamily: Noctuoidea

Family: Erebidae

Subfamily: Erebinae

Synonyms:

Noctua dotata Fabricius,1794

Artena dotata Fabricius

Distribution: Indian sub-region to Sri Lanka, Taiwan, Japan, Sumatra and Borneo.

Species of Oak infested: *Quercus leucotrichophora* (Singh,2019).

Other host plants: *Combretum, Getonia, Quisqualis* and *Terminalia* (Robinson et al.,2001).

Habit: Larva defoliates.

Fight Period: April, June &Aug-Dec.

Eggs: Spherical blue-green egg is vertically ridged (26-28 ridges), with fine cross-ridges in between. The pupa is typically ophiusine, and Bell noted a slight, white, powdery bloom on it.The eggs are laid singly on a stem or leaf. The young larva lives on the edge or underside of a young leaf and has a rapid, semi-looping gait. Later instars rest fully stretched on stems or twigs, pressed to them. Feeding is mostly at night. Pupation is in a cell of leaves bound together with silk.

Larva: Larvae spidery with the comb-like true legs on a thick thorax. Abdomen is long. Primary setae are long. Third instar larvae are light brown with a white line series, which running longitudinally.

Biology: Bell (MS) described the life history (Holloway,2005). The hatchling larvae are spidery with the true legs comb-like on a thick thorax, but with the abdomen long and thin with only the prolegs on A5 and A6 developed. The primary setae are long. In the third instar, the larvae are light brown with a series of white lines running longitudinally, with slightly broader pale fawn lines in

between them as well, such that ground colour, being darkest, is also reduced to fine lines. The setae arise from small black dots; the dorsolateral tubercles on A8 are more prominent, and there is a black patch subdorsally on A1. The mature larva and penultimate instar are similar in longitudinal lineation, and have a circular spot of variegated black within the dorsal band of A5 as seen also in *Thyas juno* ; there are indications of smaller dorsal spots on A4 and A6, and the black patch on A1 persists (seen also in *Ophiusa*); the ventral surface, with dark patches between the prolegs is also similar to that in *Thyas*. The general colour of the longitudinal lineations is variable but is usually yellow-rown of different shades, with whitish lines and purplish lineation and dotting.

Pupa: Pupa typically ophiusinein form.

(a) Larva

(b) Larva feeding on ban oak leaf

(c) Pinned moth from Pupa

(d) Emergent moth

Fig. 22. Life history stages of *Artena dotata* (Fabricius,1794) on *Quercus leucotrichophora*

Description: Wingspan is about 72mm. Body is bronze brown. Fore wings are with a white speck in the cell. Antemdial and postmedial lines of fore wings are very oblique, where antemedials are not waved and postmedials very slightly waved. Reniform is broken up into two spots. A prominent marginal greyish band with a waved line found on it. Hind wings with prominent medial incomplete white band. The margin and cilia are whitish. Ventral side is with pale basal areas in both wings. This and the next three species all have strong fasciation in the form of oblique postmedial and antemedial lines. In *dotata* these are predominantly pale and diverge significantly towards the costa; the postmedial is irregular (straight in the next three species). The blue band in the centre of the hindwing is more strongly curved than in the other species where it occurs.

Infestation: Three Larvae (2.3-2.5mm) of this moth were collected for rearing from the terminal tips of new shoots of *Q. leucotrichophora plantation* on 11.x.2017 from New Forest campus, Dehradun. Dark brownish pupa (26-28mm) formed on 29.x.2017 and the moth(50mm) emerged on 09.xi.2017.

Extent of Damage/Status: Locally common at lower elevations. Damaged is localised.

7. Yellow Tussock Moth, *Artaxa guttata* (Walker,1855)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:
Nygmia flava Swinhoe,1923
Euproctis guttata Collenette,1934

(a) Mature Larva

(b) Larva feeding on ban oak leaf

(c)Pupa **(d) Emerged moth** **(e) Pinned Moth**

Fig. 23. Life history stages of *Artaxa guttata* Walker,1855 on *Q. leucotrichophora*

Distribution: Occurs in India, Bangladesh, Nepal and Sri Lanka (http://www.nhm.ac.uk/ &https://www. inaturalist.org/taxa /556271-Artaxa-guttata).

Species of Oak infested: *Quercus leucotrichophora* (Singh,2019).

Other Host Plants: The known host plants of this species are *Ricinus communis*L., *Jasminun sp., Lantana camera*L.., *Mangifera indicaL.*, *Terminalia* spp., *Ziziphus mauritiana*Lam., *Shorea robusta*Roth., *Maesa lanceolata*Forssk, *Mallotus philippensis*(Lam.)Muell.Arg., *Anogeissus acuminata* (Roxb.ex Candolle) Guillemin et al., *Barringtonia acutangula* (L.)Gaertn.,*Carissa carandas* L.and *Lagerstroemia indica* (L.) Pers (Robinson et al.,2010).

Habit & Infestation: Larva defoliates.A fourth instar larva (10mm) was collected on 24.viii.2018 feeding on foliage of *Q. leucotrichophora* in the oak plantation in New Forest Campus. The larva underwent on moulting into final instar on 26.viii.2018 (11-27 mm). Pupation (pupa:18m) on the surface of the oak leaf took place on 04.ix.2018. The emergence of moth (42 mm) took place on 13.ix.2018in the laboratory at FRI, Dehradun. Anotherlarva of the same moth collected on 16.v.2018 from the same location on oak emerged from pupa on 18.v.2018.

Extent of Damage/Status: Occurs commonly in oak forest. Minor pest.

8.Cocoa Tussock Moth, *Orgyia postica* (Walker,1855)

Superfamily: Noctuoidea

Family: Erebidae

Subfamily: Lymantriinae

Synonyms:

Lacida postica Walker,1855

Orgyia ceylanica Neitner,1862

Orgyia nebulosa Walker,1862

Notolophus nebulosa

Orgyia ludekingii Snellen,1879

Orgyia ocularis Moore,1879

Notolophus oculari

(a) Mature larva

(b) Pupa inside cocoon

(c)Apterous female emerged from pupa

(d) Male moth

Fig. 24. Life history stages of *Orgyia postica*(Walker, 1855) on *Q. leucotrichophora*

Distribution: This species commonly occurs the Oriental tropics of India, Sri Lanka, Myanmar, Borneo, Java, New Guinea and Taiwan (https://en.wikipedia.org/wiki/Orgyia_postica).

Species of Oak infested: *Quercus leucotrichophora* (Singh,2019).

Other Host Plants: Larvae are known to feed on *Buchanania, Mangifera, Durio, Ochroma, Casuarina, Terminalia, Shorea, Hevea, Ricinus, Pelargonium,Cinnammum, Acacia, Albizia, Caesalpina, Cajanus, Cassia,Dalbergia, Erythrina, Pithecellobium,Pterocarpus, Sesbania, Xylia, Lagerstroemia, Eucalyptus,Tristania, Zizyphus, Malus, Coffea, Citrus, Santalum, Dimocarpus, Litchi, Nephelium, Theobroma, Camela, Grewia* and *Tectona* (Holloway, 1999) and also *Populus deltoides* W.Bartram ex Marshall (Singh,1991).

Habit & Infestation: Larva defoliates. Overlapping generations occur at lower elevations. In Dehradun, larva (15mm) are recorded from time to time during October-November and pupal stages generally over winter [collected on 29.x.2017 while feeding on the foliage of *Q. leucotrichophora* in the plantaton in the New Forest Campus of FRI, Dehradun. The larva pupated on 28.ix.2017,

with the moth (male; wingspan: 22mm) emerged on 06.x.2017. Larvae were again collected on 15 and 22.x.2018 and 8 and 20.xi.2018 from the Ban Oak foliage in the same locality. Pupatonoccurred in October and November varied (Pupa: 24-40mm). Emergence of one apterous female took place on 24.x.2018 and one male on 10.xi.2018, while two pupae remained under hibernaton until January 2019. No emergence].

Extent of Damage/Status: Locally common at lower elevations.Minor pest.

9. Brown-bordered Tussock Moth, *Olene inclusa* (Walker,1856)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae

(a) Larva

(b) Cocoon

c) Moth

Fig. 25. Life history stages of *Olene inclusa* (Walker,1856) on *Q. leucotrichophora*

Distribution: Occurs in the N.W.Himalayas, Poona (Maharashra, India), Java (Hampson,1892); West Malaysia, Indonesia, Hong kong, New Guinea, Java, South East Asia, Thailand, Andaman Islands (Robinson et al.,2010).

Species of Oak Infested: *Quercus leucotrichophora.*

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

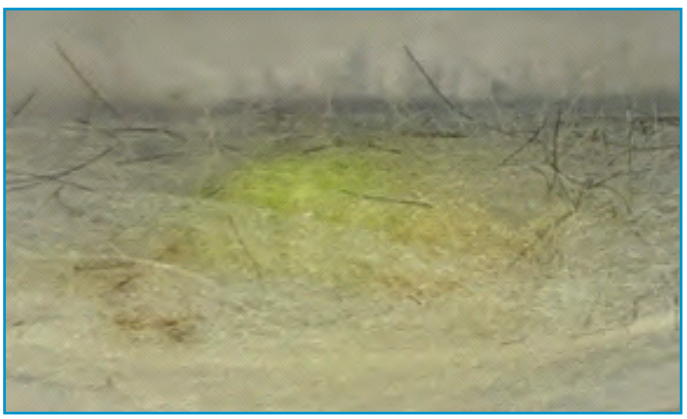
Larva: Larvae of male are dark brown in colour, with lateral tufts of long hair; head red-brown; two white dorsal lines on 4th somite and dorsal tufts of silky reddish hair on 4th to 7th somite. While the larvae of female have dorsal tufts dark brown; a sundorsal white stripe and crimson dorsal spots on 9th and 10th somites. Sporadic incidence of defoliation by *O.inclusa* was recorded on *Q.leucotrichophora* trees in a young plantation in New Forest campus, Dehradun, Uttarakhand, India during 2018-2020. Feeding by larval (2-5 instars) feeding caused minor defoliation to oak foliage. The larva fed by eating the leaf margins and finally consumed the entire leaf. Its incidence was observed from June to November (27.vi.2018; 03.vii.2018; 16.viii.2018; 26.viii.2018; 20.xi.2018; 03.vii.2020; 09.vii.2020; 16.vii.2020 & 18.vii.2020).

Pupa: A full grown fifth instar larva measured 30 mm in length that formed into a pupae (24mm) inside a tightly woven cocoon (30mm) in the laboratory at FRI, Dehradun. The larval period varied from 14-17 days (1st instar up to pupal formation) while the pupal period varied from 5-6 days in July.

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

Extent of Damage/Status: Localised infestations, damage minor.

10. *Olene dudgeoni* (Swinhoe,1907)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:
Dasychira dudgeoni Swinhoe,1907.
Pseudodura dasychiroides Strand,1914.
Dasychira dudgeoni Holloway,1976.
Distribution: N.E. Himalaya to Taiwan and Sundaland (Holloway,1999); China (Lui et al.,2012). It has also been recorded from Godavari village (1 male 08.v.1991 & 1 male 07.viii.1991 & 1 female 01.xi.1991) near Kathmandu in Nepal (Central Himalaya) .
Oak species host plant: *Quercus leucotrichophora.*
OtherHost plants: *Camellia oleifera* (Lui et al., 2012); *Camellia sinensis* (Theaceae)
Habit & Infestation: Larva defoliates. Larvae of this moth were recorded defoliating Ban oak, *Quercus leucotrichophora* tree on 25.ix.2020 in Chaubati village (29.81294 N & 80.21558E; 1838 m) in Pithoragarh district, Uttarakhand. Full grown larva was found feeding on the leaf margin and then entire leaf leaving midrib behind only. Larvae were collected and reared for life history studies. Length of larva ranged from 30-43 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 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 on 25.ix.2020 after 16 days of larval feeding. Pupal (length 29 mm) is yellowish-green in colour and enclosed in cocoon whose length is 40 mm attached to the leaf surface. Pupal period was 11 days and the moth (female wingspan: 46 mm) emerged on 21.x.2020.
Eggs: Lui et al.,(2012), studied the biological characteristics of *Dasychira dudgeoni* in China where the eggs hatch during late February and early March.
Larva: According to Lui et al.,(2012), the first to third instar larva feed on lower surface leaves of Camellia oleifera. Later they feed mainly on leaves. The 5th instar larva move to lower leaves and combine two complete leaves by spinning silk into a rigde shaped cocoon and then pupate inside it.
Adult: According to Swinhoe (1907), antennae, palpi, head, thorax and forewings are dark brown in colour; the forewing s variegated in parts with pinkish grey, two brown ring spots of that colour near the base; an oblique indistinct band of lunular marks from the middle of hinder margin to the costa at the one third from the apex; a double row of similar pale markings near outer margins; cilia variegated with the pale line at the base; abdomen and hind wings are pale brownish grey without any markings. Underside is whitish grey with indications of transverse, discal darker grey bands on across both the wings. According to Holloway (1999), this species resembles *O.mendosa* 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.
Extent of Damage/Status: Uncommon. Localised infestation.



(a)Larva (b) Cocoon with greenish pupa(c)Moth

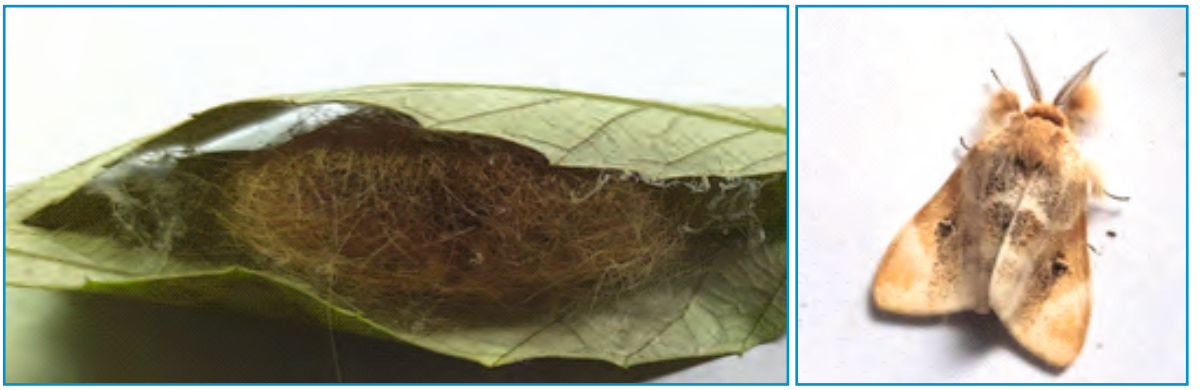
Fig. 26. Life history stages of *Olene dudgeoni* (Swinhoe,1907) on *Quercus leucotrichophora*

11. *Pida decolorata* (Walker,1869)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae

Synonyms:
Cyclidia decolorata Walker,1869
Dasychira maculosa Matsumara,1911
Distribution: Garhwal, Uttarakhand, India

(a) 4th instar larva

(b) 5th instar larva



c) Cocoon **(d) Moth**

Fig. 27. Life history stages of *Pida decolorate* (Walker,1869) infesting *Q. leucotrichophora*

Habit: Larva defoliates. IInd instar larva was collected on 16.vii.2020 feeding on ban oak foliage in Chakrata hills (2100m), Garhwal Himalaya in July2020. Length of larva is 10 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. Larva underwent mouting on 23.vii.2020 (IIIrd instar), 28.vii.2020 (IVth instar) and 05.viii.2020 (Vth instar). IIIrd instar larva (20 mm) head enlarged in size and body colour changes from brown to dark brown and long white hairs all over the body and feeding on the leaf margins. IVth instar larva is 23 mm and whole body is covered with brown and black hairs and larva possess black band behind the head region and feeding on the leaf tips.Vth instar larva is 30 mm, body colour changes from dark brown to light brown with brown and white hairs all over the body and feeding on the leaf tips and margins. Larva undergoes into pupation on 24.viii.2020. Length of pupa is 35 mm, brown colour and attaches itself to folded oak leaves inside the cocoon made of larval hairs. Emergence of male moth (wingspan: 35mm) took place at dusk on 08.ix.2020.

Male: Walker (1869) described it as *Cyclidia decolorata.* According to him, it 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.

Female: Matsumura (1911) described it as *Dasychira maculosa*. According to him,female length is 22 mm, wings are grayish white. Forewing sprinkled with pale brownish scales, at costal margin with 3 dark spots, one in the middle, one upon cross vein

and one another near the apex. Cross vein is white, on its outside with brownish spot; in the middle of the hind margin a brownish patch connected with the costal specks makes an indistinct broad curved band. Under side and hind wing is without any marking; head, palpi, fore legs and pygidium are yellowish brown and thorax is grayish. Its coloration resembles somewhat to female of *Orygia.*

Extent of Damage/Status: Uncommon. Damage not significant.

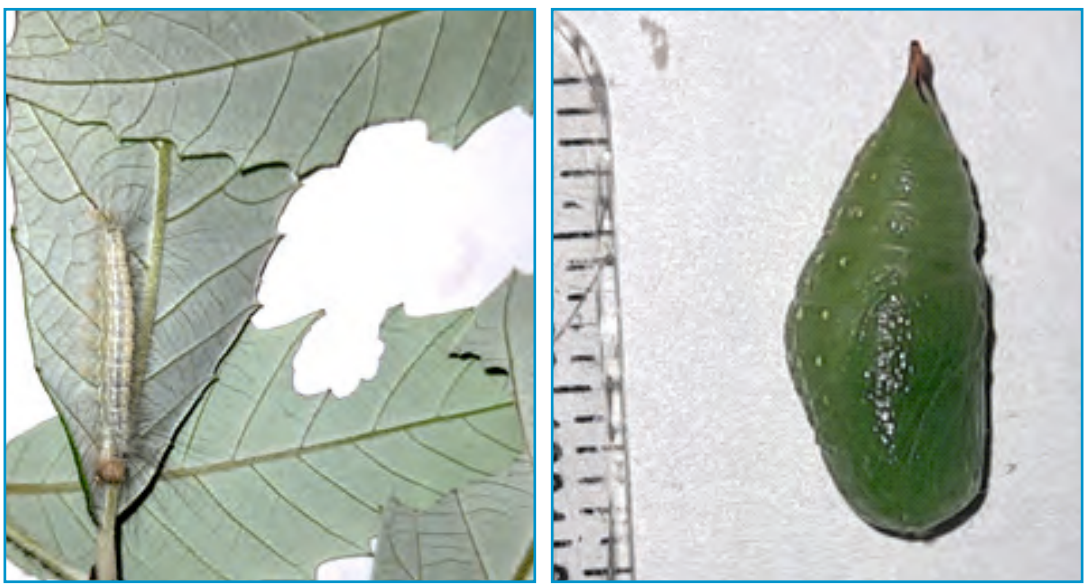
12. Black-spotted Arctornis, *Arctornis submarginata* (Walker,1855)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:
Redoa submarginata Walker,1855.
Leucoma sikkima Strand,1914.
Leucoma keiana Hulstaert,1923.

Distribution: Found throughout India, Ceylon, Burma and Java (Hampson,1892); N.E. Himalaya, Borneo, Sumatra (Schintlmeister,1994); Sri Lanka (Subhhalaxmi,2018) and northern Australia (https://en.wikipedia.org/wiki/Arctornis_submarginata).

Species of oak infested: *Quercus leucotrichophora* (Western Himalaya)

Other Host plants: The larvae have been recorded feeding on bamboo and other hosts. They are a potential pest of tea (*Camellia sinensis, Theaceae*) (https://en.wikipedia.org/wiki/Arctornis_submarginata).

Habit: Larva defoliates. Larva collected on 23.ix.2020 in Dhauli-ghauli, (1027m; 29.843N & 80.165E), Pithoragarh district, Uttarakhand. Feeding takes place on leaf margins by eating part of it but never the entire leaf.



(a) Larva feeding on ban oak leaf (b) Pupa

(b)Freshly emerged moth

Fig. 28.Life history stages of *Arctornis submarginata* (Walker,1855)on*Quercus leucotrichophora*

Larva: Larva is pale fuscous with simple long scattered spatulate hairs. There is a dorsal tuft of long black hairs from the second somite. There are sub-dorsal and sub-lateral black lines present. The second somite is with a yellow band present (Hampson,1892). The length of full grown larva is 28 mm and larva feeds on the ban oak leaf margins. Larval period is of 14 days (September)

Pupa: Pupa is dark green in colour and having small, yellow coloured dots on the dorsal side and length of pupa is 17 mm. Pupal period 6-7 days (27.ix.2020-2.x.2020).

Adult: According to Holloway (2005), the wings of male are dull satiny white, the forewing with a small black discal spot. The head has two blackish brown bars on the frons between the antennal bases and dorsal part of the eyes that blur into each other. The palps are basally and internally ochreous but grade blackish towards the apex. The legs are spotted black in the usual places. Hampson (1892), described it as a *Leucoma submarginata*. According to him, adult is pure white; palpi brownish; two brown spots on frons and a brown aband between antennae, which have the branches brownish; legs spotted with black. Fore wings irrorated with silvery scales ; a black specks at the end of cell; costa ochreous towards the apex; wings membrane slightly corrugated on outer area; cilia of both wings are more or less tinged with fuscous. According to Subhalaxmi (2018), adult is pure white; forewing is covered with silvery scales, black spot near cell end, upper margin is yellowish brown towards wingtip and both wings margins are tinged with brownish grey. Antennae are brownish. The adult female moths of this species are white with a green abdomen. The females have a wingspan of about 5 cms. The male moths are also white with a green abdomen, and also have a black spot near the middle of each forewing. The males have a wingspan of about 30mm.Moth emerged on 02.x.2020.

Extent of Damage/Status: Sproadic but widespread.Damagenot significant.

13. Eyes-underwing Thyas, *Thyas juno* (Dalman,1823)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Erebinae
Synonyms:

Noctua juno Dalman, 1823
Ophideres elegans Hoeven, 1840
Lagoptera multicolor , 1852
Thyas bella Bremer & Grey, 1853
Dermaleipa juno ceramensis Prout, 1922
Dermaleipa juno f. renalis Bryk, 1948

(a)Mature larva (b) Larva inside folding leaf before pupation (c)Pupa

(d) Emerged moth **(e) Pinned moth**

Fig.29. Life history stages of *Thyas juno*(Dalman,1823) on *Quercus leucotrichophora*

Distribution: The moth is known to occur in the Indian sub-region, China, Japan, Korea, Thailand, Borneo, Java, Sulawesi and on the Southern Moluccas (https://en.wikipedia.org/).

Species of oak infested: *Q.leucotrichophora* (Singh,2019).

Other Host Plants: The larvae feed on *Castanea, Quercus, Juglans* and *Pterocarya* species(Holloway, 2005). Oak species infested are *Quercus acutissima* Carruth., *Q. phillyraeoides* A.Gray, *Q. serrata* Murray and *Q.variabilis* Blume in Japan (Robinson *et al.* 2001). The adult is a fruit piercer in Thailand (Kuroko & Lewvanich,1993).

Habit: Larva defoliates. Fifth instar larva (65mm) was collected on 07.x.2018 while feeding on leaves of *Q. leucotrichophora* in the plantaton in New Forest Campus in FRI, Dehradun. The mature larva (70mm) underwent pre-pupaton on 12.x.2018 by the formation of a hairy mass of body hairs by

twining together three leaves and finally formed a pupa (38mm) on 15.x.2018. The emergence of the moth (wingspan: 90mm) took place on 5.xi.2018.

Flight Period: The species is known to be in flight in April & August-September in Mussoorie, Uttarakhand & Eaglenest Wildlife Sanctuary in Arunachal Pradesh across the Himalaya (Anonymous, 2018).

Extent of Damage/Status: Widespread in ban oak forest. Localised damage.

14. *Calliteara grotei* (Moore,1859)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:
Dasychira grotei Moore,1859
Dasychira kausalia Moore,1879
Dasychira nilgirica Hampson,1891
Dasychira horishanella Matsumura,1927
Dasychira atomariana Matsumura,1927
Dasychira dehra Collenette,1938
Orgyia horsfieldii.

Distribution & Habitat: Throughout India, Ceylon, Burma, Java. This species occurs in India in the plains up to 2133m elevation in the Himalayas (Hampson,1892).

Species of Oak infested: *Quercus leucotrichophora* (Beeson, 1941; Mathur & Singh,1959)

Other Host Plants: *Acacia arabica, Berberis* sp., *Eugenis aquea, Lagerstromia flos-reginae, Mallotus philippinensis, Psidium guava, Shorea robusta, Tectona grandis, Terminalia crenulata, Wagatea spicata* (Beeson,1941)

Habit: Larva defoliates. Larvae occur throughout the year (March-June; October-December) on Ban oak trees in lower reached of Uttarakhand. Second instarlarva (13 mm) collected on 22.v.2020 feeding on the tender leaves of *Quercus leucotrichophora* in ban oak plantation of New Forest Campus (640 m), Dehradun, Uttarakhand. Young larvae feed on leaf margins whereas mature larvae consumed the entire leaf. The larvae underwent moulting into third instar on 29.v.2021, fourth instar on 04.vi.2020 and final instar on 10.vi.2020 and larva pupated on 20.vi.2020. A full grown fifth instar larva formed into pupae inside a tightly woven cocoon which was attached to the eaten ban oak leaf. Pupa (25 mm) is brown in colour. Moth emerged on 29.vi.2020.

Larva: The larva is pale green or yellowish with rows of brushes of very long white hairs/tufts of long yellow hairs, 4th to 7th and 11thsomites with thick dorsal shorter tufts, a black dorsal patch between 4th and 5thsomites (Beeson,1941).

(a) 2nd Instar larva (b) 3rd instar larva

c) 4th Instar larva (d) 5th Instar larva (e) Cocoon

(f) Emerged Moth (g) Pinned Male Moth (h) Pinned Female moth

Fig. 30. Life History stages of *Calliteara grotei* (Moore,1859) on *Q.leucotrichophora*

Male: Head and thorax whitish grey, branches of antennae red-brown, abdomen orange with anal tuft grey, legs spotted with black, forewings grayish-white, irrorated with dark scales and slightly suffused with brown, a dentate sub-basal black line, two medial lines, inner nearly straight, the outer waved, reniform spot with dark outline, a waved postmedial line, bent outwards near inner margin, an irregularly dentate submarginal line, hindwing pale, the inner area orange, a more or less prominent dark spot at the end of the cell, the outer area generally suffused with fuscous, underside

with prominent cell spots to both wings (Hampson,1892).

Female: Head, thorax and forewing white, slightly powdered with grey, the last with indistinct diffused antemedial, postmedial and submarginal lines, abdomen and hindwing pure white (Hampson, 1892).

Expanse: Male- 46 mm; Female- 70-86 mm (Hampson,1892).

Life History: There are 6-8 moults. Larva occuring in the cold season in NW India, pupate in Nov-Jan. and produce moths in February, March after a pupal period of 4-7 weeks. In Assam, Bengal the life cycle is shorter and moths appear in Jan-Feb. Eggs laid in February produce moths at the end of April, later broods give rise to moths in June and in August (Pupal period: 9 Days). Larva occurring during the monsoon produces moths in September-November (Pupal period in November: 30 days). There are normally four generations in a year (Beeson,1941).

Extent of Damage/Status: Common at lower elevations. Can cause potential damage when population is high.

15. *Calliteara strigata* (Moore,1879)

Superfamily: Noctuoidea

Family: Erebidae

Subfamily: Lymantriinae

Subspecies: *C. s. cordata* (Holloway,1976).

Synonyms:

Dasychira strigata Moore,1879

Dasychira niveosparsa Butler,1881

Dasychira cordata Holloway,1976

Orgyia strigata.

Distribution: Himalayas (Shimla,Almora, Sikkim), Thailand, Sundaland, Buru (ssp. *cordata*), (http://www.jpmoth.org) [1 specimen in NFIC collected from Sitoli,Almora,Uttarakhand by J.C.M.Gardner on 03.vii.1937].

Fig.31.Pinned Moth *Calliteara strigata* (Moore,1879)

Habitat preference: This is a rare montane species, recorded between 1050m and 2110m on G. Kinabalu and singly at 1465m on Bukit Retak, Brunei (http://www.mothsofborneo.com).

Species of oak infested: *Quercus leucotrichophora* (Beeson,1941; Mathur & Singh,1959).

Habit: Larva defoliates (Mathur & Singh,1959).

Description: Head and thorax iron-grey, slightly tinged with yellow, forewing dark, non-grey, slightly tinged with brown, an indistinctive angulated sub-basal line, a double antemedial waved line, the reniform with dark outline, a double waved postmedial line and single submarginal line. Hindwing fuscous, the inner area tinged with orange, an indistinct dark spot at end of cell, a post medial band and marginal line (Hampson,1892). This species also has a yellow hindwing as do horsfieldii and cerigoides, but it is a duller orange-yellow with a narrow submarginal fascia rather than a broad marginal one. The forewings are more generally and evenly fasciated, with a pale, cordate patch subbasally (http://www.mothsofborneo.com).

Expanse: Male- 62 mm; Female- 73 mm. (Hampson,1892).

Extent of Damage/Status: Data deficient.

16. *Calliteara varia* (Walker,1855)

Superfamily: Noctuoidea

Family: Erebidae

Subfamily: Lymantriinae

Synonyms:

Dasychira varia Walker,1855

Dasychira maruta Moore,1859

Orgyia varia.

Distribution: Himalayas: Sikkim (Hampson, 1892) & Himachal Pradesh [1 specimen in NFIC collected from Kangra Forest Division, Himachal Pradesh 27.viii.1917].

Fig.32. Pinned Moth *Calliteara varia* (Walker, 1855)

Species of oak infested: *Quercus leucotrichophora* (Beeson,1941; Mathur & Singh,1959).
Habit: Larva defoliates (Mathur & Singh,1959).
Male: Pale cinereous, hoary beneath. Palpi is blackish from above towards the tips. Antennae arewith tawny branches. Fore tibiae ispartly black from above, tawny from beneath; fore tarsi is with black bands. Fore wings are with four blackish bands; first band slender, very near the base; second broad and diffused, at one-third of the length; third and fourth beyond the middle, slender, undulating and composed of lunules. Hind-wings are hoary, with a pale brown ciiscal spot, two pale bands and a darker marginal band.
Female: Head, thorax, and abdomen are brownish grey, palpi black at sides. Head and forewing are brownish grey, with a nearly erect subbasal dark line; an indistinct dark forked antemedial line, a dark mark on discocellulars, a doubly curved postmedial black line; a submarginal lunulate line. Hindwing is pale fuscous, trace of a dark mark on discocellulars and postmedial band, a marginal dark line. Expanse: 70 mm. (Hampson, 1892). Thorax and fore wings from above are whitish hoary.Femaleis whitish/grey. Fore-wing is densely irrorated with dark-brown scales, with three transverse irregular darkbrown lines, the first sub-basal, the second nearly adjoining, and bifid anteriorly, the third beyond the disc, blackish, recurved, and undulated, a fourth submarginal zigzag line, a marginal row of spots, and an indistinct pale discal spot. Hind-wing paler, with two very indistinct suffused brownish discal bands, and a submarginal brown line, which is more distinct beneath than above
(http://archive.org/stream/catalogueoflepid02east#page/339/mode/1up).
Extent of Damage/Status: Data deficient.

17. Yellow-tail Tussock Moth, *Somena scintillans* (Walker,1856)

Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:

Nygmia scintillans
Porthesia scintillans.
Artaxa scintillans Butler (1880)
*Artaxa justicia*Moore (1859)
*Orvasca subnotata*Walker (1865)
Euproctis scintillans

(a) Larva (Dorsal view) **(b) Pinned Moth**

Fig. 33.*Somena scintillans* Walker,1856

Distribution: N.W. Himalaya.
Species of Oak Infested: *Quercus leucotrichophora.*
Other Host Plants: It is a polyphagous pest, commonly collected on ragi, castor, pigeonpea, cowpea, field bean, cucurbits, mango, ber, citrus, hibiscus, rose, ficus, coffee, tea, etc. It is a minor, sporadically serious pest (nbair.res.in).

Male: Testaceous. Head is somewhat luteous. Thorax and abdomen are brown, the latter with a luteous tip. Disk of the fore wings brown, wholly studded with black tubercles, and adorned with silvery spangles along its exterior side, where the brown hue forms two branches.
Extent of Damage/Status: Common, causes minor damage.

18. *Euproctis varians* (Walker,1855)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:
Artaxavarians, Moore,1878
Euproctis varians (Walker,1855)
Artaxa varians Walker,1855
Euproctis varians tjamba Collenette,1947

Distribution: China, Formosa, Throughout India, Ceylon, Burma (Hampson, 1892).Thailand.[6 specimens in NFIC collected from Mussorie and Dehradun, Uttarakhand].

(a) Larva **(b) Moth** **(c) Pinned Moth**

Fig.34. *Euproctis varians* (Walker,1855)

[(b)-Source:
http://www.phuketnaturetours.com/Pages/thumbnailpopup.php?z=http://www.phuketnaturetours.com/Images/Moths%20800/Euproctis%20varians%2002%20-%20Phuket.jpg&width=800&height=601&title=Euproctis%20varians%20%20-%20Phuket]

Species of Oak Infested: *Quercus leucotrichophora* (Mathur& Singh,1959)
Habit: Larva defoliates(Mathur& Singh,1959)
Host Plants: *Brassica oleracea* var. *capitata* (nhm.ac.uk), *Ricinus communis* (Hill,2008)
Description: Male and female yellow, underside and hindwing pale yellow, forewing with some oblique, indistinct whitish marks (archive.org).
Male: Small size, the two pale lines of the forewing more prominent, but with no dark powdering between them, the orange cell spot generally absent. Expanse: 18-22 mm (Hampson,1892).
Body is partly clothed with whitish hairs. Antennae is whitish from above, with darker branches, Legs are whitish. Whitish marks on the forewings are more distinct than those of female. Length of the body: 2.5-4 line; of the wings: 7-12 lines (archive.org).
Female: Paler and without marking. Expanse: 18-29mm (Hampson,1892).
Extent of Damage/Status: Common at lower elevations, causes minor damage.

19. *Lymantria concolor* (Walker,1855)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae

Synonyms:
Lymantria superans Walker,1855
Lymantria micans Felder,1874
Lymantria carnecolor Moore,1888
Lymantria horishana Matsumura,1931
Lymantria concolorlacteipennis Collenette, 1933
Liparis concolor.

(a) Male **(b) male** **(c) Female**

Fig.35. *Lymantria concolor* (Walker,1855)

Habitat: North-West Himalayas, Sikkim, Burma (Hampson,1892).
Species of Oak Infested: *Quercus leucotrichophora* (Mathur & Singh,1959).
Larva: Brown with tufts of brown and black hair, speckled and the back blotched with yellow, a conspicuous blotch on second somite (Hampson,1892).

Male: Head and thorax marked with black, fore wings with the marking black, antemedial line much more irregularly waved and with a black streak in the cell beyond it, two postmedial lines more lanulate and more or less connected by black blotches, the submarginal line also more irregular. Hind wing white or suffused with black and with traces of submarginal band (Hampson,1892).

Female: Line behind the head yellow and ground colour of the abdomen is yellow (Hampson,1892).

Description: Expanse: Male- 56 mm; Female-88 mm (Hampson,1892).

Extent of Damage/Status: Moths common in Ban oak forests.Data deficient.

20. Pink Gypsy Moth, *Lymantria mathura*(Moore,1866)

Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:
Porthetria mathura(Moore)
Ocneria mathura(Moore)
Lymantria aurora Butler
*Lymantria fusca*Leech
Lymantria mathura aurora Butler

Distribution & Habitat: Japan, North West Himalaya, Sikkim (Hampson,1894), Bangladesh, Japan, China, Korea, India, Nepal, Taiwan, USA, Russian Federation, Siberia (cabi.org)

Species of Oak Infested: *Quercus leucotrichophora, Q.mongolica, Q.serrata.* (Mathur & Singh,1959).

Other Host Plants: This species is one of the principle defoliators of Shorearobusta in Assam & North India. Other food plants are *Eugenia jambolana, Terminalia arjuna, T. myriocarpa* (Beeson,1941), *Abies, Castanea, Castanea mollissima, Larix, Liquidambar formosana, Litchi chinensis, Mangifera indica, Neolamarckia cadamba, Pinus* sp., *Pseudotsuga menziesii, Shorea robusta, Syzygium cumini, Terminalia arjuna,Terminalia myriocarpa* (Plantwise.org)

(a)Eggs

(b) 2nd Instar larva

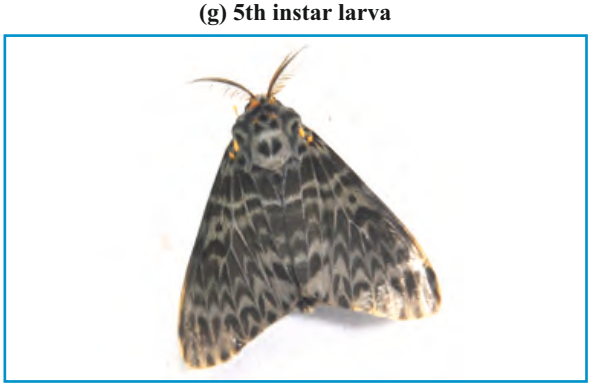
c) & d) 2nd and 3rd instar larva

(e) 3rd instar larva

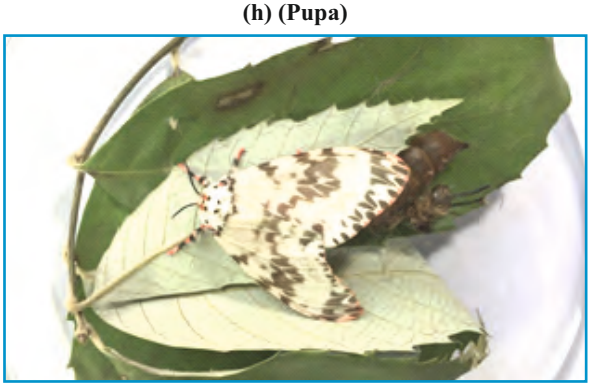
(f) 4th instar larva

(g) 5th instar larva

(h) (Pupa)



(i)Male moth



(j) Female Moth

(k) Pinned specimen (Male)

(l) Pinned specimen (Female)

Fig. 36 (a-i). Life history stages of *Lymantria mathura* Moore,1866 on *Q.leucotrichophora*

Habit: Larva defoliates.Larvae are active during June-September (summer) when moths emergethrough out summer from June-October in lower reaches of Uttarakhand.

Eggs: The eggs are deposited in masses of about 200 eggs each, usually in bark crevices. The egg masses are pale-yellow when first laid and darken after approximately 2 weeks (Cabi.org). Egg masses covered by female spume-like transparent secretions and not by female hairs (EPPO Bulletin,2005).

Larva: The larva reaches the length of 2 inches in male and 3.5 inches in female, colour ashy with yellow band across the thorax; abdomen with rows of papules bearing tufts of long hairs; two long plumes of hair project on either side of the head (Beeson,1941).

The larvae are stout bodied, ashy-grey-brown, with transverse yellow bands on the thorax. The entire body is covered with prominent bristles. They have one pair of anterior and two pairs of posterior hair pencils or long hair tufts. The larvae are approximately 3.4 mm long when first hatched, the second-instars are 5.8 mm long, the third-instars are 2 cm long and the fourth-instars are 3 cm long. When the third-instar stage is reached, the female larvae are significantly larger and faster growing than the males. The mature male larvae are approximately 4.2 cm long and the females are approximately 6 cm long (Mohn,2001).

Pupa: The pupa is 0.5 to 1 inch long, smooth except for a few group of short bristles. Pupation takes place in a leaf fastened with a few strands (Beeson,1941).

The pupae are stout and medium-brown. The male pupae are on average 2 cm long and the female pupae are on average 3 cm long. The first abdominal segment has a pair of clusters of short white hairs (Mohn,2001).

Adult: The adults are moderately sized, hairy and heavy bodied. The females are larger than the males and have a thick anal-

tuft of scale hairs. The final three abdominal segments of the female are extended. The ovipositor is slightly elongated. The forewings of the males are beige with dark-brown markings and the hind wings are yellow and bear a distinct dark spot. The forewings of the females are less distinctly marked than the males and the hind wings have a pinkish or rosy appearance. The hind wings of the females also bear a dark spot. The female body is beige with pink or rosy areas on the anterior abdominal segments. The wingspan is an average of 46 mm for the males and 84 mm for the females (Pucat and Walter,1997;Mohn,2001).

Female: The female moth has a white forewing with dark marking and edged with pink, hindwing pink with a band of dark brown, abdomen half white half pink, legs pink & black. Expanse: 76-101mm (Beeson,1941).Head and thorax white; frons fuscous, two black spots each on collar, meso and metathorax, palpi, antennal tuft and two spots on mesothorax crimson, abdomen crimson, with small black spots on vertex, the terminal segments whitish, legs black and crimson. Forewings are white, some crimson and black basal spots, a subbasal line, an antemedial waved line joining at inner margin two postmedial lunulate lines, the space between which is often completely filled in with fuscous, a fuscous spot towards end of cell, some lunulate submarginal marks forming a more or less complete band, a marginal series of spots. Costa and cilisare crimson. Hindwing is crimson, with a fuscous spot at end of cell, a submarginal maculate band and some spots on center of margin. Expanse: 96-112 mm. (Hampson,1892). White-pinkcoloured; hind wings, abdomen, base of antennae, legs and tops of veins on front wings bright pink; other parts of the body are pinkish; fore wings are pink with white longitudinal strokes along veins; head and notum with light strokes (white and grey); valvawith three appendixes and acute distal top; 9th segment with subunci. Male wingspan 40-50 mm, female wingspan 70-90 mm (Kozhanchikov,1950).

Male: The male with the forewing mainly marked with dark brown, hindwing yellow with a black spot and line (Beeson,1941). The black spot on vertex of abdomen, the ground colour of forewing pale, the hindwing orange, with a black spot forming a curved band, some spots on center of outer margin. Expanse: 40-55 mm. (Hampson,1892). Antennae is strongly pectinate, yellow-grey with black segments; head and thorax yellow-grey with grey strokes; abdomen yellow with bundles of grey hairs on tergites; ventral side of abdomen and thorax yellow; fore wings yellow-grey with many grey and white transversal stripes, yellow veins and yellow-grey fringe; hind wings dull, grey-yellow, with light yellow fringe; upper side yellow, uncoloured, sometimes slightly pinkish (Kozhanchikov,1950).

Biology: Outbreaks of *L. mathura* usually occur once in 4 years. Eggs with almost completely developed larvae overwinter under bark scales. Neonate caterpillars usually appear in the first half of May and continue to hatch for around 20 days. For the first 4–5 days, they neither spread nor feed. The feeding period covers May, June and July. Caterpillars feed first on buds, then on leaves, preferring to stay on leaves and not on branches. The most active feeding is observed in the evening. During outbreaks, the pest population level may reach more than 1000 caterpillars per tree. Male caterpillars usually have 5, female 6 instars. Larval development lasts 50–60 days. Pupation of *L. mathura* occurs on leaves and branches in crumbly cocoons or almost without cocoons in July, Pupal development lasts 12–18 days. Flights occur at the end of July and in August. Males and females are strong fliers, active at night and attracted to lights. Males are not strongly attracted to disparlure. Females lay eggs in small multiple masses that are well hidden under bark scales on trunks (not only of host plants, e.g. on *Picea*) usually close to the soil or in crevasses on other objects making them difficult to detect. Eggs are covered with female spume-like transparent secretions. One female may lay 150-600 eggs (EPPO Bulletin,2005). A brood of larvae is found in April with moths in May after a pupal period of 8-10 days; larvae occur again during the hot weather and early rains, pupation occurs from July to September with moths after about 10 days. Eggs of another generation are laid in October (Beeson,1941).

Extent of Damage/Status: Widespread and locally common. Can cause potential damage when population is high.

21. Indian Gypsy moth, *Lymantria obfuscata* (Walker,1865)

Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:
Lymantria obfuscata Walker,1865
Liparis obfuscata.

Distribution: Himalayas. [42 specimens are kept in NFIC collected from Sindh valley,Kashmir by C.F.C.Beeson on 26.vi.1928; Bunter,H.P.collected by Bhupesh Thakur on 28.v.2008]

Species of oak infested: *Quercus leucotrichophora*(Mathur & Singh,1959)

Other Host Plants: Indian Gypsy Moth, is a serious pest of about 200 broad-leaved tree species, throughout India, namely oak (*Quercus spp.*), willow (*Salix* spp.), popular (*Populus* spp.), walnut (*Jugulans* spp.), apple (*Malus* spp.), apricot (*Prunus* spp.), cherry (*Prunus cerasus*) and almond (*Prun us amygdalis*) (Dharmadhikari et.al.,1985;

Rishi &Shah,1985). It was reported as the major pest of ban oak (Beeson,1941) and of apple trees at Kotgarh, Shimla (H.P.) (Rahman,1941). In earlier studies, it was reported as one of the most destructive pests of fruit and forest plantations including apple, walnut willows and poplars in Kashmir (Malik et al,1972; Dar et al,1977; Sheikh, 1975; Masoodi et al.,1990; Kumar et al., 2007). An outbreak was reported from Sarahan and Narag areas in Sirmour (H.P.), where massive defoliation of oak trees took place (Singh et al.,2007).

Habit: Larvae defoliates as are active during the rainy season i.e July and pupae in July-August when moths also emerge in lower reches of Uttarakhand.

Larva: Pale brown, with short dorsal tufts of hair and long lateral tufts, a dark brown dorsal band, with pale lines down the center and on each side (Hampson,1892).

(a) Mature larva feeding on ban oak

(b) Larva (Dorsal view)

(c) Pupa

(d) Male moth

e) Female

Fig. 37.Life History stages of *Lymantria obfuscata*Walker1865 on *Quercus leucotrichophora*

According to Ferguson (1978), the tribe Lymantriini has shorter, more even tufts of hair, arising in clumps from the verrucae and conspicuous yellowish-red dorsal glands on sixth and seventh abdominal segments. Earlier, (Gardner,1938) described the full grown larvae of *L. obfuscata,* (Roonwal, 1977) the other stages and (Adhikari,1979), the head capsule, but only briefly. According to Verma et.al.,(1979), the caterpillars were nocturnal, brown with black specks on the dorsum, head was prominent, brownish-yellow having two dark brown specks on the median suture. Body was covered with tufts of brown hairs. Besides three thoracic, there were four pairs of abdominal pseudolegs and the full grown larva measured 3.3 cm × 0.5 cm (Thakur et.al.,2015).

L. obfuscata has six larval instars separated by five moulting stages. The caterpillars were nocturnal and fed gregariously, from the periphery towards the mid rib of the leaves. Young caterpillars spread to new locations by spinning silken thread. Each larval instar had a cylindrical, elongated body that was differentiated into head, thorax and abdomen. The colour changed from greyish-black in the first instar larva to reddish-brown in the last instar larva. The splitting of the exuvae started near the first thoracic segment, and the head capsule got itself split to the opposite direction. The head was hypognathus, black to reddish-brown in colour with small microscopic setae. It was composed of two parietal plates differentiated from each other by a distinct Y-shaped pericardial suture. In the head, the median epicranial sulcus was well-developed and the frons was represented by a pair of narrow oblique plates termed the adfrontals. Both clypeus and labrum were evident and the typical number of ocelli was six which were situated just behind, and a little above the bases of the segmented antennae. The mouthparts were found to be of mandibulate type and each mandible had three teeth, which were powerful and helpful in mastication of food. Larvae bore three thoracic segments which had a pair of legs each which end in a single curved claw. There were ten abdominal segments and 3rd, 4th, 5th, 6th and 10th abdominal segments bore a pair of prolegs each. A typical abdominal leg was a fleshy and was provided with a series of hooks which helped in locomotion. A pair of eversible glands was present on the dorsum of the 6th and 7th abdominal segments. Small hairs were scarcely distributed dorsally over the whole body of the larva and an anal comb was present prior to anus. The armature of the larval body consisted of simple hairs, tubercles and verrucae, bearing tufts of setae. The double row of tubercles on the dorsal surface of matured larvae were more prominent as the first five pairs were bluish and last six pairs brick red in colour (Thakur et.al.,2015).

From a single egg-mass around 300-400

neonate larvae emerge in spring just when the new leaves emerged (Thakur et.al.,2015). The larvae of different instars were observed regarding their feeding habits. The newly hatched larvae rested for sometime on the top of their egg-mass. Thereafter, larvae moved to the leaf surface, where they started feeding on the outer soft parenchyma tissue of the leaf and formed minute holes in the leaf surface. The second instar larvae also preferred softer and fresh leaves and formed patches and holes in the epidermis. Feeding along the margins of the leaves was also observed. In the past it was observed that first instar larvae made small perforations on upper surface of leaves, and late instars dvoured the leaves completely leaving the mid-rib of leaves only (Masoodi,1991). The third instar larva fed upon the softer leaf tissues along with the softer veins of the leaves. More larvae were found feeding along leaf margins as compared to previous stages. The fourth and fifth instars were found to cause maximum damage to the foliage by feeding upon the harder tissues of the ban oak leaves. Sixth instar larvae had slow rate of feeding and after sometime they stopped feeding and transformed into the next pupal stage. All the larvae fed gregariously, and move to the other part of the foliage in search of food, showing their voracious feeding nature. Later instars of gypsy moth move down the trees at dawn and climb back at the dusk. This daily migration appeared to be influenced by environmental conditions, including abiotic factors and sunlight was probably responsible for stimulating large caterpillars to migrate up and down the trees (Weseloh,1989). It was noticed that when larvae were crowded or partially starved, pupal weights were reduced but the period of larval development was extended by 0-3 (crowding) and 8 (starvation) days (Lance,1986).

Male: Male grayish brown, forewings with the postmedial double lines more regular, hindwing with a dark lunule at end of the cell and dark marginal band (Hampson,1892) Cinereous-ferruginous. Palpi is porrect, rather slender, hardly extending beyond the head; third joint very minute. Antennae are very broadly pectinated. Abdomen, fore wings, beneath and hind wings dark are ochraceous. Abdomen is tapering from the base to the tip; apical tuft small. Fore wings with two brown bands; first across the middle, including a blackish discal mark; second marginal, partly connected on its inner side with a zigzag transverse brown line; a blackish transverse angular line between the first band and the base, where there are two blackish dots. Hind wings with a narrow brown border. (Archive.org).

Female: Pale, ochreous, a dark mark at end of cell of forewing (Hampson,1892).

22. *Rhypotoses drepanioides* (Kishida, 1995)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Distribution: Garhwal,Uttarakhand. Also occurs in Kumaon Himalaya, India (Smetacek & Smetacek, 1995; Smetacek & Smetacek,2011)

Species of oak infested: *Quercus floribunda* (Smetacek & Smetacek,1995; Smetacek & Smetacek,2011) & *Quercus leucotrichophora* (Singh,2019).
Habit: Larva defoliates. Larvae collected during October and adults emerge from Pupae in November in lower reaches of Uttrakhand.

Fig. 38-*Rhypotoses drepanioides*Kishida,1995 (Pinned specimen)

Final instar larva:Head black, mandibles dark brown. First two thoracic segments and entire dorsal length of larva black with some white between the tubercles. Second, third, and fifth to ultimate segments with paired white dorsal tufts; a pair each of large, dark brown tufts on fourth and eleventh segments, the tufts on fourth segment much larger than those on eleventh segment; remaining tufts white except tufts on ultimate segment, which have some dark hair in addition to the white hair; paired dorsal and sub-dorsal tubercles varying from dark orange to ochreous. A dull white lateral band is present. Legs and prolegs are dark brown. Pupation took place in a loosely woven cocoon on the side of the plastic breeding box (Smetacek & Smetacek,1995).
Extent of Damage/Status: Common at higher elevations. Can cause potential damage when population is high.

23. Clearwing Tussock Moth, *Perina nuda*(Fabricius,1787)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Synonyms:
Bombyx nuda Fabricius,1787
Stilpnootia subtinca Walker,1855
Pterina basalis Walker,1855
Euproctis cominata Walker,1865
Perina pura Walker,1869
Acanthopsyche ristemae Heylaerts,1881
Perina basalis Moore,1878
Perina pura Swinhoe,1923.

Distribution: It is found in the Indian sub region, Sri Lanka, to southern China Hong Kong, Thailand and Sundaland (https://en.wikipedia.org/wiki/Perina_nuda).
Species of oak infested: *Quercus leucotrichophora.*
Other host plants: *Ficus* spp., *Ficus benghalensis, F. benjamina, F. carica, F. elastica, F. microcarpa, F. pumila, F. racemosa, F. religiosa; Mangifera indica, Artocarpus integer, A. integrifolia* (https://www.nh m.ac.uk).

(a) Pupa **(b) Emergent moth pa** **(d) Pinned Moth**

Fig.39. Life history stages of *Perina nuda* Fabricius, 1787 on Ban oak, *Quercus leucotrichophora*

Habit: Larva defoliates. Larvae collected from *Q. leucotrichophra* plantation in New Forest campus, Dehradun in November (01.xi.2019). The total larval period ranged from 28days before pupation (28.xi.2018). Pupa (17mm) is yellowish- green in color covered with orange hairy setae and two brown spots. Moths emerged in January (29.i.2019) (Wing Span: 40mm).
Eggs: According to Cheanban et al.,(2017) the eggs are small, maroon colour and smooth surface.

Larva: The caterpillar has a greyish head and flanks, with the broad black dorsum. Setae are white in color (https://en.wikipedia.org/wiki/Perina_nuda). Eruciform larvae, gray head and dark brownish dorsum, thorax with 3 paired of legs, prolegs on the 3rd, 4th, 5th, 6th and the last abdominal segments, its body covered with 3 different types of setaes: charaza, verricule (dense tuft of upright hairs) and verrucae. The total larval period was 24.90 days before pupation (Cheanban et al.,2017).

Pupa: Pupa is bristly, piebald in dark grey and cream. Setae in pupa are orange in color (https://en.wikipedia.org/wiki/Perina_nuda) . Pupa is yellowish gray color covered with orange hairly setae and the pupal stage lasted 4.85 days for the male adult and 4.55 days for the female moth. (Cheanban et al.,2017).

Moth: According to Gurule (2013), palpi are minute; antennae are black, bipectinate with the branches long in male and shorter in female. Mid and hind tibia has minute terminal pairs of spurs. Male: Head and legs are orange in color; antennae are black; thorax is grey and brown; abdomen is brown, the segments fringed with white; anal tuft is orange in color. Fore wing with the outer margin are extremely oblique; hyaline, with a patch of brown scales on inner basal area. Hind wings are dark brown, with the apical area hyaline. Female: Head, thorax and abdomen are pale ochreous or white; the anal tuft is orange in color; antennae are pale. Outer margin of fore wings is not oblique as in male; Fore wings are pale ochreous or white; irrorated with brown scales below the cell.

According to Cheanban et al.,2017 male have very small proboscis, bipectinate antenna , body length is 10-14 mm, transparent forewing, one large brown frenulum at the anterior of the hindwing whereas female have pale yellow head and labial palp, bipectinate antenna, body length is 11.0-12.50 mm, abdomen covered with white hairs and 2-3 smaller frenulums on the hindwing.

Extent of Damage/Status: Minor pest.

24. Unidentified Erebidae Moth-1
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Distribution: Garhwal.
Species of Oak Infested: *Quercus leucotrichophora*

Habit: Larva defoliates.Brown coloured hairy larva (15mm) with two black spots on the forehead was collected in July(16.vii.2020) feeding on foliage of *Quercus leucotrichophora* in ban oak forest of Chakrata Forest Division (2087 m), Uttarakhand. Larva fed on the leaf margins.

Extent of Damage/Status: Data deficient.

Fig.40. Larva

25. Unidentified Erebidae Moth-2
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Lymantriinae
Distribution: Garhwal.
Species of Oak Infested: *Quercus leucotrichophora.*
Habit: Larva defoliates.15 nos. of second instarlarvae (7-8 mm) collectedin September (23.ix.2020) feeding on the foliage of *Quercus leucotrichophora* in ban oak forest of Lalghati, Dhauli-Ghauli village in Didihat block of Pitthoragarh district of (N 29.90278; E 80.21139; 1155m), Uttarakhand. The young larvae were black in colour and having white vertical lines on the upper part of the body and having black tufts of hairs in the middle of abdomen and two red dots on the forehead and last few abdominal segment of the body. As larvae grow in size, the colour of body becomes black to brown, more segmented and hairs all over the body. Second and third instars larvae were feeding on the leaf margins whereas fourth and final instar larvae consumed the entire leaf. The larvae underwent moulting into third instar on 05.x.2020, fourth instar on 19.x.2020 and final instar on 26.x.2020 and larvae pupated on 29-30.x.2020. A full grown fifth instar larva formed into pupae inside a tightly woven cocoon which was attached to the eaten ban oak leaf. Pupae were brownish in colour (length-30-35mm). Moths failed to emerge.

(a)3rd instar larva (b) 4th instar larva (c)5th instar larva (d) Cocoon
Fig.41. Life history stages of Lymantriidae larva on *Quercus leucotrichophora*

Extent of Damage/Status: Uncommon. Can cause damage locally.

26. *Ischyja manila* (Cramer,1776)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Erebinae
Synonyms:
Noctua manlia Cramer,1776.
Noctua squalida Fabricius, 1787.
Ischyja amboinensis Felder,1861.
Ischyja manlia Cramer; Holloway,1976.
Distribution: Indian Sub-region, Burma (Myanmar), Thailand, China, Okinawa (Japan), Sundaland (Thailand), Sulawesi (Indonesia); S. Moluccas (ssp. *amboinensis*) (Holloway, 2005). Nielsen et al. (1996) recorded it from Australia, and Fukushima (1947) recorded it from Palau. Philippines; Ceylon and Burma; Andamans; Java (Hampson,1894). It has also been reported from Arunanchal Pradesh, Uttarakhand, Assam and Karnataka (Anonymous,2020).
Species of Oak infested: *Quercus leucotrichophora.*
Other Host plants: *Schima* (Theaceae) (Holloway,2005); *Aglaia lawii* (Meliaceae), *Cupaniopsis anacardioides* (Sapindaceae), *Dalbergia monetaria, Xylia xylocarpa* (Fabaceae), *Terminalia paniculata* (Combretaceae) (Robinson *et al.* 2010).


(a)Mature larva feeding (Lateral view) (b) larva folding on being threatened


(c)Larva before goint into pupation (d)Pupa

(f) Emergent moth (female)

(g) Pinned moth (female)

Fig.42. Life history stages of *Ischyja manila* Cramer,1776 on *Q.leucotrichophora*

Habit: Larva defoliates by feeding on the frontal half of the leaf by cutting it into half. Larva (40 mm) of this moth was recorded defoliating a *Q. leucotrichphora* tree in plantation in New Forest campus, Dehradun in September (09.ix.2020).Pupa (35mm)formed on 17.ix.2020, is efflorescent, ashy black in color and enclosed in cocoon (50mm) which is enclosed inside 3-4 ban oak leaves wrapped together around it from all the sides. Emergence of female moth (Wingspan:90mm) took place in October (01.x.2020).

Larva: According to Holloway (2005), larva is dark rich brown, finely reticulated with paler squiggles. The final instar has a band of paler rufous brown encircling the area of A1, and the anal section is also more this colour. There are small tubercles dorsally on A2 and A3 (Holloway,2005). According to Hampson (1894), larva is purplish brown and ochreous, irregularly marked with short black streaks; the bands are ochreous; speckled with brown; the 4th, 5th,6th, 10th and 11thsomites are short with dorsal caoical prominences. Full grown larval length is 40 mm .

Pupa: Length 35 mm, ashy black in color and enclosed in cocoon whose length is 50 mm and enclosed inside 3-4 ban oak leaves wrapped together around it from all the sides. According to Hampson (1894) pupa is efflorescent.

Adult: According to Holloway (2005), males have the forewing shades of brown, without any significant purplish tint except on the longitudinal streak immediately posterior to the stigmata. The stigmata are paler than the ground, with dark edging, the ground being a medium brown; the reniform is rather irregular in shape and contains darker blotches. There is a dark brown longitudinal streak posterior to the purplish one, and this indents and sharpens the otherwise rather

diffuse oblique boundary to the much paler brown marginal zone. The medial loop from the dorsum is darker brown but is only edged paler antemedially within the dark brown streak, if at all. On the underside there are blue postmedial fasciae, that on the forewing distinctly broader over its posterior half, and that on the hindwing thin and crenulate. Females are a similar in colour but the forewing is more uniform basal to the paler, marginal zone.According to Hampson (1894), male head and thorax are red brown; abdomen is fuscous or red brown; a white spot at base of hind tibia and others on the outer spur of mid legs and outer medial spur of hind legs. Fore wing is pale or dark red brown or olive brown, irrorated with dark specks; traces of antemedial and medial waved lines; a straight oblique postmedial line; the orbicular and reniform grey or ochreous or in the form of deep black quadrate spots with white edges; black spots below centre and end of cell is generally resent, each with a white lunule on it and conjoined by a streak; a large ochreous patch sometimes present marginal line commencing as an oblique streak from the apex. Hind wing are very dark red brown; the area near anal angle is greyish, with dark strigae; a broad, irregularly angled, purplish-blue medial band from the cost to vein 2; a black spot with pale streak on it above anal angle. Underside of fore wing with whit irregular postmedial band from the cost to vein2; hind wing is with dentate postmedial white line. Wingspan of male is 80-100 mm. Female fore wing is much more uniform in color and without the black oatches; the oblique line prominent; hindwing with the band broader and more regular; no marks above anal angle. The color is often very dark and wingspan of female is 96-112 mm.

Extent of Damage/Status: Widespread at lower elevations. Can cause potential damage when in large numbers.

27. *Ophiusa olista* (Swinhoe,1893)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Erebinae
Synonyms:
Anula olista (C. Swinhoe,1893)

Distribution: Thailand, Vietnam, NE. India, Nepal, China, Taiwan, Korea, Philippines, Japan (Honshu, Shikoku, Kyushu, Tsushima). Rather, it is a temperate moth from northern India to China, Korea and Japan, to the northern limit to Kyushu in the mainland and Tsushima (jpmoth.org), Nanchuan, China (archive.org).

Species of Oak Infested: *Quercus leucotrichophora* (Mathur & Singh,1959).

Habit: Larva defoliates

(a) Moth **(b) Pinned specimen**

(sources:http://www.jpmoth.org/~dmoth/80_Noctuidae/09Catocalinae/4205_Ophiusa_olista/Ophiusa%20olista.htm; http://v3.boldsystems.org/index.php/Taxbrowser Taxonpage?taxid=560874).

Fig.43. *Ophiusa olista* (Swinhoe,1893)-Moth

Female: Cupreous brown, with a slight pinkish tinge. Forewings with a small brown dot for the orbicular; reniform large, ear shaped, with pale border; inner line pale sinuous, oblique, from hinder margin at one third to cost at one fifth; postmedial line composed of pale dots, nearly erect, bends slightly outwards outside the reniform; submarginal line pale, zigzag, more or less edged with brown and with two or three black marks. Hindwing is blackish brown, paler towards the base; cilia of both wings ochreous. Underside is grey; forewings with a darker spot at the end of cell; both wings with the outer border broadly darker (archive.org).

Extent of Damage/Status: Data deficient.

28. Fruit-piercing Moth, *Hypocala rostrata* (Fabricius,1794)

Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Erebinae
Synonyms:
Hyblaea plumicornis Guenée,1852
Hyblaea efflorescens Guenée,1852
Hyblaea genuiai Wallengren,1856
Hyblaea bohemani Wallengren,1856

Distribution: Uttrakhand. Chakrata hills (June-August).

Species of Oak Infested: *Quercus leucotrichophora* (Mathur & Singh,1959).

Other Food Plants: It defoliates on *Erioglossum rubiginosum, Diospyrus ehretioides, D. melanoxylan, D. montana, D. tomentosa, Glechidion lanceolarium, Spondia smangifera, Barrringtonia acutangular* (Beeson,1941).

Habit: Larva defoliates(Mathur & Singh,1959).

Description: It can be distinguished by head and thorax being paler. Hindwing orange not

conjoined to a large spot in end of cell and with marginal orange spot near anal angle (*Sivasankaran* et.al., 2017).The moth is violaceous grey, forewing with dark spot, hindwing orange, costal area dark brown (Beeson, 1941).Wingspan: 30-50 mm. (Beeson,1941).The larva is 25 mm., pupa 18 mm. long (Beeson,1941).

Extent of Damage/Status: Occasional in Ban oak forests. Data deficient.

(a-c) Moths

Fig.44. *Hypocala rostrata* Fabricius,1794

29. Fruit-piercing Moth, *Hypocala subsatura*(Guenee,1852)

Superfamily: Noctuoidea

Family: Erebidae

Subfamily: Erebinae

Synonyms:

Hypocala aspersa Butler,1883

Hypocala subsatura var. limbata Butler,1889

Hypocala tungusa (Graeser,1890)

Distribution: Oriental Region to Sundaland (mothsofborneo.com), Eritrea, Mauritiana, Tanzania, United Republican of Yemen, Oriental: Bangladesh, India, Pakistan, Palaearctic: Russia (Siberia) (discoverlife.org), China, East & South Africa, India (N.W. Himalayas, Uttarakhand, Karnataka, Tamilnadu) (Shubhalaxmi et al.,2011).

Habitat: *H. subsatura* occurs from the lowlands to 1930m, and has been recorded in greater numbers in montane habitats (mothsofborneo.com).

Species of Oak infested:*Quercus leucotrichophora*(Mathur & Singh,1959).

Other Host Plants: Robinson et al. (2001) attributed *Diospyros* (Ebenaceae), *Quercus* (Fagaceae), *Garcinia* (Guttiferae), *Caesalpinia* (Leguminosae), *Carapa* and *Xylocarpus* (Meliacae) to *subsatura* as host plants; records of Malus and Citrus may be

for adult feeding, though Miyata (1983) also listed the former. It is a defoliator of *Diospyrus montana* and *D. melanoxylan* (Beeson,1941).

Description: The forewings are variable, with a common and distinctive form that has an undulating grey border to the dorsum and a similar lens-shaped grey patch subapically on the costa (mothsofborneo.com).Palpi are porrect. Head and thorax is dark violaceous grey; abdomen orange, with broad black bands above; thorax and abdomen smoothly scaled; tibiae slightly hairy and without spines. Fore wing with the costa slightly arched towards apex, which is rectangular; dark violaceous grey coloured; a dark spot at base; an antemedial waved line, angled below median nervure; a black speck in cell; reniform a large dark lunule; the postmedial line sinuous, highly excurved beyond the cell, then bent inwards to below reniform; a submarginal rich brown double line filled in with whitish, arising from the outer margin below apex and angled outwards to the margin at vein 3. Hind wing orange, the costal area black- brown, conjoined to a large spot in end of cell; a broad fascia from base below cell; the outer area black-brown, angled inwards at vein 2 and with a submarginal orange spot at centre and a small marginal spot near anal angle; the cilia orange. Underside orange; the costal and apical areas of fore wing and costa of hind wing ochreous and brown speckled; disk of fore wing black, with a large yellow spot; hind wing with large cell-spot; the outer area marked as above. (Wingspan of Male - 45 mm) (Gurule,2013).

Extent of Damage/Status: Data deficient.

(source: https://commons.wikimedia.org)

Fig. 45. *Hypocala subsatura* (Guenee,1852)

30. Unidentified Erebidae Moth -3
Superfamily: Noctuoidea
Family: Erebidae
Distribution: Garhwal.
Species of Oak Infested: *Quercus floribunda*
Habit: Larva defoliates.Larva observed feeding on 25.x.2017 feeding on foliage of Moru oak in forest at Chakrata Forest Division (2600m),Dehradun district, Uttarakhand. Larva is white coloured with tufts of long hairs present all over the body and possesses one black spot behind the head region.
Extent of Damage/Status: Occasional in oak forests. Data deficient.

Fig 46. Erebidae larva

31. *Spilarctia leopardina* (Kollar,1844)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Arctiinae
Synonyms:
*Euprepia leopardina*Kollar,1844
*Ardices liturata*Walker,1869
Diacrisia leopardina.
Distribution: N.W. Himalayas- Kashmir, Simla, Almora (Hampson,1901). Chakratahills, Garhwal, Uttarakhand.
Species of oak infested: *Quercus leucotrichophora, Quercus* sp. (Mathur & Singh,1959)
Adult: Yellowish white ; palpi, sides of frons, and antennae black ; tegulse usually with black spots ; patagia and vertex of thorax striped with black ; legs striped wdth black, fore coxae on outer side and femora above crimson ; abdomen orange above, more or less strongly tinged with crimson, dorsal, lateral, and sublateral series of black spots. Fore wing with black streaks at base on costa, in cell, and on vein 1 ; an antemedial fascia on inner margin with elongate spot above its extremity above vein 1 ; a gradually dilated fascia on each side of median nervure conjoined to spots from costa before middle and at end of cell ; a postmedial maculate band curved from costa to vein 3, where it is

Fig.47.Adult- *Spilarctia leopardina* (Kollar,1844)

joined by an oblique series of short streaks from apex ; a subterminal series of spots on each side of veins 5 to 1; a terminal series of short striae. Hind wing with the interspaces more or less completely filled by black, sometimes reduced to a streak on inner area, a discoidal spot, a subterminal maculate band, and some points near termen. Underside of fore wing to postmedial band and inner area of hind wing suffused with scarlet showing through to upperside. Expanse: Male- 44 mm.; Female- 56 mm. (Hampson, 1901).

Extent of Damage/Status: Uncommon in Ban oak forests. Data deficient.

32. *Floridasura tricolor* (Wileman,1910)

Superfamily: Noctuoidea

Family: Erebidae

Subfamily: Arctiinae

Synonyms:

Miltochrista tricolor Wileman,1910.

Asura magica Strand,1917.

Barsine coccinea Moore,1886.

Miltochrista coccinea; Hampson,1900.

Asura magica.

Asura tricolor Hampson,1914.

Floridasura tricolor Volynkin, Huang & Ivanova,2019.

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

Species of oak infested: *Quercus glauca.*

Habit: Larvae recorded defoliating *Q. glauca* in moist temperate forest at Ogla, Didihat, Thal (1560-1800m), Pithoragarh district of Kumaon region of Uttarakhand (Western Himalaya).

(a) Mature larva (b) Pupa (Moth)

Fig.48. Life history stages of *Floridasura tricolor* (Wileman,1910) on *Quercus glauca*

Larva: Full grown larva (20 mm) is grayish in color having long spiny hairs all over the body and two pairs of black hair tufts on the dorsal surface of the 4-5 segments of the body spread laterally. The larvae feed on the lateral surface of the leaf. Up to 2-4 larvae may feed on a single twig. Larval period is of 3-4 weeks in September in the Western Himalaya.

Pupa: Pupa is 15 mm in length, dark brown in color and 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 enemies. Pupa period is of 5-6 days in September in the Western Himalaya.

Adult: Male head and thorax are crimson coloured, the latter marked with dark grey; abdomen is cinereous, fainted tinged with reddish, anal segment is pale ochreous brown. Fore wings are crimson color with yellow patches on the centre and outer areas and four dark grey transverse bands ;subbasal and antimedial bands are curved towards each other , touching about middle; postmedian line is curved, hardly separate from sinuous and interrupted submarginal bands . Hind wings are pale ochreous, suffused with reddish (Wileman,1910). According to Volynkinet al,2019 it is small moths with red body and wing ground colour. Forewing pattern is diffuse, dark grey in combination with yellow spots. Antennae of both sexes are ciliate. According to Bayarsaikhan (2020), length of forewing is 13-15 mm in male and 17-18 mm in female. This species is characterized by the forewing with much extensive dark lines edged finely with red, and a red, short discoidal band. Hampson (1914), described it as Asura tricolor. According to him head and thorax of male is scarlet; a black point between antennae, the patagia with black spots, the prothorax with pair of black points and the

mesothorax with black patch; abdomen is brownish white, the ventral surface tinged with scarlet. Fore wing is scarlet with some yellow in the interspaces and more prominent patches in end of cell and three on subterminal area; small subbasal fuscous spots are below costa and in and below the cell; an excurved fuscous antemedial band, confluent in the cell with an incurved medial band; an excurved postmedial band, dilated at middle and confluent at inner margin with the medial band, a series of spots beyond it produced as streaks on veins 6 and 4 to near termen. Hind wing is pale crimson.

Extent of Damage/Status: Restricted to *Q.glauca* forests in Kumaon.Damage not significant.

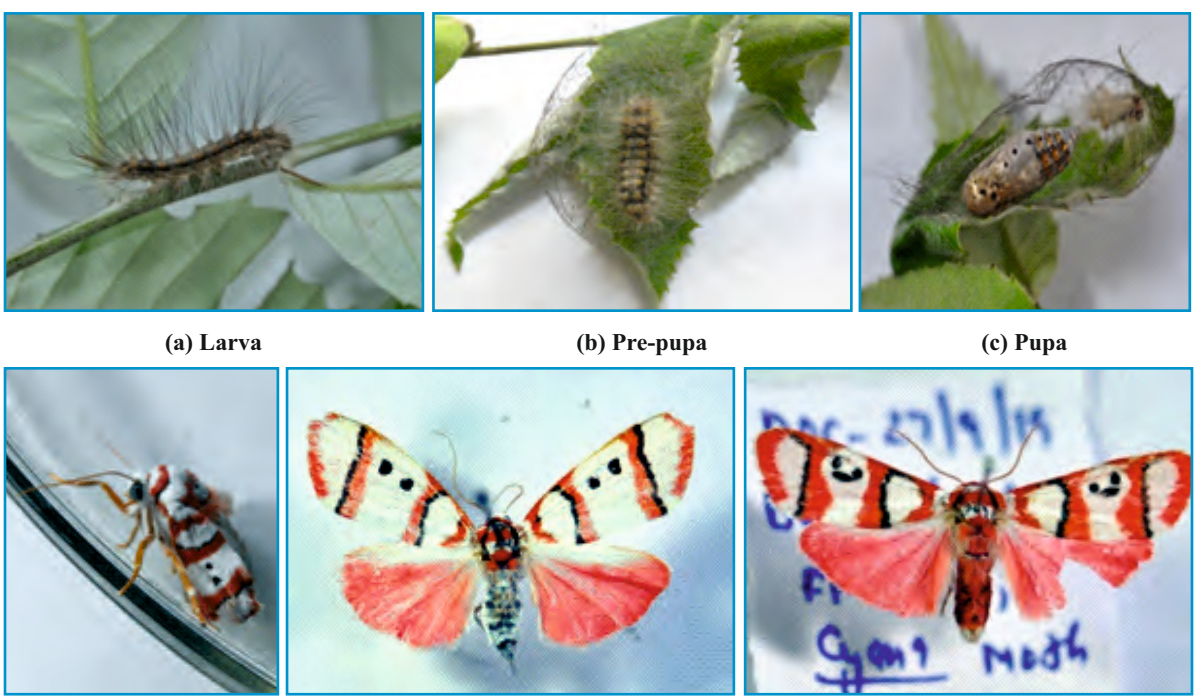
33. Unidentified Erebidae Moth-4
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Arctiinae
Distribution: Garhwal,Uttarakhand,India.
Species of Oak Infested: *Quercus floribunda.*
Habit: Larva defoliates. Brownish, hairy larva (mm) was collected on 23.v.2018 feeding on foliage of Moru oak in Chakrata Forest Division (2500m), Uttarakhand. Larva was observed feeding on the leaf tips of tender moru oak leaves. Larva died on 29 .v.2018.

Extent of Damage/Status: Occasional in Moru oak forests. Data deficient.

Fig. 49. Unidentified Arctiinae larva

34. *Cyana coccinea* (Moore,1878)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Arctiinae
Synonyms:
Bizone coccinea Moore,1878
Chionaema coccinea
Distribution: The species is distributed in India from the Himalayas (Uttarakhand, Nepal, Sikkim) to North-east India (Sikkim, Assam, West Garo Hills in Meghalaya, Nagaland) & Andamans during October-November (Anonymous,2018d). It also occurs in China, Thailand, Malaysia, Vietnam &Laos.(Hampson,1894b, Strand,1922, Ghosh & Chaudhury,1998; Chaudhury,2003,Tangmitcharoenet al.,2006; Sondhi& Sondhi,2016).

Species of Oak Infested: *Quercus leucotrichophora* (Singh et al.,2019).
Other Host plants: Host plants recorded for this species are *Dimocarpus* sp.(Kuroko & Lewvanich, 1993); *Camellia sinensis*(L.) Kuntze(Theaceae), *Dalbergia sissoo*Roxb.(Leguminosae), *Shorea robusta*Roth. (Dipterocarpaceae); *Tectona grandis* (Verbenaceae); *Mangifera indica* L. (Anacardiaceae) & *Dimocarpus longan* Lour.(Sapindaceae)(Robinson et al.,2010; Kuroko & Lewvanich, 1993). Sanyal et al.(2013) studied the life history of this moth on *S. robusta* in Dehradun and reported its outbreak in Rajaji National Park in Uttarakhand, India.



(a) Larva (b) Pre-pupa (c) Pupa

(d) Emerged moth (e) Pinned female moth (f) Pinned male moth

Fig.50. Life history stages of *Cyana coccinea* (Moore, 1878) on *Quercus leucotrichophora*

Habit: Larva defoliates(Singh et al.,2019). Fifth instar larva (30mm) collected on 19.vi.2018 feeding on leaves of *Q. leucotrichophora*plantation in New Forest campus, Dehradun. The larva underwent pre-pupal stage (20mm)on 20.vi.2018 by the formation of a hairy dome (40mm) from the mass of body hairs on the upper surface of a leaf and finally formed a pupa (20mm) on 21.vi.2018. The emergence of moth (female; wing span:30mm) took place on 28.vi.2018 in the laboratory at FRI, Dehradun.

Adult: Wingspan ♂ 30-32 mm; ♀ 33-44 mm. This species shows extreme sexual dimorphism. Cyana coccinea differs from congeners by having the forewing of male with red median area edged dark; 3 triangle discoidal spots within rounded, white-yellow patch; in male genitalia, valvae triangular with rounded apex; saccular process tapered, and curved to acute apex, almost same length with valvae; vesica with two groups of longer spines, fields of short, irregular spines, and scobination; in female genitalia, corpus bursae globular, with large irregular signum near cervix of bursae, and large tadpole-shaped signum (Bayarsaikhan and Bae,2016).

Male: Upperside crimson-red, the base of forewing slightly yellow: forewing with a sub-basal and discal black band, former bent inward and the latter outward at the costal end; 3 black spots at end of the cell. Thorax yellowish, banded with red, anal tuft and abdomen beneath yellow, legs yellow, with red bands, underside of wings uniform red. Expanse: 31.8 mm. (Moore,1878).

Head and collar ochreous, the latter fringed with crimson; thorax and abdomen crimson; the anal tuft ochreous. Wings are dark crimson; fore wing is with some black sub-basal specks; a broad excurved antemedial band; an incurved submarginal band with dentate outer edge. Expanse: 53 mm. (Hampson, 1894).Male is crimsoncoloured; palpi, head, and legs orange-yellow; vertex of head, tegulae, and front of thorax and patagia with yellow patches, sometimes becoming white. Fore wing with slight yellow or white mark at base; an antemedial black line incurved to costa, and joined at costa and inner margin by slight oblique black streaks above and below a large yellowish patch which sometimes has a white centre; a black spot in end of cell and two on discocellulars on a rounded yellow patch connected with inner margin by an obscure line; a strong postmedial black line with minutely dentate outer edge bent outwards just below costa, which it does not reach; the lobe small. Hind wing is crimson; cilia of both wings yellowish (Hampson,1900).

Female: Head white, antenna yellow; tegulie, patagia, meso and metathorax with white patches. Fore wing white; a sub-basal scarlet band bent outwards at costa and inner margin, on the former joining the antemedial scarlet band, which has a curved black line on its inner side; a black spot in end of cell and one on discocellulars; a postmedial scarlet band expanding below middle and with nearly regular black line on its outer side; a terminal band running round the apex to the postmedial line, its inner edge minutely waved (Hampson,1900). The female have wingspans of 38 mm. and have the usual "tiger" pattern of

white wing sections alternated with 2 mm broad crimson fasciae. The full sub-basal with a breadth of 1 mm, distinctly separated from the wing-base, forms the inner half of an oval basal white spot, aided by a wedge on the outer margin. The other half is formed by the heavy half-moon shaped black margin. The white spot is fully closed on the costa, and on the sub-basal part inwardly light black dusted. Female display a distinct balaclava mask, predominantly formed by the shape contribution of the post-median (Lourens,2017).

Extent of Damage/Status: Common and widespread. Can cause potential damage when in large numbers.

35. Yellow-banded Cyana Moth, *Cyana arama* (Moore,1859)

Superfamily: Noctuoidea

Family: Erebidae

Subfamily: Arctiinae

Synonyms:

Bizonea rama Horsfield & Moore,1859

Bizonetri guttata Walker,1869

Cyana distincta babui Kishida,1993

Distribution: It is distributed in North East India (Sikkim, North of West Bengal, Assam, Meghalaya, Nagaland, Mizoram, Manipur) (Hampson,1900; Singh et al. 2014), Nepal (Kishida 1993, as distinctbabui) and West China (Tibet) (Fang,2000). India (Himachal, Sikkim, Meghalaya, Maharasthtra) (Subhalaxami,2018).

Species of oak infested: *Q. leucotricho phora*

Habit: Larva defoliates (ban oak forest (2100m), Chakrata Forest Division, Dehradun district, Uttarakhand).

Biology: Caterpillars is blackish red with long black body and hairs growing in tufts from red spots. It also feeds on lichens of oak trees. Cocoon is cage like, composed of criss-cross body hairs. Pupa is dark brown with pale yellow stripes, remains suspended in centre of cocoon among meshwork of its own hair (Subhalaxami,2018).

Adult: White; the palpi is black, collar and tegulae are banded with yellow; abdomen with the distal portion suffused with crimson. Fore wing with subbasal, antemedial, postmedial, and submarginal obliquely curved yellow bands; the three black spots are large in female, smaller in male, the upper spot being placed outside the postmedial band below the costa. Hind wing is white, more or less suffused with pale pink; a dark lunule at end of cell on underside. (Hampson,1894).

Extent of Damage/Status: Occasional in Ban oak forests. Data deficient.

Fig.51.*Cyana rama*:Moths resting on ban oak leaves

36. Hill Cyana Moth, *Cyana signa* (Walker,1854)

Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Arctiinae
Synonyms:
Bizone signa Walker,1854
Bizone fasciculata Walker,1856

Fig.52.Adult- *Cyana signa*

Distribution: North and North East India (Himachal Pradesh, Uttarakhand, Sikkim, Meghalaya, Manipur, Arunachal Pradesh, Manipur) (Hampson 1900; Singh et al. 2014), Nepal (Kishida 1995; 1998), North Bangladesh (Walker,1854), North Myanmar (Kachin State) (Hampson,1900), China (Tibet, Yunnan) (Fang 2000) and North Thailand (Chiang Mai Prov.) (Cerny &Pinratana 2009). India (N.W & N.E Himalaya) and Myanmar (Subhalaxami,2018).

Species of oak infested: *Q. leucotricho phora.*

Habit: Larva defoliates. Colected from Ban oak forest (2100m), Chakrata Forest Division, Dehradun district, Uttarakhand).

Male: Pure white; palpi is black; collar and tegulae are narrow with crimson bands; a small spot on vertex of thorax. Fore wing is with a basal crimson spot on costa; a narrow obliquely curved antemedial band, the costa is crimson from the base to the band; a postmedial curved narrow band; a black spot towards end of cell and one in each angle, the two latter being conjoined into a streak in one specimen; the costal fold on underside is ochreous or pink (Hampson,1894).

Female: Without the crimson streak on base of costa; the lower black spot at origin of vein 3 instead of at angle of cell; the postmedial band is angulated as well as curved; in some specimens the black spots are reduced to specks, one specimen having the spot at upper angle of cell only (Hampson,1894).

Extent of Damage/Status: Occasional in Ban oak forests. Data deficient.

37. *Goniocraspidum ennomoides* (Hampson,1894)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Calpinae
Synonym: *Ectogonitis ennomoides*
Distribution: Kumaon,Uttarakhand. 1 specimen at NFIC,collected from Ramgarh, Nanital (1830m).
Species of Oak Infested: *Quercus leucotrichophora* (Mathur & Singh,1959).
Habit: Larva defoliates.
Extent of Damage/Status: Data deficient.

(a)Pinned moth

Fig.53 . Adult- *Goniocraspidum ennomoides* (Hampson,1894)

38. *Cosmia ochreimargo* (Hampson,1894)
Superfamily: Noctuoidea
Family: Noctuidae
Synonym: *Caradrina ochreimargo* Hampson,1894.
Distribution: N.W.Himalaya.
Host Plant: *Quercus semecarpifiolia* (Mathur & Singh,1959).
Habit: Larva defoliates (Mathur & Singh,1959).
Extent of Damage/Status: Occasional in Ban oak forests. Data deficient.

39. *Acronicta* (*Viminia*) *grumi bicolor* (Moore,1881)
Superfamily: Noctuoidea
Family: Noctuidae
Superfamily: Acronictinae
Distribution: This subspecies is known from the Himalayas and Southwestern China (*Volynkinet al.,*2015). North West India (Punjab; Solan of Himachal Pradesh) (Moore,1881). Kulu, Sultanpur, Shimla, Dharamsala (Hampson,1909).
Species of oak infested: *Quercus leucotrichophora.*
Other host plants: Other species of the same genus i.e. *Acronicta aceris* are known to feed on *Acer* spp, *Morus*spp, in Europe, *Quercus robur* in Finland. Other species of same genus *A. alni* feeds on *Alnus glutinosa, A. incana, Betula* spp., in Finland and British Isles (Robinson et al.,2010).
Habit: Larva defoliates.Green coloured final instar larva (16mm) was collected on

14.vii.2018 feeding on foliage of *Quercus leucotrichophora* in Binsar Wildlife Sanctuary (20.91611 N & 79.84806 E; 2229 m), Almora,Uttarakhand. Larva fed on the leaf margins and underwent pupation on 22.vii.2018. Pupa isdark brown (15 mm). Moth emerged on 06.viii.2018.

Moth: According to Moore (1881), fore wing of adult is black, minutely speckled with grey; orbicular and reniform marks and transverse sinuous lines indistinctly blacker; hind wing are white; costal and subcostal veins are slightly black-speckled; a marginal row of black-speckled spots and cilial border. Thorax, palpi, and legs are black and grey-speckled; tarsi with pale bands; abdomen is brown with black dorsal bands.

(a)Larva **(b) Pupa** **(c)Moth**

Fig.54. Life history stages of *Acronicta* (*Viminia*)*grumi bicolor* (Moore,1881) on *Quercus leucotrichophora*

According to Hampson (1909) head and thorax of adult is black, with few scales; tarsi ringed with whitish; abdomen is grey suffused with brown. Fore wing are black to brown colour and slightly irrorated with grey; subbasal line is represented by indistinct double black stritc from costa and single striga from cell; antemedial line is indistinct, double, oblique, waved; orbicular and reniform faintly defined by black, the former round ; traces of a waved medial line incurved below the cell; postmedial line is indistinct, double, with whitish lunule on it below submedian fold, bent outwards below costa, then waved, incurved below vein 3 and angled outwards on vein 1, some minute whitish points beyond it on costa; an indistinct subterminal series of dark marks in the interspaces; a terminal series of black points with blackish marks beyond them on the cilia. Hind wing is pure white; the veins tinged with brown; cilia are white mixed with brown and with series of small dark spots; the underside with the costal area is irrorated with brown and a slight discoidal spot.

Extent of Damage/Status: Rare in Ban oak forests. Minor damage.

40. *Gazalina apsara* (Moore,1859)
Superfamily: Noctuoidea
Family: Notodontidae
Superfamily: Thaumetopoeinae
Synonyms:
Dasychira apsara Moore,1859
Oligoclona nervosa Felder & Rogenhofer,1875
Gazalina venosata Walker,1865
Distribution: North India (Horsfield and Moore,1858-59).
Species of oak infested: *Q. dilatata, Quercus sp.,* (Mathur & Singh,1959).
Habit: Larva defoliates (Mathur & Singh,1959).
Female: Silky-white; fore-winy with the veins yellowish basally, and brownish apically; palpi and hairs beneath the head, blackish; thorax above and beneath, and legs, white; abdomen blackish, with white segmental bands, narrow above, broad beneath; anal tuft, yellowish. Expanse- 44.5 mm. (Horsfield and Moore,1858-59).
Male: White. Head black in front. Palpi and antennae black. Abdomen black; hind borders of the segments white; apical tuft pale gilded yellow, iridescent. Legs striped with black. Wings are silvery; veins black; fore wings along the costa and hind wings towards the base thickly speckled with black beneath. Length of the body 9 lines; of the wings 24 lines (Walker,1864).
Extent of Damage/Status: Occasional in oak forests. Data deficient.

(https://www.inaturalist.org/taxa/124612-Gazalina-apsara)
Fig. 55. *Gazalina apsara*

41. Black-veined Prominent Moth, *Gazalina chrysolopha* (Kollar,1844)
Superfamily: Noctuoidea
Family: Notodontidae
Superfamily: Thaumetopoeinae
Synonyms:
Liparis chrysolopha Kollar,1844
Dasychira antica Walker,1855
Oligoclona chordigera Felder,1874
Oligochlona chrysolopha
Oligochlona nervosa Felder,1868

(a)Adult (Lateral view) (b) Adult (Dorsal view)

Fig.56. *Gazalina chrysolopha* (Kollar,1844)

Distribution: Sikkim & Northern India (Shipley & Francis,1922).Chakrata Forest Division, Garhwal, Uttarakhand during the rainy season (July-August).
Species of oak infested:*Quercus floribunda* (Orwa et.al.,2009).
Habit: Larva defoliates (Orwa et.al.,2009).
Male: White, head in front and palpi black. Antennae are brown. Thorax is with a pale luteous band in front. Abdomen from above is with a black band on the fore border of each segment, not extendingbeyond the hind wings. Fore legs are mostly black. Fore wings are with three slender oblique slightly undulating brown bands; first very near the base; second at one-third of the length; third about the middle(Walker,1855).
Extent of Damage/Status: Common in oak forests. Damage not significant.

42. *Syntypistis fasciata* (Moore,1879)
Superfamily: Noctuoidea
Family: Notodontidae
Synonyms:
Dasychira fasciata Moore,1879
Quadricalcarifera fasciata (Moore)
Distribution: India (Sikkim), China (Shubhalaxmiet al.,2011); Myanmar, Java (https://en.wikipedia.org/wiki/Syntypistis_fasciata).
Species of oak infested: *Q. semecarpifolia, Quercus* sp., (Mathur & Singh,1959).
Habit: Larva defoliates(Mathur & Singh,1959).
Male: Forewing with two broad grayish-white bands, the first extending from middle of costa and narrowing to near posterior margin, the other along exterior margin, both intersected by brown veins; base of wings and

space between the bands greenish- brown, crossed by grey lunules; hindwing are creamy-white; anterior margin to below apex grayish-white; apex crossed by brown streaks. Underside is creamy-white; costa and cilia of forewing furruginous. Head and front of thorax white; hind part of thorax greenish-brown; abdomen paletestaceous, tip dark brown; antennae brown; Palpi, pectus and legs ferruginous. Expanse 6.2 cm. (Moore,1879).

Extent of Damage/Status: Data deficient.

43. Sinus Moth, *Zaranga pannosa* (Moore,1884)

Superfamily: Noctuoidea

Family: Notodontidae

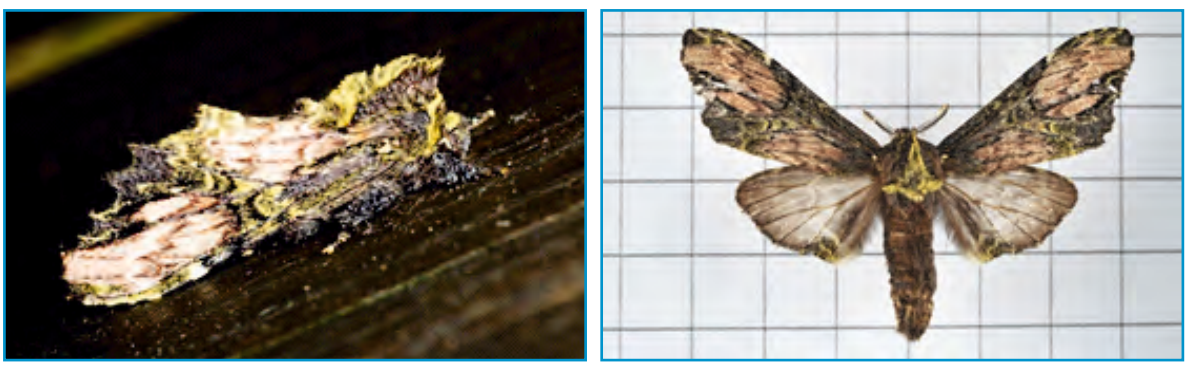
Subfamily: Dudusinae

Distribution: It is found in Asian countries including India [Ambala, Punjab (Moore,1884), Shimla, Himachal Pradesh (Hampson,1892)], Nepal, Pakistan, China, Taiwan and Japan (https://en.wikipedia.org/wiki/Zaranga_pannosa).

Host Plants: *Quercus* sp. (Mathur & Singh,1959).

Habit: Larva defoliates (Mathur & Singh,1959).

Adult: Fore wing is hoary-black, with a large vinous-brown subapical patch, and a similar coloured patch extending from below the cell to posterior margin, the subapical patch with black-speckled sinuous outer border; the medial interspace between the patches is numerously marked with yellow scales, which more or less form lunular marks; a yellow-speckled spot at base of the wing, a lunular spot on the costa towards the apex, and a row of speckles along exterior margin. Hind wing is dusky vinous-brown, the medial area dusky white; a series of black and yellow speckled lunules ascending from anal angle; cilia yellow-speckled. Thorax, head, and legs are hoary-black; abdomen is vinous-brown, tuft with some yellow hairs; tarsi with white bands; antennae isdark brown. Expanse, 7 cm. (Moore,1884).



[sources:(a)https://en.wikipedia.org/wiki/Zaranga_pannosa#/media/File:Zaranga_pannosa_(4653152340).jpg; (b) https://commons.m.wikimedia.org/wiki/File:V37-20181008-072_(31686778908).jpg)]

Fig. 57. *Zaranga pannosa* (Moore,1884)

Male: Head, thorax and abdomen are brown; meta-thorax fringed with yellow; antennae tipped with white; tarsi banded with white. Fore wing dark brown, a white speck at base; a large pale red-brown patch on inner margin, nearly joined by a similar patch occupying all the apical area except the costa and apex; an indistinct antemedial waved line; black lines on each side of discocellulars; an indistinct waved postmedial line, white at costa and towards inner margin. Hind wing is fuscous; the disk whitish two pale streaks above anal angle. Expanse: 74 mm (Hampson,1892).

Extent of Damage/Status: Data deficient.

44. Unidentified moth
Superfamily: Noctuoidea
Family: Notodontidae

(a) 2nd instar larva(b) 3rd instar larva

(c) 4th instar larva (Lateral view) (d) Larvae feeding on ban oak laeves

Fig.58. Larvae feeding on ban oak leaves

Distribution: Garhwal.

Species of Oak Infested: *Quercus leucotrichophora.*

Habit: Larva defoliates.15 fourth instarlarvae (20-30 mm) were collected on 28.viii.2019 feeding in a congregation on the foliage of *Quercus leucotrichophora* in Chakrata Forest Division (2087m), Uttarakhand. The larvae were black in colour and having white vertical lines on the upper part of the body and having tufts of hairs all over the body. At the end of the abdomen,

larvae have dark brown tuft of hairs which sometimes act as a head. The dark brown tufts of hairs on the edge of abdomen are upwards when the larvae were found sitting. Fourth instars larvae were feeding on the leaf margins and final instar larvae consumed the entire leaf. The larvae underwent moulting into final instar on 03.ix.2019 and underwent pupation on 20.ix.2019. Pupa (24-26mm) are brown in colour. Moths failed to emerge.

Extent of Damage/Status: Occasional in Ban oak forests.Localised infestations but can cause potential damage.

45. Unidentified Prominent moth
Superfamily: Noctuoidea
Family: Notodontidae Distribution: Garhwal Himalaya.
Species of Oak Infested: *Quercus leucotrichophora*.
Habit: Larva defoliates.Larva recorded feeding on foliage of Ban oak tree on 25.x.2017 feeding oak forest near Anusuiya Devi Temple near Gopeshwar, Chamoli district, Uttarakhand. Larva was pale green coloured with the distinct abdominal segments and decreasing posteriorly with yellow pointed tail on the last segment.

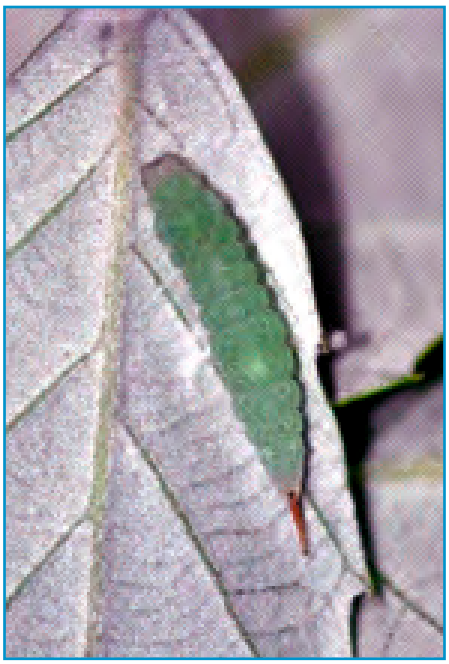


Fig.59. Larva of prominent moth

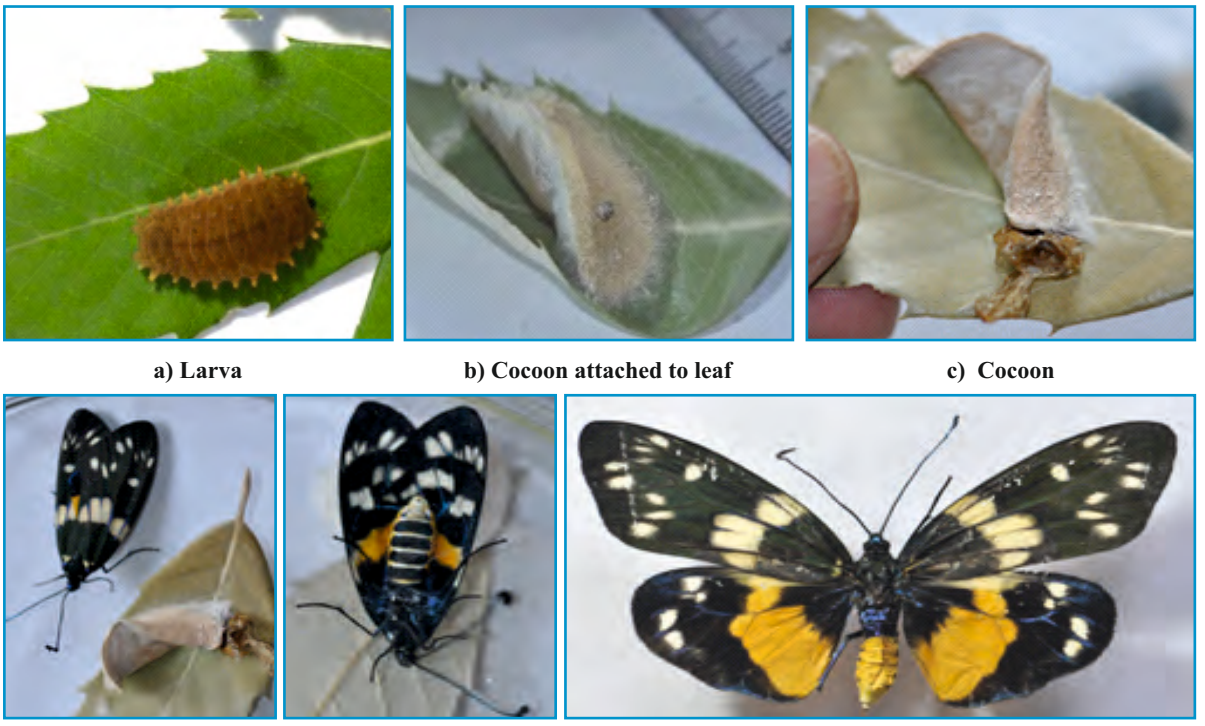
Extent of Damage/Status: Data deficient.

46. **Red Slug Caterpillar Moth, *Eterusia aedea* (Clerck,1759)**
Superfamily: Zygaenoidea
Family: Zygaenoidea
Subfamily: Chalcosiinae
Synonyms:
Eterusia magnifica Butler,1879
Heterus dulcis Butler,1881
Eterusia lepcha Jordan,1907
Eterusia okinawana Matsumura,1927
Eterusia postlutea Strand,1916
Eterusiasa kaguchii Matsumura,1927
Eterusia magnifica Butler,1879
Heterusia signata Möschler,1872
Eterusia sinica Ménétriès, 1857

Distribution: The species is found in Sri Lanka, India, Taiwan, Japan and China. The sub-species E.a.aedea occurs in North-east India including Sikkim, Assam, Nagaland, Manipur, Meghalaya during the months of April, May, July, August & October(Hampson,1892; Shubhalaxmi et al.,2011;Anonymous,2018a).

Species of Oak Infested: *Quercus leucotrichophora* (Singh et al.,2019).

Other Host Plants: The larvae have been recorded feeding on a wide range of plants, including *Bischofia javanica, Aporosa lindleyana, Aporosavillosa, Cornusflorida, Lagerstroemia, Melastoma candidum, Myrica rubra, Sloanea formosana, Rhododendron, Symplocos glauca, Camellia* (including *C.japonica, C.sasanqua, C. sinensis, C.oleifera, Eurya japonica, Eurya septata, Cleyera japonica* and *Buddleja.* The larvae of subspecies *aedea, sinica, formosana, cingala* and *virescens* have been reported as pests on tea (Yen, 2004).



a) Larva | b) Cocoon attached to leaf | c) Cocoon

(d) Moth emerged from Pupa | (e) Pinned specimen

Fig.60. Life history stages of *Eterusia aedea* (Clerck,1759) on *Quercus leucotrichophora*

Habit: Larva defoliates (Singh et al.,2019). Dark reddish-brown larva (42mm) was recorded feeding on foliage of *Q. leucotrichophora* plantation on 12.iv.2018 from the New Forest campus, Dehradun. Pupa (30mm) was formed on 16.iv.2018, inside an arch shaped pale coloured cocoon with one end flat while rest of curved the surface is like a 'purse' in shape is stuck to the surface of the half curled oak leaf. The moth (wing span: 62 mm) emerged on 14.v.2018, from the mouth of the cocoon which is covered with a lid like structure.

Adult: Forewing purple-brown, with a slight green tinge, the markings white; the medial band with blue on the veins where they cross it. The apical area largely shot with blue; the upper spots on it triple; the yellow of hindwing may be pale or bright. Expanse: Male- 66 mm; Female-80 mm. (Hampson,1892).

Female: Allied to *E. tricolor;* primaries dark purplish chocolate-brown, crossed before the middle by a broad irregular yellowish-white belt, interrupted by ultramarine streaks upon the nervures; a dash across the base, a large spot at the end of the cell, two spots and a dash between them crossing the lower half of the disc, and an irregularly-bisinuated subapical belt, divided by the nervures into seven more or less ovoid spots, white; the discal spots with pale blue internal borders; secondaries black, crossed in the centre by a very broad externally angulated bright ochreous belt which unites with a white costal streak running to the base; base, apex, outer border and veins beyond the ochreous belt brilliant metallic cobalt-blue; two small spots beyond the cell, and two between the second and fourth median branches, white; thorax dark brown, the main stem of the antenna, crest, two spots at the back of the collar in the centre, the tips of the tegulte, metathorax and two basal segments of the abdomen, blue, changing in certain lights to green; internal angles of tegula white; remaining segments of abdomen yellow, with lateral black dots; wings below nearly as above, but the white spots tinted with sulphur-yellow, all the veins blue-bordered; body below dark green, legs brown; coxae white spotted; segments of venter white-edged (Butler,1879).

Extent of Damage/Status: Uncommon in Ban oak forests. Damage is not significant.

47. *Tasema bipars*(Walker,1856)

Superfamily: Zygaenoidea

Family: Zygaenoidea

Subfamily: Chalcosiinae

Fig. 61. Pinned specimen- *Tasema bipars***(Walker,1856)**

Distribution: Kangra, Nagas (Hampson,1892).A specimen of a female inNFIC,FRI Dehradun from Jakh, Paithani, Garhwal,Uttarakhand collected on 31.viii.1941 by Balwant Singh on ban oak.

Species of oak infested: *Quercus leucotricophora* (Mathur and Singh,1959).
Male: Black, hindwing hyaline, the costal areas and margins black. Expanse:16 mm (Hampson,1892).
Extent of Damage/Status: Data deficient.

48. Tea- Coffee Slug Moth, *Cheromettia apicata* (Moore,1879)
Superfamily: Zygaenoidea
Family: Limacodidae
Subfamily: Cheromettia
Synonyms:
Parasa laleana Moore,1859
Belippa laleana Moore,1859
Distribution: Oriental tropics such as India and Sri Lanka(https://en.wikipedia.org/wiki/Cheromettia_apicata).
Species of Oak infested: *Quercus leucotrichophora.*
Other host plants: *Camellia sinensis, Ceiba pentandra, Cocos nucifera, Gliricidia sepium, Schleichera oleosa, Schleichera trijuga, Vernicia fordii, Aleurites fordii, Butea monosperma, Coffea arabica, Derris elliptica, Juglans regia, Pyrus communis, Theobroma cacao, Toona ciliata* and *Malus pumila* (https://en.wikipedia.org/wiki/Cheromettia_apicata).
Habit: Larva feeds on leaf tips and margins.
Larva: Larva (18 mm and width 9 mm) is a slug like watery caterpillar 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 larvae (length: 18 mm and width: 9 mm; Fig.68) were recorded defoliating *Q.leucotrichophora* treesin the New Forest Campus (30.3333N & 78.0166E; 670m) of the Forest Research Institute, Dehradun on 12.viii.2020. Pupae (25mm Fig.1c) were formed on 21.viii.2020 and chestnut brown moths (wing span: 30 mm; Fig.1b&c) emerged on 09.ix.2020.

(a)Larva **(b) Pupa** **(c)Moth**

Fig.62. Life history stages of *Cheromettia apicata* (Moore,1879) on *Quercus leucotrichophora*

Pupa: Pupal length is 25 mm enclosed in hard, white-spherical cocoon enclosed amongst 2-3 green leaves folded together on the tree itself.

Adult: Emergence of moth (Wing span: 30mm) takes place by an opening of the lid like operculum at one end of the cocoon. (pers.obs.). Male is chestnut brown; forewing is red-brown, 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).

Extent of Damage/Status: Occasional in Ban oak forests. Damage localized and not significant.

49. Parasa Tea Moth, *Parasa pastoralis* (Butler,1885)

Superfamily: Zygaenoidea

Family: Limacodidae

Subfamily: Limacodinae

Synonym:*Parasa pastoralis tonkinensis* Hering,1931

Distribution: India, Pakistan, Nepal, Bhutan, China, Vietnam, Indonesia (https://indiabiodiversity.org/species/show/268443). According to Holloway (2005), it is widespread in the Oriental tropics from N.E. Himalaya to Sundaland. According to Solovyev& Witt (2009), it is widespread in South-East Asia, in India, Pakistan, Bhutan, Nepal, Myanmar, Southern China, Taiwan, Thailand, Vietnam, Borneo, Sumatra, Java, and Bali.

Species of oak infested: *Quercus glauca.*

Other host plants: *Musa* sp. (Musaceae), *Aleurites cordata* (Thunb.) Steud. (Euphorbiaceae), *Tectona grandis* L. (Verbenaceae), *Triadica sebifera* (L.), (Euphorbiaceae)(Joannis,1929); *Camellia sinensis* (L.) Kuntze (Theaceae) India) (Robinson et al.,2007). *Quercus glauca* (Fagaceae).

(a) 5th instar Larva **(b) Moth**

Fig.63.Life history stages of *Parasa pastoralis* Butler, 1885 on Riyanj oak, *Quercus glauca*

Habit: Larva defoliates. Larva feeds from the leaf margin with its head retracted beneath fleshy thoracic folds (James,2017). According to James (2017) its larva has four rows of spiny tubercles running the length of its green body. The anterior dorsal pair is the largest cluster. Its spines are orange, and the central few are markedly thicker and black-tipped. There are four black patches on the posterior segments, a vivid purple stripe outlined in black along the back, and wave-shaped markings along the sides. Defoliation by larvae (17mm) was recorded on *Q. glauca* tree in moist temperate forest at Ogla, between Didihat and Thal (29.84339N & 80.16503E; 1560-1800m), Pitthoragarh district of Kumaon region of Uttarakhand (Western Himalaya) on 23.ix.2020. The larvae continued feeding on the margins of the tender leaves; it has a particular habit of retracting its head beneath fleshy thoracic folds. Pupae formed on 06.x.2020 and emergence of moth took place on 18.x.2020 (femalewingspan:38-40mm).

Extent of Damage/Status: Occasional in *Q.glauca* forests. Localised damage.

50. *Demonarosa rufotessellata* (Moore, 1879)

Superfamily: Zygaenoidea

Family: Limacodidae

Subfamily: Limacodinae

Synonyms: *Narosa rufotessellata* Moore,1879

Arbelarosa rufotessellata

Cheromettia melli Hering,1931

Demonarosa rosea Matsumura,1931

Distribution: It 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).

Species of oak infested: *Quercus glauca*

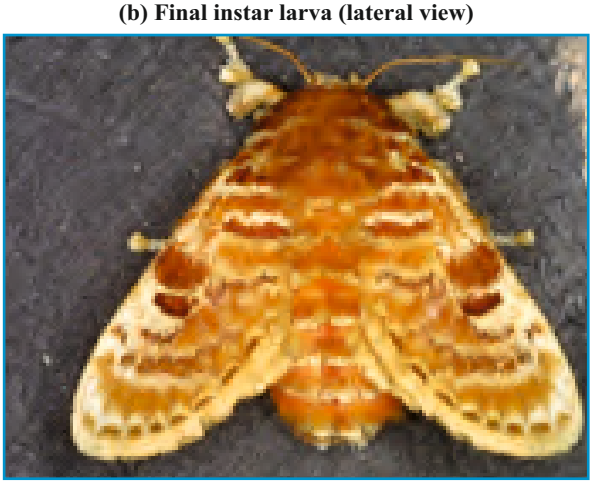
Other host plants: Rock Oak (*Lithocarpus konishii*), Litchi spp.), and *Liquidambar* spp. (James,2017).

Habit: Larva defoliates. A tent shaped greenish larva (16mm) recorded defoliating *Q. glauca* tree in moist temperate forest at Ogla, between Didihat and Thal(29.84339N & 80.16503E; 1560-1800m), Pithoragarh district of Kumaon region of Uttarakhand (Western Himalaya) on 23.ix.2020. Caterpillar moved slowly in a smooth, sluglike 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 inbrown and intricate, armor-plating markingsacross its top and sides. The larva only fed on the leaf margin and turned brownish just before pupation. Pupa, a hardened ball cocoon is placed between two leaves tied together (10 mm), was formed on 25.ix.2020. The moth failed to emerge.

(a) Final instar larva (Dorsal view)

(b) Final instar larva (lateral view)

c) pre-pupa



(d) Moth

[(d) source: https://www.thaibugs.com/wp-content/gallery/limacodidae/Limacodidae%20Demonarosa%20rufotessellata.jpg]

Fig.64.Life history stages of *Demonarosa rufotessellata*Moore, 1879 on Riyanj oak, *Q. glauca*

Larva: According to James (2017), it has a strange,uncaterpillar-like tent shape with no obvious head or tail and canbe difficult to detect on the shaded underside of leaves. Typicalof cup moth larvae (also called slug moths or ski moths), theactual size caterpillar move slowly in a smooth, sluglike fashion. They donot travel far and, before moving on, will consume the same leaf until there is nothing left. It is smooth, non-stinging limacodid species thathas an unusual, peaked, angular shape withan ambiguous rounded front end, pointed tailend, and no distinct walking legs. It moves likea slug with an adhesive muscular underbelly.It is green, with the dorsal peaks outlined inbrown and intricate, armor-plating markingsacross its top and sides.

Pupa:The caterpillars pupate in a hardened ball cocoon usually sandwiched between two leaves (James,2017).

Extent of Damage/Status: Widespread but occasional in Q.glauca forests, localized damage.

51. *Adoneta* sp.
Superfamily: Zygaenoidea
Family: Limacodidae
Distribution: Uttarakhand. The genus occurs worldwide.
Species of oak infested: *Quercus glauca*
Other host plants: Other species of the same genus i.e. *Adoneta spinuloides* feeds on the *Malus*, *Prunus* (Rosacae) and *Quercus* (Fagaceae) in the Neacrtic region (https://www.nhm.ac.uk) whereas A. gemina feeds on *Ebenopsis ebano*(Berland.) Barneby & J.W.Grimes (Fabaceae) at Texas North America (https://bugguide.net/node/view/1034734).

(a)Larva **(b) Pupa**

Fig.65. Life history stages of Adoneta sp. on Riyanj oak, *Quercus glauca*

Habit: Larva defoliates. Larva (23mm) was recorded defoliating *Q. glauca* trees in moist temperate forest at Ogla, between Didihat and Thal(29.84339N & 80.16503E; 1560-1800m), Pitthoragarh district of Kumaon region of Uttarakhand (Western Himalaya) on 23.ix.2020.The larva starts feeding from the leaf margins before consuming the entire leaf. A hard balled pupa formed on 08.x.2020 between a folded leaf. Moths failed to emerge.
Extent of Damage/Status: Widespread but uncommon in *Q.glauca* forest. Damage not significant.

52. *Mahanta* sp.
Superfamily: Zygaenoidea
Family: Limacodidae
Distribution: One species of this genus *Mahanta leworthyi* Holloway,1986 is found in Borneo and Sumatra (https://www.mothsofborneo.com/part-1/limacodidae/limacodidae-20-1.php). Another species of this genus *Mahanta quadrilinea*Moore,1879 is distributed in India and Bhutan and Taiwan (http://www.wikiwand.com/en/Mahanta_qu

adrilinea).

Species of oak infested: *Quercus leucotrichophora* (Fagaceae).

Habit: Larva defoliates: Larva (12mm) was recorded defoliating *Q. leucotrichophora* tree in moist temperate forest at Chakrata hills(Chakrata Forest Division: 30.7246 N & 77.8610E; 2100m), Uttarakhand, India on 28.viii.2019.The larva was observed feeding on mature leaves till formation of a hardened ball like pupa on 20.ix.2020.

(a)Larva (Dorsal view) (b) Larva (Lateral view)

Fig.66. Larva of *Mahanta* sp. on *Quercus leucotrichophora*

Extent of Damage/Status: Rare in ban oak forests. Localised and damage not significant.

53. *Abraxas intermedia* (Warren,1888)

Superfamily: Geometroidea

Family: Geometridae

Subfamily: Ennominae

Synonym:

Abraxas determinata Warren,1894.

A. peregina

Distribution: North-West Himalayas (Subathu) Sikkim, Assam (Khasia Hills), Nilgiris, Penang (Hampson,1895).

Species of oak infested: *Quercus semicarpifolia* (Mathur & Singh,1959).

Habit: Larva defoliates (Mathur& Singh,1959).

Larva: Bluish white; the dorsum yellowish, with a black line and series of black specks (Hampson, 1895).

Adult: Forewing white with a small basal patch of mixed fuscous and tawny scales, followed by a clear white fasciform space; in the middle of the wing are the remains of a curved central fascia, consisting of a leaden-grey spot on the costa, fulvous at its costal edge, immediately followed by two small leaden grey spots, one touching the costa, and the other beneath it, and of two or three leaden-grey variable spots near the inner margin; a submarginal curved row of flattened oval grey spots is proceded on the costa by a single larger one, and terminates on the inner margin in a large irregular blotch of fulvous and bluish grey; hind margin with

a series of grey lunules, preceded by a few scattered grey dots, which sometimes coalesce a little below the center into a small marginal lunules; a fulvous and grey blotch at the anal angle, like that on the forewing and a sub-marginal row of small grey dots, one on each vein; sometimes there is a faint, central fascia, most pronounced on either margin. Head, thorax and abdomen yellow, spotted with black. Expanse of wing: 3.8-4 cm. (Warren, 1888). Distinguished at once by the shape of the anal blotch of the forewing, the edges of which are obliquely sinuous and which is connected above with a smaller irregular shaped grayish blotch; exterior line represented by a curved series of irregular dots, sometimes almost obsolete; a few grey costal spots, partially confluent in middle, sometimes with a few discal spot below them, the usual large costal spot before the exterior line distinct; hind margin clouded with leaden grey form anal angle to just before apex. Hindwing with an irregular triangular blotch on inner margin, with traces of a curved line of dark spots, but these are more often than not obsolete, fringe with dark disconnected blotches. Expanse of wing- male: 5.4 cm; female: 5.6 cm. (Warren, 1894).

(a)Pinned specimen

Fig.67. ***Abraxas intermedia*** **Warren,1888**

Head, thorax and abdomen orange, spotted with black. Forewing white, with olive-fulvous patch at base, and another with some silvery marks on it on inner margin beyond middle; a grey patch with a dark mark on it at end of cell extending to the costa; some grey spots below the cell and often in the cell and on the costa; a curved postmedial series of spots with short dark streaks on them at the veins and often other spots beyond them; some spots on the margin expanding into a patch at middle. Hindwing white, with a more

or less complete antemedial series of spots with fulvous streaks on them at the veins, often with other spots beyond them, and ending on inner margin in a large olive-fulvous patch with some silvery marks on it; a more or less developed marginal series of spots. The both large and small forms have the grey spots of both wings more or less reduced. Expanse: 4.3 cm. (Hampson, 1895).
Extent of Damage/Status: Occasional. Data deficient.

54. ***Biston porphyria*** **(Butler,1889)**
Superfamily: Geometroidea
Family: Geometridae
Subfamily: Ennominae
Distribution: N.W. Himalaya

Species of oak infested: *Quercus semecarpifolia* (Mathur & Singh,1959)
Habit: Larva defoliates (Mathur& Singh,1959).
Extent of Damage/Status: Data deficient.

55. ***Lasaaba albidaria*****(Walker,1866)**
Superfamily: Geometroidea
Family: Geometridae
Subfamily: Ennominae
Synonym: *Medasina albidaria* Walker,1866
Distribution: Himalayas-Shimla, Dharmsala, Sikkim, Khasis (Hampson,1895).
Species of Oak infested: *Quercus semecarpifolia* (Mathur & Singh,1959).
Other Host Plants: *Pinus wallichiana* (http://www.globalspecies.org/ntaxa/1433660).

Fig.68. ***Lasaaba albidaria*****(Walker,1866)**

Habit: Larva defoliates (Mathur& Singh,1959).Adults are in flight during Sept-October.

Adult: White, irrorated and spotted with very pale brown; branches of antenna blackish; Palpi black at sides; legs spotted with black. Forewings is with distinct waved antemedial, medial, postmedial, and submarginal fuscous lines, arising from blackish patches on the costa, the postmedial line with a black mark between veins 3 and 4. Hind wing is with indistinct waved antemedial, medial and submarginal lines; a speck at end of cell; both wings with a marginal series of black specks. Underside is with black cell-spot and three lunulate marks below apex of forewing. Expanse: 6-6.4 cm. (Hampson,1895).

Extent of Damage/Status: Widespread but moths are uncommon in Ban oak forests. Data deficient.

56. **Zigzag-winged Geometer Moth, *Hypomecis transcissa* (Walker,1860)**

Superfamily: Geometroidea

Family: Geometridae

Subfamily: Ennominae

Synonyms

Boarmia transcissa Walker,1860

Boarmia lineataria Walker,1866

Chogada latipennis Butler,1881

Distribution: Moth occurs in Indian sub-region, from Sri Lanka to Sundaland (Holloway,1993). Distribution in India is in Dharamsala; Sikkim; Assam; Nilgiris; Bhutan, Ceylon; Burma; Java (Hampson,1895). Species is also found in Malaysia, Hong Kong (Robinson, 2010). Species is also found in Malaysia, Hong Kong (Robinson,2010). Flight period is from August to December in Himachal Pradesh, Maharashtra, Assam, Tripura & Uttarakhand (Sondhi& Sondhi,2016; Singh et al,2019).

Species of Oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959; Singh et al, 2019).

Other Host Plants: *Aleurites*(Euphorbiaceae) species.Host plants recorded outside India are *Aleurites montana* Lour.; *Castanopsis fissa* (Champ. ex Benth.) Rehd. &Wils.;*Cinnamomum zylanicum* Blume; *Nephelium lappaceum*L.; *Hevea* sp.; *Theobroma cacao*L. & *Vernicia fordii* (Hemsl.) Airy Shaw (Robinson et.al,2010).

(a)Larva feeding on ban oak leaf (b) Larva (Lateral view) (c)Pupal shell &Moth

Fig.69. Life history stages of *Hypomecis transcissa*(Walker,1860)

Habit: Larva defoliates (Mathur & Singh,1959). Flight period is from August to December in Himachal Pradesh, Maharashtra, Assam, Tripura (Anon., 2108d) & Uttarakhand (Sondhi& Sondhi,2016).Ffth instar larva (38-40mm) dark brown and black, was collected on 24.viii.2018 feeding on foliage of *Q. leucotrichophora* in New Forest Campus,Dehradun, Uttarakhand. Pupation took place (pupa:17mm; dark brown) between two oak leaves on 30.viii.2018 and the moth (42mm) emerged on 06.ix.2018.

Male: Cinereous, slender, brown-speckled. Antennae are thickly and broadly pectinated, except towards the tips. Hind tibiae isvery much incrassated. A brown band is present on the thorax, and one on the hind border of each of the abdominal segments. Wings moderately broad; interior and exterior lines blackish, denticulated, slightly undulating, accompanied by parallel bands, the latter bent and acutely angular towards the costa of the fore wings; submarginal line pale, zigzag, very distinct, brown-bordered; marginal lunules blackish; discal mark forming an elongated brown-bordered ringlet, the latter almost wholly brown beneath, where the broad brown marginal band is diffuse on the inner side. Fore wings with a brown streak, which are traverses, the exterior line. Length of the body is 6 lines; of the wings 16 lines.Cinereous, brown-speckled. Head brown in front. Palpi brown, broad, obliquely ascending, not rising so high as the vertex; third joint extremely short. Antennae are rather broadly pectinated to a little beyond two-thirds of the length. Thorax is with two narrow brown bands. Abdomen nearly as long as the interior border of the hind wings, with a brown band at one-fourth of the length. Wings with a brown line, which extends from one-fourth of the length of the interior border of the hind wings to four-fifths of the length of the costa of the fore wings, near which it is zigzag and bent; a submarginal brown band which contains a zigzag cinereous line; marginal lunules brown. Fore wings with two brown lines between the base and the common line; first line undulating, with, two brown streaks between it and the base; second acutely dentate, with a transversely elongated brown ringlet between it and the first line, and with a brown streak proceeding from it to the exterior border. Hind wings with an elongated brown ringlet between the common line and an exterior brown line which is dentate in front and has a brown band on its outer side. Wings beneath is with a brown spot in the disk and with a brownish marginal band. Length of the body 7 lines; of the wings 19 lines (Butler,1881).

Whity brown, irrorated with smoky brown; external area slightly browner, bounded internally by a dark brown dentate-sinuate baud enclosing a pale stripe; a second somewhat similar baud, bounded internally by a black line, beyond the middle; this line on the primaries is elbowed and strongly

denticulated from the eosta to the angle; a more regular dentatesinuate dark brown central line; a very irregularly angulate black line across the basal third; "reniform" spot blackish-bordered, elongate-pyriform: secondaries with an elbowed line across basal fourth; the discocellular spot cnneiform: abdomen crossed by abbreviate white edged black transverse bars. Underside is pale scriccous brown; blackish discocellular dashes; an arched postmedian series of blackish dots on the veins, and a diffused greyish submarginal hand; costa of primaries oehraceous. Expanse of wings 47 mm. (Butler,1881).

Extent of Damage/Status: Occasional in Ban oak forests at lower elevations. Localised infestations.

57. *Hypomecis infixaria* (Walker,1860)

Superfamily: Geometroidea

Family: Geometridae

Subfamily: Ennominae

Synonym: *Boarmia infixaria* Walker,1860

(a)Larva feeding on ban oak leaf

(b&c) 5th instar larva

(d)Male moth –Upperside (e)-Underside

(f)Male moth pinned-Upperside

Fig.70. Life history stages of Hypomecis infixaria (Walker,1860).

Distribution: Recorded from Dehradun in Uttarakhand (Singh et al,2019).

Species of Oak infested: *Quercus leucotrichophora* (Singh et al,2019).

Other Host Plants: Host plants in India include *Bauhinia divaricata* L.; *Carissa*

*spinarum*L., *Dalbergia sissoo*Roxb., Derris scandensRoxb. (Benth.), *Planchonia careya*(F.Muell.) R.Knuth, *Platycladus orientalis*(L.) Franco, *Schleichera oleosa*(Lour) Oken, *Shorea robusta* Roth, *Xylia xylocarpa* Roxb. Taub.,*Tectona grandis*L.f.(Robinson et al.,2010). Another species of the same genus i.e. Hypomecis punctinalis(Scopoli, 1763) is known to feed on the family Fagaceae and the genus Quercus in Central and South Europe, Asia Minor, Transcaucasia, Russia, Russian Far East, Japan, Korea, Ussuri, West China (Robinson et al.,2010).

Habit: Larva defoliates. A second instar larva (08 mm) was collected on 05.vi.2018 on leaves of *Q. leucotrichophora* from New Forest campus, Dehradun. Fifth instar larva (36mm) was formed on 18.vii.2018 and a dark brown pupa (16 mm) was formed on 31.vii.2018. The emergence of moth (male; 30mm) took place on 06.viii.2018.

Extent of Damage/Status: Occasional in Ban oak forests. Localised infestations.

58. Black Looper Moth, *Hyposidra talaca* (Walker,1860)

Superfamily: Geometroidea
Family: Geometridae
Subfamily: Ennominae
Subspecies: *H. t. talaca; H.t. schistacea* Warren,1896 & *H.t. successaria* (Walker, 1860).
Synonyms:
Lagyra talaca Walker,1860
Lagyra bombycaria Walker,1866
*Lagyra successaria*Walker,1860
Chizala deceptatura Walker,1860
Chizala decipiens Walker,1860
Lagyra flaccida Lucas,1894
Hyposidra grisea Warren,1902
Hyposidra khasiana Warren,1894
Lagyra myciterna Druce,1888
*Lagyra humiferata*Walker,1863]
Lagyra rigusaria Walker,1863
*Hyposidra schistacea*Warren,1896
Hyposidra vampyraria Snellen,1880

Distribution: The species is distributed from India to Indochina, Sundaland, Sulawesi, the Philippines, Sri Lanka, the Solomon Islands, Thailand, Taiwan, New Guinea and Australia, where it has been recorded from Queensland. Throughout India, Ceylon, and Burma; Andamans; Java; Borneo; Celebes; Philippines. (Hampson, 1895); India (N.E. Himalaya, Uttarakhand, Andaman & Nicobar Is.), China, Australia (Shubhalaxmi et.al, 2011). In India, the species has been reported from Assam, Meghalaya, Himachal Pradesh, Uttarakhand, Goa, Madhya Pradesh & Karnataka with a flight throughout the year. The flight period in western Himalaya is during the monsoons (July-Sept.) (Sondhi&Sondhi,2016;Singh, 2018).

Species of Oak infested: *Quercus leucotri chophora* (Singh et al,2019).

Other host plants: *Jambrona, Combretum,* and *Ficus parasiticus* (Hampson,1895). It is polyphagous, recorded from the following

plant taxa Anacardiaceae(*Anacardium*); Bombacaceae (*Bombax*); Combretaceae (*Terminalia*); Compositae (*Chromolaena, Gynura, Mikania*); Cupressaceae (*Cupressus*); Euphorbiaceae (*Aleurites, Aporusa, Bischofia,Breynia, Glochidion, Hevea, Manihot*); Moraceae (*Ficus, Morus*); Myrtaceae (*Psidium*); Polygonaceae (*Polygonum*); Rosaceae (*Rubus*); Rubiaceae(*Cinchona, Coffea, Mussaenda*); Rutaceae (*Citrus, Euodia*); Sapindaceae (*Schleichera*); Sterculiaceae (*Theobroma*); Theaceae(*Camellia*); Verbenaceae (*Tectona*) (http://www.mothsofborneo.com/part-11/Boarmiini/boarmiini_7_1.php).

Habits: Larva defoliates. Second instar larva (12mm) was collected on20.vi.2018 while feeding on foliage of *Q. leucotrichophora* plantation in New Forest campus, Dehradun. Moulting into fifth instar larva took place on 25.vi.2018 (30mm-43mm); pre-pupa was formed on 02.vii.2018 and finally turning into a dark brown pupa (18 mm) on 04.vii.2018. The emergence of female moth (32mm) took place on 10.vii.2018 in the laboratory at FRI, Dehradun.

(a)Larva feeding on ban oak leaf

(b)2nd instar larva

(c)3rd instar larva (d) 5th instar larva(e) Pre-pupa

(f) Pupa **(g) Moth (alive)** **(h) Moth (pinned-Upperside)**

Fig.71. Life history stages of *Hyposidra talaca* (Walker,1860)

It is a major defoliating pest in tea plantations. It has earned considerable importance as a defoliator during last decade in north east India. Characteristic features of *H. talaca*, such as switching from wild plants to *Camellia sinensis*, and completion of 6–8 generations in a year without winter diapause appear to be the major reasons for persistence of the defoliator on *C. sinensis*. There are reports on the aggressive infestation of the pest on *C. sinensis* than on alternate host plants and development of high tolerance/resistance to certain insecticides. Till date, more than one hundred alternate host plants have been recorded for *H. talaca,* but with very few natural enemies.

Adult: Dark olive fuscous, more or less irrorated and suffused with grey; both wings with faint traces of medial and crenulate post- medial lines; the cilia dark. Fore wing with traces of antemedial line and more or less distinct subapical patch in male. Underside is with crenulate postmedial line to both wings. The form rigusaria is paler and redder. Expanse- male: 44, female: 54-60 mm. (Hampson, 1895).Both sexes are blackish grey with diffusely darker fasciation, the female much larger than the male and with a more crenulate margin (http://www.mothsofborneo.com/part-11/Boarmiini/boarmiini_7_1.php).

Male: Forewings: dull silvery slate-colour, the markings darker, purplish slate-colour; first line at one-fourth, bent below costa, thick; the basal area within it darker along inner -marginal half; a dark fascia beyond middle, edged internally by a nearly straight line and outwardly by a wavy and bluntly angulated one, hind margin suffused with darker, preceded by an obscure wavy dark submarginal line and a dark vertical streak at anal angle. Hindwings: with basal two-thirds more or less suffused with dark, the whole marginal area pale, with the darker waved submarginal line more distinct. Underside like upper, but duller, neither wing with the base darker. Head, thorax and abdomen are concolorous; the centre of abdomen blacker (Warren,1896).

Palpi are hairy and reaching beyond the frons; antennae bipectinate with long branches to three-fourth length. Head, thorax and wings are dark olive fuscous, more or less irrorated and suffused with grey; abdomen dark fuscous. Fore wings are with fovea; the costa arched towards apex, which is much produced; a faint traces of antemedial, medial and crenulate postmedial lines; more or less distinct subapical patch. Hind wings are with faint traces of medial and crenulate postmedial lines; the cilia dark. Wingspan: 38 mm. (Gurule,2013).

Female: Female is cinereous-brown. Wings with a slight glaucous tinge, alike in colour, with two or three oblique indistinct slightly undulating brown lines; under side not paler. Fore wings with the costa convex towards the tip, which is obtuse; exterior border very oblique, slightly convex. Hind wings with the exterior border very slightly scolloped, forming an acute and almost caudate angle in the middle. Length of the body 9 lines; of the wings 23 lines (Walker,1860).

Female has fawn colour. Wings with a dull rosy tinge, middle band ferruginous, indistinct. Forewings with an indistinct interior ferruginous line and with a ferruginous tinge along the fore part of exterior border (Walker, 1862). Dark fuscous suffused with grey; fore wings are with costa evenly arched; outer margin excised below the apex; markings similar as in male. Wingspan: 54 mm.

Larva: Pinkish olive-green, irrorated with black, and with dark patches on 4th and 6thsomites (Hampson,1895). Larva described by Singh (1953).

Extent of Damage/Status: Wide spread and occasional in Ban oak forests. Localised infestation.

59. *Alcis variegata*(Moore,1888)
Superfamily: Geometroidea
Family: Geometridae
Subfamily: Ennominae
Synonyms:
*Pseudocoremia variegata*Moore,1888
Cleora nebulosa Swinhoe,1891
Cleora hypopoecila Prout,1928
Alcis hypopoecila

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).

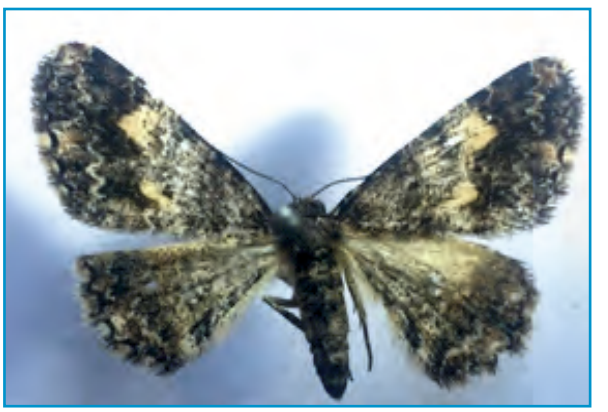
Species of oak Infested: *Quercus leucotrichophora.*

Other Host plants: In Japan another species of the same genus Alcis i.e A.anguliferaButler,1878feeds 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,1758feeds on *Alnus incana*(L.) Moench, *Betula pendula* Rotth, *Salix aurita*L., *Tilia cordata* Mill. (Robinson et al.,2010).

(a)Larva (Dorsal view

(b)Larva feeding on ban oak leaf

(c)Moth emerged from pupa



(d) Pinned Moth

Fig.72-Life history stages of *Alcis variegata* (Moore,1888)

Habit: Larva defoliates. Larvae (12 mm) recorded on defoliating *Q.leucotrichophora* trees in the New Forest Campus (30.3333N & 78.0166E; m) of the Forest Research Institute, Dehradun on 03.iv.2019. Dark brown pupa (12m) formed on 16.iv.2019 and emergence of moth (wingspan 27mm) took place on 26.iv.2019.

Extent of Damage/Status: Uncommon in Ban oak forests at lower elevations. Localised infestation.

60. *Swannia marmarea*(Prout,1926)

Superfamily: Geometroidea

Family: Geometridae

Subfamily: Ennominae

Distribution: This species was described by Prout (1926) and known from Myanmar. It has also been recorded in Central Himalaya i.e. Nepal (Godavari village near Kathmandu:1 male 20.iii.1992 & 1 male 3.iv.1992). Chaubati village (29.81294 N &80.21558E; 1838 m), Pithoragarh district, in Uttarakhand.

Species of oak Infested: *Quercus leucotrichophora.*

Habit: Larva defoliates.

Larva: Larvae of this white moth were

recorded feeding on Ban oak foliage on 25.ix.2020 in Chaubati village in Pithoragarh district, Uttarakhand. Larvae were collected and reared for life history studies. Larval feeding takes place only on leaf margins only. Length of larvae ranged from 20-28 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.

(a) 4th instar larva

(b) 5th instar larva

(c) Pupa inside folded leaves

(d)Moth-Underside

(e) Moth-Upperside

Fig.73. Life history stages of *Swannia marmarea* (Prout,1926) on *Q.leucotrichophora*

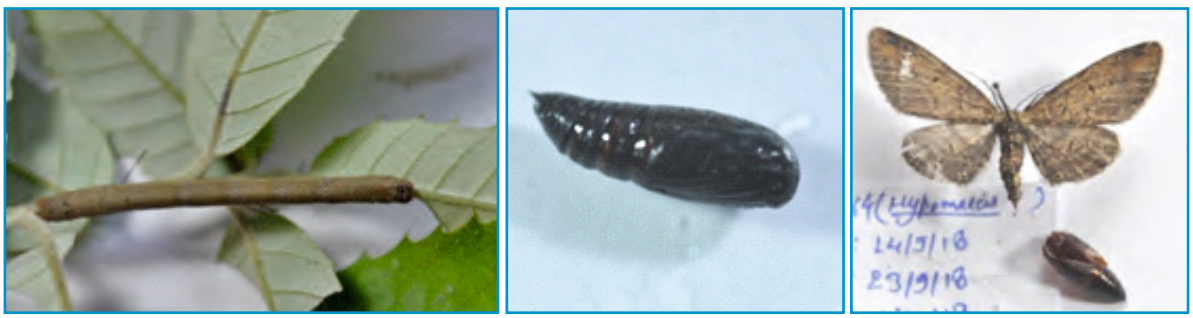
Pupa: Pupa was formed on 13.x.2020. The pupa is yellowish in colour and enclosed in a cocoon. Pupal length is 10 mm, while the cocoon measures 22mm and is attached and enclosed in 2-3 ban oak leaves attached together. Pupal period was of 7 days.

Adult: White moth [female: wingspan 42 mm] with sharp black wing margins that are chequeredalong the outer margin (termen); legs yellow] took place on 20.x.2020.

Extent of Damage/Status: Rare in Ban oak forests. Localised infestation.

61. *Eupithecia maculosa* (Vojnits,1981).
Superfamily: Geometroidea
Family: Geometridae
Subfamily: Larentiinae
Synonyms: *Eupithecia flvitornata* Herbulot,1984.

Distribution: It is found in Nepal (Mironov etal., 2010); North-Eastern India and Pakistan (Mironov et al.,2008).
Species of oak infested: *Quercus leucotrichophora.*



(a)Larva **(b) Pupa** **(c) Pinned moth**

Fig.74. Life history stages of *Eupithecia maculosa* (Vojnits,1981).

Other 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 Holacrtic realm. One more species of same genus *Eupithecia interrubrescens* is known to feed on Pinus spp. in India (Robinson et al., 2010).
Habit: A green coloured larva (24mm) was collected on 14.ix.2018 feeding on foliage of *Quercus leucotrichophora* in ban oak plantation of New Forest Campus (640 m), Dehradun, Uttarakhand. Larva fed on the leaf tips and margins of tender oak leaves and pupated on 23.ix.2018. Pupa is dark brown in colour (20 mm length, 4 mm width). Emergence of moth took place on 01.x.2018.
Extent of Damage/Status: Rare in ban oak forests at lower elevations. Localised infestation.

62. *Mixochlora vittata* (Moore,1868)
Superfamily: Geometroidea
Family: Geometridae
Subfamily: Geometrinae
Subspecies: *M. v. kalisi* Prout,1935;M. *v. prasinus* (Butler,1879);M. *v.sumatrensis* Prout,1933.

Synonyms:
Geometra vittata Moore,1867
Tanaorhinus prasinus Butler,1879
Tanaorhinus vittata sumatrensis Prout,1933
Mixochlora vittata kalisi Prout,1935
Mixochlora vittata Moore; Holloway,1976
Distribution & Habitat: Himalaya, China;

Japan (ssp. prasinus); Sumatra, Borneo (ssp. sumatrensis); Java (ssp. *kalisi*) (www.mothsofborneo.com), India (Dalhousie, Solan, Subathu, Sairighat) (http://faunaofindia.nic.in).

Species of Oak infested: *Quercus leucotrichophora* (Mathur& Singh,1959).

Other Host Plants: *Castaea crenata* (shodhganga.inflibnet.ac.in). The host in India is *Quercus* (Fagaceae), but the Japanese subspecies has also been reared from *Fagus* in the same family and *Corylus* (Corylaceae) (Nakajima & Sato,1979).

(a)3rd instar larva

(b) 4th instar larva

c) Pupa

(d) moths emerging from pupae

(e) Moth

Fig.75- Life history stages of *Mixochlora vittata* (Moore,1868) on *Quercus leucotrichophora*

Habit: Larva defoliates (Mathur& Singh,1959). The larva feeds on young leaves from July-September at lower altitude in Garhwal.Pupation and emergence of moths taks place during August- October.

Larva: The larval body is always cylindrical, sparsely granulate, a dirty white, with oblique triangular dorsal green stripes from A3 to A8 (mothsofborneo.com).

Pupa: Pupation is within in a curled leaf. Sevastopulo (1947) described the pupa as ivory white, the abdomen streaked finely with pink and sparsely speckled black along with the thorax.

Adult: Bright green, suffused with silvery white, the markings dark green. Fore wing with outwardly oblique subbasal and antemedial bands and inwardly oblique postmedial and submarginal bands: a lunule at end of cell. Hind wing with outwardlv oblique medial, postmedial, and submarginal bands. Underside suffused with orange-yellow (Hampson,1895).

Male and female grayish green, with darker green, but not very prominent, transverse bands: forewings with two straight subbasal bands and three oblique bands exterior to a discal spot, the second subbasal band joined posteriorly to the third, which with the outer two cross the hindwing, the three outer bands having a pale or whitish exterior border. Underside is greenish yellow, with a darker discal spot and narrow outer band. Legs and antennae are yellowish (archive.org) Male-35mm; Female- 45mm (archive.org).

Extent of Damage/Status: Widespread and commonoak forests. Localized but can cause potential damage.

63. Unidentified Geometridae Moth-1

Superfamily: Geometroidea

Family: Geometridae

Distribution: Garhwal.

Species of Oak Infested: *Quercus leucotrichophora*

Habit: Larva defoliates

Larva: One larva of length 18 mm was collected on 09.iv.2019 feeding on the leaf margins of tender leaves of *Quercus leucotrichophora* in ban oak plantation of New Forest Campus (640 m), Dehradun. Larva died on 14.iv.2019.

Extent of Damage/Status: Data deficient.

(a)Larva feeding on ban oak leaf **(b) Larva (Lateral view)**

Fig.76. Unidentified geometrid larva

64. Unidentified Geometridae Moth-2
Superfamily: Geometroidea
Family: Geometridae
Distribution: Garhwal.
Species of Oak Infested: *Quercus semecarpifolia.*
Habit : Larva defoliates.Green coloured larva was recorded feeding on young shoots of Kharsu oak tree on 24.x.2017 near Kanchula Kharak (2500m in KedarnathWildlife Sanctuary), Chamoli district, Uttarakhand. Larva was green colored with central black line running on the abdominal region.
Extent of Damage/Status: Rare. Localised infestation.

Fig.77-Geometridae larva

65. *Pyrosis undulosa* (Walker,1855)
Superfamily: Lasiocampoidea
Family: Lasiocampidae
Subfamily: Pinarinae
Subspecies: *P. undulos undulosa* (Walker, 1855); *P. undulosa gadrangana* (Zolotuhin & Witt,2000).
Synonyms:
Pcecilocampa undulosa, (Walker,1855)
Pyrosis undulosa (Walker,1855)
Bhima undulosa (Walker,1855)

Fig.78. Adult-*Pyrosis undulosa* (Walker,1855): Male

Distribution:Uttarakhand & Northeast, India. [3 specimens inNFIC from Naga hills collected by N.L.Bor in 1943 and in Almora on 15.xii.1937 by J.C.M.Gardner].

Species of oak infested: *Quercus leucotrichophora* (Beeson,1941)

Habits: The larval period during the hot weather and monsoon lasts several months and the pupal period about 7 weeks. At lower elevations moths emerge in December; at higher elevations the life-cycle is annual (Beeson,1941).

Cocoon: Pale rusty-brown silk, intermixed with short sharp spiny black hairs (Proceedingsofgen88proc.pdf).

Male: Semi-transparent. Wings fuliginous-black externally, fuliginous- bronze basally: fore wing crossed by two contiguous inwardlyoblique waved antemedial, and two lunular discal fuliginous-grey lines, and a submarginal zigzag black-bordered grey fascia; a grey lunule at end of tbecell: hind wing with two indistinct grey discal fascise. Body fuliginous-brown; front of head ochreous; antennae and legs black. Expanse: 1.88 inches (Proceedingsofgen88proc.pdf).

Female: Less semitransparent. Wings are fuliginous ochreous brown; the transverse markings ochreous-grey. Body and front of head are ochreous-brown; anal tuft is ochreous. Expanse: 3.25 inches (Proceedingsofgen88proc.pdf).

Extent of Damage/Status: Data deficient.

66. *Euthrix inobtrusa* (Walker,1862)
Superfamily: Lasiocampoidea
Family: Lasiocampidae
Subfamily: Pinarinae
Subspecies: *Cosmotrichelaeta infra*sp. *decisa* (Walker,1921)

Synonyms.:
Lasiocampa inobtrusa Walker,1862
Odonestis chinensis Leech,1899.

(a)Moth resting on wall **(b) Pinned moth (Dorsal view)**

Fig.79. *Euthrix inobtrusa* (Walker,1862)

Distribution: Northern India, Nepal, Bhutan, central and southern China (Hunan, Jiangxi, Fujian, Guangdong, Guangxi, Yunnan, Guizhou, Hainan), Thailand, Vietnam, Peninsular Malaysia, Sumatra (Armin et.al.,2011 [1 specimen in NFIC collected from Jharipani Mussoorie, Uttarakhand on 15.ix.1917 by C.F.C.Beeson; 1 specimen recorded at Vinayak Khal, Tehri Garhwal, Uttarakhand in September].
Species of Oak infested: *Quercus leucotrichophora* (Hampson,1892).
Other Host Plants: Dalbergia sisso, D.latifolia (Hampson,1892).
Cocoon: The spindle shaped coccon is formed of tough buff or yellow silk sheet, aligned along a twig or grass stem (Hampson,1892).
Life History: Moths occur in March from pupation in January, again in June and September-November (Hampson,1892).
Extent of Damage/Status: Widespread and common in Ban oak forests. Localised infestations.

67. Rose Myrtle Lappet Moth, *Trabala vishnou* (Lefebvre,1827)

Superfamily: Lasiocampoidea
Family: Lasiocampidae
Subfamily: Pinarinae
Synonyms:
Gastropacha vishnou Lefèbvre,1827
Amydona prasina Walker,1855
Trabala mahananda Moore,1865
Amydona basalis Walker,1855
Trabala mandarina Roepke,1951
Trabala obscurior Roepke,1951
Amydona prasina Walker,1855
Gastropacha sulphurea Kollar,1848
Trabala viridis Roepke,1951
Distribution & Habitat: Widely distributed in the Oriental region including India, Sri Lanka, Myanmar, Malaysia, Thailand, Indonesia, China and Taiwan (http://www.nbair.res.in), China, throughout India, Ceylon, Burma, Java (Hampson,1892), In India Uttarakhand, West Bengal & Andaman Islands (Shubhalaxmi,2011) .[17 specimens in NFIC from Mussoorie,Uttarakhand by J.C.M.Gardner 30.ix.1936 and Dehradun on 17.xi.1936].
Species of Oak Infested: *Quercus dilatata, Q. leucotrichophora*(Beeson,1941).
Other Host Plants: The larvae feed on a wide range of host plants including castor, jamun, pomegranate, rose, sandalwood, poplars, etc. (http://www.nbair.res.in). The species is polyphagus. As sporadic pest of castor, it is known as the Castor Hairy Caterpillar. Damage to Shorearobusta forests is most frequent in Assam, Bengal and in the Central Provinces. Its other food plants are *Anogeissus, Bischofia javanica, Barberis aristata, Butea frondosa, Careya arborea, Eucalyptus robusta, Eugenia jambolana, Largerstroemia flos-reginae, Lantana, Mallotus philippinensis, Psidium guava, Quisqualis indica, Shorea robusta, Terminalia belerica, T. myriocarpa, T. tomentosa, Verbascum Thapsus* (Beeson,1941). *Camellia sinensis, Coffea liberica, Combretum indicum (Rangoon creeper), Lagerstroemia speciosa,* (http://www.globalspecies.org), *Punica granatum, Prunus dulcis, Koelreuteriab*i

pinnata, Rhodomyrtus tomentosa, Ricinus communis (Jorrit et. al.,2014), In Calcutta usually on Castor (*Ricinus communis Linn*.), but also on *Qidsqnalis indica* Linn,and *Lagerstroemia flosreginae*Retz. InShillong on *Rubus* sp. and in Murree on *Rosa* sp. *Terminalia* and *Eugenia* in Ceylon (Sevastopulo,1939).

Habit: Larva defoliates. Large number of 3-4 instar larvae and pupa were recorded on ban oak foliage in Chakrata Forest Division, Dehradun district in August and also New Tehri, Tehri Garhwal, Uttarakhand in October-December. Pupal stage recorded from Jan-April and adults in April and larvae recorded on Ban oak in Didihat, Pithoragarh district of Kumaon in October.

Eggs: slightly oblong, very pale cream, laid in a double row and covered with hairs from the anal tuft of the female (Sevastopulo,1939).

(a)Mature Larva

(b) cocoon

c) male moth

(d)female moth

Pinned specimens: (e) male moth **(f) female moth**

Fig.80.Life history stages of *Trabala vishnou* (Lefebvre,1827)

Larva: Head yellow, spotted with red, the colour brownish grey, with long lateral tufts on each somite, that on the first black and grey, the others grey, paired dorsal and lateral black spots on each somite, from which sprung long black hairs, the spots on the thoracis somite coalescing. Another form of larva is blackish with a broad white dorsal stripe, the anterior tufts red brown, a third form is reddish with the lateral spot blue (Hampson,1892). The larva as 'olive-brown or pinkish-brown; with a subdorsal and lateral row of black tubercular spots, from which radiate a tuft of black hairs; a dorsal tuft of radiating black hairs, and an intervening conical tuft of pale pinkish hairs, a lateral row of decumbent tufts of pale pink hairs, and a projecting tuft of long hairs on each side of the head; a black dorsal collar on front of second segment; head with red spots; legs red. Cocoon pale olivaceous or pinkish-brown, protuberant laterally on one side at each end. Pupa is brownish-red. Hampson writes 'Head yellow, spotted with red ; the colour brownish grey, with long lateral tufts on each somite; that on the first black and grey, the others grey; paired dorsal and lateral black spots on each somite, from which spring long black hairs, the spots on the thoracic somites coalescing. Another form of the larva is blackish with a broad white dorsal stripe, the anterior tufts red-brown; a third form is reddish with the lateral spots blue. Cocoon ochreous, with short black hairs projecting from it, which are intensely irritating (Sevastopulo,1939)

In 1stinstar, head is red brown. Body is yellow green with eleven transverse black bands. 1st somite is with very slight subdorsal pencils of dark hair arising from dark warts. Body is with sparse white hairs. Legs black. Claspers pink. Gregarious.2nd instar is similar but head crimson with two vertical yellow stripes. The subdorsal tufts on the 1st somite are larger.3rd instar is similar to proceeding but more hairy. The black transverse bands each with four blue hairy spots. Ceases to be gregarious.4thinstar is very like the final but

less hairy so that the yellowish ground colour is visible and the blue spots more pronounced.5th instar is similar to final instar. In final instar the head is crimson with two vertical narrow yellowstripes and a fine network of vertical and horizontal yellow lines. 1st somite with subdorsal warts giving rise to long- pencils ofdark brown hair, giving the larva the appearance of a Lymantriid.Body thickly clothed with dense whitish fur, developing dorsallyand laterally into tufts, intermixed with stouter, sharp black hairs.Just prior to pupation the fur becomes bright yellow. 2nd to 12thsomites is each with a pair of dull blue subdorsal spots giving riseto a few coarse black hairs. A lateral series of similar spots are almost hidden by the fur of the body. Legs and prolegs are pinkmarked with yellow. Venter yellow blotched with pink (Sevastopulo, 1939).

Pupa: Pupa smooth and shining, pale reddish brown with the venter and wing cases yellowish, not very highly chitinised. Meta-thorax with a pair of raised crescent-shaped black marks. Cremaster has cluster of minute hooked hairs. Spiracles are darker brown. In a cocoon of thick felted yellowish silk, into which the short black, and extremely irritating, larval hairs are worked. Boat-shaped with a dorsal hump at each end and a slit at the front and back, the cast larval skin being ejected through the hinder one and the imago emerging through the front. When spun on a thin stalk or twig, there is a barrier of silk and hairs on each side of the cocoon itself (Sevastopulo,1939).

Cocoon: Cocoon ochreous, with short black hairs projecting from it, which are intensly irritating (Hampson,1892). The cocoon is tough and papery, interwoven with larval hairs and is usually tent shaped or with protuberant ends fastened along a twig; the larval skin is pushed out from one end of the cocoon (Beeson,1941).

Male: Pale apple green, antennae ochreous brown, the disk of forewing and inner margin of hindwing whitish, forewing with a faint pale antemedial line curved below the costa, a dark speck at end of cell, a pale straight oblique postmedial line, which becomes medial on the hindwing, both wings with a series of small submarginal dark spots. Expanse: 50-60 mm. (Hampson,1892).

Female: Yellowish green, which fades to ochreous, the lines and spots of both wings enlarged and blackish, the spot at the end of cell of forewing large, conspicuous and irrorated with black scales, and sometimes centred with grey; a red brown patch thickly irrorated with black occupying the whole medial inner area from the median nervure to inner margin, cilia of both wings blackish. Expanse: 80-90 mm. (Hampson,1892)

Life History: The leaden grey eggs are laid in straight double rows on the plant. The larva feeds mainly during the night, sheltering in cracks and under leaves by day. There are four or more generations in a year. In the North the first moths from cold season larva and pupae may appear at any time in January-April. The pupal period in November to January is about 50 days falling to about 35 days in February-March

and to 15 days in April. There may thus be 1 or 2 complete life cycles in the hot weather. The egg stage lasts 11 days in April. In July, the pupal period is 17 days. The rains generation lasts 7-8 weeks (August to October) with the egg 10 days, larva 25 days and pupa 16 days. The pupal period of later broods is in October and November about 22 days. The coldest season may be passed as caterpillar or pupa. There are 6 larval stages (Beeson,1941).

Extent of Damage/Status: Widespread and occasional in oak forests. Localised infestations but can cause potential outbreaks.

68. Tent Caterpillar, *Malacosoma indica*(Walker,1855)

Superfamily: Lasiocampoidea
Family: Lasiocampidae
Subfamily: Malacosimatinae
Synonyms:
Clisiocampa indica (Walker,1855)
Malacosoma indica (Walker,1855)
Malacosoma tibetana (Hou,1982)
Distribution: Common in Himalayan region (Himachal Pradesh, Uttarakhand, Eastern India) (Sanyal,2015)
Species of Oak Infested: *Quercus dilatata, Q.leucotrichophora* (Mathur& Singh,1959; Sanyal, 2015).
Other Host Plants: *Betula utilis, Malus pumila, Populus ciliata, Salix denticulata* (Singh & Singh,1986; Sanyal, 2015).

(a)Larva **(b) Moth**

Fig.81. Life history stages of *Malacosoma indica* (Walker,1855)

Habits & Habitat: 2000-3400m., Moist Temperate Deciduous forest, Western Mix Coniferous forest, West Himalayan Birch-Fir Forest, Deciduous Alpine Scrub (Sanyal,2015). The caterpillar constructs a tent like shelters at the forking twigs and hides within during the day time. The caterpillar feeds on the leaves gregariously during the night hours causing severe defoliation (ecoursesonline.iasri.res.in).

Male: Head, thorax and abdomen are pale red brown, forewing is grayish with red-brown patches at base and center of costal area, the outer area is red brown; ante and postmedial oblique lines, hindwing uniform red-brown (Hampson,1892). Size: 34mm

(Sanyal,2015).

Life Cycle: Defoliation occurs from April to early June, the pupal period is 7-9 days with moths emerging in May and June. The rest of the annual life cycle is passed as a dormant egg laid in rings or bands on twigs and hatching in March, April. Serious defoliation prevents the settling of acorns and hence affects the regeneration, as for example in the Mukteshwar range forests, Uttarakhand, where an outbreak occurred in 1926-28 (Beeson,1941).It is active only from March to May and passes the remaining months of the year during eggs stage. The adult female moth is light brown with a wing expanse of 29-32 mm. It lays eggs in masses of 300-400 on branches of the tree during May-June. The eggs are hatched in the following month. The larva has black head and abdomen. The larval period is 40-70 days. It pupates on stem and on ground in cocoon during May for 7-21 days (http://ecoursesonline.iasri.res.in/).

Extent of Damage/Status: Occasional in oak forests at higher elevations. Localised infestations but can cause potential outbreaks.

69. *Suana concolor*(Walker,1855)
Superfamily: Lasiocampoidea
Family: Lasiocampidae
Subfamily: Gastropachinae

Distribution: The species is distributed in India and Sri Lanka to S. China, Java, Borneo and the Philippines(https://www.mothsofborneo.com/part-3/lasiocampidae/lasiocampidae_6_1.php)

Species of Oak infested: *Quercus leucorichophora.*

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

Habit: Larva defoliates. Larva (85mm) of this lappet moth was recorded defoliating *Q.leucotrichphora* tree in oak plantation in New Forest campus, Dehradun on 31.v.2020. The larva consumed large amount of foliage before pupating. Shiny, brown, elongated, bean shaped pupa (length 100 mm) was formed inside a cocoon on 20.vi.2020 and the moth (female; wingspan: 110 mm) 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. There are 7 larval instars and larval development usually lasts 60–80 days for the males and 85-100 days for the females (Pugaev & Skrobotov,2011).

Extent of Damage/Status: Widespread but uncommon in oak forests at lower elevations. Localised infestations.

(a)Mature larva

(b) Cocoon

(c) Moth(Dorsal view)

(d) Pinned specimen

Fig.82. Life history stages of *Suana concolor* Walker,1855 on *Q. leucotrichophora*

70. *Mustilizans hepatica* (Moore,1879)
Superfamily: Bomboicoidea
Family: Endromidae
Synonyms :
Mustilia hepatica **Moore,1879**
Mustilia columbaris **Butler,1886**
Distribution: From the Himalayas (Pakistan, northern India, Nepal) eastwards (in southern and eastern China, northern Vietnam, Thailand, Laos, and northern Malaysia), where the moth is represented by a somewhat smaller separate subspecies that can only be identified by the malegenitalia (Vadim,2007).[2 female specimens collected by J.C.M.Gardner on 13.vi.1926 at Mussoorie, Uttarakhand in NFIC].
Species of oak infested: Quercus leucotrichophora (Mathur & Singh,1959).
Habit: Larva defoliates (Mathur &

Singh,1959).

Male: In external characters it is diagnosed by a wavy postmedia (especially in its basal third), a triangular discal spot that is smaller than in dierli Holloway, and the rounded edge of the hind wings. The moth is not of a reddish colour. Wingspan:45-55 mm., forewing length 24-29 mm (Vadim,2007).

Female: Larger (wingspan 64-72 mm, forewing length 35-39 mm), with much lighter coloration and a significant reduction in dark patterning (Vadim,2007).

Extent of Damage/Status: Data deficient.

(a) **(b)**

(Source: (a)- http://insecta.pro/taxonomy/120615)

Fig.83. *Mustilizans hepatica* (Moore,1879)- Pinned specimens

71. Unidentified Eupterotidae Moth

Superfamily: Bomboicoidea

Family: Eupterotidae

Distribution: Garhwal

Species of Oak infested: *Quercus floribunda*

Habit: Larva defoliates.

Larva: Light green coloured hairy larva of length 18mm was collected on 23.v.2018 feeding on foliage of Quercus floribunda in moru oak forest, Chakrata Forest Division (2647m), Uttarakhand. Larva was observed feeding on the leaf tips of tender moru oak leaves. Larva died on 28.v.2018.

Extent of Damage/Status: Rare in Moruforests at higher elevations. Localised infestations.

Fig.84. Eupterotid larva

72. Himalayan oak Tasar Silk Moth, *Antheraea roylei* (Moore,1858)
Superfamily: Bomboicoidea
Family: Saturniidae
Subfamily: Saturniinae
Synonyms: *Antheraea confuci* Moore, 1875
Distribution: Himalaya, Indo-malayan Peninsular, down to notthwesternSundaland (Malaya, Sumatra)(http://www.jpmoth.org/~dmoth/Digital_Moths_of_Asia/80_BOMBYCOIDEA/06_SATURNIIDAE/01_Antheraea/Antheraea%20roylei/Antheraea%20roylei.htm); Darjeeling (India) (Horsfield and Moore, 1858-59); Hills in neighborhood of Shanghai, N China (Moore, 1874); Bhutan (Checklist of Bombycoidea of Bhutan).

Moths (Source: http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=455120)

Fig.85. *Antheraea roylei* (Moore,1858)

Host plant: *Quercus sp.* (Mathur & Singh,1959).
Other Host plants : *Betula alnoides,* apple and pear (Beeson,1941);
Habit: Larva defoliates (Mathur & Singh,1959).
Adult: Greenish buff colour: fore wing with the base of costal margin purple-grey, and two short sub-basal pinkish transverse lines, and two outer submarginal, transverse, parallel, pinkish lines; a dusky fascia from costa to hind margin passing outside the ocellus; ocelli of both wings small, oval, grey within, outer ring pink internally and black externally; inner ring white and yellow; central spot minute, half diaphanous, and yellow: hind wing with fainter pinkish sub-basal line and two submarginal lines. Allied to *Antheraea pernyi,* from which it differs in colour and in the distinct double submarginal lines (Moore,1874).
Male: Dull buff-colour; fore-wing with the costal band brownish-grey, the sub-basal lines and the oblique submarginal line indistinct, greyish; hind-wing with the submarginal line indistinct; ocellus of both forewings and hind-wings ill-defined, buff-

colour within, with a minute vitreous spot. Female with the wings somewhat brighter coloured exteriorly, the submarginal line of both wings more distinct; ocelli more distinct; frontal band brownish-grey; antennae brownish; body buff-colour. Expanse of male is 14.6 cm; female is16.5 cm (Horsfield and Moore,1858-59).

Extent of Damage/Status: Widespread but data deficient.

73. Chinese Oak Tussar Moth/ Temperate Tussar Moth, *Antheraea pernyi* (Guerin-Meneville,1855)

Superfamily: Bomboicoidea

Family: Saturniidae

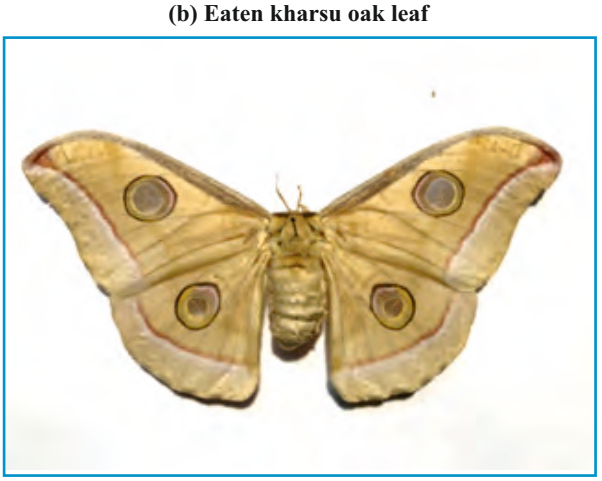
Subfamily: Saturniinae

Synonym: *Antheraea hartii* (Guerin-Meneville,1855).

(a)Larva

(b) Eaten kharsu oak leaf

(c)Cocoons



(d) Moth

Fig.86. Life history stages of *Antheraea pernyi* (Guérin-Méneville,1855)on *Q.semecarpifolia*

Distribution: Native of China, where it was domesticated for silk production (Liu et

al.,2010). It is also present from Mongolia and Northern China to India (Himalayas) and Japan (De Viedma& Gomezbustillo,1976). Now a days, its distribution on the European continent is restricted to the Balearic Islands and the province of Barcelona (Leraut,2006). Uttarakhand,India.

Species of Oak Infested: *Quercus semecarpifolia.*

Other Host plants: *Betula, Carpinus, Castanea crenata, Cinnamomum camphora, Crataegus pinnatifida, Fagus crenata, Larix, Malus sylvestris, Prunus, Quercus acutissim, Q. alba, Q. cerris, Q. falcata, Q. lyrata, Q. macrocarpa, Q. mongolica, Q. palustris, Q. phellos, Q. robur, Q. serrata, Q. stellata, Q. variabilis, Salix* and *Xylosma japonicum* (https://www.nhm.ac.uk/).

Habit: Larva defoliates. Defoliation (6 larvae: 43-72mm) observed in Deoban RF in Chakrata Division,Uttarakahand on Kharsu oak, *Q.semecarpifolia* on 06.vii.2019. The larvae continued feeding up to 18.vii.2019 before pupating on 18.vii.2019. Large sized(50mm) pupae were enclosed in a silken cocoon spun together on 2-3 leaves on the oak tree itself. Moths emerged on 08.viii.2019.

Eggs: The real color of the egg is off-white (china-white) but because the surface is covered with a colloid substance (with brown gum) it appears to be brown. The egg is oval-shaped, with a length of 2.2-3.2 mm and a width of 1.8-2.6 mm. The blunt end has a fertilization pore. Each female adult lays 200-400 eggs, weighing 8-10 mg per egg (Qin et al.,2003).

Larva:The larval stage of *A. pernyi* lasts for 45-55 d at 21-27^{0}C (usually including fourth-instar and fifth-instar dormancies). The newly hatched larvae are basically black with a reddish-brown head. The first to third-instar larvae favor eating tender oak leaves and living in a high humidity environment (80–90% relative humidity) while fourth- to fifth-instar larvae prefer to feed on older oak leaves and live in relatively dry conditions (Li et al.,2017).

Pupa: The pupa is fusiform-shaped, with a length of 3-4 cm and a width of 1.8-2.2 cm, and weighs 8-15 g. It is slightly yellow colored at the early stage, and the color turns to dark brown after 35 days. During the eclosion, the moth secretes an alkaline solution to make a hole in the cocoon, which facilitates the escape of the moth (Li et al.,2017).

Adult: The moth is 3-5 cm long with a 14-16 cm wingspan. Females are bulkier than males. They are grayish brown colored or orange colored, covered with androconia. On each side of the fore wings and hind wings, there is a pair of eyespots surrounded by black, red, blue, or white stripes. Adults do not feed and live for about 1-2 week (Li et al.,2017).

Extent of Damage/Status: Uncommon in Kharsu oak forests at higher elevations (above2500m). Localised infestation.

74. Green Pergesa Hawk Moth, *Pergesa acteus* (Cramer,1779)
Superfamily: Bomboicoidea
Family: Sphingidae
Subfamily: Macroglossinae
Synonyms:
Pergesa acteus (Cramer,1779)
Sphinx acteus Cramer,1779)
Panacra butleri(Rothschild,1894)
*Rhyncholaba acteus*Cramer
*Oreus acteus*Hubner

Distribution: South & East Asia. Sri Lanka, Nepal, Bhutan, Burma, Thailand, eastern and southern China, Taiwan, Japan (Ryukyu Archipelago), Malaysia (Peninsular), Indonesia (Sumatra, Java, Sulawesi), the Philippines (Palawan) (http://tpittaway.tripod.com). India (Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Assam, Meghalaya, Arunachal Pradesh, Nagaland, Manipur, Mizoram, West Bengal, Maharashtra, Karnataka, Andaman Is.) (Shubhalaxmi et.al.,2011), Borneo, Japan, Oriental tropics, Moluccas, this is a species of open and cultivated lowland habitats (www.mothsofborneo.com).

Fig.87. Pinned specimen -*Pergesa acteus* (Cramer,1779)

Species of Oak Infested: *Quercus leucotrichophora* (Mathur & Singh,1959)
Other host plants: *Alocasia odora* (Araceae) in Hong Kong; *Syngonium podophyllum* in Bangkok, Thailand. In India on *Amorphophallus, Arisaema, Caladium, Colocasia, Dieffenbachia, Begonia, Commelina, Leea, Cissus and Vitis* (Bell & Scott,1937). *Alocasia cucullata, A. zebrina, A. princeps, A.macrorrhizos, A. sanderiana., Amorphophallus yunnanensis, Amorphophallus* sp., *Caladium bicolor, C. humboldtii, C. schomburgkii, Colocasia esculenta* cv., *C. esculenta* cv. Rhubarb, *Colocasia esculenta* (L.), *C. esculenta, C. gigantea, Spathiphyllum cannifolium, Typhonium trilobatum, Xanthosoma sagittifolium, X. violaceum, Monstera obliqua, Philodendron burle*Marx, *Syngonium podophyllum* and *Syngonium* sp.,

*Impatiena balsamina, Ludwigia hyssopifolia,*L. *octovalvis* and *Vitis vinifera* (Danarun et. al.,2017).

Habit: Larva defoliates (Mathur & Singh,1959).

Eggs: Bright green, broadly oval, surface smooth and shiny (Bell & Scott,1937).

Larva: Larva pale olivaceous-green on 5th segment a large lateral blue ocellus ringed with white, green and yellow; on 6th to 11th segment on oval green-ringed yellowish oblique lateral spot, below each of which is an oblique whitish stripe; a dorsal blue line on anterior segments, and a pale waved subdorsal line from the ocellus to head; horn pink; spiracles white (archive.org).

Full-fed 70mm, width 11mm, horn 3mm (http://tpittaway.tripod.com).

Pupa: Length 40-50mm, width 10mm and cremaster length is 3 mm. Colour of head and thorax dull pale yellow suffused with fuscous; the yellow also extending ventrally to tip of wing-case (https://tpittaway.tripod.com/ china/p_act.htm).

Description: Wingspan: 64-80mm. Pale grey dorsal band running longitudinally from the anterior edge of the thorax to the tip of the abdomen. Forewing apex is strongly falcate; upperside with a characteristic diffuse green band running obliquely across from the inner margin to the apex; discal spot a minute but conspicuous black dot. Upperside of thorax and abdomen is with a conspicuous pale grey longitudinal band (http://tpittaway.tripod.com).

Extent of Damage/Status: Data deficient.

75. Cinnamon Cypa, *Cypa pallens enodis*(Jordan,1929)

Superfamily: Bomboicoidea

Family: Sphingidae

Subfamily: Smerinthinae

Distribution: Uttarakhand-Dehradun (Sondhi& Sondhi,2016),Nanital (Smetacek,2008), Nepal, Sikkim; Meghalaya, northeastern India, Thailand, southern China, northern Vietnam, Peninsular Malaysia (Genting Highlands) and Taiwan(http://tpittaway.tripod.com/china/c_eno.htm).

Species of Oak Infested: *Quercus dilatata* (Mathur & Singh,1959).

Other Hostplants: *Betula alnoides* in India (Bell & Scott,1937)

Habit: Larva defoliates (Mathur & Singh,1959). In the Khasi Hills of Meghalaya (formally Assam), India, on the wing at the beginning of the rainy season, at an altitude of 1200-1500 meters (Bell & Scott,1937).

Larva: Full length larva is 60 mm.; width 9 mm.; horn 7 mm. In the fourth instar, head triangular with a short process rising from apex of each lobe. Body is increasing in diameter from segment 2 to 7, then cylindrical. Horn is rather short, straight. Colour of head pale green dotted with white tubercles, but processes yellow; with a pale yellow cheek stripe. Body is pale green, with

a transverse row of small white tubercles around each secondary ring. A broad dorsal stripe, which is dark green edged narrowly with white, runs from segment 2 to the base of the horn. There are seven narrow white oblique lateral stripes. Horn is green with white tubercles. In the final and fifth instar, head elongate triangular, 7mm long by 4.5mm broad, with a short process rising from the apex of each lobe, these processes closely appressed to near tips. (Bell & Scott,1937).

(Source: http://tpittaway.tripod.com/china/c_eno.htm)

Fig.88. ***Cypa pallens enodis*****Jordan,1929**

Pupa: 30mm, brown in colour, but head, thorax and wing-cases of a darker shade. Surface is smooth and shiny. Slender in build; head very small, the eye very low and near front of pupa(Bell & Scott,1937).

Adult: Wingspan: 65mm. Uppersideis clay-coloured to cinnamon, with a strong drab or fawn bloom in fresh specimens; hindwing tawny. Underside basal is two-thirds of forewing (except margins) tawny, terminal area greyish, contrasting with the tawny area; hindwing clay-coloured, with a long and prominent tawny smear along abdominal fold. Distal margin of forewing is irregular; second segment of palpus very short (Bell & Scott,1937).

Extent of Damage/Status: Data deficient.

76. Variegated Hawkmoth, *Degmaptera mirabilis* (Rothschild,1894)

Superfamily: Bomboicoidea

Family: Sphingidae

Subfamily: Smerinthinae

Synonym: *Cypa mirabilis* Rothschild, 1894.

Distribution: Northern India-Uttarakhand (Smetacek,2008),Northeast India, Nepal, Thailand, China (Guangdong, Anhui) and Taiwan. (http://dearlep.tw/species.html?namecode=347651)

Species of Oak Infested: *Quercus dilatata* (Mathur & Singh,1959) and *Quercus fenestrata* in the Khasi Hills, India (Bell & Scott,1937).

Habit: Larva defoliates (Mathur & Singh,1959). The larva rests on the underside of a leaf. When alarmed it raises the head and anterior segments, the head being held so that the long apical processes continue in the line of the body, the true legs being bunched together. In all instars the young tender leaves are ignored and only old hard leaves are eaten, with round holes being bitten between the side-veins, or the whole portion between two side-veins being removed. Before pupation, the body becomes suffused with pink and the larva leaves the hostplant and hurries about looking for a suitable place to pupate. During this period it jumps when touched like the larvae of the genus *Ambulyx,* and the body is very hard and firm. Pupation takes place in a cell underground (Bell & Scott,1937).

(Source: http://tpittaway.tripod.com/china/d_mir.htm)

Fig.89. *Degmaptera mirabilis* (Rothschild,1894)

Eggs: Elongate-oval in shape, surface smooth and moderately shiny. Pale bluish-green when first laid, with reddish-brown markings developing later. These markings take the form of a narrow reddish-brown stripe running round the lower portion of the egg roughly parallel with the line of attachment to the leaf, and broken at each end of the egg. In India, the eggs are laid singly, usually on the underside of a leaf of *Quercus fenestrata* Roxb. (Bell & Scott,1937).

Larva: Full-fed 55mm; width 8mm; horn 9.5mm. In the final instar, head elongate-triangular, the apex of each lobe produced upwards, these upward extensions closely appressed and together forming a blunt point. Surface of head is dull, covered with small tubercles. Body long and thin, diameter of segments 2 and 3 only half length of head; hind segments increasing gradually to 8, then decreasing slightly to 12. Horn is long, gently down-curved, flattened laterally, bifid, the arms long and thin. In colour, head pale green, apex of each lobe is reddish; a broad

stripe formed of small black tubercles extends from near the apex of each lobe to base of antenna, and dorsally from near apex of each lobe to nape. Body is green or bluish-green, darker than head; tubercles white. There is a dorsal stripe of black dots on segments 2 to 4, sometimes extending further back as a blackish quadrate patch on the middle of each segment, and always present on 5, where it is surrounded by yellow. A large, enamel-white, irregular, rounded patch is usually present in the middle of the subdorsal area of 8, with a line of black tubercles along its upper edge. On one or more of the median segments there are usually subdorsal patches of varying size and shape, yellow ringed narrowly by red-brown. Seven narrow oblique lateral stripes are present, each running along one segment and a portion of the adjoining segments. These are pale yellow, sharply defined above by a brown line, ill-defined below, that on 11 broader than the rest and running to base of horn. True legs are purplish; prolegs and claspers of body-colour. Spiracles small, those of segments 2 and 12 larger than the rest, narrowly oval in shape, colour brown (Bell & Scott,1937).

Pupa: It is 30 mm in length; width 10 mm., mainly chestnut in colour, with a large rounded patch below and in front of eye, and the hind bevels of abdominal segments 8 to 10 pale cream-colour; abdomen darker, cremaster and spiracles black. Cremaster is stout, five-sided ending in a simple, blunt point (Bell & Scott,1937). The pupa is very lively, moving the abdomen freely when handled (http://tpittaway.tripod.com/china/d_mir.htm).

Male: The male wingspan: 44-82mm. Forewing from upperside is deep ferruginous-red, variegated with ochreous and orange-yellow, with a fawn-colored band just beyond the cell; discal spot black with a minute transparent centre. Hindwing is deep reddish-brown, with traces of red median and submarginal bands. Costal edge excavated resulting in a conspicuous subapical lobe, which projects anteriorly, as in *Smerinthulus olivacea.* Abdomen from upperside with a central row of pale golden dots (http://tpittaway.tripod.com/china/d_mir.htm).

Male: The male wingspan: 44-82mm. Forewing from upperside is deep ferruginous-red, variegated with ochreous and orange-yellow, with a fawn-colored band just beyond the cell; discal spot black with a minute transparent centre. Hindwing is deep reddish-brown, with traces of red median and submarginal bands. Costal edge excavated resulting in a conspicuous subapical lobe, which projects anteriorly, as in Smerinthulus olivacea. Abdomen from upperside with a central row of pale golden dots (http://tpittaway.tripod.com/china/d_mir.htm).

Female: Upperside forewings are ferruginous, almost chestnut red towards the apex; basal half crossed by a rather broad band of ochreous, narrowly bordered with blackish brown; middle of the wing with a drab grey transverse patch which extends from the first branch of the median nervure to the subcosta, and just touches the apex of the cell; the patch is broadest and somewhat

rounded anteriorly, streak like posteriorly, bears a small blackish spot on the disco cellular nervules, and is sinuate opposite this spot; between the discal drab grey mark and the sinus of the inner margin the scales are partly buff; anal and apical angles pale baff, this colour well defined; costa also somewhat buff between cell and apex; disc crossed by one or two hair like brown lines which are bent inwards in the middle and hooked at the costa; the whole of the wing with dispersed blackish scales. Hindwings are dark chestnut, base and a submarginal indistinct band, running from the anal angle to the costa, somewhat lighter. Underside: forewings tawny, with a blackish spot at the apex of the cell; disc crossed by a dark brown line (like the upperside); middle of the apical margin broadly chestnut, apical and anal angles as on the upperside; space outside the discal line ochreous, with dispersed blackish scales. Posterior wings ochreous buff, with a faint ferruginous transverse line behind the cell, and a dark ferruginous one crossing the disc, corresponding to the line of the forewings; disc outside this line chestnut; a submarginal, very ill-defined baud buff, outer margin light chestnut. Thorax and abdomen ferruginous; an ill-defined spot on each side of thorax anteriorly, and sides of the abdomen buff (Rothschild,1894).

77. Small Olive Hawkmoth, *Rhodoprasina callantha*(Jordan,1929)
Superfamily: Bomboicoidea
Family: Sphingidae
Subfamily: Smerinthinae
Distribution: From Northern India across Nepal, Bhutan, and northeastern India, northern Myanmar/Burma, southwestern China (Yunnan), northern Thailand to northern and central Vietnam (http://tpittaway.tripod.com/china/r_cal.htm)

Species of Oak infested: Species of

Ecology & Biology: Inhabiting forest belts between 1000 and 2300 meters above sea level; adults occur in 3-4 months and are rare. In the period of adulthood, there is obvious phototaxis from dusk to night (Source: http://dearlep.tw/species.html?namecode=347651). The moth rests with the wings horizontal and held so that the lobe of the hind wing projects well in front of the costa of fore wing; the abdomen is left uncovered and bent upwards. It is very sluggish during the daytime, and does not take to the wing for a long time after emerging from the pupa, but when it does so the flight is rapid. The moth does not appear to feed, nor is it attracted by light. It emerges about two to three weeks after pupation, except when the pupa is formed about October. These late pupae hibernate, and the moths emerge in the following spring (Bell & Scott,1937). It frequentlyoccurs in high altitude evergreen oak forests. Bell & Scott (1937) obtained eggs and larvae in forests with heavy rainfall at an altitude of about 1500 meters in the Khasi Hills of Meghalaya, India. Larvae were plentiful locally in the rainy season (http://tpittaway.tripod.com/china/d_mir.htm).

Extent of Damage/Status: Data deficient.

Quercus, especially *Q. fenestrata* (Bell & Scott,1937) and *Quercus dilatata* (Mathur & Singh,1959)

Habit: Larva defoliates (Mathur & Singh,1959). The larva lies on the underside of a leaf when small and on twigs and branches when large. In the resting position the front part of the body is raised slightly from the surface, the elongated head pointing upwards. The larva is very active. Though none of those found were attacked by parasites they were very difficult to rear, dying for no apparent reason, especially in the earlier instars. They do not become suffused with brown or pink before pupation, which takes place in a cell underground (Bell & Scott,1937). In Thailand, it occurs at between 1200 and 2100 m. altitude in dense oak forests which become very wet during the rainy season. In India, a female exposed for three or four nights failed to attract a male. She was very active at night and battered her wings to pieces (Bell & Scott,1937). In Thailand the flight period is from January-April, June and August-November (http://tpittaway.tripod.com/ china/r_cal.htm).

(source: http://sphingidae.myspecies.info/taxonomy/term/2496)

Fig.90. *Rhodoprasina callantha*(Jordan,1929)

Eggs: Pale green, elongate-oval, surface smooth and shiny. These are laid singly on the underside of a leaf of the host plant (Bell & Scott,1937).

Larva: Full-fed 90mm, width 18mm, horn 6mm, head 14mm long by 8mm broad. In the fifth and final instar, head very large and heavy, elongate-triangular in shape, vertex rounded and dorsal line shallowly impressed. Body short and stout; the vertex of the head rises high above segment 2 and the segments increase in diameter gradually to 8, then decrease gradually to 12. Horn short, stout, straight, tapering gradually to a blunt point, and held horizontal or directed slightly downwards, touching or nearly touching dorsum of anal flap; anal flap and claspers tumid and heavy. Surface of body dull, with an encircling row of small pointed tubercles around each secondary ring. There is a line of larger sharply-pointed tubercles on each side of the dorsal line from front margin of

segment 2 to base of horn, these tubercles gradually increasing in length to near base of horn.Face of head bluish-green, cheek pale green; a whitish stripe, edged on the inner side with green, from apex of each lobe to base of antenna, separating face from cheek; a green dorsal stripe from vertex to nape; tubercles white; labrum pale green; ligula brown with a pale green stripe down each lobe; basal and middle segments of antenna greenish, end-segment greenish with brown tip; mandible pale green, tip dark brown. Body varying from pale apple-green to pale bluish-green with segments of 2 to 4 paler than the rest and the anal segments are darker. There is a whitish subdorsal stripe on 2 to 4, a broad, dark green dorsal stripe from the front margin of 2 to base of horn, and an indistinct whitish stripe on each side of the dorsal stripe, on which the subdorsal line of large tubercles is situated. Seven oblique lateral stripes are present, these being pale yellow, that on 5 broader than the rest, all edged above with dark green and bearing the oblique lines of tubercles. True legs are green; prolegs pale blue, the hooklets on the feet red-brown; venter pale bluish-green. Spiracles white edged with black, the white forming a narrow ellipse containing the central slit; the white portion of the spiracle on segment 5 broader than that of the others, and this spiracle surrounded by an ocellus-like marking, dark green edged with crimson (Bell & Scott,1937).

Pupa: 44-60mm, width 15 mm. Colour dark chestnut, the head, thorax, anterior part of wing-cases and cremaster darker, spiracles black with the central slit orange. The pupae are also delicate, and the moths which emerged are often crippled (Bell & Scott,1937).

Adult: Wingspan: 90-120mm; sexually dimorphic; female often considerably larger than male. An unmistakable species with sharply pointed, olive-green (male) or tawny-olive (female) forewings crossed by diagonal dark lines and diffuse white/silver bands. Hindwing is carmine red above with costal and anal margins olive-green. Extent of white/silver and carmine pigmentation is variable. Body is olive-green and darker from below. Antennae are pink. Tibiae and tarsi are blackish and grey (Bell & Scott,1937).

Extent of Damage/Status: Data deficient.

78. Mango Hawkmoth, *Amplypterus panopus*(Cramer,1779)

Superfamily: Bomboicoidea
Family: Sphingidae
Subfamily: Smerinthinae
Synonyms:

Sphinx panopus(Cramer,1779)
S. pavonica (Moore,1877)
Amplypterus pavonicus
Composogene panopus.

Distribution: Sri Lanka, southern and northern India (including the Andaman and

Nicobar Islands), Nepal, Bhutan, Burma/Myanmar, southern China, Thailand, Vietnam, Indonesia and the Philippines (http://tpittaway.tripod.com/china/a_pan.htm).

Species of oak infested: *Quercus sp.* (Mathur & Singh,1959)

Other host plants: Recorded from *Dracontomelum, Mangifera indica, Rhus, Durio, Garcinia and Calophyllum*. In Metro-Manila, the Philippines, larvae can be common on parkland and roadside mango trees (*Mangifera indica*) (http://tpittaway.tripod.com/china/a_pan.htm).

Habit: Larva defoliates (Mathur & Singh,1959). The moth is sluggish during the daytime and allows itself to be handled, but at night it flies strongly. It has never been seen feeding at flowers, nor does it seem to come readily to light, though Mell states that it has frequently been caught at light in Java. It emerges from the pupa after dark, and pairs after midnight when in captivity (https://tpittaway.tripod.com/china/a_pan.htm).

Eggs : Yellow and oval (2.60 x 2.15mm). Surface is smooth and shiny. Laid singly on the underside of a leaf (Bell & Scott,1937).

Larva: Full-fed 110mm long, 16mm wide; horn 20mm. Larva grey and granulose, with a subdorsal yellow spotted line from the head to the horn. The larva lives on the underside of a leaf, generally choosing one in a dense cluster. It lies stretched out straight when at rest, is sluggish, and feeds chiefly at night. Before leaving the hostplant to pupate it becomes suffused with brown-pink and later is somewhat greasy looking (Bell & Scott,1937).

(a) Final instar larva **(b) Adult**

(source:https://www.inaturalist.org/taxa/204801-Amplypterus-panopus/browse_photoshttp://tpittaway.tripod.com/china/a_pan.htm)

Fig. 91.*Amplypterus panopus*(Cramer,1779).

Pupa: 58-75mm long, 16mm wide. Stout in build. Dark red-brown in colour, but nearly black on segments 1 to 3 and on 13 and 14. Cremaster short and triangular, constricted near base, surface shiny and rugose, with a deep hollow on each side of the ventral surface penetrating to the dorsal surface and thus making a perforation (Bell & Scott, 1937).Pupation is in a cell underground. The pupal stage lasts about three weeks except in the case of hibernating pupae, when it may last as many months or even longer (http://tpittaway.tripod.com/china/a_pan.htm).

Adult: Wingspan: 130-168 mm. Head, thorax, and terminal segments of abdomen golden brown; the proximal segments pale. Fore wing purplish flesh-color; some brown waved lines near the base; then an oblique band; some waved brown lines from the costa to lower angle of cell; an oblique post-medial band; a highly waved and irregular whitish submarginal line; a dark ocellus near outer angle. Hind wing flesh-color, the outer area brown; the disk suffused with pink; antemedial, medial, and two postmedial lines, the last two angled below the costa. Underside much mottled with yellow (https://tpittaway.tripod.com/china/a_pan.htm).

Extent of Damage/Status: Data deficient.

79. Oak Hawkmoth, *Marumba quercus* (Denis &Schiffermuller,1775)

Superfamily: Bomboicoidea

Family: Sphingidae

Subfamily: Smerinthinae

Synonyms:

Sphinx quercus Denis &Schiffermüller

S.denisii (Fuessly,1779)

*S.brunnescens*Rebel,1910

*S.canescens*Closs,1922

S.pallescens Closs,1922

S.costimacula O. Bang-Haas,1938

Marumba quercusmesopotamica O. Bang-Haas,1938

*Marumba quercus schirasi*O. Bang-Haas,1938

pallida Vilarrubia,1973.

Distribution & Habitat: From the Rif and Atlas Mountains of Morocco, Portugal, Spain, across southern and central Europe to Turkey, the Crimea, Transcaucasia, Armenia, the Republic of Georgia, Azerbaijan, western Kazakhstan, Lebanon, Israel, western and northern Jordan, northern Iraq and south-west Iran. This species occurs at low population densities so its presence may go undetected for long periods. Moreover, it is prone to wander beyond its normal range and vagrants have been discovered in northern France, the Netherlands, Bavaria, and southern Switzerland and near Moscow, Russia (http://tpittaway.tripod.com/sphinx/m_que.htm).

It occurs in dry and warm oak woodland in the Mediterranean and Supramediterranean region (http://www.pyrgus.de/ Marumba_quercus_en.html).

Species of oak infested: *Quercus* sp.(Mathur & Singh, 1959; *Quercus ilex* (http://tpittaway.tripod.com/sphinx/m_que.htm).

Other Host Plants: Especially dry-leaved species such as *Quercus suber*, *Q. coccifera,*

Q. pubescens and *Q. cerris.* Shrubby bushes are preferred to large mature trees (http://tpittaway.tripod.com/sphinx/m_que.htm).

Habit: Larva defoliates (Mathur & Singh,1959). The chrysalis hibernates. The moths appear mostly in a single generation between late April and July. More rarely, there is a partial second emergence in August or early September. The caterpillars occur between late May and early October. First instar larva does not feed prior to the first moult, except for the egg shell (Source: http://www.pyrgus.de/Marumba_quercus_en.html). Dry, sunny, wooded hillsides with a preponderance of young, shrubby oaks are favoured, usually in areas where the soil is of a light, gritty nature. Adults rest by day suspended amongst foliage where they resemble dead leaves. A few may be found on tree trunks, especially *Quercus suber*(cork oak), having climbed there after emergence. It is here that mated females can sometimes be discovered, having parted from the male before dawn. As neither sex feeds in the adult stage, flowers have no attraction, although both sexes come to light (http://tpittaway.tripod.com/sphinx/m_que.htm).

Eggs: Large (3.5 x 3mm), oval, pale green; upto 100 laid per female. Deposited singly on the underside of leaves, preferably on somewhat isolated bushy saplings. Prior to hatching, young larva is clearly visible through the shell (http://tpittaway.tripod.com/sphinx/m_que.htm).

Larva: Full-fed 65-80 mm. Dimorphic: green or bluish white. On hatching, the 8 mm-long, whitish-green larva may or may not eat the eggshell before wandering off to find a leaf on which to moult. Not until the second instar does normal feeding commence from beneath that leaf. At this stage the final body coloration is established: an apple- or blue-green ground colour speckled with very fine yellow tubercles. Laterally, the body is marked with seven oblique yellow stripes, alternately wide and narrow, the last of which merges with the horn. In the first and second instars the horn is enormous - more than half the body length, and pale orange with a pale yellow base and encircling band of the same colour below the darker tip. Head concolorous with body, with yellow or orange cheek lines, and heavily spined in the first four but not in the final two of the six instars. When this species feeds on *Q. ilex*, the larva tends to be greyish-blue with white stripes and tubercles. Whatever the colour form, a fully-grown larva is extremely well camouflaged as it hangs in a leaf cluster. Prior to pupation, it becomes reddish-brown before descending from its hostplant during the night or early morning (http://tpittaway.tripod.com/sphinx/m_que.htm).

Pupa: 45-55mm. Rugose but glossy, dark reddish brown with a double-tipped cremaster. Pupation is noticeably deep in fine, gritty soil, where a large chamber is constructed (http://tpittaway.tripod.com/sphinx/m_que.htm).

(a) Final instar larva **(b) Adult**

(source: http://www.leps.it/indexjs.htm?SpeciesPages/MarumQuercus.htm; http://sphingidae-haxaire.com/index.php/smerinthinae/marumba-quercus/nggallery/page/2/)

Fig.92.*Marumba quercus* (Denis & Schiffermuller,1775)

Adult: Wingspan: male 85-100 mm; female up to 125 mm. Similar to a large, pale, ochreous *Laothoe populi* although, when at rest, the hindwings do not project above the forewings. Ground colour very variable, ranging from very pale ochreous or buff to dark brown. In some, smoky grey is the main colour, while individual brown females may have yellowish white transverse lines on the wings, or a complete absence of any line. Another form has bright pink basal areas on the hindwings with the ventral surface of a similar colour (http://tpittaway.tripod.com /sphinx/m_que.htm).

Extent of Damage/Status: Data deficient.

80. Large Swirled Hawkmoth, *Marumba sperchius* (Ménétriés,1857)

Superfamily: Bomboicoidea

Family: Sphingidae

Subfamily: Smerinthinae

Subspecies: M. s. gigas Butler,1875.

Synonyms:

Smerinthus sperchius Ménétriés,1857
S.albicans(Butler,1875)
S. gigas (Butler,1875)
S. piceipennis (Butler,1877)
S. michaelis (Oberthür,1886)
S. scotti Rothschild,1920
S. handelii Mell,1922
S. ochraceus O. Bang-Haas,1927
S. ussuriensis O. Bang-Haas,1927
S. horiana Clark,1937
S. castanea O. Bang-Haas,1938
S.coreanus O. Bang-Haas,1938
S. obsoleta O. Bang-Haas,1938
S. koreaesperchius Bryk,1946

Distribution: From northern Pakistan, northern India [Gangotri landscape area-Uttarakhand (Smetacek,2008; Sanyal et.al.,2013)], Korea, South Korea and Japan. Also south to continental Thailand, Laos & N-Vietnam (http://tpittaway.tripod.com /china/m_spr.htm); Bhutan (Checklist of Bombycoidea of Bhutan); Sumatra, Borneo

(http://www.mothsofborneo.com/part-3/sphingidae/sphingidae_10_2.php); India (Uttarakhand- Nainital distt.) (Smetacek,2008).

(a) Larva **(b) Adult**

(source: https://tpittaway.tripod.com/china/m_spr.htm)

Fig.93. *Marumba sperchius* (Ménétriés,1857)

Species of oak infested: *Quercus sp.* (Bell& Scott,1937; Mathur & Singh,1959); *Quercus glauca* in Taiwan.In China, reported from *Juglans regia* and Castanea, Recorded in Russia, on Juglans mandschurica,Quercus mongolica. In Japan, recorded from *Castanea crenata, Lithocarpus edulis, Quercus acutissima, Q. glauca* and *Q. myrsinaefolia.* Recorded in Korea on *Quercus acuta, Q. salicina, Q. acutissima, Q. serrata* and *Castanea crenata* (http:// tpittaway.tripod.com/china/m_spr.htm).

Habit: Larva defoliates (Mathur & Singh,1959).

Eggs: Elongate-ovoid in shape, pale green when first laid, after some days two reddish brown stripes appear on the top, somewhat variable in shape and size but roughly parallel with the long axis. Length 3.5 mm; breadth 2.5 m. (Bell & Scott,1937). Laid singly, oval, 1.8 x 1.5 mm, pale yellow, turning greenish brown with red stripes before hatching in 7-9 days; chorion not eaten (http://tpittaway.tripod.com/china/m_spr.htm).

Larva: Mature larva is 72-120 mm. Last instar larvae head and body is green, head triangular with pointed protrusion; face yellow whitish. First and fifth abdominal segments lateral with oblique white line, the other abdominal segments lateral with gray line; horn 12 mm. Body dorsal pink before pupation, lasting 13 days. Hatching to pupa 47 days, prepupa to pupa 8 days (Source: http://tpittaway.tripod.com/china/m_spr.htm). Bell & Scott (1937) noted that in India (Khasi Hills) larvae were often found with numbers of small black flies sitting on them, but that they did not appear to cause any ill effects. Larva are common on the oaks growing in gardens, but were difficult to rear in the imago stage, hibernating pupa usually

dying.

Pupa: 40-61 mm. Fuscous; frontal area porrect; base of clypeus with pointed processes; abdomen glossy ventrally, dorsal surface moderately rugose, tapering anteriorly. Overwinters as pupa (http://tpittaway.tripod.com/china/m_spr.htm).

Adult: A large grey form; the external line of the post-discal pair absent or vestigial, while the inner one is as distinct as the exterior discal line. The apical area outside the post-discal line of forewing underside not tawny as is M. dyras. Fringe of forewing not white between the veins (http://tpittaway.tripod.com/china/m_spr.htm).

Extent of Damage/Status: Data deficient.

81 Lime Hawkmoth, *Mimas tiliae* (Linnaeus,1758)

Superfamily: Bomboicoidea
Family: Sphingidae
Subfamily: Smerinthinae
Synonyms: Sphinx tiliae Linnaeus,1758

Distribution: Europe and Northern Asia.Pakistan (http://tpittaway.tripod.com/sphinx/m_til.htm).

Species of oak infested: *Quercus* sp. (Mathur & Singh,1959)

Other Host Plants: Many species of Tilia, *Ulmus, Alnus* and *Prunus* (cherry, ornamental or wild). Minor Hostplants- In northern and central Europe, *Betula pendula, Quercus, Corylus avellana, Acer, Sorbus* (all of which may, in some places, become major hostplants, e.g.*Acer pseudoplatanus* in Berlin and Sorbus aucuparia in the Alps), *Malus, Pyrus* and *Fraxinus.* In southern areas of Europe also on *Juglans regia, Castanea sativa* and *Aesculus hippocastanum.* It has also been recorded from *Morus* spp. (http://tpittaway.tripod.com/sphinx/m_til.htm).

Habit: Larva defoliates (Mathur & Singh,1959).

Eggs: Oval in form, plump, with shining-pale green shell, about 1.75 mm. in length and 1.4 mm. in width (Tutt, 1902). Oval (1.75 x 1.40mm) and distinctly dorso-ventrally flattened, glossy, pale olive green (a tint imparted by its gum). Up to 130 may be deposited by each female, usually in pairs, on the underside of the leaves of its hostplant. If a tree is selected, the eggs are laid high in the crown (http://tpittaway.tripod.com/sphinx/m_til.htm).

Larva: The fully grown Lime Hawkmoth caterpillar has a maximum length of 65mm. Notable features of the caterpillar are the curved blue tail horn with hints of red and yellow on the underside. Beneath the tail horn is a small cluster of raised yellowy orange tubercles. The pre-pupating caterpillars are brownish grey, sprinkled with white tubercles. These pre-pupating caterpillars are commonly recorded in late summer on urban pavements lined with lime trees when wandering in search of a place to pupate. The pupae may be found buried just

below the surface of the soil beneath trees of the larval food plant. The pupae overwinter with the adult Hawkmoth emerging in May (http://www.wildlife insight.com/british-moths/lime-hawkmoth-mimas-tiliae/).

Pupa: The larva generally goes underground for pupation, Length 26-35 mm., width 8.5.-9.6 mm. Some pupae of both sexes have a brilliant shining black aspect, others a dull grey-brown appearance. The majority have more or less of this dull grey-brown muddy and muddled appearance (Tutt,1902). Pupa is 30-35 mm, very dark brown with a reddish tinge, rough and not glossy, unlike most sphingids. Pupation is normally at the base of the host-tree, under a loose mat of grass or, sometimes, damp, dead leaves and flat stones. Bare ground prompts most to wander off elsewhere, although light gritty soil will induce some to burrow 1-2 cm deep. Occasionally, pupae can be found high up in elm trees, wedged into cracks in the bark, or even under loose bark. The overwintering stage (http://tpittaway. tripod.com/sphinx/m_til.htm).

Adult: It is 56-71 mm in length. Wingspan: 60-80 mm. Sexually dimorphic; a very distinct species, not confusable with any other sphingid of the area despite being highly variable. Sexual dimorphism marked: normally, the forewing ground colour is brownish in females and decidedly green in males, but there are many exceptions. The wing pattern is also very variable, the dark median band of the forewing being entire (*f. transversa* Tutt), narrowly interrupted (*f. tiliae*), or completely absent (*f. obsolete* Clark). Gynandromorphs are also quite common. Sexual dimorphism is also evident in body-shape: the female abdomen is straight and fat because most eggs are already fully formed when the female emerges, as in all species of Smerinthini. The male abdomen, on the other hand, is strongly curved and slender (Source: http://tpittaway.tripod.com/sphinx/m_til.htm).It has a wingspan of up to approximately 80 mm and flies in a single generation from May to July in northern regions with a second generation in warmer parts of its range. Despite having variable brown and green ground colouring to the forewings it's an easily recognisable species. Females generally having a brown ground colour to the forewing while males tend to be greener. The central, irregular shaped, dark bar is commonly broken but may becomplete or occasionally absent. Adult Lime Hawkmoths don't feed. Both males and females are attracted to light. The normally browner females can be reliably identified by their swollen and straighter abdomen when compared to the slimmer and upward curving abdomen of the males (http://www. wildlifeinsight.com/british-moths/lime-hawkmoth-mimas-tiliae).

(a) larva **(b) Adult**

(source: http://tpittaway.tripod.com/sphinx/m_til.htm)

Fig.94. *Mimas tiliae*(Linnaeus,1758)

Biology: The eggs appear to be normally fastened to the underside of the leaves of the food plant, either singly or in pairs; eggs laid on lime leaf fastened by a tenacious gum (Tutt,1902). The eggs are are attached to the underside of leaves of the foodplants. The larvae, like those of most hawkmoths have a prominent curved "horn" on the anal segment. When in the first instar this horn is almost as long as the body, but becomes progressively shorter and thicker with each successive moult. When fully grown the larva is pale green, and covered with tiny yellowish tubercles, giving it a very rough texture. The horn is blue, and there are a series of diagonal whitish stripes along each side of the body. The larva is very well disguised, with the stripes perfectly simulating the veins of the leaves among which it rests. When ready to pupate the larva changes colour to a dull earthy brown, and wander down the trunk of its lime or elm tree, whereupon it burrows a centimetre or two into the soil and excavates a cell which it lines with a few strands of silk. Sometimes the pupa is formed on the surface of the ground, among mosses. It can occasionally be found in crevices in the bark of the trees. It is a dull reddish-brown colour, with a rough texture. The adult emerges from the pupa in May or June, usually at about midday, and climbs up a nearby stem or tree trunk, where it hangs for about an hour as it inflates and dries it's wings. Males take flight at dusk the same evening to search for females, which do not themselves make any attempt to fly until mated. During the daytime the moths rest on the stems of bushes, or on the branches of trees. Both sexes will enter buildings, attracted by house lights. The Lime hawkmoth produces several beautiful colour forms. Some are patterned entirely in shades of green; others have green markings on a buff ground colour; and others have a brick red ground colour and red forelegs (http://www.learnaboutbutterflies.com/Britain%20-%20Mimas%20tiliae.htm).

Extent of Damage/Status: Data deficient.

82. Common Gliding Hawkmoth, *Ambulyx sericeipennis agana* (Jordan, 1929)

Superfamily: Bomboicoidea
Family: Sphingidae
Subfamily: Smerinthinae
Synonyms:
A.brunnea (Mell,1922)
A.reducta (Mell,1922)
Oxyambulyx sericeipennis agana Jordan,1929
Oxyambulyx amaculata Meng,1989

Distribution: From northern Pakistan and northern India [Nainital district-Uttarakhand (Smetacek et.al.,2008); Sikkim, Assam (Jordan,1929)], eastwards across Nepal, Bhutan, Burma/Myanmar, Thailand, Laos, Cambodia and Vietnam to central and southern China, including Taiwan (http://tpittaway.tripod.com/china/a_ser.htm); Bhutan (Checklist of Bombycoidea of Bhutan).

Species of oak infested: Quercus sp. (Mathur & Singh,1959).

Other Host Plants: Recorded from *Juglans regia, Engelhardia spicata*, *Elaeocarpus, Quercus, Myrica nagi, Betula alnoides and Rhus* (Bell & Scott,1937); defoliates *Buchanania latifolia, Engelhardtia spicata, Rhus insignis and Xylia dolabriformis* (Beeson,1941);

Habit: Larva defoliates (Mathur & Singh,1959)

Eggs: Pale green when first laid, turning after a few days to a beautiful orange, and then, a day or two before hatching, to translucent white. Slightly oval, surface is smooth and shiny. Usually laid on the underside, but sometimes on the upper side of a leaf, or on twigs of the hostplant (Bell & Scott, 1937).

Larva: Full-fed 80 mm long, 12 mm wide; horn 12-16 mm. There are several colour forms. In colour, head bluish-green, the tubercles white. A narrow white stripe runs along each side of the dorsal line from the vertex to the clypeus apex, and there is a broad white cheek-stripe. Vertex processes pale yellow, with a white subdorsal stripe running from each process to the nape and then joining the subdorsal line of tubercles on the body. Body is bright bluish-green, paler below the spiracles, the row of tubercles yellow. The subdorsal dorso-lateral line of tubercles and those forming the oblique lateral stripes is yellow. There is also a narrow supraspiracular stripe on segments 2 to 4 which meets the oblique lateral stripe on segment 5 at its lower end; this is also yellow. Horn green, with the tubercles is paler green. Legs reddish with a black ring on each segment; prolegs and claspers green (Bell & Scott,1937).In another form of the larva the transverse rows of tubercles are white, those forming subdorsal and oblique lateral stripes mauve; the supraspiracular stripe is also mauve. In a third form the head-processes and the dorsal stripe down back of the head is brown. The dorso-lateral line of tubercles and supraspiracular stripe is whitish, with a broad, irregular, purple-brown band between them and below them on to broad triangular

blotches of brown and purple above each oblique lateral stripe, which is orange. Horn is dark purple. Legs, prolegs and a large triangle on claspers is brown. There are still other forms intermediate between the above. Spiracles oval, sky blue, with a raised edged to the central slit and a narrow border of paler blue (Bell & Scott,1937).

(http://tpittaway.tripod.com/china/a_ser.htm)
Fig.95.-*Ambulyx sericeipennis agana*(Jordan,1929)

The larva lies on the underside of a leaf and adopts the characteristic attitudes of the genus Ambulyx. When full grown it rests without feeding for four or five days before leaving the hostplant to seek a place to pupate and the dorsum becomes suffused with violet. If touched during this resting period, or while on the ground looking for soft earth to dig in, it jumps violently, bending the head to one side till it touches the claspers and then suddenly to the other side. The movement is so vigorous that the larva sometimes jerks itself off the hostplant on to the ground (Bell & Scott,1937).

Pupa: 51 mm in length, closely resembles others in the genus. Pupation takes place in a cell underground, smoothed and lined with silk. The pupal stage lasts from about three weeks, to many months in the case of hibernating pupae (Bell & Scott,1937).

Adult: Wingspan: 95-124 mm. Similar to Ambulyx maculifera but greyer and the submarginal band of the forewing upperside extends to the costal and anal margins, whereas it fades before meeting the anal margin in Ambulyxmaculifera. Tergum A8 of the male is weakly bi-sinuate, with a dark patch dorsally. There is a distinct mesial line in both sexes. Underside a deep chrome colour(Source: http://tpittaway.tripod.com/china/a_ser.htm). On the whole larger than *A. s. sericeipennis.* Underside of both wings pale yellow, brick red, particularly in outer half process (uncus) of anal tergite narrower, its apical portion as seen from the side wider vertically; dentate ridge of Harpe somewhat larger (Bell & Scott,1937).

Extent of Damage/Status: Data deficient.

83. Eyed Hawkmoth, *Smerinthus ocellata* (Linneus,1758)
Superfamily: Bomboicoidea
Family: Sphingidae
Subfamily: Smerinthinae
Subspecies : *S. o.atlanticus* (Austaut,1890); *S.o. flavescens* Neumoegen,1930 & *S. o.ocellata* (Linnaeus,1758).
Synonyms:
Smerinthus ocellatus (Linnaeus,1758)
Sphinx ocellata Linnaeus,1758
Sphinx semipavo Retzius,1783
Sphinx salicis Hübner,1796
Smerinthus ocellata cinerascens Staudinger, 1879.
Distribution: Europe and Northern Asia across the southern Urals to Novosibirsk and Krasnoyarsk, and western Mongolia and northern Xinjiang Province (China). (http://tpittaway.tripod.com/sphinx/s_oce.htm). Northern India.
Species of oak infested: *Quercus sp.* (Mathur & Singh,1959).
Other Hostplants: *Populus nigra, Salix caprea, Salix viminalis, Populus italica, P. treinula, Primus spinosa, Pyrus communis, birch, rarely, Salix triandra, Cydonia vulgaris, Primus padus, Perska vulgaris, Amygdalus communis,* wild crab, *Salix repens, Populus alba* (Tutt, 1902); Mainly species of *Salix, Populus* and *Malus.* Other than that*Betula, Alnus, Prunus, Tilia, Ligustrum* and *Viburnum.* Amongst the Prunus complex, *Prunus spinosa* is frequently taken, whereas *Prunus avium*, *Prunus dulcis* and *Prunus persica* are less favoured. In London, commonly found on the ornamental *Prunus laurocerasus* (cherry laurel) (http://tpittaway.tripod. com/sphinx/s_oce.htm); *Salix fragilis, S. alba, S. viminalis, S. caprea, S. aurita, S. cinerea, S. myrsinifolia, S. phylicifolia, Betula, Populus tremula, Malus domestica, Prunus padus, Pyrus communis, Viburnum opulus , Alnus glutinosa, A. incana,* Pear, plum, apple and poplar(http://insecta.pro/ taxonomy/2850).
Habit: Larva defoliates (Mathur & Singh,1959).
Eggs: Oval, very shiny, pale green (1.6 x 1.4 mm), becoming greyish white prior to hatching. Laid singly or in pairs beneath leaves not more than 2 m above the ground (http://tpittaway.tripod.com/sphinx/s_oce.htm).
Larva: Full-fed: 70-80 mm in length. Dimorphic: bluish green or apple-green. On hatching, the young larva is about 5 mm long, whitish green, with a pale pink horn. It clings tightly with all legs to a vein on the underside of a leaf. In the second instar, pale lateral stripes appear, the head becomes dorsally pointed and, when not feeding, it rests in a typical sphinx-like posture, holding on with the last three pairs of prolegs only. When so positioned beneath a leaf, the larva is very difficult to detect due to its excellent counter-shading. With growth, a number of changes take place: the horn gradually changes from pink, through purple, to blue in the final instar; the counter-shading becomes more noticeable; the dorsal surface becomes

much paler than the ventral, with more of the prominent white or yellow tubercles; and the head eventually loses its pointed apex. Two colour forms are found: the commonest is bluish white with white lateral stripes and tubercles; the other, yellowish green with yellow markings and, occasionally, red blotches and stripe edging. Prior to pupation, all become suffused with brownish yellow before the larva wanders off to find a pupation site, which is usually some distance from the hostplant. Up to 80 per cent of larvae in a colony may perish in any one year due to parasitoids, such as *Microplitis ocellataeBouché.* In northern regions found from early June until September, but in southern regions from early May until early October in two broods which often overlap (http://tpittaway.tripod.com/sphinx/s_oce.htm).

Pupa: 35-41mm in length and glossy blackish brown. Thickset, anteriorly blunted and tapering posteriorly, in shape resembling that of *Laothoe populi* (Linnaeus,1758). Most are formed in an earthen cell 2-3 cm under the surface of the soil away from the hostplant. The overwintering stage (http://tpittaway.tripod.com/sphinx/s_oce.htm).

(a)Larva **(b) Moth**

(source: http://tpittaway.tripod.com/sphinx/s_oce.htm)

Fig.96. *Smerinthus ocellata* (Linneus,1758)

Adult: 68-93 mm in length. Thorax and abdomen isdove-grey to fawn with a broad central velvety-brown dash on thorax. Anterior wings dove-grey or fawn, shaded, mottled, and streaked transversely with olive-brown, a dark outer marginal border, a small patch on inner side of transverse streak, a suffusion of central area strongest towards base and below the pale grey lunule; the posterior wings beautifully suffused with bright rose-pink from base for two-thirds towards margin; the ocellated spot consisting of a bluish-black pupil surrounded by bright blue, in turn enclosed by a broad black margin.

Sexual dimorphism: The female is decidedly larger than the male say as 85 mm. to 73 mm. The female is much heavier and, in

a set specimen, the male abdomen has. a concave margin, the female convex; this is more marked during life, when the male sits with the abdomen very markedly curved upwards. The male has larger and denser hairs on many parts, the thoracic dark crest stands up more markedly, but especially the legs are more roughly haired; this is very pronounced in the tibiae and first tarsal joints of the front legs. The first tibiae and spurs are more robust in the male. The male colouring is perhaps lighter and brighter, and the markings more crisply detailed than in the 2, but ndividual variation quite swamps any such distinction between any specimens taken at random. The antennae differ as in all other Sphinges, but the hairs on the male antennae are especially well-developed, so that the sexual difference is more marked than usual. The antennal joints 54 to 56 seem the same in both sexes (Tutt,1902).

Biology: Whilst small, the larva eats away both sides of a leaf of sallow or willow, leaving the midrib untouched, and using it as a resting-place. The larva, when small, as "resting" on the midrib or on one of the larger veins of the leaf, and having the power, like those of *Mimas tiliae* and *Sphinx ligustri* in their early stages, of dropping on a thread, if by any chance it loses its hold (Tutt,1902).A local species occurring year after year in a given area, while nearby localities, which may appear very suitable, never support a population. Even where present, numbers may fluctuate markedly from year to year due to the attentions of parasitic wasps, especially *Microplitis ocellatae* Bouché. Found in many different localities, especially disused railway cuttings overgrown with Salix spp., riverine shingle bars, wet river valleys, country lanes bordered by willows (*Salix* spp.), apple orchards, coastal sand-hills, and suburban gardens, up to 2000 m in the Alps. At rest, both sexes hang suspended amongst foliage, the cryptic forewing markings mimicking patterns on dead leaves, as with *Mimas tiliae.* Its form is further broken up by the slight projection of the hindwings above the forewing costa. Also, as in Mimas tiliae, pairing takes place in such situations, usually after midnight, the male often hanging freely beneath the female until dusk the following day. After separation, females commence egg-laying almost immediately, continuing over four or five nights, with maximum activity between dusk and midnight. When alarmed, resting adults exhibit a very effective defence mechanism: the body is hunched as the forewings are flicked upwards to reveal a pair of glaring 'eyes' each side of a narrow, beak-like abdomen. Following more disturbance, this startling 'face' is further enhanced: the forewings are repeatedly lowered and raised, causing a blinking effect to the eyes. If this does not succeed, then refuge is sought on the ground. As a non-feeding species, flowers hold no attraction; light, however, can often lure large numbers of males (http://tpittaway.tripod.com/sphinx

/s_oce.htm).

Flight-time: Univoltine in northern latitudes, from the end of May to early July; farther south bivoltine, during April/May and again in August. Occasionally trivoltine during April/May, June/July and August/September. In southern Urals, from mid June until mid July, with a partial second generation in early September (http://tpittaway.tripod.com/sphinx/s_oce.htm)

Extent of Damage/Status: Data deficient.

84. Coffee Clearwing Moth, *Cephonodes hylas*(Linnaeus,1771)

Superfamily: Bomboicoidea

Family: Sphingidae

Subfamily: Macroglossinae

Synonyms:

Sphinx hylas Linnaeus,1771

Macroglossa confinis Boisduval,1875.

Distribution: It is widely distributed in Asia, from northern Pakistan, India-Uttarakhand (Smetacek,2008), Nepal, Bhutan and Sri Lanka, east through Burma and China, to South Korea and southern Japan, then south and east through Thailand, Laos, Vietnam, Taiwan, Peninsular Malaysia, the Philippines and Indonesia as far as Borneo and Java. The single record from the southern Russian Far East is of a vagrant (http://tpittaway.tripod.com/china/c_hyl.htm); Angola, Central African Republic, Congo, Ethiopia, Gambia, Ghana, Guinea, Ivory Coast, Kenya, Madagascar, Namibia, Nigeria, Somalia, South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe. . (https://www.africanmoths.com/pages/SPHINGIIDAE/MACROGLOSSIDAE/cephonodes%20hylas.htm).

Species of Oak infested*Quercus* sp. (Mathur & Singh,1959).

Other Host plants: Recorded from *Gardenia jasminoidesin* Korea and coffee (*Coffea spp.*) in Yunnan, China. In Hong Kong, *Gardenia jasminoides, Catunaregam spinosa* and *Tarenna attenuata* are the preferred hosts. Common on ornamental *Gardenia jasminoidesin* the public parks of Hangzhou, Zhejiang. During the very hot summer months, plants growing in deep shade are preferred. Elsewhere also from *Adina, Haldina, Mitragyna, Mussaenda, Randia, Catunaregam, Wendlandia, Ixora, Pavetta* and *Hymenodictyon* (Source: http://tpittaway.tripod.com/china/c_hyl.htm) ; *Kraussia lanceolata, Gardenia augusta, Guettarda speciosa, Pavetta mollissima, Morelia senegalensis, Camthium bibracteatum, Burchellia, Vangueria* (https://ww w.africanmoths.com/pages/SPHINGIIDAE/MACROGLOSSIDAE/cephonodes%20hylas.htm).

Habit: Larva defoliates (Mathur & Singh,1959). The moths are rather slow in taking to the wing, but when they do so the flight is very rapid. They make a deep humming note when slightly alarmed, as do

Macroglossum moths. They are very active in the morning and evening and dart rapidly from flower to flower, as well as ovipositing on the wing. They are not attracted by light. Bred females do not readily attract wild males, but pair freely in captivity (Bell & Scott,1937).

(a) Larva

(a&b-Source: http://tpittaway.tripod.com/china/c_hyl.htm)

Fig.97-*Cephonodes hylas*(Linnaeus,1771)

Larva: The larvae are sluggish but eat very greedily and continuously. When molested they sometimes throw the head back over the dorsum until the mouth-parts are directed upwards and eject green fluid from the mouth. The body becomes suffused with brown before pupation (http://tpittaway.tripod.com/china/c_hyl.htm).

Pupa: It is 27-35mm long; breadth 10mm. Colour dark brown, the bevels of the free abdominal segments red-brown, spiracles dark brown and cremaster black. (Bell & Scott,1937). Pupation takes place in a rough cocoon on the surface of the ground amongst the foliage of the hostplant, or more rarely just under the surface of the earth. It is formed of leaves, earth particles etc., held

together by a few strands of silk. The pupa is not attached to the inside of the cocoon (http://tpittaway.tripod.com/china/c_hyl.htm).

Adult: Its wingspan of 45–73 mm. Its marginal borders are very narrow and black. Abdomen varies in colour from yellow to green. Nominate subspecies has bright reddish 3rd and 4th abdominal segments. Larva has two colour forms, green and blackish. In greenish form, body greenish with a white-bordered blue dorsal line and whitish sub-dorsal line ending in a yellow streak at base of horn. Head and spiracles are blue (Hampson,1892).

Extent of Damage/Status: Data deficient.

85. *Opogona iolychna* (Meyrick,1920)

Superfamily: Tineoidea

Family: Tineidae

Subfamily: Hieroxestinae

Synonym. *Hieroxestis iolychna* Meyrick,1920

Distribution: N.W. Himalaya.

Habit: Larva feeds on dead bark of *Quercus leucotrichophora*(Mathur & Singh,1959)

Extent of Damage/Status: Data deficient.

86. *Nemapogan diarthrota*(Meyrick, 1936)

Superfamily: Tineoidea

Family: Tineidae

Subfamily: Nemapogoninae

Synonym: *Tinea diarthrota* Meyrick,1936.

Distribution: N.W. Himalaya.

Habit: Larva feeds on dead bark of *Quercus leucotrichophora*(Mathur & Singh,1959)

Extent of Damage/Status: Data deficient.

87. *Tinea* sp.

Superfamily: Tineoidea

Family: Tineidae

Distribution: N.W. Himalaya.

Habit: Larva feeds on dead bark of *Quercus leucotrichophora*(Mathur & Singh,1959).

Extent of Damage/Status: Data deficient.

88. *Ephestiodes* sp.(*infimella* Ragonot, 1887?)

Superfamily: Pyraloidea

Family: Pyralidae

Subfamily: Phycitinae

Distribution: (Western Himalaya)Chakrata Forest Division, Uttarakhand on 22/05/2018.

Species of Oak Infested: *Quercus leucotrichophora* (Singh et al.2019)

Other Host Plants: An allied species of the same genus i.e. *Ephestiodes infimella* Ragonot,1887 is native to North America(Source: https://en.wikipedia.org/wiki/Ephestiodes_infimella) and feeds on wild cherry and Ambrosia sp. with adults on the wing from June to September (Stegmaier,1971) besides *Prunus* sp. & *Smilax rotundifolia* in theNeartic region (Robinson *et al*.,2010).

Description: The wingspan is about 11 mm. They have slender light brown forewings with yellowish shading in the basal third and darker reddish brown in distal two-thirds. The hindwings are much wider than the forewings and are pale gray with a brown terminal line and long pale fringe scales. Adults are on wing from June to September in Maryland (https://en.wikipedia.org/wiki/Ephestiodes_infimella).

(a)Larva inside folded leaves

(b) Larva (Dorsal view)

(c)Pupa

(d) Pupa inside cocoon

(e) Eaten leaf

(f)Emerged moths

(g) Moth (Dorsal view)

(h) Pinned specimen

Fig.98. Life history stages of *Ephestiodes* sp.(*infimella* Ragonot,1887?)on *Q. leucotrichophora*

Habits: Larvae feed by scratching &skeleonizing the leaf oak surface.Two pale coloured larvae (32 mm and a mass of 11 dark brown pupae (14-15 mm) with in interwoven leaves collected from Chakrata Cantonment Forest (N 30°44.623 & E77°52.293; 2610m). Four moths (24-32mm) emerged on 24 & 25.05.2018 in the laboratory at FRI,Dehradun. Moths were slender with light brown forewings with yellowish shading in the basal third and darker reddish brown in distal two-thirds. The hind wings were much wider than the forewings and were pale with a brown terminal line and having long pale fringe scales.

Extent of Damage/Status: Uncommon in Ban oak forests. Localized infestation.

89. *Salma* sp. (Walker,1863) **Family: Pyralidae**
Superfamily: Pyraloidea **Subfamily: Epipaschiinae**

(a)2ndinstar Larva

(b) Pupa

(c)Emerged moth

(d) Pinned specimen

Fig.99. Life history stage of *Salma* sp. (Walker,1863) of Ban oak, *Quercus leucotrichophora.*

Distribution: N.W. Himalaya.

Species of Oak Infested: *Quercus leucotri chophora.*

Other host plants: Host plants forgenus Salma in this region are mainlyof the family Combretaceae (*Terminalia &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. Larva (10mm)

collected on 27.vi.2018 while feeding on leaves of *Q. leucotrichophora* plantation in New Forest campus, Dehradun. Moulting into fifth instar larva took place on 05.vii.2018 (26m). Full grown fifth instar larva (35mm) formed into a shiny brown pupa (Fig.11 b) on 16.vii.2018. Emergence of moth (Wing span: 25mm) took place on 27.vii.2018 in the laboratory at FRI, Dehradun.

Extent of Damage/Status: Uncommon. Localized infestation.

90. Grapevine Leaf roller, *Sylepta lunalis* (Guenee,1854)

Superfamily: Pyraloidea

Family: Pyralidae

Synonyms:

*Botys lunalis*Guenee,1854.
Sylepta (Pramadea) lunalis. Hampson,1896.
Sylepta lunalis, Klima,1939.
*Botysthy asalis,*Walkar
Coptobasis incrassata, Warr.

(a) Larva **(b) Moth**

(a)source: http://agritech.tnau.ac.in/crop_protection/grapes_pest/grapes_4.html)

Fig.100. Adult- *Sylepta lunalis*(Guenee,1854)

Distribution: Throughout India (Beeson,1941), Ceylon, and Burma, Andamans, Borneo ; Celebes ; Sumbawa (Hampson,1896). Uttarakhand: Dehra Dun, Mussoorie; Maharastra: Bombay, Poona; Tamilnadu, Nilgiris; Karnataka, Kurg; West Bengal: Kolkata, Darjeeling; Meghalaya, Khasis; Andaman), Sri Lanka, Burma, Thailand, Vietnam, Cambodia, Laos, Taiwan, Philippines, Malacca, Sumatra, Nias, Java, Borneo, Celebes, Lombok, Sambawa, Papua, Hawaii (Christmas Island), South America (Venezuela) (Mandal & Bhattacharya,1980). Andaman & Nicobar Islands (Chandra & Kumar,1992).

Species of Oak infested: *Quercus leucotrichophora*(Beeson,1941).

Other Host Plants: *Helicteres isora, Lanata aculenta, Leea aspera, L. crispa, Melastoma crinita* and *Vitis vinifera* (Beeson,1941; Mandal & Bhattacharya,1980).

Habit and Habitat - The moths are nocturnal in habit and are found in abundance during the rainy season. The life of the adult is very short. The female moth normally dies in about 4 days after egg

laying. The eggs are laid singly on the ventral surface of the leaves. Rarely two or three eggs are laid together. The females prefer to lay eggs on the growing leaf buds which can be easily taken by the young caterpillars. They leave the skeletonized leaf rolls after consuming the foliage properly and travel to fresh and healthy leaves. The pupae remain hidden in the leaf rolls till the adult emergence. The emergence generally takes place during late night hours. Soon after emergence, the adults search for suitable match and mating takes place. Copulation does not take place during day or early night hours and usually happens late in the night or early morning hours (Mandal & Bhattacharya,1980).

Eggs: The egg are minute in size (0.59-0.72 mm long and 0.23-0.29 mm. wide) and cylindrical in size. When freshly laid, the egg is pearl white which soon gives a pale yellow shade and ultimately becomes dark before hatching. The chorion is transparent, soft and iridiscent with the micropilar suture at the apex. The incubation period varies from, 2 to 3 days depending on the season (Mathur,1970).

Larva: The larva is three quarter of an inch long with tufts of white hairs; it feeds gregariously and carries the skin of previous moult on the thorax behind the head (Beeson,1941).

Pupa: Immediately before pupation the full grown caterpillar throws out its gut contents by quick regurgitation and by passing excreta. The pupa remains secure in the roll of the leaf fastened to itself by silken thread from the spiny processes on fourth and fifth abdominal sterna. The general body colour of the newly formed pupa appears light brown. The wing buds and thoracic region are light green which two days after' pupation turns into dark brown colour. The pupa assumes a cylindrical shape and measures 13.19-16.07 mm. in length and 3.05-5.13 mm. across. The ninth abdominal segment is partly covered by the tenth which is produced in a long slender cremester. The male genital aperture is located on the tenth sternum. In female, the apertures of bursa copulatrix and oviduct are separately placed on eighth and ninth abdominal sterna respectively. The anal opening' in both the sexes is near the caudal margin of the tenth segment (Mathur,1970).

Pupal period: The duration of pupal period varies from 4 to 7 days. Before pupation the full grown larva ceases feeding, remains stationary for few minutes within the roll of the leaf and pupates there (Mathur,1970).

Adult: Underside with slight greyish suffusion; abdomen with slight segmental dorsal white bands towards extremity (Hampson,1896). The moth is dark grey with a light streak near the margin of forewing; expanse about one inch (Beeson,1941).The adult is a small moth having a wing span of 2.2-2.6 mm. The colour, of the body is dusky black. The head capsule is globular, cephalocaudally flat, compact with few

distinct scleristes and measures to 1.89-2.07 mm in width. The compound eyes are subglobular and extend beyond the level of fronto-clypeus. The lateral ocelli are prominent. Each antenna is composed of 69-71 segments. In male, the pedicel bears a tuft of hair which entirely absent in female. The last segment of the flagellum bears four sensory tubercles near the apex. The forewings are 10.9-13.9 mm long and 3.7-6.7 mm wide. The apices of the wings are broadly flat with long marginal pubescence. Dorsally each wing is covered with small dusky scales with a crescent white spot between first radius and third media. A retinulum is present at the base of media and cubitus on the ventral side. The hind wing is roughly triangular in shape and measures 8.7-11.1 mm long and 6.8-8.3 mm wide. The margins of the wings are adorned by small pubescence. On the dorsal surface of each wing, large numbers of small, white spots are unevenly distributed. The foretibia bears a long and pointed epiphyses while the tibia of the second and third legs are armed with a pair of unequal spinous spur at the distal end. The abdomen is elongated and tapers posteriorly; It is composed of ten segments, the last few undergo modifications to form, genitalia. Abdominal tip in female is slightly broader and robust than the male in which it is narrow and pointed (Mathur,1970). Abdomen mesially excised, ventro-laterally swollen with slight tufts of scales and distally tapering, and both wings with postdiscal line reaching the mid-dorsum (Mandal & Bhattacharya,1980).

Life cycle: The period required for one life cycle to complete varies from 21 to 34 days. The longivity of male and female adults varies from 2 to 3 and 3 to 4 days respectively (Mathur,1970).

It feeds during the rainy season June-October; the pupal period is 8-10 days (Beeson,1941).

Extent of Damage/Status: Data deficient.

91. *Heterocrasa expansalis* (Warren, 1896)

Superfamily: Pyraloidea

Family: Pyralidae

Distribution: N.W. Himalaya.

Species of Oak infested: *Quercus leucotri chophora* (Smetacek& Smetacek,2011),

Other host plants: *Malus pumila* (http://www.nhm.ac.uk/our-science/data/hostplants/search/list.dsml?PSpeciesqtype).

(source: https://www.flickr.com/photos/griffonsnest/6230377167/in/photostream/)

Fig.101. *Heterocrasa expansalis* (Warren,1896)

Description: Forewing ochreouse with a pink suffusion, which is strongest at base and along costa and inner margin; the two lines slightly darker, the first at one fourth, curved, the second at three fourth, nearly parallel to hind margin; a slightly darker discal spot; fringe concolorous. Hindwings ochreous, hardly tinged with pink but dusted with pale fuscous, with a faint submarginal darker line. Head, face, thorax and abdomen ochreous, more or less tinged with pink, the patagia pink. Underside is like upper, but the forewings darker, being dusted with fuscous. Expanse of wings: 40-48 mm.
Extent of Damage/Status: Data deficient.

92. *Enarmonia disperma* (Meyrick, 1931)
Superfamily: Tortricoidea
Family: Tortricidae
Subfamily: Olethreutinae
Distribution: N.W. Himalaya.
Species of oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959).
Habit: Larva defoliates (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

93. *Eucoma dryocarpa* (Meyrick, 1925)
Superfamily: Tortricoidea
Family: Tortricidae
Subfamily: Olethreutinae
Distribution: N.W. Himalaya.
Species of oak infested: *Quercus floribunda* (Mathur & Singh,1959).
Habit: Larva bores in acrons (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

94. *Tortix s*p.
Superfamily: Tortricoidea
Family: Tortricidae
Distribution: N.W. Himalaya.
Species of oak infested: *Quercus semecarpifolia*(Mathur & Singh,1959).
Habit: Larva defoliates (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

95. Barred Fruit Tree Tortrix- *Pandemis cerasana*(Hubner,1786)
Superfamily: Tortricoidea
Family: Tortricidae
Subfamily: Tortricinae
Synonyms:
Pandemis ribeana
P.grossulariana (Stephens,1829)
P.obscura(Schöyen,1882)
Pandemis balticola Strand,1917
Pandemis balticola Strand,1917
Lozotaenia grossulariana Stephens,1835
Tortrix obscura Schöy,1882
*Tortrix ribeana*Hübner,1797
Pandemis transiens Dufrane,1957

Distribution:*Pandemis cerasana* is widely distributed in the Palearctic from Western Europe to Asia. In North America it has been introduced to the Pacific Northwest. The first North American records are from British Columbia in 1965 (http://idtools.org/id/leps/tortai/ Pandemis_cerasana.htm).Europe to Asia Minor, Siberia, China, Mongolia, Korea and Japan (https://web.archive.org/

web/20160304201412/http://wbd.etibioinformatics.nl/bis/ tortricidae.php?selected=beschrijving&menuentry=soorten&id=248)

Species of oak infested: *Quercus sp.* (Mathur & Singh,1959) and *Quercus leucotrichophora.*

Other Host plants: The larvae are polyphagous, occurring on many trees and shrubs including apple (*Malus*), pear (*Pyrus*),cherry and plum (*Prunus*), currant (*Ribes*), blackberry and raspberry (*Rubus*), hazelnut (*Corylus*), *Abies, Alnus, Acer, Betula, Crataegus, Fraxinus, Ribes, Rhamnus, Rosa, Salix, Sorbus, Picea, Tilia, Ulmus* and *Vaccinium*, also a pest in tea plantations (*Camellia*) (https://web.archive.org/web/20160304201412/http://wbd.etibioinformatics.nl/bis/tortricidae.php?selected=beschrijving&menuentry=soorten&id=248)

Habit: Larva defoliates.Larvae were collected from Makkumath,Rudraprayag, district, Uttarakhand on 27.x.2017 (13-24mm) infesting young shoots of *Quercus leucotrichophora;* Pupation took place on 13&15/22.xi.2017 (10mm) and emergence of moths (wing span :3.8mm) on 05.xii.2017 in Lab at FRI,Dehradun.

Egg: Each egg is about 1 mm in diameter (https://www.cabi.org/isc/datasheet/42396).

(a)Larva

(b) Pupa

(c)Emerged moth

(d)Moth (Dorsal view)

Fig.102. Life history stages of *Pandemis cerasana*(Hubner, 1786) on *Q.leucotrichophora*

Larva: Late instar larvae are entirely green and unmarked with moderately large pinacula and long setae. Head and prothoracic shield are light green to yellowish green with black posterolateral markings. The spiracles on the prothorax and eighth abdominal segment are 2-3 times the diameter of other abdominal spiracles. A well developed anal comb is present with 6-8 teeth (http://idtools.org/id/leps/tortai/Pandemis_cerasana.htm).

Late instar larval length: 16 mm. Head: Pale green frons. Capsule; yellowish brown with light green tints. Mouthparts are dark brown. Black postero-lateral mark. Stemmatal area is black. Prothorax: Translucent apple green. Prothoracic shield; pairs of black spots and, laterally, black crescent. Thoracic legs: Translucent pale green with yellowish tarsus. Body: Translucent apple. Contractile dorsal vessel shows as darker dorsal line. Integument may be coloured to suggest indistinct lighter subdorsal band and darker lateral band. Spiracles: Whitish green with fine pale brown peritreme. Largest on A8 & T1. Pinacula: Concolorous, unobtrusive. Setae: Translucent colourless. Anal plate: Light green. Prolegs: Concolorous. Crochets light brown (https://ukmoths.org.uk/species/pandemis-cerasana/).

Adult: Wing-span:6-24 mm. (https://www.cabi.org/isc/datasheet/42396). Forewing length: 0.8-1.2 mm. Adults are straw to light brown with fasciate marking and grayish-brown hindwing. This species can be separated from others by the grayish-brown hindwing and dark scales on the second abdominal sternite in the male (http://idtools.org/id/leps/tortai/Pandemis_cerasana.htm).

Male: Frons and labial palpus varying from dark brown to light brown, sometimes with greyish white admixture; labial palpus paler interiorly. Antenna weakly dentate-ciliate, with notch near base, flagellum whitish ochreous posteriorly, segments indistinctly barred with brown. Costa of forewing without costal fold, curved outwards in basal half; dorsum strongly curved at base, then slightly concave. Forewing ground colour varying from pale ochreous-yellow to greyish brown (sometimes with an olive tint), weakly strigulateddistally; markings pale brown, edged with chestnut-brown; outer margin of basalfasciae sinuous, slightly oblique, median fascia strongly oblique. Ciliais darker than ground colour. Hindwing is almost uniform greyish brown; cilia whitish (Bradley et al., 1973).

Female: Antenna sparsely ciliate, without notch, scaling of flagellum as in male. Forewing colouration and markings as in male (https://web.archive.org/web/20160304201412/http:// wbd. etibioinformatics.nl/bis/tortricidae.php?selected=beschrijving&menuentry=soorten&id=248).

Biology: Moths occur from June to August. The egg batches are deposited on the leaves or branches, some hatchingafter a few weeks but others not until the spring. Young summer larvae feed on the foliage for a short time and then, whilst still small, spin silken retreats on the twigs, in which they overwinter. Activity recommences at bud burst, when overwintered eggs also hatch. Larvae feed in a rolled or folded leaf until May or early June

and then pupate in a whitish cocoon spun in the larval habitation or in a folded leaf (Alford, 1984; Alford, 1995). Just before emergence of the adult the pupa protrudes from the cocoon (https://web.archive.org/web/20160304201412/http://wbd.etibioinformatics.nl/bis/tortricidae.php?selected=beschrijving&menuentry=soorten&id=248). September to May, the larva feeds in rolled or folded leaf on many deciduous trees, including fruit trees (https://ukmoths.org.uk/species/pandemis-cerasana/).

In Europe, *P. cerasana* completes one or two generations per year. Adults are present June-July for the first generation and August-September for the second generation. Females deposit eggs in masses on the upper surface of leaves or on branches. Some eggs hatch in late summer; others overwinter and larvae emerge the following spring. Larvae that emerge before winter construct a hibernaculum in the 2nd or 3rd instar. Larvae feed on leaves in the spring and pupation occurs in the final larval feeding site (http://idtools.org/id/leps/ tortai/ Pandemis_cerasana.htm).

Extent of Damage/Status: Wide spread and common in ban oak forests. Minor.

96. *Pandemis dumetana* (Treitschke, 1825)

Superfamily: Tortricoidea

Family: Tortricidae

Subfamily: Tortricinae

Synonyms:

Tortrix crataegana Frey,1832

*Pandemis gravana*Caradja,1932

Distribution: It is found in China, South Korea, Japan, Russia, northern India, almost all of Europe, Asia Minor, Iran, southern Siberia and Transcaucasia (https://en.wikipedia.org /wiki/Pandemis_dumetana). It is somewhat scattered distribution between South-east and Northern England. It occurs both in damp fenland habitats, and drier, chalky habitats (https://www.ukmoths.org.uk/ species/pandemis-dumetana)

Species of Oak Infested: *Quercus leucotrichophora, Quercus* sp. (Mathur & Singh,1959).

Other Host Plants: The polyphagous larva feeds on a range of plants and trees, either in a rolled leaf, or sometimes in the flowers (Source: https://www.ukmoths.org.uk/species/pandemis-dumetana). The larvae feed on *Cerylus heterophyllus, Chenopodium album, Dictamnus dasycarpus, Fraxinus mandshurica, Glycine max, Juglans mandschurica, Lysimachia clethroides, Malus pumila, Mentha, Parthenocissus tricuspidata, Sanguisarba officinalis, Spiraea salicifolia, Thalictrum* and *Agastache rugosus.* They feed on the flowers and leaves of their host plants, living in a spun or rolled leaf. The species overwinters as a young larva in a silken chamber (https://en.wikipedia.org/wiki/Pandemis_dumetana).

(a)Larva **(b) Pupa** **c) Moth**

(Source: http://www.lepiforum.de/webbbs/media/f1_2012/71/71400_2.jpg)

Fig.103. Life history stage of *Pandemis dumetana*(Treitschke,1825)

Habits: Larva defoliates (Mathur & Singh,1959). Larva defoliates (Mathur & Singh1959). Larvae were collected from Makkumath,Rudraprayag, district, Uttarakhand on 27/10/2017 (13-24mm) infesting young shoots of Quercus leucotrichophora; Pupation took place on 13/15/22.11.2017 (10mm) and emergence of moths (wing span :3.8mm) on 05/12/2017 in Lab at FRI.

Eggs: Eggs are laid in groups (sheets) on leaves (https://www.biodiversitylibrary.org/page/32117365#page/115/mode/1up).

Adult: Wingspan- 20mm. (https://www.ukmoths.org.uk/species/pandemis-dumetana). The wingspan is 18–20 mm for males and 19–22 mm for females (https://en.wikipedia.org/wiki/Pandemis_dumetana).

Biology: Second instar larva develop in summer without estivation. Flight of moths occurs at end July-August. Oviposition and development of larva takes place in August-September until they enter hibernation (https://www.biodiversitylibrary.org/page/32117336#page/86/mode/1up).

Larvae of second instar hibernate in deposits of dry leaves. They are polyphagus and after emergence from hibernation, roll leaves of various arboreal plants with silky discharge and live in leaf clumps at apex of shrub. In the far East slightly damage strawberry. Pupation takes place in leaves. (https://www.biodiversitylibrary.org/page/32117365#page/115/mode/1up)

Extent of Damage/Status: Data deficient.

97. Oriental Fruit Moth, *Grapholita molesta* (Busck,1916)

Superfamily: Tortricoidea

Family: Tortricidae

Subfamily: Tortricinae

Synonyms:

Grapholita (Aspila) molesta (Busck,1916)

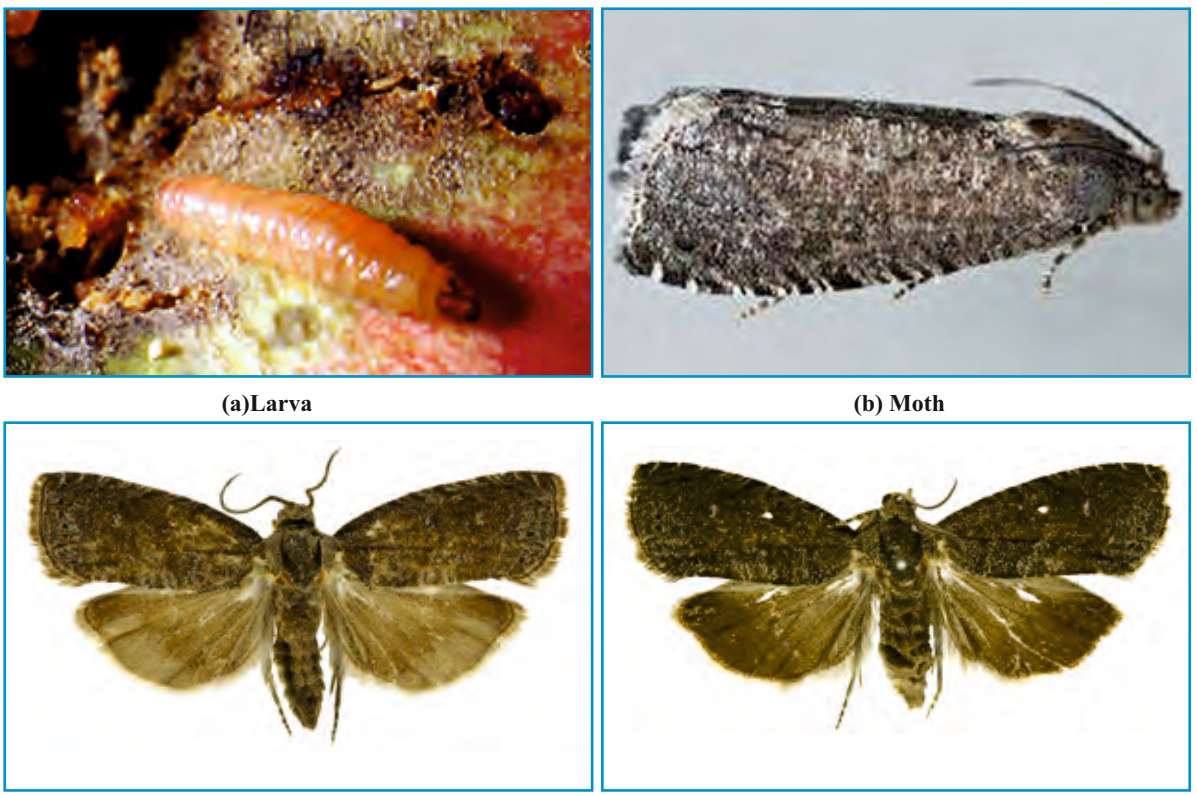
*Cydia molesta*Busck,1916

*Laspeyresia molesta*Busck,1916.

Distribution:*Grapholita molesta* is thought to have originated in northwest China. The first North American records are from 1913-1915. It is currently widely distributed on all continents where stone-fruit is grown (http://idtools.org/id/leps/tortai/Grapholita_molesta.htm).

This pest is native to north-west China, and

spread from Japan to Australia, central Europe, the east coast of the USA and Brazil at the beginning of the twentieth century. Since then the pest has been introduced into many other countries (Gonzalez, 1978) (https://www.cabi.org/isc/datasheet/29904).



(a)Larva **(b) Moth**

(c)Male Moth **(d)Female Moth**

(source: http://idtools.org/id/leps/tortai/Grapholita_molesta.htm)

Fig.104.*Grapholita molesta* (Busck,1916)

Species of Oak infested: *Quercus dilatata*(Mathur & Singh,1959).

Other Host Plants: It is an important pest of stone-fruit crops throughout the world. Most economic damage occurs in peach and nectarine, or when other fruit crops are grown adjacent to peach. In addition to the Rosaceae, larvae have been recorded feeding on plants in several families (http://idtools.org/id/leps/tortai/Grapholita_molesta.htm).*G.molestacauses* damage of varying importance on peaches, nectarines and apricots. The larvae of the first generation are mostly found in buds and shoots of peaches, but occasionally also on shoots of apricots, plums, almonds, cherries, apples, pears and quinces. In young trees when terminal twigs are attacked, several lateral shoots will appear below them and grow rapidly. Under severe and continued attack, the tree may become somewhat bushy. Severe attacks on the rapidly growing shoots of recently budded peaches result in crooked stems (https://www.cabi.org/isc/datasheet/29904).

Habits: Larva defoliates (Mathur &

Singh,1959).

Egg: The egg when first laid is translucent-white, later becoming yellow, slightly convex, round or slightly oval, measuring about 0.7 mm across (https://www.cabi.org/isc/datasheet/29904).

Larva: Last instar larvae are approximately 10-12 mm in length with a pinkish abdomen and large pale pinacula. The head and prothoracic shield are yellowish brown. The anal shield is light brown without mottling. An anal comb is present with ca. 5 teeth. Early instars are assumed to be whitish with a black head and prothoracic shield. Larvae may appear similar to those of many other species of *Grapholita* and *Cydia*. *Cydia pomonella* larvae can be separated from *G. molestaby* the absence of an anal fork. Other species of *Grapholita* cannot be reliably separated from G. molesta based solely on larval morphology (http://idtools.org/id/leps/tortai/Grapholita_molesta.htm).

The full-grown larva has a length of approximately 12 mm, and is pink to almost red. The head, the prothoracic notum and the anal plate are brown. A black anal fork (anal comb), above the anal opening, is present (https://www.cabi.org/isc/datasheet/29904).

Pupa: The cocoon is a protective covering for the full-grown larva and pupa. It is made of silken threads and particles of the objects on which it rests. The pupa is reddish-brown (https://www.cabi.org/isc/datasheet/29904).

Adult: Forewing length: 5.0-6.5 mm. Forewings are dull grayish brown with a row of black dots near the apex and termen. Male genitalia are characterized by an elongate valva with rounded cucullus. Female genitalia are characterized by rectangular lateral extensions of the sterigma with sharply pointed posterolateral projections. Adults are similar to other species of *Grapholita,* including *Grapholita funebrana, G. libertina, G.tenebrosana,* and several others. A genitalic dissection may be necessary to confirm species identity, especially if individuals are recovered from sticky traps. Males of *G. funebrana* can be distinguished by the thornlike projection off the ventral margin of the valva, which is lacking in *G. molesta* (http://idtools.org/id/leps/tortai/Grapholita_molesta.htm).

The adult has a wing span of 10-16 mm, and is dark-grey. When at rest, the wings are held in a roof-like position over the body, and the antennae are bent backwards over the wings. For exact identification, investigation of the genitalia is necessary (https://www.cabi.org/isc/datasheet/29904).

Extent of Damage/Status: Data deficient.

98. Unidentified Tortricidae Moth

Superfamily: Tortricoidea
Family: Tortricidae
Subfamily: Tortricinae
Distribution: Garhwal.
Species of Oak infested: *Quercus leucorichophora*

Habit: Larva defoliates.

Larva: Green coloured larvae (15-20mm) were collected on 28.xi.2018 feeding on foliage of *Quercus leucotrichophora* in ban oak plantation of New Forest Campus (640 m), Dehradun, Uttarakhand. Larvae fed by

skeletonizing the oak leaves by only eating soft tissues on the both sides of the leaf. Larvae died on 08.ii.2019.

Extent of Damage/Status: Localised infestation of minor significance.

(a)Larva feeding on ban oak leaf (b) Larva (Dorsal view) (c)Feeding pattern of larva

Fig.105. Unidentified tortricid larva

99. *Dichomeris quercicola* (Meyrick, 1921)

Superfamily: Gelechioidea
Family: Gelechiidae
Subfamily: Dichomeridinae

Distribution: It is found in Northern India, Mongolia, Transbaikalia, south-eastern Siberia, China (Beijing, Shaanxi, Hunan, Jiangxi), Korea and Japan (Funet.fi).

Species of oak infested: *Quercus leucotrichophora* (Beeson,1941).

Habits: Larva feeds on leaves (Mathur & Singh,1959).

Female: 17 mm. Head, thorax light yellow-ochreous, on tliorax a grey dorsal line, shoulders narrowly grey. Palpi second joint dark grey speckled whitish, tuft very long, apical edge whitish-ochreous, terminal joint longer than second, whitish, anterior edge black. Forewings ratlier narrow, termen slightlj- rounded, oblique; light yellow-ochreous; a narrow grey streak on basal fourth of costa; stigmata blackish, discal approximated, plical somewhat before first discal ; an oblique interrupted grey streak crossing disc between plical and first discal stigmata; a very irregular transverse lino across second discal from an elongate spot on costa; some irregular grey irroration and suffusion towards costa and dorsum except anteriorly, and in disc posteriorly ; an irregular grey streak along termen : cilia light yellow-ochreous. Hindwings whitish-grey, veins and apex grey; cilia whitisli-grey (archive.org).

Extent of Damage/Status: Data deficient.

100. *Telphusate tragrapta* (Meyrick, 1937)

Superfamily: Gelechioidea
Family: Gelechiidae
Subfamily: Gelechiinae

Distribution: Western Himalayas.

Species of oak infested: *Quercus leucotrichophora* (Beeson,1941)

Habits: Larva defoliates (Mathur & Singh,1959).

Extent of Damage/Status: Data deficient.

101. *Agonopterix taciturna* (Meyrick, 1910)
Superfamily: Gelechioidea
Family: Elachistidae
Subfamily: Depressariinae
Distribution: Western Himalaya-Simla,Himachal Pradesh, India (archive.in), Regions of the Russian Federation: the Lower Amur, Seaside, Mid-Amur, South Kuril (Catalog of Lepidoptera,2008).
Species of oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959).

(a)Moth (Dorsal view) **(b) Pinned specimen**

(source: http://www.jpmoth.org/Depressariidae/Depressaria_taciturna.html)
Fig. 106. *Agonopterix taciturna* (Meyrick,1910)

Habit: Larva bores in green shoots (Mathur & Singh,1959)
Description: Male & female 24-25 mm. Head and thorax light brownish. Palpi brownish sprinkled with whitish, basal of second joint, and basal and supramedian bands of terminal joint dark fuscous, sometimes almost wholly suffused with dark fuscous except apex of terminal joint. Antennae is fuscous, Abdomen is light greyish-ochreous more or less suffusedly irrorated with fuscous and dark fuscous. Forewings elongate, slightly dilated posteriorly, costa gently arched, apex rounded, termen obliquely rounded; 2 rather widely remote; brownish, sprinkled with darker, costal and terminal areas sprinkled with fuscous-whitish; two indistinctly indicated oblique darker streaks from costa towards base, apex of second more or less marked with dark fuscous; first discal stigma indicated by an oblique dark fuscous mark,sometimes followed by some fuscous-whitish scales, second by a fuscous- whitish dot, edged with some darker scales; these are connected by an indistinct streak of darker suffusion, extending more or less beyond second; a more or less developed sometimes interrupted similar streak along posterior half of submedian fold; a somewhat darker curved subterminal line, on which the veins are indicated by scattered dark fuscous scales; a series of cloudy dots of dark fuscous irroration round apex and termen: cilia light brownish sprinkled with darker, towards tips sprinkled with whitish. Hindwings pale fuscous, darker posteriorly ; cilia pale fuscous, with darker subbasal line (archive.in).
Extent of Damage/Status: Data deficient.

102. *Promalactis catathiscias* (Meyrick, 1937)
Superfamily: Gelechioidea
Family: Oecophoridae
Subfamily: Oecophorinae
Distribution: N.W. Himalaya

Species of oak infested: *Quercus leucotrichophora*(Mathur & Singh,1959)
Habit: Larva feeds on dead bark (Mathur & Singh,1959)
Extent of Damage/Status: Data deficient.

103. *Endoclita damor* (Moore,1860)
Superfamily: Hepialoidea
Family: Hepialidae

Synonyms:
Phassus damor Moore,1860
Endoclita similis Felder,1874
Phassus similis Felder,1874

(a)Male moth **(b) Female moth**

(source: http://johngrehan.net/index.php/hepialidae/endoclita)

Fig. 107. *Endoclita damor* (Moore,1860)

Distribution: India (Nielsen et.al.,2000) [Darjeeling-West Bengal (Horsfield and Moore,1858-59); Mussoorie-Uttarakhand, and Kangra Valley Himachal Pradesh; Nepal (Kathamandu, Janakpur, and Godavari Forest] (Grehan and Ismavel,2017).
Species of oak infested: *Quercus sp.* (Mathur & Singh,1959).
Other host plants: *Albizia, Altingia, Cinchona, Coffea, Erythrina, Eugenia, Glochidion, Manglietia, Nyssa, Schima, Tectona, Tetradium* and *Theobroma*(https://wikivisually.com/wiki/Endoclita_damor).
Habit: Larva defoliates (Mathur & Singh,1959).

Adult: Brown; fore-wing with numerous indistinct transverse greyish undulated lines, a large irregular-shaped dark ferruginous-brown greyish-margined discal mark, disposed transversely from near the base, then along the disc, where it widens; its anterior margin is defined by a recurved silvery-grey line, at the end of which apically is a narrow dark-brown streak: hind-wing with some grey and brown indistinct spots about the apex; thorax grayish brown, the sides dark ferruginous-brown. Expanse 8.3 cm. (Horsfield and Moore,1858-59).Antennae sparsely clothed with hairs,

cylindrical, short, tapering with about 22 segments. Labial palpi reduced, composed apparently of a single segment, with some indications of a second marked by a line and not articulated, Posterior legs of male with tibiae clothed with a large tuft of specialized hairs. Forewings with Se1 present as a branch to the costa: often a lobular expansion opposite Se1 (not evident in genotype); R1 forking with R8 well before the middle of wing – R4 and R5 forked; Cu2 becoming obsolete at one half; Pen and IV anastomosing beyond middle and extending to margin; 2V present near base. Hindwings with Sc unbranched. R1 from well before middle (Tindait,1941).Body and wings are predominantly pale brown with faint crescent-shaped transverse markings, a region of darker oblique banding in the basal region, and a longitudinal, finger-like band extending from near the central costal margin towards, but not meeting, the outer margin. This latter feature is distinctive for the species (Grehan and Ismavel,2017).

Extent of Damage/Status: Data deficient.

104. *Ypsolophus* sp.
Superfamily: Yponomeutiodea
Family: Plutellidae
Distribution: N.W. Himalaya

Species of oak infested:*Quercus semecarpifolia*. (Mathur & Singh,1959).
Habit: Larva defoliates(Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

105. Unidentified Drepanindae Moth
Superfamily: Drepanoidea
Family: Drepanindae

(a)Larva **(b) Pupa**

Fig. 108.Unidentified drepanoid larva

Distribution: N.W.Himalaya.
Species of oak infested: *Quercus semecarpifolia.*
Habit: Larva defoliates(Mathur & Singh,1959). Afinal instar, brown colouredlarva (26 mm) with tapering end was collected on 16.vii.2020 feeding on foliage of *Quercus leucotrichophora* in ban oak forest in Chakrata Forest Division (2087m),Uttarakhand. Larva fed on the leaf margins of mature oak leaves. The larva underwent pupation on 20.vii.2020. Pupa (15 mm) is yellowish in colour and attaching to the upper side of the eaten leaf with the help of woven silken threads. Moth failed to emerge.
Extent of Damage/Status: Uncommon in Ban oak forests. Minor significance.

106. Unidentified Moth -1
Distribution: Garhwal
Species of Oak Infested: *Quercus leucotri chophora.*

Habit: Larva defoliates.

(a)2nd instar larva (b)4th instar larva (c) 5th instar larva

Fig. 109. Different stages of unidentified larva

Larva: Three second instar, light green colouredlarvae (length 13-16 mm) were collected on 23.ix.2019 feeding on the tender leaves of *Quercus leucotrichophora* in ban oak plantation of New Forest Campus (640 m), Dehradun, Uttarakhand. Young larvae fed on leaf margins whereas mature larvae consumed the entire leaf. The larvae underwent moulting into third instar on 04.x.2019, fourth instar on 20.xi.2019 and final instar on 10.i.2020 and one larva pupated on 18.iv.2020.
Pupa: Pupal length is 33 mm and brown in colour. Pupa died on 23.vi.2020.
Extent of Damage/Status: Data deficient.

107. Unidentified Moth -2
Distribution: Garhwal
Species of Oak Infested: *Quercus leucotrichophora.*

Habit: Larva defoliates. Outbreak by this moth was observed in Bataghat area (N-30.453823 - 30.455893; E-78.122145 - 78.127483; 2100-2200m), Mussoorie,

Dehradun District, Uttarakhand during April-June 2016. The outbreak lasted for 2 months but subsided naturally during the rainy season.

(a)Larva (b) Defoliated twigs of ban oak

Fig. 110. Larva and defoliated ban oak foliage

Extent of Damage/Status: Data deficient. Caused significant loss to ban oak forests in pre-monsoon season of 2016.

108. Unidentified Moth -3

Distribution: Garhwal

Species of Oak Infested: *Quercus leucotrichophora.*

Habit: Larva defoliates.

(a)4th instar Larva (b) 5th instar larva (Lateral view (c) Larva (Dorsal view)

Fig 111. Different stages of unidentified larva

Larva: Fourth instar, browncolouredlarva of length 30 mm was collected on 09.iv.2019 feeding on the tender leaves of *Quercus leucotrichophora* in ban oak plantation of New Forest Campus (640 m), Dehradun, Uttarakhand. Larva was feeding on the leaf margins and tips of ban oak leaves. The larvae underwent moulting into final instar on 10.iv.2019 and underwent pupation on 27.iv.2019.

Pupa: Pupal length is 21 mm and brown in colour. Pupa died on 27.v.2010. Another browncolouredlarva (30 mm) was collected on 09.iv.2019 feeding on the tender leaves of

Quercus leucotrichophora in ban oak plantation of New Forest Campus. Larva fed on leaf margins. The larva underwent moulting on 10.iv.2019 but died on 14.iv.2019.

Extent of Damage/Status: Uncommon and localized.

109. Unidentified Moth -4

Distribution: Garhwal

Species of Oak Infested: *Quercus leucotrichophora.*

Habit: Larva defoliates.

Larva: One light green coloured larva with 2 red dots on the forehead (20 mm) was collected on 28.viii.2019 feeding on the foliage of *Quercus leucotrichophora* in ban oak forest of Chakrata Forest Division (2087 m), Uttarakhand. The larva fed on leaf margins but died on 04.ix.2019.

Extent of Damage/Status: Uncommon and localized.

(a)Larva (lateral view) **(b) Larva (Dorsal view)**

Fig. 112. Unidentified larva

110. Unidentified Moth -5

Distribution: Garhwal

Species of oak Infested: *Quercus leucotrichophora.*

Habit: Larva defoliates.

Larva: A final instar larva (15-25mm) was collected on 31.viii.2018 feeding on foliage of *Quercus leucotrichophora* tree in a forest in Chakrata Forest Division (1825m), Uttarakhand.

Pupa: Chocolate coloured pupa (22 mm)wasformed on 10.ix.2018 on the surface of the wall of the plastic container in the laboratory at FRI, Dehradun and pupa died on 28.ix.2018.

Extent of Damage/Status: Uncommon and localized.

(a)Larva (b) Pupa

Fig. 113. Unidentified larva

111. Unidentified Moth -6

Distribution: Garhwal
Species ofOak Infested: *Quercus leucotrichophora.*
Habit: Larva defoliates.

(a)Larva feeding on ban oak leaf (b) Larva (Dorsal view)

Fig. 114. Unidentified larva

Larva: One larva (12 mm) was collected on 13.xi.2018 feeding on leaves of *Quercus leucotrichophora* in ban oak forest of Woodstock School, Mussoorie (1860 m), Uttarakhand. Larva was skeletonizing the tender ban oak leaves leaving only veins. The larva underwent moulting into final instar on 04.ii.2019 (16 mm) and died on 24.iii.2019.

Extent of Damage/Status: Common and localized.

b. Ropalocera (Butterflies): 7 species

112. The Pale Himalayan Oakblue, *Arhopala dodonaea* (Moore,1858)
Superfamily: Papilionoidea
Family: Lycaenidae
Subfamily: Theclinae
Synonyms:
Amblypodia dodonea(Moore,1858)
Narathura dodonea (Moore), Evans, 1957)
Narathurado donaea(Moore), D'Abrera, 1986)
Distribution: India (Jammu & Kashmir to Sikkim), Nepal, Pakistan, Afganistan (Kehimkar,2008).
Species ok oak infested: *Quercus leucotrichophora, Q. dilatata* (Wynter-Blyth,1957).
Habits & Habitat: Larva defoliates. Common in Mussoorie and in the interior valleys from April to June and again in September. The larva feeds on common hill oak, is attended by ants.(Mackinnon & De Niceville 1899). Much of the time is spend flying high around oak canopy or resting under oak leaves,partial to damp patches, but rarely seen on flowers,on the wing from April to July and August to October,flies between 1500-1880 m. (Kehimkar, 2008). This butterfly is common from March-July to October-November (Mussoorie, Aglar valley, Pangarana-Buddha Kedar- Tehri Garhwal; Khirsu,Pauri Garhwal) (Singh & Sondhi,2016).

(a)Adult (Underside) **(b) Adult (Upperside)**

Fig. 115. Arhopala dodonaea (Moore,1858)

Adult: Wingspan: Male & Female: 40-48 mm. Hindwing with wedge-shaped tail. Underside of wings pale creamy brown with silky gloss and darker brown mottling and spots. Sexes are almost alike. In male, underside of wing light purple-blue with 4mm. black borders. Upperside of forewing is with border 6 mm. at apex, and tooth marking at end cell on underside of forewing. Underside of hindwing with 4mm. border,

and blackish veins. In female, underside of wings slightly paler blue with broader black borders (Kehimkar,2008).

Female: Upper-side, fore-wing with discoidal celland posterior base blue, palest in the centre of disc and intersectedby dark veinlets, the rest of wing dusky-brown ; hind-wing with centre, blue; outer margin brown ; anterior and abdominal margins paler. Under-side dark cream-colour ; fore-wing paler posteriorly, with an ill-defined band near outer margin, then a broad undulating band, and some spots of a darker shining tint ; hind-wing also with an ill-defined but more angulated band near outer margin, then two series of undulating lines, and also spots at base of wing. (archive.org).

Extent of Damage/Status: Locally common. Damage not significant.

113. Dark Himalayan Oakblue, *Arhopala rama* (Kollar,1844)

Superfamily: Papilionoidea

Family: Lycaenidae

Subfamily: Theclinae

Sub-species: *A. r. rama*

Synonyms:

Arhopala rama (Kollar,1844)

Thecla rama Kollar,1844

Amblypodia rama

Narathura rama

Distribution: India (Jammu & Kashmir to Sikkim), Nepal, Bhutan, Burma, Pakistan (Wynter-Blyth,1957).

Species ok oak infested: *Quercus leucotri chophora* (Wynter-Blyth,1957).

Habits & Habitat: Larva defoliates. This is the commonest oakblue in the north-west Himalayas, extending westward into much drier regions than those inhabited by any of the genus. Found in oak forest between 4000 and 9000 feet in May and June, and from late August to October. In the dry weather, before the rains, it swarms at water in shady nullahs and settles on the leaves of bushes and in grass nearby (Wynter-Blyth,1957).This species is addicted to wooded nullahs where there is running water and frequently settle on damp patches of ground and on the bushes round, also be found in oak woods and flying into gardens. The best season is before monsoon (Derhe-Philipe,1931). This common buttefly is found in June-July and September-November (Mandal-KanchulaKharak-KMDR) (Singh & Sondhi,2016). This butterfly is common in oak and sal forests at 610-2439 m. especially at Ramgarh and in Sarju valley from May to September (Hannyngton,1910).

Larva: It is triple brooded at least, the May brood being generally the largest. The larva feeds on the young leaves of the common oak. Larva is the usual lycanid shape, pink almost hairless and attended by ants. The larva are of the colour of milk and water till about half grown, when they become little greenish blue; just before they turn into a pupae, they become of a pink colour. The only marking is the dorsal stripe, which begins on the third segment, becoming wider to about 7th segment, when it narrows gradually to the 11th, on which it ends. These larva lie on the underside of new oak leaves, being exactly the same colour as the fluff on the leaves, they are very difficult to see.Larva

is always attended by black ants. The attending ant is always single and seemed to be occupied stroking the posterior end of the larva. The larva double down both edges of the leaf, station themselves on the midrib and eat from the tip backwards (Mackinnon, 1899)

Pupa: Brown with pink tinge (Mackinnon, 1899).

Description: *Arhopala rama* can be easily distinguished from other similar species like A. athada and *A. atrax* by the presence of a tail in the hind wing and not conspicuously lobed at tornus (Singh,2005). A.r.rama Kollar,1848 has underside markings dull and faint. Upper side, in male: border 1.5 to 2mm. Female border 4–7 mm and on hind wing blue colour just before end cell (Evans, 1932).Wingspan: 34-40mm (Kehimkar, 2008).

(a)Adult (Underside) **(b) Adult (Upperside)**

Fig. 116. *Arhopala rama* (Kollar,1844)

Adult: Hindwing tail short and blunt. Sexes are similar to some extent. Forewings apex sharply pointed and shortly concave just below apex point. Underside of wings is grayish brown or pale purplish with silky gloss and often indistinct bronzy brown markings. Discal band not dislocated, but continuous. Underside of hindwing is without metallic green dusting on tornus. (Kehimkar,2008).

Male: Upperside of forewing (UPF) purple with black borders, 1.5 to 2 mm broad. UPF is with black tooth or spot at end cell. Border on UPF extends along dorsum to some extent. Border on upperside of hindwing is broader. (Kehimkar,2008)

Female: On upperside of wing, it has wider borders; purple area is only beyond cell on UPF. (Wynter-Blyth,1957).

Extent of Damage/Status: Locally common. Damage not significant.

114. Tailless Bushblue, *Arhopala ganesha* (Moore,1858)
Superfamily: Papilionoidea
Family: Lycaenidae
Subfamily: Theclinae
Subspecies: A. g. ganesa.
Synonyms:
Arhopala ganesa (Moore,1858)
Amblypodia ganesa Moore,1858
Narathura ganesa
Panchala ganesa.
Distribution: India (Jammu & Kashmir to Sikkim), Nepal, Bhutan (Kehimkar, 2008). Sub species *A.g.ganesha*Moore is very common from March-October (Adwani RF, PauriGarhwal; Mussoorie; Dewalsari (Tehri Garhwal in the hills of Uttarakhand) (Singh& Sondhi,2016). Commonly recorded between May-June in oak forests in Kumaon (Hannyngton,1910).
Species of oak infested: *Quercus leucotrichophora* (Wynter-Blyth,1957).

(a)Adult (Underside) **(b) Adult (Upperside)**

Fig. 117. Arhopala ganesha (Moore,1858)

Habits & Habitat: Larva defoliates. This is the commonest species of this genus which is found in Mussoorie, flying in shady ravines near running water in May and June (Mackinnin et.al.,1899). May and June are the best months, but individual may occasionally be seen till October (Derhe-Philipe, 1931).This butterfly may be caught from early May until the rains and again in August until late October. They are very common, especially before the rains, in damp nullahs in oak forest (Wynter-Blyth,1939).It appears to be confined between altitudes of 1676-2145m. in forests. It has a wide range, occurring in Kashmir on the west to Kumaun on the east, always in oak forest, where it is rather common (http://archive.org).This butterfly keeps to the tree tops, not easily seen at lower level. Flies up to 1200-1700 m. in April, May and July to September. Common in Western Himalayas but rare in central and Eastern Himalayas. Caterpillars attended by tree ants (Kehimkar,2008).

Larva: The young larva is of a beautiful pinkish colour, covered with very fine and soft white hairs, extending all round beyond the body. When larva is nearly full grown, remain in a shelter made by fastening the edges of leaf together. This species have a honey gland on eleventh segment (Mackinnon, 1899).

Adult: Upper-side, fore-wings, with discoidal cell and posterior base, sky-blue ; the end of discoidal cell and between discoidal veinlets white ; rest of wing dark brown ; hind-wing sky-blue to near exterior margin, rest brown ; abdominal margin and cilia paler. Under-side cream-white ; fore-wings nearly covered with broad undulating brown bands; hind-wings with ill-defined undulating bands ; near outer margin of both wings appear a very faint undulated line and a series of dots. Wings shapedwithout tails. Expanse of wings: 32mm. (http://archive.org).Hindwing tailless and sexes are similar. Discal band on underside of hindwing is indistinct. Both sexes iridescent pale blue on upperside of wing with 3 mm. broad black border on upperside of forewing from costa to termen, broadening to 6 mm. at apex. Upperside of hindwing border much narrower; broadens from termen towards apex. Prominent tooth marking on upperside of forewing at end-cell, separating two small white areas between (Wynter-Blyth,1957).

Extent of Damage/Status: Locally common. Damage not significant.

115. Himalayan Common Hedge Blue, *Acytolepis puspa gisca*(Fruhstorfer,1910)

Superfamily: Papilionoidea
Family: Lycaenidae
Subfamily: Poliommatinae
Synonyms:
Cyaniris puspa gisca Fruhstorfer,1910
Lycaenopsis puspa gisca f. artena Fruhstor fer,1917
Lycaenopsis puspa telis Fruhstorfer,1917
Celastrina puspa barneyi Corbet,1941
Acytolepis puspa artena
Acytolepispuspa barneyi

Distribution: This butterfly occurs in Himalayas, Assam, Andamans, Nicobars, Sri Lanka, Myanmar (Evans, 1932), Philippines, Borneo (Seki, 1991), Sulawesi (Vane & de Jong,2003), Himalayan foothills and in wooded part of Penensula south Bombay, Madhya Pradesh and south Bihar, Simla, North-East India (Wynter-Blyth,1982), Sikkim, Assam, Birma (http://archive.org/stream/entomologischeze 711910ento#page/285/mode/1up).

Species of Oak Infested: *Quercus leucotrichophora*(Smetacek& Smetacek, 2011).

Other Host Plants: *Shorea roxburghii* (Smetacek& Smetacek,2011), *Cratoxylum cochinchinense* (Wynter-Blyth,1957; Kunte,2000), *Moullava spicata* (Saji et al.,2018), *Paracalyx scariosus* (Wynter-Blyth,1957; Kunte,2000; Robinson et al.,2010), *Xylia xylocarpa* (Davidson etal.,

1896; Wynter-Blyth, 1957; Kunte, 2000; Robinson et al., 2010), Hiptage benghalensis (Wynter-Blyth 1957; Kunte 2000), *Hiptage madablota* (Robinson et al. 2010), *Lepisanthes tetraphylla* (Saji et al. 2018), *Schleichera oleosa* (Davidson et al. 1896; Wynter-Blyth,1957; Kunte,2000), *Schleichera trijuga* (Robinson et al. 2010). *Peltophorum pterocarpum,Bridelia retusa, Bridelia stipularis* (Ravikanthachari et.al.,2018).

(a)Egg (b) Larva (c)last instar larva

(d)Pupa (e) Adult (Underside) (f) Adult (Upperside)

Fig. 118. Life history stages of *Acytolepis puspa gisca*(Fruhstorfer, 1910)

Habits: Larva defoliates. This is the most widely distributed and one of the commonest butterfly of this genus. It is not abundant in Western Himalayas but becomes very common further east. It has been caught up to 3048 feet but is primarily a species of low elevations. It is found in clearings, along roads, or on hill tops, flying around bushes or the lower leaves of trees. The males are abundant at wet sand or on damp roads in the hot weather. At Simla, it is found between July and October, but lower down and in the Eastern Himalayas its season is from spring to autumn. Over the rest of its range, it will be found throughout the year. In North-East India the seasonal forms are particularly

strongly marked (Wynter-Blyth,1982).The larvae of this species were collected from new shoots of lopped Ban oak,*Quercus leucoreichophora* trees from Buddha Kedar in Tehri Garhwal (August2017) and New Forest Campus (September2017), Dehradun, Uttarakhand.

Larva: The caterpillar is woodlouse like in shape and the glands and the organs on the 11th and 12th segments are normal. The surface of the skin is covered with tiny white tubercles, each of which bears a little golden hair. The last segment of the body bears larger tubercles and longer hair. The caterpillar is plum pink with darker dorsal and spiracular lines running for the entire length of the body. There is an indistinct, white diagonal line running across each segment (Kunte,2000).

Pupa: the pupa is small and short with little thoracic and abdominal humps. It is pale pink, marked all over except on its wings by yellowish-green and brown dots and streaks (Kunte,2000).

Description: Wet-season brood- Male: Upperside: violaceous blue, with brilliant iridescent tints in certain lights. Forewing: the costa, apex and termen bordered with black, this edging narrows from base to the middle of the costa, then broadens greatly at apex, where it occupies the apical fourth of the wing, and is again narrowed below vein 4, whence it is continued as an even band to the tornus; on the disc beyond the apex of the cell the ground colour is sensibly paler, and the dark markings of the cell are faintly visible by transparency from below. Hindwing: the costa very broadly, the termen much more narrowly black; the black bordering on the latter consists of a series of rounded coalescent spots, which on the inner side are margined by faint dark lunules; these are formed not by actual scaling but by the dark markings of the underside which show through more or less clearly.Underside: slightly bluish white; the markings, some black, some dusky, but all large and distinct. Forewing: a short bar on the discocellulars, an anteriorly inwardly curved, transverse, discal series of seven, more or less elongate spots, of which the spot in interspace 2 is vertical and sinuous, the next above it irregularly oval and obliquely placed, the next smaller and almost round, the fourth placed almost longitudinally, forms a short bar, and the apical three decrease in size to the costa; beyond these is an inner subterminal, transverse, lunular line, an outer subterminal series of transverse spots and a very slender anticiliary line. Hindwing: two basal and three subbasal spots in vertical order; a line on the discocellulars; a spot above it at base of interspace 6; a much larger spot above that in interspace 7; a lower discal irregular transverse series of five spots, followed by terminal markings similar to those on the forewing, except that the spots in the subterminal row are rounded, not transverse. Cilia of both forewings and hindwings white alternated with dusky black

at the apices of the veins. Antennae, head, thorax and abdomen dusky black, the antennae ringed with white; beneath: the palpi, thorax and abdomen white (Bingham, 1907).

Female: Upperside: white, the bases of the wings and in some specimens the hindwing posteriorly shot with iridescent blue. Forewing: costa, apex and termen broadly black; the discocellulars marked with a very short, fine black line that extends down from the black on the costal margin. Hindwing: costa and apex broadly black; termen below vein 6 with a regular subterminal series of black spots in the interspaces, enclosed within an inner lunular and an outer straight slender anticiliary black line; the veins, except vein 5 in the middle, slenderly black. Cilia of both forewings and hindwings white. Underside: ground colour and markings similar to those of the male. Antennae, head, thorax and abdomen as in the male (Bingham,1907).

Dry-season brood: Differs very slightly from the wet-season brood. In the **male** there is a small patch of white on the upperside of the forewing beyond the cell and on the upperside of the hindwing on the anterior portion of the disc; the extent of this patch varies on the forewing from a mere touch of white just beyond the cell to a large discal area of white which is diffuse with ill-defined margins. In the **female** the blue iridescence at the base of the wings on the upperside is in some specimens considerably restricted, in others entirely absent. On the underside in both sexes the ground colour is paler and in form and position the markings are much less prominent, though entirely like those of the wet-season brood (Bingham,1907; Swinhoe, 1905-1910).

Life Cycle: The male and female flutter around each other for a prolonged period before they mate. After mating, the female searches for a host plant with a flush of fresh leaves or flowers. It lays disc shaped, greenish-white, eggs singly at the base of stalks of leaves or bracts of flower buds. The caterpillar feeds only on fresh and tender leaves and lives on the underside of leaf. Ants attend to it, but only casually. The caterpillar does not wander before pupation and pupates on or very near the host plant. It pupates anywhere on the plant- under a leaf or on the stem, in a fissure in the bark or crevice. The pupa is held by a body band (Kunte,2000).

Extent of Damage/Status: Widespread and common. Damage not significant.

116. Common Onyx, *Horaga onyx onyx* (Moore,1857)

Superfamily: Papilionoidea

Family: Lycaenidae

Subfamily: Theclinae

Distribution: This species occurs throughout the Indian sub-continent up to 2000m in hilly tracts (North, Northeast, Central & South India) with flight period throughout the year (Wynter-blyth,1957), while the sub-species *onyx* occurs from

Kangra in Himachal Pradesh up to Myanmar (Evans,1932).

Species of Oak Infested: *Quercus leucotrichophora* (Singh et al,2019).

Other host plants: Larval food plant recorded as *Coriaria nepalensis* Wall. (Coriariaceae) for sub-species *onyx* in the Himalaya (Wynter-blyth,1957) while the other sub-species c*ingalensis* which occurs in South India and Sri Lanka feeds on *Mangifera indica* (Nitin *et al*.,2018). Other larval food plants for this species are *Durio zibethinus* L. (Malvaceae) in Thailand & *Glochidion rubrum* Blume, Bijdr.(1825) (Euphorbiaceae) in Taiwan (Robinson et.al.,2010).

Life Cycle: Larva defoliates.Fifth instar larva (12mm) were collected on 14.ix.2018 feeding on foliage of *Q. leucotrichophora* in New Forest Campus of the Forest Research Institute (FRI), Dehradun. Pupation took place on 20.ix.2018 (pupa: 10 mm) on the leaf stalk. The shape of the pupa being oval and light green in colour with dark spots, as eyes resembling on a human face. The emergence of butterfly (female; WS: 28 mm) took place on 28.ix.2018.

Extent of Damage/Status: Uncommon in oak forests. Damage not significant.

(a)Larva

(b) Feeding pattern

c) Pupa

(d): Adult (female)

Fig. 119. Life history stages of Common Onyx, *Horaga onyx onyx* Moore,1857

117. Western Courtier, *Sephisa dichroa* (Kollar,1844)
Superfamily: Papilionoidea
Family: Nymphalidae
Subfamily: Apaturinae
Synonym.: *Limenitis dichroa* Kollar,1844.
Distribution: India (Jammu & Kashmir to Uttarakhand), Pakistan, Afganistan, Nepal (Kehimkar, 2008).
Species of Oak infested :*Quercus leucotrichophora*(Wynter-Blyth,1957).
Other host plants: Celtis australis (Wynter-Blyth,1957).
Description: 60-75 mm., Male and female dark brown with two tawny irregular broken bands on forewing. Hindwing is tawny with black veins and a black outer discal band. Forewing apical spots tawny in male, white in female (Wynter-Blyth,1957).
Habits& Habitat: Larva defoliates. Strong flier flies along streams in oak forest between 1500-2740 m. from March to October. This common butterfly is seen in April-October (Benog: Woodstock school; Bata Ghat, Mussoorie; Magra RF- Algar valley; Chakrata; Mandal KMDR; Chauri Khal; Khirsu, Pauri Garhwal) (Singh & Sondhi,2016). Fond of basking high up on tall trees and comes down to settle on damp patches (Kehimkar,2008). This western courtier flies between 3000-8000 feet in late May, occasionally during, and again after the monsoon. It is rather local but common enough in wet nullahs in oak forest where both sexes settle readily on damp sand – between 2 & 3 pm, rather than most butterflies, the favourite time being between 11 am and 1 pm. They also settle on the leaves of oak and other trees from which they take short flights around. They are greatly attracted by sap, overripe fruit, refuse etc (Wynter-Blyth,1957). It may be taken freely at Chadwick falls, San Damiano, behind Jakko and from Tera Devi nullahs in Simla (Wynter-Blyth,1939). Common at Takula, Binsar, Nainital etc. at 1829-2073 m. in May and October (Hannyngton). Flies in open oak forest in May and June. One may often see a dozen or more fitting round a tree or coming down to drink at damp patches by the roadside. There is a less prolific autumn brood (DeRhe-Philipe,1931).

(a)Adult (Underside) **(b) Adult (Upperside)**

Fig. 120. *Sephisa dichroa* (Kollar,1844)

Extent of Damage/Status: Locally common. Damage not significant.

118. The Himalayan Grand Duchess, *Euthalia patala patala*(Kollar,1844)

Superfamily: Papilionoidea

Family: Nymphalidae

Subfamily: Limentidinae

Synonyms:

Euthalia patala (Kollar,1844)
Dophla patala
*Adolias patala*Kollar,1844
Adolias doubledayii Gray,1846
Bassarona patala
Euthalia doubledayii Gray,1846
Euthalia epiona Moore,1859

Distribution: The sub-species *patala* is distributed in India from Jammu & Kashmir to Uttarakhand and Nepal (Wynter-blyth, 1957).

Species of oak infested: Quercus leucotri chophora (Mackinnon and de Niceville, 1899; Hannyngton,1910; Wynter-blyth, 1957; Kehimkar,2008; Singh,2011).

Description: Wingspan: 80-100 mm. Wings olive-green with black in the costal nervure; the forewings with a spotted white band across the middle, from the middle of the anterior margin towards the posterior angle, and two white spots near the summit; the hinder wings with three spots in the centre of the anterior margin. Under surface is like the upper, but of a cinereous colour (archive. org). Sexes are similar, but female are larger and slightly darker than male. forewing with larger white spot in space 2, two whitish costal spots in spaces 6 and 7 on hindwings are larger, the former filling the space whereas that of the former species small and at the upper portion of space 6. Female usually has two additional small white spots in space 1b, one may absent, but traceable.

Pupa: Depicted by Mackinnon and de Niceville (1899).

Fig. 121.*Euthalia patala patala*(Kollar,1844)-Adult female

Extent of Damage/Status: Locally common. Damage not significant.

COLEOPTERA

2.COLEOPTERA
(Beetles- mainly wood borers): 96 species

Order Coleoptera are considered to contain manyspecies which are perhaps more injurious to oak trees than any series of similar insects belonging to the other orders. The feeding habits are extremely varied. Adults and larvae feed on dead wood (including timber) at various stages of decay; live plants, including their roots, leaves, shoots, stems/trunks, flowers, seeds, dung and rottenwood.Thesegroups of insect pests spend most part of their adult or larval life stage feeding inside stems and branches by tunneling beneath the bark or into the heartwood of many trees. They tunnel and feed under the bark in living wood, destroying water and sap conducting tissues causing girdling, branch dieback, structural weakness, decline and eventual death of susceptible plants.

Stem borers are among the most destructive pests. The damage is caused by the larva which makes zig-zag or straight galleries beneath the bark and tunnel into the trunk or main stem and as a result of feeding on the internal tissues, which leads to the destruction of vascular system of trees and causes drying, wilting and at last death of trees eg.*Aphrodisium hardwickianum, Rosalia lateritia*. Deadwood borers often invade a tree that has been killed by primary stem borers and bark beetles or is on the verge of death. These borers attack mostly newly felled trees, logs which are left in the jungle within a month of felling. The neonate larvae start feeding on the bark initially and after few days they enterinto the main stem and start feeding on sapwood. As they grow bigger the gallery grooves both the bast and the sapwood. The larval tunnels are excavated on the surfaces of the sapwood and inner bark, are flattened-oval in section and tightly packed with bark and wood-dust. These borers not only destroy the trees but also reduce the value of timber eg. *Xylotrechus smei, X. basifuliginosus*. Bark beetles are tiny insects with hard, cylindrical bodies that penetrate the bark or wood in order to construct special galleries for laying eggs. These mainly feed in the inner bark (living and dead phloem and cambium tissues) layer of trees by making small holes, sawdust on the tree trunk and branches and kill the live trees. These often attack trees that are already weakened by disease, drought, smog, overcrowding or physical damage. When their population explodes they invade and kill healthy trees eg. *Dryocoetes hewetti, Scolytoplatypus pubescens, Diapus himalayensis*. Rottenwood borers are mainly found in moist decaying wood and tree stumps. Grubs of these borers are large, fleshy and curved which on hatching burrow below the surface than tunnel into the wood to feed. The tree selected is invariably a dead in which the wood has already undergoes considerable decay. The adults do not feed, living only a few days to mate and find a new site to lay eggs eg. *Cladognathus giraffa, Lucanus lunifer*. Larvae of acron borers mainly of the family curculionidae bore into the acorns and feed on the nutritive tissues (endosperm) inside completely reduced it to a yellow-brown granular frass at the end of development which may causes premature dropping of young acorns and effect the regeneration of trees. Small holes on the fruits are the symptoms of attack eg. *Curculio glandium, Curculio sikkimensis*.

A few species of oak beetles are leaf rollers that cut the veins or midrib and roll it up in a particular way so that healthy sappy tissue withers under conditions favorable for the development of the larva.
Eggs are laid inside the rolled leaf and the larva feeds within the shelter of the roll and pupates therein or in the soil. The tree is heavily defoliated when the beetles are numerous and reduces the plants photosynthetic potentials and making it harder for them to survive eg. *Apoderus bistriolatus*, *A. bihumeratus*.

119.*Hymaloxylon quercus*(Gardner,1935).
Superfamily: Lymexyloidea
Family: Lymexylonidae
Subfamily: Atractocerinae
Synonym: *Atractocerus quercus* Gardner,1935.
Distribution: This species is known only from India(Gardner,1936;Simmonds,1956); N.W. Himalaya (Beeson,1941).
Habit: Larva bores in rottenwood (Mathur & Singh,1959).
Species of oak infested: *Quercus leucotrichophora and Q. floribunda* (Beeson,1941).
Larva: It is 25 mm, long larva which can makes clean-cut cylindrical tunnels running radially for 2 or 3 inches from the surface of the sapwood; these vary in diameter with the age and size of the larva and clean of wood-dust (Beeson,1941).
Adult: This beetle is described as *Atratocerus quercus* by Beeson. It is black, 11-24 mm, long, with elytra slightly longer than the prothorax, bores the hard sound wood of *Q. floribunda* and *Q. leucotrichophora*. Emergence of beetles occurs in June (Beeson,1941).
Extent of Damage/Status: Data deficient.

120.*Calochromus darjeelingensis* (Bourgeous,1883)
Superfamily: Elateroidea
Family: Lycidae
Subfamily: Calochrominae
Distribution: N.W. Himalaya.
Species of oak infested: *Q. leucotrichophora* (Mathur & Singh,1959).
Habit: Larva breeds in rottenwood (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient. Minor importance.

121.*Calochromus kashmirensis* (Kleine,1928).
Superfamily: Elateroidea
Family: Lycidae
Subfamily: Calochrominae
Distribution: N.W. Himalaya.
Species of oak infested: *Q. leucotrichophora* (Mathur & Singh,1959).
Habit: Larva breeds in rottenwood (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient. Minor importance.

122.*Calochromus tarsalis* (Waterhousie,1879)
Superfamily: Elateroidea
Family: Lycidae
Subfamily: Chalochrominae
Distribution: N.W. Himalaya.
Species of oak infested: *Q. leucotrichophora* (Mathur & Singh,1959).
Habit: Larva breeds in rottenwood(Mathur & Singh,1959).
Extent of Damage/Status: Data deficient. Minor importance.

123.*Agrilus niveoguttatus* (Kerremans,1892)
Superfamily: Buprestoidea
Family: Buprestidae
Subfamily: Agrilinae
Distribution: Garhwal Himalaya,

Uttarakahnd. [8 specimens are kept in NFIC, Dehradun. Chakrata (2133-2743m) collected by C.F.C Beeson on 9.vi.1924 and by H.G.Champion on 12.vii.1930].

Species of Oak infested: *Quercus leucotrichophora* and *Q. dilatata* (Beeson,1941).

Fig. 122.*Agrilus niveoguttatus*(Kerremans,1892)

Habit: Larva bores in dead sapwood (Mathur & Singh,1959).

Adult: It is medium in size and cuneiform in shape, body is slender and unicoloured. Eyes are large. Antennae are moderate in length. Pronotum is elongate, visually square or transverse, maximal width is at anterior margin and rarely at middle. Anterior lobe is moderate or obvious. Disk is flat or moderately convex. Prehumerus are absent, obsolete, rarely filamentary, bisinuate in shape and its extent is beyond half of pronotal length or to anterior pronotal angle whereas its anterior end is joining pronotal marginal carina or joining anterior pronotal angle. Marginal and submarginal carina has interspace and is narrow or moderate. Scutellum is well developed. Elytron is unicolored. Humeral carina is absent. Abdomen is basal ventrite or metacoxae in male. Pygidium is extended into long spine. Aedeagus is rarely markedly dorsoventrally bent, and ovipositor is elongate (Jendek& Grebennikov,2011). Beetles emerge in June (Beeson,1941).

Extent of Damage/Status: Data deficient.

124.*Cypriacis impressicollis* (Kerremans,1892)
Superfamily: Buprestoidea
Family: Buprestidae
Subfamily: Buprestini
Distribution: N.W.Himalaya. [7 specimens kept in NFIC, FRI, Dehradun. Kaisdhar, Kulu (2590m),Himachal Pradesh collected by C.F.C Beeson on 9.vi.1934; from Lolab Valley, Kupwara, Kashmir collected by Sher Singh on 4.iv.1923; Gulmarg, Kashmir collected by C.F.C Beeson on 4.iv.1928].

Fig. 123. *Cypriacis impressicollis* (Kerremans,1892)

Species of Oak infested: Quercus leucotrichophora (Mathur & Singh,1959).
Habit: Larva bores in dead sapwood of Q. leucotrichophora (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

125.Fire beetle, *Melanophila coriacea* (Kerremans,1894).
Superfamily: Buprestoidea
Family: Buprestidae
Subfamily: Buprestini
Synonyms:
Melanophila acuminata de Geer,1774
Melanophila atra Gory,1841
Melanophila atropurpurea Say,1823
Melanophila caudata Laporte & Gory,1837
Melanophila cockerellae Wickham,1912
Melanophila consputa LeConte,1857
Melanophila cuspidata Klug,1829
Melanophila eschscholtz 1829
Melanophila gestroi Obenberger,1923
Distribution: Northern & Central India, Sindh, Pakistan (Beeson,1941). [34 specimens kept in NFIC, FRI, Dehradun. Collected from Dehradun, Uttarakhand by B.S.Gusain on 12.vi.1930, C.F.C. Beeson, on 14.vi.1923 & A. K. Sharma on 13.iv.1930; from Chakrata (on *Quercus semecarpifolia* planks) collected by E.A.C.Coll. on 01.vi.1926; from Lalkua, Haldwani Uttarakhand by S.N Chatterjee on 27.v.1932; from Mandvi W. Thane, Mumbai, Maharasthra by B.M Bhatia on 08.iv.1930, from SambhalpurDiv, Orissa by R.N. Mathur on 09.vi.1955; from Amarkantak (1066m), Madhya.Pradesh by C.F.C Beeson

on 03.vi.1928 & from Sind, Karachi, Pakistan on 05.iv.1939].

Species of Oak infested: *Quercus semecarpifolia* (Mathur & Singh,1959).

Other Host Plants: *Adina cardifolia, Bauhinia vahlii, Cereya arborea, Clerodendron infortunatum, Ficus religiosa, Grewia optiva, Holoptelea integrifolia, Lannea grandis, Mallotus philippinensis, Morus indica, Prosopis spicigera, Shorea robusta* (Beeson,1941).

Fig. 124.*Melanophila coriacea* (Kerremans,1894).

Habit: Larva bores in deadwood of Q. semecarpifolia (Mathur & Singh,1959).

Larva: According to Gardner (1929), the labrum of larva is slightly wider anteriorly and length of larva is 16 mm, anterior margin are weakly curved without lateral lobes; prothoracic plates with fine brown asperities; each asperity is transverse, the elevated margin is sinuate, carinate; dorsal plate is sub-circular and wider than long, with two grooves which do not reach posterior margin and meet before the anterior margin; vertical plate is longer than wide, with a single median groove; neither plate is with anterior shining testaceous area.

Pupa: Thepupal chamber is an elongate oval cell with the walls stained black, joined by a short neck to the outside (Beeson,1941).

Adult: The beetles are attracted to forest fire and burnt trees and adults emerge from May to July (Beeson,1941).

Extent of Damage/Status: Data deficient.

126.*Sphenoptera deobani* (Obenberger,1926).
Superfamily: Buprestoidea
Family: Buprestidae
Subfamily: Buprestini
Distribution: N.W. Himalaya (Uttarakhand) [(Holotype) -One specimen was collected by C.F.C.Beeson on 23.v.1915 from Deoban, Chakrata (2804m) in NFIC,FRI,Dehradun].
Species of Oak infested: *Quercus semecarpifolia* (Mathur & Singh,1959).
Habit: Larva bores in dead wood (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

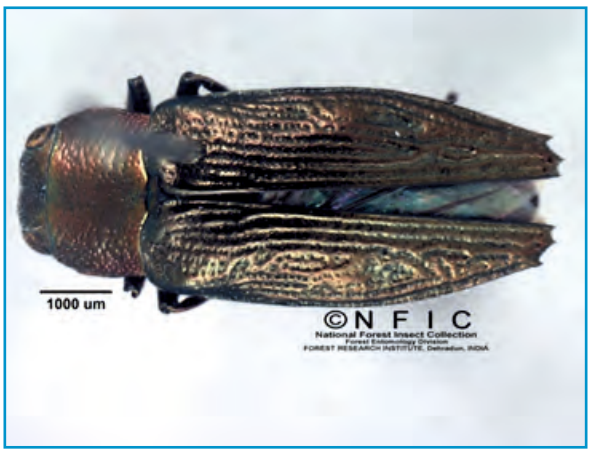


Fig. 125. *Sphenoptera deobani* (Obenberger,1926).

127.*Laenae rubripes*(Reitter,1908).
Superfamily: Tenebrionoidea
Family: Tenebrionidae

Fig. 126. *Laenae rubripes*(Reitter,1908).

Distribution: Garhwal Himalaya [11 specimens are kept in NFIC, Dehradun. Mundali (2562m), Chakrata collected by J.C.M. Gardner on 26.vi. 1933 and 1934].

Specie of Oak Infested: *Quercus dilatata* and *Q. leucotrichophora*(Beeson,1941).
Other host plants: *Abies pindrow*, *Pinus wallichiana* (Beeson,1941).
Habit: The larva bores in decaying or rotten wood (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient. Minor.

128.*Setenis cribrifrons* (Fairmarie,1894).
Superfamily: Tenebrionoidea
Family: Tenebrionidae
Distribution: N.W.Himalaya (Beeson,1941). [38 specimens kept in NFIC, Dehradun. Gwaldam, Chamoli, Uttarakhand collected by J.C.M Gardner on 11.vi.1937; Mussoorie, Dehradun, Uttarakhand collected by J.C.M Gardner in 1926; Bajwar, Almora, Uttarakhand collected by J.C.M Gardner on 14.vi.1937; Airadeo, Almora collected by J.C.M Gardner on 28.v.1937; Deoban (2956 m) Chakrata, Dehradun Uttarakhand collected by B.M Bhatia on 24.vii.1933; Kaisdhar (2590 m) Kulu, Himachal Pradesh collected by C.F.C Beeson on 7.vi.1934; Bhowali Nainital, Uttarakhand collected by B.M. Bhatia on 17.vi.1937].

Fig. 127. Adult-*Setenis cribrifrons*(Fairmarie,1894).

Species of Oak Infested: *Q. leucotrichophora* and *Quercus floribunda* (Beeson,1941).
Other Host plants: *Alnusnitida, Cedrus deodara, Pieris ovalifolia*(Beeson,1941).
Habit: Larva bores in rotten wood (Mathur& Singh,1959 and Singh,2011).One individual collected from Dangan village (1850m) near Naitwar,Uttarakshi district, Uttarakhand on 14.viii.2007 from rotten log of ban oak.
Larva: It is 40 mm in length (Beeson,1941). Gardner (1929) found two larvae in rotten billet of oak, Mussoorie on 23.vii.1926. One larva was preserved in alcohol and other larva was kept alive in wood. The beetle emerged on 01.x.1926. The imago has been taken from dry deodar, Chakrata Provinces. The larva was elongate, cylindrical, somewhat flattened ventrally. General coloration is pale yellowish with certain darker parts. Body with soft skin, nearly glabrous, and setae are few. Head capsule is brown from above, rounded, transverse, broadest at the middle. Frons is longer than the epicranialsuctures; with scattered circular pits which are also found on the adjacent parts of epicranium. Epicranial halves are separated ventrally by the gula which is about as wide as long, slightly

narrowed anteriorly. Ocelli are not distinct. Clypeus is trapezoidal, widest behind the posterior half castaneous and with two setae on each side. Labrum is about 1.4 times wide as long, anterior margin with two weak median lobes; with numerous marginal setae; disc with two rather large setae. Epiypharnyx has two short rather stout setae near middle. Antennae consisting of well developed basal skin and three joints; first joint is longest somewhat enlarged towards base and apex; second joint is widened towards apex rather more than two-thirds length of first joint; terminal joint is very small, cylindrical, about one-sixth as long as second joint. Mandibles are apically tridentate; the left one with an additional tooth on dorsal cutting edge behind apex; molar structure strongly developed with a transversely carinate grinding zone. Lateral face of mandibles is normal. Maxillae: Palps are three jointed with a small palpiger, basal joint slightly longer than wide. Maxillary articulating area is soft, cushioned connecting cardo and submentum. Labium: palp two jointed about one-half as long as maxillary palps. Pronotal plate nearly rectangular, longest along the median line, rather more than twice as wide as long, anteriorly and posteriorly with longitudinally striate band. The ten following tergites are shorter than pronotum, more transverse, each with a posterior striate band. Mesonotum and metanotum each with a fine castaneous medially interrupted transverse ridge behind anterior margin. Prothoracic sternum has large dark brown plate on each side anterior to legs. Prothoracic legs differ from following two pairs in being conspicuously larger and in having numerous coarse castaneous granules on the inner surface of 2nd, 3rd and 4th joints. Spiracles are transverse, broadly oval and the external openings are protected by branched projections. Ninth segment is short, ending in two moderately large upwardly directed spines or cerci; each spines broad and testaceous basally, acute and castaneous spines, one directly anterior of intermediate size and two antero-lateral of smaller size. Tenth abdominal segment is small, ventral bearing the transverse anal cleft.

Adult: Beetle is 20 mm long and dark brown in colour, collected during August 2008 from the borer infested *Q. leucotrichophora* in Dangan village, Uttarakhand (Singh,2011). Beetle emerges in May and June (Beeson,1941).

Extent of Damage/Status: Minor.

129.*Uloma rubripes* (Hope,1831).

Superfamily: Tenebrionoidea

Family: Tenebrionidae

Subfamily: Stenochiinae

Distribution: India (Uttarakhand, Sikkim, West Bengal, Assam and Meghalaya) (https://www.threatenedtaxa.org/index.php/JoTT/article/view/5046/6605). [19 specimens are kept in NFIC, Dehradun. Bajwar, Almora, Uttarakhand collected by J.C.M Gardner on 13.iv.1937; Debrepani (1828 m) Darjeeling, West Bengal collected by J.C.M Gardner on 18.ix.1929; Bagdogra range, Kurseong, West Bengal collected by N.C.Chatterjee on 22.vi.1935; Gwaldam, Chamoli, Uttarakhand collected by J.C.M Gardner on 11.vi.1937; Sunderban, West Bengal collected by C.F.C Beeson on 27.xi.1920].

Species of Oak Infested: *Quercus leucotrichophora,* (Beeson,1941).

Other Host plants:*Phoebe lanceolata, Pinus roxburghii* (Beeson,1941).

Habit: Larva bores in rotten wood (Mathur & Singh,1959).

Larva: It is elongate and cylindrical in shape with a large tergite forming the greater part of the wall of the cylinder with the 9th segment is ellipsoidal, without spines or

processes. The life cycle is annual. (Beeson, 1941).

Extent of Damage/Status: Data

Fig. 128. Adult- *Uloma rubripes* ((Hope,1831)

130.*Uloma scita* (Walker,1858).
Superfamily: Tenebrionoidea
Family: Tenebrionidae
Tribe: Ulomini

Fig. 129. Adult-*Uloma scita* (Walker,1858)

Distribution: India (Kashmir, Himachal Pradesh, Uttarakhand, West Bengal and Meghalaya (Garo hills), Pakistan, Nepal and Bhutan (https://www.threatenedtaxa.org/index.php/JoTT/article/view/5046/6605). [29 specimens are kept in NFIC, Dehradun. Sunderbans, West Bengal collected by Beeson, on 27.x.1920; Kathian (2590m), Chakrata, Dehradun Uttarakhand collected by C.F.C Beeson on 15.vi.1924; Afan (1676m),Lolab valley, Kashmir collected by B.M Bhatia on 21.v.1928; Gwaldam, Chamoli, Uttarakhand collected by J.C.M Gardner on 12.iv.1937; Malhan, Dehradun, Uttarakhand collected by J.C.M Gardner on 10.vi.1936; Bhowali, Nainital, Uttarakhand : For. Zoo. Coll on 29.vi.1917].

Species of oak infested: *Quercus leucotrichophora*(Mathur & Singh,1959).

Habit: Larva bores in rotten wood (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient. Minor

131.Darkling Beetle, *Lyprops indicus*(Wiedmann,1823).
Superfamily: Tenebrionidae
Family: Lagriidae

Distribution: India: Uttarakhand (Harrawala, Dehradun),West Bengal (Darjeeling, Pashok) and Uttar Pradesh (Dudhwa National Park) (Hedge et al.,2013).
Host plants: *Quercus sp.*(Mathur & Singh,1959).
Habit: Beetle defoliates (Mathur & Singh,1959).

(source:https://www.researchgate.net/publication/282667891_Darkling_Beetles_Tenebrionidae_Coleoptera_of_Dudhwa_National_Park_Uttar_Pradesh_India/figures?lo=1).

Fig. 130. Adult- *Lyprops indicus* (Wiedmann,1823).

Larva: The larva has been found living in the soil under stones and length of larva is around 11 mm (Beeson,1941). According to Gardner (1929), the length of larva is 11 mm; width about 2.5 mm. Body is moderately depressed, nearly parallel side. Body is closely covered above with short pubescence; with longer setae laterally. General color is yellowish; the dorsal surface is unevenly smoky black to variable extent. Head capsule is brownish, transverse, and narrower than thorax, the frontal and well developed epicranialsuctures as pale line. Ocelli in a group of five in each side, each group set in a patch of blackish pigment. Labrum is about 1.5 times as wide as long, anteriorly emarginate with transverse series of long setae. Maxillae with mala set with numerous short rather course setae on inner surface; palps is three jointed with a very small pulpier, joint transverse, joint 2nd is the longest, cylindrical, about twice as long as wide. Labrum has numerous rather than long setae on the ventral surface. Hypopharyngeal sclerite is sub rectangular and the anterior margin is weakly emarginated. Antennae is brownish with numerous short fine setae, two a short basal connecting skin; joint a very short ring, more than twice as long as mandibles, slightly increasing in thickness towards the more abruptly swollen apex which carries a

circular membranous sensory area. Pronotum is about as wide as long and slightly narrowed anteriorly. Mesonotum is about 3 times as wide as long and metanotum a little shorter. Ventral surface of body is dull yellowish to smoky brownish; 2nd and 3rd sternite each with a pair of lateral oval transverse swelling. The 4th sternite has a median broadly median patch of minute setae. Thoracic spiracles are transversely oval, slightly more than twice as long as the first abdominal spiracles are found on the ventral surface. Legs increasing in length from first to third pairs, very pale testaceous, claws partly castaneous, joints with numerous fine reddish setae ,the tibiae with longer ventral series of setae; claws weakly curved each with a slightly basal bisects widening (Gardner,1929).

Pupa: The pupal period lasts for one to two weeks and pupating in January and February. The body of pupa is closely covered above with a minute setae; vertex of head with a pair of small setiferous projections; pronotum with three setiferous projections on each lateral margin; two approximate and anterior and third behind the middle; abdominal segments 1 to 8 each with a single lateral projections, each slender and apically bisetiferous, 9th segment is truncate with a pair of posterior slightly curved spines. The curious organs on the second and third abdominal segments require further investigations into their structure and function; each appears to be associated with a large spherical subcutaneous sac (Gardner,1929).

Beetle: It has been sheltering under the bark of logs and there is possibly a short life-cycle during the cold season (Beeson,1941).

Extent of Damage/Status: Data deficient.

132.Fan-bearing Wood Borer, *Ptilinus binodulus*(Motschulsky,1858).
Superfamily: Bostrichoidea
Family: Anobiidae
Subfamily: Pitinidae

Fig. 131. Adult-*Ptilinus binodulus*(Motschulsky,1858).

Distribution: Occurs throughout India and Sri Lanka (Beeson,1941). [A total of 38 specimens in NFIC, Forest Research Institute (FRI), Dehradun. India. Dehradun, Uttarakhand collected by J.C.M Gardner on 04.viii.1936; Kolkata collected by B.M Bhatia on 26.iv.1934; Kalimpong (548 m), West Bengal collected by A.M. Postford on

01.viii.193; Makum, Assam collected by C.F.C Beeson on 17.v.1937 and Colombo collected by Gauri Dutt on 02.v.1936].

Species of Oak infested: *Quercus leucotrichophora* and *Q. serrata* (Beeson,1941).

Other Hosts plants: *Boswellia serrata, Canarium euphyllum, Ficus roxburghii, Grevillea robusta, Morus alba, M. laevigata, Parisha insignis, Semecarpus anacardium, Spatholobus roxburghii, Stercula campanulata and Vateria indica.* (Beeson,1941).

Habit: Larva bores in the drywood of *Q. leucotrichophora* (Mathur & Singh,1959).

Larva: According to Gardner (1937), the larva of this borer differs from Ptilinus pectinicornis in lacking spinules on either the terga or the pleural lobes of the abdomen. The epipharynx with more regularly arranged paramedian setae and the inner branch of torma are much shorter; the premantum although is strongly angulate posteriorly and less cleared defined. Larval gallery is circular in cross-section and the dust is fine and floury (Beeson,1941).

Life Cycle: Annual but prolonged to several years under adverse conditions,17 years in logs of *Quercus leucotrichophora* in Dehradun from which the beetles emerged year after year regularly in April-June, mainly in hot weather of May. It is possible that fresh oviposition by beetles before swarming took place in these logs (Beeson,1941).

Extent of Damage/Status: Data deficient.

133.Fan-bearing Wood Borer, *Ptilinus pectinicornis*(Linnaeus,1758).

Superfamily: Bostrichoidea

Family: Anobiidae

Subfamily: Pitinidae

Synonyms:

Bostrichus pectinatus Laicharting,1781
Dermestes pectinicornis Linnaeus,1758
Ptilinusas pericollis Menetries,1832
Ptilinus cylindricus O.F. Muller,1776
Ptilinus impressifrons Kuster,1847
Ptinus serraticornis Marsham,1802
Xyletinus discolor Faldermann,1839

(a) Male **(b) Male on kharsu oak log**

Fig. 132. Adult-*Ptilinus pectinicornis*(Linnaeus,1758).

Distribution: A European species that occurs in the Himalayas (Beeson,1941). [71 specimens in NFIC, FRI, Dehradun. Konain (2392 m), from Chakrata collected by J.C.M. Gardner on 25.v.1934 on *Quercus leucotrichophora*; Kaisdhar Kulu (2590m), Himachal Pradesh collected by C.F.C Beeson on 30.v.1934 & 09.vi.1934].

Species of Oak infested: *Quercus floribunda, Q.leucotrichophora* and *Q. semecarpifolia* (Mathur & Singh,1959).

Other Host Plants: *Fagus* sp., *Sambucus* sp., *Fraxinus* sp., *Acer caesium, Ulnus* sp. (Beeson, 1941).

Habit: Larva bores in the drywood (Mathur & Singh,1959). Both standing and felled timber are attacked (Gardner,1937).A male beetle was collected from small sized gallieries in dead wood of Kharsu oak tree inDeoban (2,815m) ,Chakrata Forest Division,Uttarakhand on 08.iv.2019.

Eggs: Eggs are laid in the tunnel so that the whole life cycle is completed in the shelter of the wood (Beeson,1941).

Larva: According to Gardner (1937), larval length is about 6 mm and has tormae with long inner brach; labium with very distinctly defined angulate prementum. Spinules are present in two dorsolateral groups on mesonotum, a few dorsally on metanotam and in transverse patches five or six deep on the eight abdominal terga and dorsally and laterally on the ninth segments; spinules are also present on the first six pleural lobes on the abdomen. Each spinule is small, rather stout and blunt apically. Gardner collected larva and beetles from the dead standing trees of *Quercus*spp. from Chakrata, Uttarakahnd, India. The dust in the larval tunnel is fine and powdery like that of *Lyctus*(Beeson,1941).

Adult: Body length is 3 to 6 mm, slender, brown to black colour with darker pronotum which softly sloped; females with serrated and males with comb-like antennae. Elytra are with indistinct rows of larger punctures among strong granular microsculpture. Head and pronotum are black or dark brown, elytra is lighter and entire upper surface with short dense golden pubescence. Legs are red with femora, especially front pair, often darker. Beetles are in the wood in May and June. Beetles pass greater part of their lives in the tunnel and do not leave them for pairing (Beeson,1941). In United Kingdom, males crawl quite quickly, constantly waving their antennae and, eventually after ignoring many females will mate. Females are much less active and typically sit alone presumably signaling for a mate. During this intense activity more individuals are seen emerging from among the hundreds of pre-existing holes in the wood. Females and less often so males, frequently disappear into these tiny holes. Adults are active from May-July. (http://www.thewcg.org.uk/anobiidae/0032G.htm).

Extent of Damage/Status: Damage is not significant.

134.Oriental Wood borer/Boxwood borer, *Heterobostrychus aequalis*(Waterhouse,1884).

Superfamily: Bostrichoidea

Family: Bostrychidae

Tribe: Bostrichini

Synonyms:

Bostrichus aequalis Waterhouse,1884.
Bostrichus uncipennis Lesne,1895.
Bostrychu suncipennis Lesne,1895.
Heterobostrichus uncipennis Lesne,1895.
Rhizoperta papuensis MacLeay,1886.

Distribution: It is found in Africa, Australia, Europe & Northern Asia (excluding China), North America, Oceania, and Southern Asia (https://en.wikipedia.org/wiki/Heterobostrychus_aequalis). It is found all across India [More than 650 specimens in NFIC, Dehradun. Dehradun, Uttarakhand collected by R. N Mathur on 15.vii.1993; Nilampur Madras collected by B.M Bhatia on 27.i.1924; Samalkot Godavari, Madras collected by D.F.O in May,1925; Dhubri, Assam collected by C.F.C Beeson on 30.v.1937; Calcutta collected by B.M.Bhatia on 17.iii.1933; Buxa, West Bengal collected by J.C.M Gardner on 19.vii.1926; Dubri, Assam collected by C.F.C Beeson on 17.iv.1937; Saharanpur,Uttar Pradesh collected by B.M Bhatia on 29.viii.1932; Ghazipur, U.P collected by C.F.C Beeson on 29.vii.1925; Andaman Island collected by C.F.C Beeson on 23.v.1930].

[(a)-source: https://inpn.mnhn.fr/espece/cd_nom/273064?lg=en]

Fig.133. Adult- *Heterobostrychus aequalis* (Waterhouse,1884).

Species of Oak infested: *Quercus* sp. (Mathur & Singh,1959).

Host plants: *Adina cordifolia, Albizzia stipulata, Anisoptera glabra, Bambusa arundinacea, Bombax anceps, Bombax insigne, Bombax malabaricum, Boswellia serrata, Canarium euphyllum, Cassia fistula, Cedrela toona, Dalbergia sissoo, Dendrocalamus strictus, Dipterocarpus pilosus, Dipterocarpus turbinatus, Endospermum chinense, Garuga pinnata, Koompassia malaccensis, Kydia calycina, Lannea grandis, Leucaena glauca, Mangifera indica, Morus indica, Parashorea stellata, Parishia insignis, Poinciana elata, Pterocarpus indicus, Quercus sp., Shorea leprosula, Shorea robusta, Sterculia alata, Sterculia campanulata, Tectona grandis, Terminalia belerica, Terminalia bialata, Terminalia myriocarpa, Terminalia tomentosa* (Beeson & Bhatia,1937).

Habit: Beetle and larvae bore in sapwood of dead wood (Mathur & Singh,1959).

Larva: Larva is 15 mm long,white, curved, constricted posterior with a brownish-black head and three pairs of jointed legs on the thoracic segments, the abdominal segments corrugated (Stebbing,1914). According to Gardner (1933), the length of larva is 11 mm and head capsule is about 2.3 mm. Antennae with second segment is stout, widest near middle, much less than twice as long as wide. Thoracic spiracles are small, about one-third as wide as labrum.

Pupa: Pupation takes place in a cell at the end of or in off-shoot of the tunnel. The immature beetle remains inside the wood for a variable period towards the end of which it is occupied in further boring and feeding

among the larval tunnels, finally emerging by an exit-hole on the surface (Beeson,1941).

Beetle: Length ranges from 6-13mm. Parallel, very slightly depressed, dark brown, often glabrous. Front of head similar in both sexes, rasp-like, without the tubercle present in above-described species; pubescence short and not thick. Prothorax with posterior angles often lobed and posterior surface showing deep-impressed punctures, the disk with a more or less defined sculpture resembling imbricate scales. Elytra is strongly and densely punctuate, the punctures arranged in fairly regular rows of striae; punctuate of apical declivity variable; apical margin turned up with a thickened border laterally and with marginal tubercles, the inner of which may be hooked. Abdomen with legs is much dense punctures, rasp-like. Second tarsal joint of hind legs are much shorter than the last. Variation occur in size and in the elytral teeth and callosities in the various forms of the males and females (Stebbing,1914).

Life history: In the year 1898 some specimens of this insect were forwarded to the Superintendent of the Indian Museum, Calcutta, by Mr. Edgar Thurstan, C.I.E., Superintendent of the Central Museum, Madras with the information that they committed a good deal of damage by tunneling into Semul (*Bombax malabaricum*) timber at Calicut. As this timber was converted into tea-box planking, the destruction committed was of considerable importance. The adult beetle was found on the wing at Calicut in May-June. Between the year 1902 and 1909 Stebbing took this insect commonly in Dehra Dun in July. The insect tunnels into Sal timber in this locality and is a common pest in the Sal rafters of the thatched bungalows in the station. The insect oviposits in the timber, the grubs eating out irregular galleries in the wood and when numerous gradually reducing the latter to powder (Stebbing,1914). It is a serious pest of seasoned hardwood timber throughout the Oriental region and several areas beyond. Some early collection records of H.?aequalis from Australia in the 1950s and 1960s indicated that the insect was present in Northern Queensland, but no confirmed breeding population has been found in the past few decades suggesting either that it may have not established permanently or it is difficult to detect. The ambiguity about the breeding status of the pest in Australia has caused confusion for regulating authorities needing to respond to each new post?border detection (Wylie & Peters,2016).

Nature and Extent of Damage: The extent of damage done by the borings of H. aequalis is determined by the nature and dimensions of the wood infested by the borer and are confined to wood that contains starch. That starch is an essential constituent of the food of the larva has been experimentally determined in *Bombax malabaricum*. If the tree is felled and hole is not cross-cut into logs and the crown branches are not severed, the bark remains green for several months. During this period, the starch in the outer zones of the wood is depleted and the wood is rendered unsuitable as food for *Heterobostrychus* (Stebbing,1914).

Status: Data Deficient.

135. *Heterobostrychus hamatipennis* (Lesne,1895)

Superfamily: Bostrichoidea

Family: Bostrychidae

Tribe: Bostrichini

Synonyms:

Apate nipponensis Lewis,1896.

Bostrychus hamatipennis Lesne,1895.

Distribution: Kumaun Tarai, Uttarakhand. Also reported from the Jhelum Valley; North-east, Sikkim; Bhutan; Sylhet,

Bangladesh and Sri Lanka (Stebbing,1914). [More than 340 specimens are kept in NFIC, Dehradun. Dehradun collected by S. Bahadur on 26.vi.1926, by B.S.Gusain on 13&15.vi.1931, by R.N. Mathur on 17.vi.1936; Haflong, Chachar, Assam collected by C.F.C Beeson on 16.v.1925; Kurseong Div. West Bengal collected by F. Economist on 04.viii.1929; Katha Div. Myanmar collected by C.R. Robbins in May, 1924; Horsangabad Div. collected by C.F.C Beeson in November, 1941; Lakhimpur, Assam collected by C.F.C.Beeson on 20.iv.1921].

Species of Oak infested: *Quercus* sp., (Mathur & Singh,1959).

[source:https://commons.wikimedia.org/wiki/File:Heterobostrychus_hamatipennis_(Lesne,_1895)_ale_(28927935041).png].

Fig. 134. Adult-*Heterobostrychus hamatipennis* (Lesne,1895)

Other Host Plants: *Acacia catechu* (Stebbing,1914). *Acacia catechu, Anogeissus latifolia, Bombax malabaricum, Boswellia serrata, Canarium strictum, Dalbergia sissoo, Dendrocalamus strictus, Eugenia jambolana, Garuga pinnata, Machilus sp., Mallotus philippinensis, Quercus sp., Shorea robusta, Terminalia belerica and Vatica lanceaefolia* (Beeson and Bhatia,1937).

Habit: Beetle and larva bore in sapwood of dead wood (Mathur & Singh,1959).

Larva: The larvae of *H. hamatipennis* are un-described and little is known about the life cycle other than there is one generation per year with 70% of the emergence in June in India (Beeson and Bhatia,1937). According to Gardner (1933), the length of larva is 17 mm, body is having setae, extremely short and inconspicuous except on legs, pleural region and on caudal segment where they are moderately long. Head is rectangular, the posterior margin slightly curved; length is 3.5 mm and width 2.8 mm; anteriourlyregulose, castaneous near mandibular articulations; without distinct ocelli; antenna are with three brown segments, the first one is short, weakly transverse, the second one is widened on apical half, very long, rather long than three times as long as width near base; third segment is small, slightly more than one

fourth as long as second; accessory appendage is about one third as long as apical segment. Clypeus is well developed, with transverse group of setae on the each side. Labrum is transverse, the anterior margin with short dense red setae. Maxillae are with mala stout, with short dense apical setae. Labium is with wide setose ligula; the two palps are nearly equal in length. Legs are reddish with setae. Thoracic spiracles are twice as long as posterior abdominal spiracle and two third as wide as labrum.

Beetle: Length of male varies from 9 mm to 15.5 mm, parallel, fairly large, robust, dark brown with femora reddish at times; upper surface covered with a pubescence, very short and sparse, denser near the anterior edge of the prothorax and in the male, on the apical declivity of the elytra, which often appears as if covered with a yellowish pubescence; the pubescence on the scutellum is dense and often appears as a well-marked light colored blotch. Ventral pubescences are less short and more abundant than dorsally. Head is large, the profile of the upper part forming a regular curve in both sexes; front not depressed, punctuate or rasp-like. Posterior angles of the prothorax are straight or obtuse; sculpture of posterior surface is fairly large, rasp-like, consisting of scaloidal tubercles, more prominent in the female. Apical edges of the elytra are not reflexed; the punctures are well marked, dense and arranged in regular series. Female eyes are larger; anterior angles of the prothorax are furnished with only one large erect tooth; apical declivity of elytra is with a marginal callosity on either side. Males anterior angles of the prothorax is prolonged into upturned horns; posterior surface is covered with scales medianly; apical declivity is less strongly and less densely punctate than dorsal surface of elytra and has on each side a marginal sub-cylindrical apophysis obliquely truncate on top (Stebbing,1914).

Life History: Stebbing found this beetle in April into the wood and large branches of Khair (*Acacia catechu*) trees felled in the Jaulasal forests of Kumaon the preceding cold weather. The beetles were egg-laying. For this purpose, they tunnel down into the wood about half inch and then eat out a tunnel at right angles to right and left of the entrance-tunnel. Small ridges and unevenness are left in this long tunnel which is the egg-tunnel and is carried round the stem parallel to the outer surface. There is often a depression in the floor of the egg-tunnel just at its juncture with the entrance-tunnel, which may be the pairing chamber (Stebbing,1914). In India, adults emerge in June (Beeson and Bhatia,1937).

Extent of Damage/Status: Data Deficient.

136.Chinese Auger Beetle, *Sinoxylon anale*(Lesne,1897).

Superfamily: Bostrichoidea

Family: Bostrychidae

Subfamily: Bostrichinae

Synonyms :

Apatodes macleayi Blackburn*,1889.*

Sinoxylon geminatum Lesne,1897.

Distribution: North-Western, Northern, Central, North-East India and Myanmar (Punjab, United Provinces, Central Provinces, Bombay, Bengal; Upper and Lower Burma) (Stebbing,1914). Described from India, S. *anale* is also found in Sri Lanka, Iraq, Saudi Arabia, Asian Southeast, South of China, Malay Archipelago, Philippines, Australia, Indonesia and New Zealand, USA and has been introduced to various parts of the world by trading activities (Lesne,1906 & Fisher,1950). [More than 2800 specimens in NFIC, Dehradun. Doiwala Timber yard, D.Dun collected by N.C. Chatterjee on 28.vi.1921, by C.F.C. Beeson on 11.v.1922; Anamalai Hills, Madras (731 m.) collected by J.C.M.

Gardner on 08.v.1930; Balaghat collected by B.M Bhatia on 01.vii.1927; Amarampalam Nilampur, Madras collected by C.F.C Beeson on 12.iv.1927; Palgarh N. Thane, Bombay collected on 27.iv.1939; Goalpara, Assam collected by R.N. De on 29.vii.1933; Tithimatti, S. Coorg collected by C.F.C Beeson on 17.vi.1933; Raipur collected by N.C. Chatterjee on 09.iii.1923; Pachmarchi (1143m), Hosangabad collected by B.M Bhatia on 12.v.1926); NagargallBelgaun Div., Mumbai collected by B.M. Bhatia on 29.x.1929; Motinal Range, Mandla, M.P. collected by N.C. Chatterjee on 12.vi.1927].

Fig. 135. Adult- *Sinoxylon anale* (Lesne,1897).

Species of Oak infested: *Quercus* spp. (Mathur & Singh,1959).

Host plants: *Terminalia belerica, Shorea robusta, Dalbergia sissoo, Acacia modesta, Xylia dolabriformis, Dalbergia latifolia, Prosopis spicigera, Terminalia tomentosa, Acacia catechu, Dendrocalamus strictus, Pterocarpus marsupium* (Stebbing,1914). *Acacia arabica, Albizzia lebbek, A. procera, Adina cardifolia, Anogeissus acuminata, A. latifolia, Cassia fistula, Casuarina equisetifolia, Cedrela toona, Ficus glomerata, Ficus religiosa, Gmelia arborea, Grevillea robusta, Grewia optiva, Indigofera tinctoria, Lagerstroemia lanceolata, Mallotus philippinensis, Mangifera indica, Melia azedirach, Morus indica, Prosopis juliflora, Pterocarpus marsupium, Tectona grandis, Terminalia arjuna, Zizyphus jujuba, Z. rugosa, Z. xylopyrus* (Beeson,1941).

Habit: Beetle and larva bore in sapwood of dead wood (Mathur & Singh,1959).

Larva: Mature larva is 5.5 to 6.5 mm. The larva is a little, white curved grub, with the anterior segments enlarged and a median dark colored line running down the back; three pairs of legs are present. The grub is active in its movement, wriggling about when disturbed (Stebbing,1914).

Pupa: The pupa has the ordinary white, beetle like form, which gradually assumes the shape of the mature insect. The head, legs and wings are pressed on to the under surface (Stebbing,1914).

Beetle: Length of adult ranges from 4 mm to 5.5 mm, firstly light yellow in colour than becoming darker-coloured as its outer parts harden. When mature it is oblong slightly dilated behind, black with the elytra anteriorly rufous chestnut, more or less dusky with antennae, palpi and testaceous, the thighs being paler in colour and abdomen reddish at the apex. Head is tuberculate on the front and punctate. Antennae end in a strongly fan-shaped club, the second joint of the club being about six times as broad as long. Prothorax is very convex, culminating in appoint medianly on disk, rugose-

punctate with a transverse band of rasp-like elevations anteriorly and four teeth on lateral edges of anterior margin; posterior portion depressed, finely rugose-punctate. Elytra is truncate, widest apically, strongly rugose-punctate posteriorly with two sharp teeth on apical declivity (Stebbing,1914).

Life history: It was first discovered in the Bombay presidency. Mr. Bell observed this species boring into the bark of *Dalbergia latifolia* and then mining out beneath the bark a longitudinal gallery. One or more of these Bombay specimens was described by Lesne in 1897. It was in the year 1897 that Stebbing first took the insect attacking Sal logs in the Singbhum forests of Chota Nagpur (Stebbing,1914). The different generations of this beetle appear on the wing vary in different parts of the country. In North India (Changa Manga, Dehradun etc.,) the beetles issue early in April. In Bombay, they first appear in March or even February. In Dehradun, however, Stebbing bred out beetles in the third week of November from Sissoo billets brought from Changa Manga; so that a portion, at least of the September laid eggs mature and hibernate as beetles. He discovered that these beetles hibernate in the thicker bark of old dying or dead Sissoo standards. As regards the number of generations passed through during the year, in the north of India, generally, i.e., Punjab, the Siwalik and the Sub-montane terai areas of the United Provinces, the insect passes through two and a half to three complete life cycles, the first eggs being laid early in April. The beetles from these eggs appear in May and June, laying eggs which give rise to the September beetles. These oviposit produce the third generation, of which some beetles mature and issue in late November (Stebbing,1914).

According to Stebbing (1914), the presence of *S. anale* in a tree or in a billet or log can be easily recognized by the beautifully circular entrance orifice and the white sawdust powder it ejects from the orifice during its tunneling operations. This, if the outer surface of the bark or wood is at all uneven, is caught up in white masses and inevitably betrays the presence of the beetle.

To oviposit, the beetle bore straight through the bark (or, if absent, sapwood) until it has got down about a quarter of an inch to half an inch into the sapwood and then sops out a deep pit-like gallery which forms the pairing chamber. This chamber may have only the one entrance-tunnel or there may be two entrance-tunnel into it made by the male and female. The eggs are laid at intervals in the long axis of the tree or log. The larval gallery unlike the beetle egg-tunnel, which is kept entirely free from wood-dust and particles are blocked with wood-dust and excreta throughout their entire length, save for the slight enlargement of the tunnel at the end which forms the pupal chamber. On maturing, the beetle either eats its way out through the wood and barks above it till it reaches the outside or when the wood is badly attacked, eats upwards until it cuts into an empty egg-tunnel, up which it creeps to the outside. This beetle is one of the most destructive wood-borers of India. Observations have shown that it tunnels into and oviposit in dying trees, dead trees, fresh-cut logs and firewood billets and old, dry or even rotting materials. Another curious fact about the beetle is that it attack the wood of the tree anywhere, from the thick knotty wood of the roots, the wood of the main stem, to that of the branches. Adults emerge mainly between March and July (Stebbing,1914).

Extent of Damage/Status: Data Deficient.

137.False Powderpost Beetle, *Xylocis tortilicornis* (Lesne,1901).
Superfamily: Bostrichoidea
Family: Bostrychidae
Subfamily: Bostrichinae
Distribution: This monotypic genus with the single species *Xylocistortilicornis* is known from India, Sri Lanka, Southeast Asia, China and Taiwan (http://www.padil.gov.au/pests-and-diseases/pest/main/136068/19856). India (Uttarakhand, Assam), Sri Lanka. Thailand (Beaver et al. 2011), Laos, Hong Kong (Liu, 2010).
Species of Oak infested: *Quercus* spp. (Mathur & Singh,1959).

Other Host plants: *Amoora wallichii, Berberis aristata, Bombax malabaricum, Caesalpinia sepiaria, Celtis australis, Colebrookia oppositifolia, Cordia myxa, Eugenia jambolana, Flemingia congesta, Colebrookia oppositifolia, Mallotus philippinensis, Pongamia glabra, Pterocarpus* marsupium, *Shorea robusta, Swietenia mahagoni, Tectona grandis, Terminalia tomentosa, Thespesia populnea, Zizyphus xylopyrus* (Beeson,1941).
Habits: This species breeds mainly in small stuff, dead branches etc., but also in the sapwood of logs throughout India and Ceylon (Beeson,1941). Beetle and larva bores in sapwood of deadwood of *Quercus* sp. (Mathur & Singh,1959).

(source: http://www.padil.gov.au/pests-and-diseases/pest/main/136068/19856).
Fig.136. Adult- *Xylocis tortilicornis*(Lesne,1901).

Beetle: The genus *Xylocis* is characterised by body length of 20-30mm; last visible abdominal sternite is prolonged as a truncate lobe and with a large pleural on each side; pronotum anterior angles with a hook-shaped tooth and distinct hair tufts on sterna 5 (http://www.padil.gov.au/pests-and-diseases/pest/main/136068).
Life cycle: There are two complete life-cycle in a year with fairly sharply marked emergence-periods, one of which overwinters and emerges in April-June (with about 80 % of the generation emerging in May) and other of which emerges in July to September (With 50% of the generation emerging in August). The hot weather life-cycle may be completed in three months. Individuals of belated development may take two or three years to mature (Beeson,1941).
Extent of Damage/Status: Data Deficient.

138.Auger Beetle, *Xylothrips flavipes* (Illiger,1801).
Superfamily: Bostrichoidea
Family: Bostrychidae
Subfamily: Bostrichinae
Synonyms:
Apate dominicana Fabricius,1801
Apate flavipes Illiger,1801
Apate macrocera Latreille in Dejean,1833
Apate sinuata Stephens,1830
Bostrichus iracundus Vollenhoven et Longchamps,1869
Bostrichus mutilatus Walker,1858
Distribution: Algeria, Bhutan, Comoros, India, Indonesia, Israel, Italia, Japan, Madagascar, Mauritius, Philippines, Reunion, Seychelles, South Africa, Sri Lanka, Taiwan, ReinoUnido, USA, Yemen(http://coleopteraneotropical.org/paginas/3ac_familias/BOSTRICHOIDEA/1sp/Bostrichidae/Bostrichinae/*Xylothrips-flavipes*.html). According to Stebbing (1914), it is distributed in Peradiniya, Ceylon, Indo-Malayan, Madagascar and neighbouring islands. In India it has been reported from Sylhet, Khasia Hills, Bhutan, Tetara (West Bengal) and Travancore. This species is widely distributed in the Indian Ocean and Southeast Pacific Ocean archipelagoes and the Arabian Peninsula. These new records show that species also occurs in the Himalayan mountain area (https://www.zobodat.at/pdf/MittMuenchEntGes_100_0103-0117.pdf).

(source: https://www.nbair.res.in/insectpests/Xylothrips-flavipes.php).
Fig. 137. Adult- *Xylothrips flavipes*(Illiger,1801).

Species of Oak infested:*Quercus* spp. (Mathur & Singh,1959).
OtherHost plants: Cocoa (*Theobroma cacao*) (Stebbing,1914). According to Beeson (1941), its host plants are *Albizzia odoratissima, Anacardium occidentale, Bombax malabaricum, Butea frondosa, Canarium strictum, Dipterocarpus turbinatus, Eugenia jambolana, Ficus glomerata, Ficus religiosa, Hevea* sp., *Hopea odorata, Hopea parviflora, Lannea grandis, Machilus odorratissima, Mallotus philippinensis, Mangifera indica, Myristica longofolia, Parishia insignis, Phyllanthus emblica, Poinciana elata, Pterocarpus indicus, Shorea robusta, Terminalia bialata, Terminalia myriocarpa, Terminalia paniculata, T.tomentosa, Theobroma cacao, Vateria indica, Vatica lanceaefolia* and *Vitis vinifera.*
Habits: Larva and beetle bore in sapwood of dead wood (Mathur & Singh,1959) .
Beetle: The length of beetle ranges from 6 mm to 8.5 mm. It is chocolate-brown in colour, posterior parts of elytra are darker in colour; often entirely reddish; under-surface is lighter colored, especially the abdomen; antennae are reddish and club brown. The

rasp-like elevations on prothorax interrupted by small teeth; posterior surface is shining or very finely punctured. Elytra is finely punctuate, stronger from behind, especially near declivity; later furnished with three marginal tubercles, the median one is longest and most prominent; suture elevate on declivity, the sutural margin is with one or several tubercles; suture is slightly gasping. Breast and abdomen is covered with a very fine and dense reddish-gold pubescence. In male, the front of head is transversely convex, finely and densely punctuates and finely pubescent with a few scattered stiff, more numerous near the eyes (Stebbing,1914).

Life Cycle: It has two generations a year in North and under favorable conditions may complete a third. The minimum life cycle during the monsoon period is three months; the first generation of the year beginning in April takes four months at the shortest. The emergence of the overwintering broods is sharply marked in March-May; the first generation emerges during the rains and there is a post monsoon emergence from the ovi-position of early monsoon swarms. About two third of the population of one infestation matures at the quicker rate and the remainder overwinter and matures in the hot weather of the second year (Stebbing,1914).

Extent of Damage/Status: Data Deficient.

139.Powderpost Beetle, *Lyctus africanus* (Lesne,1907).

Superfamily: Bostrichidae

Family: Lyctidae

Subfamily: Lyctinae

Distribution: It is found in Africa, Europe & Northern Asia (excluding China), North America, and Southern Asia (https://en.wikipedia.org/wiki/Lyctus_africanus).

Species of Oak Infested: *Quercus semecarpifolia* (Mathur & Singh,1959).

Other host plants: *Acacia arabica, Acacia modesta, Albizzia lebbek, A. Procera, A. Stipulata, Alnus nepalensis, Alstonia scholaris, Artocarpus hirsute, Bamboo sp., Bauhinia vahlii, Boswellia serrata, Cassia fistula, Dalbergia sissoo, Emblica robusta, Grevillea robusta, Ficus palmate, Ficus religiosa, Terminalia arjuna, Tectona grandis, Terminalia tomentosa, Vateria indica* (Beeson,1941).

Fig. 138. Adult- *Lyctus africanus*(Lesne,1907).

Habit: Beetle and larva bores in sapwood of deadwood (Mathur & Singh,1959).
Larva: The larva is described by Gardner (1933). The larva is about 3 mm. Body has sparsely very short setae except on pleural region. Antennae are segmented, two weakly transverse, the appendages as one half as long as third segment. Spiracles are without marginal lobe; that of thorax narrowly oval, more than twice as long as wide; abdominal spiracles are oval, the posterior pair widely oval, about 2.5 times as wide as thoracic pair; anterior spiracles are widely oval to almost circular. Metathoracic legs are terminating in a soft rather blunt point (Gardner,1933).
Adult: The beetle is 2-4.5 mm long, does not display the wide range in size characteristic of *L. brunneus*.It attacks logs, branch wood and stumps of felled trees in the forest and practically every kind of manufactured wooden article that contain sapwood (Beeson,1941). The frass of *L. africanus* is almost entirely depleted of starch and it is presumed that starch and its associated disaccharides form an essential part of the food-supply. The borer will attack unseasoned wood a short time after the tree has been felled. A heavier attack occurred on logs stored in the sun than on logs stored in the shade indicating that a certain amount of drying out is essential (Beeson,1941).
Emergence-period: Ordinarily there is very little emergence during the first three months of the year at the most irregular series of individuals amounting to a small percentage of the annual total. At the beginning of the warm weather there is a fairly sudden increase in the number of emerging beetles which rapidly rises to a high peak. This phase of abundant emergence usually commences in the half of May and lasts for three or four weeks and then falls to relatively low figures (Beeson,1941).
Number of Generations: *Lyctus africanus* may complete three generations a year the commencement of each corresponding with one of the three dominant peaks in the emergence (Beeson,1941).
Extent of Damage/Status: Data Deficient.

140.*Holotrichia longipennis* (Blanchard,1851)
Superfamily: Scarabaeoidea
Family: Scarabaeidae
Subfamily: Melolothinae
Synonym: *Lachnosterna longipennis* (Blanch.)

Fig. 139.Adult-*Holotrichia longipennis*(Blanchard,1851)

Distribution: It usually occurs in Himalayas in Northern India and Pakistan at altitude varying from 700 to 2500 m (Thakur,2000). [14 specimens in NFIC, Dehradun. From Mundali, Chakrata collected by B.M. Bhatia on 24.iv.1933; Airadeo, Almora collected by J.C.M. Gardner on 03.vi.1937; Someshwar, Almora collected by J.C.M Gardner on 15.vi.1937; Dehradun collected by J.C.M Gardner on 16.v.1936; Bhowali, Kumaon collected by C.F.C Beeson on 09.vi.1915 &Kangra, Dharamsala, Himachal Pradesh collected by O.H.Walters on 22.viii.1916].

Species of oak infested: *Q. leucotrichophora* (Mathur & Singh,1959).

Other host plants: *Rubus lasiocarpa* (Beeson,1941). Sharma and Bhalla (1964) reported *H. longipennis* feeding on apple, apricot peach and plum leaves for the first time from Himachal Pradesh. First record of *H. longipennis* grubs causing damage to agricultural crops is in potato in India was from Himachal Pradesh.

Habit: Beetle feeds on foliage (Mathur & Singh,1959).

Larva: The newly hatched grubs were creamy white in colour with light brown head, which is prominently broader than the rest of the body. There were three instars during the larval development which were distinguished from one another on the basis of head capsule width. Grubs attained a body length of 8.35 to 9.11 mm, 18.98 to 20.1 mm, and 32.98 to 34.2 mm, respectively, during instars I-III (Pathania et al.,2016).

Prepupa: The terminal portion of the last instars, or prepupal period was relatively short, about 11-16 days which constitutes 4.2% of total development cycle. The prepupae of *H. longipennis* were attained a typical 'C' shape (Pathania et al.,2016).

Pupa: The pupal stage of *H. longipennis* accounted for 3.08% of the development cycle with a range of 8-11 days. The pupa measured on an average 22.34 ± 0.34 mm and 9.64 ± 0.06 mm wide. The average pupal period was 9.5 ± 0.27 days. The pupa was exarate, initially light brown and turns brown later on (Pathania et al.,2016).

Adult: The adultbeetles are shining; light chestnut-brown in colour with light brown abdomen and dark brown legs. In thoracic segments, the under surface has a creamy pubescence. In male beetles, the eighth abdominal tergum and small portion of the seventh tergum remain uncovered by the elytra, whereas in female beetles, a greater part of the seventh tergum besides the eighth is exposed. The flagellum segment of antennae of male of *H. longipennis* is larger than that of the female which aids in of pheromonal communication between the adults (Pathania et al.,2016).

Shreedevi*et* al.,(2014) described the adults of *H. longipennis*. According to them, the raster possessed two closely separated, prominent parallel, long palidia that are divergent posteriorly. The palidia comb likes structure at the centre and the hamate setae (lateral to palidia on each side -Tegillum) covered nearly half of the last ventral abdominal segment and located in close proximity to the 9th abdominal segment. Each palidium possesses a long, sharp 12-14 pali. The septula (space between two palidia) is narrow with tips of pali of each side overlapping at the terminal ends. Septula is linear and appears narrow 'V' shaped. Tegilla is occupied nearly caudal half of the area between lowers anal lip and the anterior margin of the last abdominal segment.

Extent of Damage/Status: Damage minor.

141.*Mimela fulgidivittata*
(Blandford,1851).
Superfamily: Scarabaeoidea
Family: Scarabaeidae
Subfamily: Rutelinae
Distribution: India: Uttarakhand, Haryana, Assam, Arunachal Pradesh (Itanagar), Sikkim & Bhutan (http://www.checklist.org.br/getpdf?NGD059-12). [25 specimens in NFIC, Dehradun. Barechina (1219 m), Almora (Uttarakhand) collected by R.N. Parker on 02.vi.1923; Nakronda, Dehradun collected by J.C.M Gardner on 16.vi.1936; Bagdogra range, Kurseong,West Bengal collected by C.F.C. Beeson on 14.vii.1935 and Lawacherra, Sylhet, Bangladesh collected by C. Chatterjee on 02.vi.1938].
Species of oak infested: *Quercus leucotrichophora* (Beeson,1941).
Habit: Beetle feeds on the foliage (Mathur & Singh,1959).

Fig 140.Adult-*Mimela fulgidivittata* (Blandford,1851).

Adult: Beetle is a ruteline and deep metallic green from above and beneath, with the antennae ferruginous and with fiery-red markings on elytra (Beeson,1941) Pronotum is finely and rather evenly punctured. Elytra is finely but distinctly punctured all over except at the apices. Pygidium is very finely and scantily punctured. Mesosternum is bluntly prominent in the middle but not produced. Front tibia is bidentate (Chandra & Gupta,2012).
Extent of Damage/Status: Damage is not significant.

142.*Anomala lineatpennis*
(Blanchard,1850).
Superfamily: Scarabaeoidea
Family: Scarabaeidae
Subfamily: Rutelinae

Fig. 141. Adult- *Anomala lineatpennis*(Blanchard,1850).

Distribution: N.W. Himalaya [20 specimens in NFIC, Dehradun. Mussoorie collected by S.N. Chatterjee on 23.vi.192; Someshwar, Almora collected by J.C.M. Gardner on 31.vi.1937; Naldera, Shimla collected by C.F.C Beeson on 02.vii.1938; Barenag (1828m), Almora collected by R.N. Parker on 30.vi.1923; Bowali, Kumaon collected by A.D. Imms on 24.vi.1912 and Dwarahat (1524m) collected by R.N. Parker on 21.vi.1923].

Species of oak infested: *Quercus* spp. (Mathur & Singh,1959).
Other host plants: *Cedrus deodara* (Beeson,1941).
Habit: Larva damages roots of seedlings (Mathur & Singh,1959).
Beetle: The beetle defoliates plum trees and damages the fruits of apple trees (Beeson,1941).
Extent of Damage/Status: Minor damage.

143.Elegant Green Scarabid, *Heterorrhina elegans* (Fabricius,1781)
Superfamily: Scarabaeoidea
Family: Scarabaeidae
Subfamily: Cetoniinae
Synonyms:
Cetonia aeruginea Herbst,1786
Cetonia cuprea Herbst,1790
Coryphe cyanoptera Westwood,1842
Corypho ceracoxalis Blanchard,1850
Corypho cerafulgidissima Kannegieter,1891
Gnathocera feisthamel Gory & Percheron,1833
Gnathocera feisthameli Burmeister,1842
Heterorrhina anthracina Westwood,1848

(a)Adults mating on kharsu oak

(b) Adult (Dorsal view)

Fig. 142. Adult- *Heterorrhina elegans* (Fabricius,1781)

Distribution: India and Sri Lanka (https://en.wikipedia.org/wiki/Heterorrhina_elegans). According to Beeson (1941), it occurs throughout India. Western Himalaya: Uttarakhand. [3 specimens in NFIC,FRI Dehradun from North Salem, Tamilnadu collected on 04.vi.1930; Suduganga Matale and from Sri Lanka collected by R. Senior White on 10.iii.1920].

Species of oak infested: *Q. semecarpifolia*.
Other host plants: *Rosa* spp. and *Mangifera indica* (Kumar et al.,2009).
Habit: Beetle feeds on sap of Kharsu oak trees. A pair was recorded mating and feeding on sap at Deoban (2800m), Chakrata Forest Division,Uttarakhand in 09.viii. 2017.
Larva: It is 33 mm in length developing in rich leaf-mould or in manure (Beeson,1941).

Adult: According to Beeson (1941), it is shining beetle varying in color from emerald green, blue and fiery red to black. According to Arrow (1910), it is emerald green, blue, fiery red (var. *fulgidissima*), indigo, or black (var.*anthracina*), with the sides of the hind coxa orange and the antennae, legs, the sutural margins of the elytra posteriorly and the apical call) black (generally also the humeral calli, but less distinctly).The form is elongate oval, with the surface very smooth and moderately convex above. The clypens is sparingly punctured, quadrate and parallel-sided, with the front margin straight, strongly recurved, and broadly toothed in the middle, the tooth minutely notched, and the forehead furnished with a lobed longitudinal carina. The prothorax is rather narrow in front and feebly punctured at the sides alone. The scutellmn is unpunctured, and the elytra are almost smooth at the sides and apices, with vestiges of seriate punctuation on the disc. The lateral margins are only feebly sinuated. The sterna pygidium is coarsely strigose transversely and the metasternum and abdomen are very sparingly punctured. The sternal process is narrow, curved and blunt. The middle and hind tibia are fringed in both sexes. In male, the length is 21-28 mm, front tibia are unarmed, the hind tibia bear a tuft of long hairs near the extremity, the hind tarsi are longer than those of the female, and the abdomen is deeply channeled beneath.According to Kumar et al.,2009, they are seen in aggregations made up of large numbers in southern India during June to October.

Extent of Damage/Status: Damage minor.

144.*Jumnos roylei* (Hope,1839).

Superfamily: Scarabaeoidea

Family: Scarabaeidae

Subfamily: Cetoniinae

Distribution: N.W. Himalaya.

Host plants: *Quercus* sp. (Mathur & Singh,1959).

Habit: Larva bores in rotten wood(Mathur & Singh,1959).

Extent of Damage/Status: Damage minor.

145.Giraffe Stag Beetle, *Cladognathus giraffe* (Fabricius,1794).

Superfamily: Scarabaeoidea

Family: Lucanidae

Subfamily: Lucaninae

Synonyms:

Lucanus girafa Olivier,1789

Prosopocoilus girafa Olivier,1789

Distribution: It occurs in the Himalayas and Assam-Bengal hill ranges (Beeson, 1941). This species occurs from India to Indonesia (https://en.wikipedia.org/wiki/Cladognathus_giraffa). [29 specimens in NFIC, Dehradun. From New Forest, D.Dun collected by J.C.M Gardner on 06.viii.1938; Mussoorie, Dehradun collected by N.C. Chatterjee on 22.i.1912; Ranikhet, AlmoraFor. Zool. Coll. on 15.v.1915; Jaunsar (2743 m),Uttarakhand collected by students on 25.xi.1916].

Host plants: *Quercus* spp., (Beeson,1941).

Other host plants: *Mangifera indica, Picea smithiana* (Beeson,1941).

Habit: Beetle and larva bores in rotten wood (Mathur & Singh,1959).One male was recorded at New Forest, FRI, Dehradun on 02.vii.2020.

Larva: It feeds on rotten trunks of trees (Beeson,1941).

Male **Female**

Fig. 144. Adults- ***Cladognathus giraffe*** **(Fabricius,1794)**

Beetle: It is the world's largest saw-tooth stag beetle with long and sharp jaws, also is one of the largest stag beetles in the world. It is strong and rough natured, but the large jaws are sometimes beyond its control. Aggressive, fierce and powerful, it fights using its muscular jaws. It is up to 119 mm in length. Body color is typically determined by habitat. It can reach a length of about 100 mm in males and its antler-like jaws reach about half of its total length. The females are much smaller, reaching about 40-60 mm. The body is flat and completely black, included the antler-like jaws and the legs. Males' jaws show several small teeth along inner edge and are slightly forked at the top (https://www.revolvy.com/page/Cladognathus-giraffa). Beetle matures in May-August and life cycle is prolonged for two years (Beeson,1941).
Extent of Damage/Status: Damage minor.

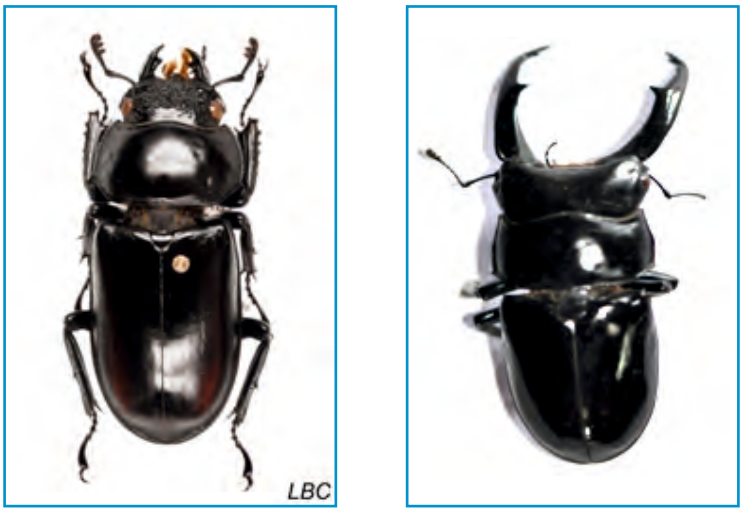
146.*Dorcus antaeus* (Hope,1842).
Superfamily: Scarabaeoidea
Family: Lucanidae
Subfamily: Lucaninae
Synonyms:
Dorcus dispar De Lisle,1970.
Dorcus mercurius Boileau,1913.
Lucanus scaritoides Hope,1845.
Rhaetusparryi Boileau,1902.
Distribution: Malaysia, Thailand, Vietnam, India, Myanmar, Laos (https://www.beetlebreeding.ch/dorcus-antaeus/). [3 specimens in NFIC, Dehradun. Bhowali, Nainital collected by Student on 01.vi.1915; Kanasar (1674 m), near Chakarata, Dehradun district, Uttarakhand collected by S.K. Pillai on 25.vi.1923].
Species of oak infested: Quercus leucotrichophora (Mathur & Singh,1959).
Habit: Larva bores in rottenwood (Mathur & Singh,1959).
Breeding Hint: It is rather easy to breed. The females lay eggs into relatively hard white rotten wood logs. The larvae can be reared in these logs or be separated and fed with white rotten wood pieces stuffed into containers. Big specimens are commonly reared on kinshi fungus. For the rest of the world who are not privileged enough to have kinshi available, the larvae can also be reared on fermented saw dust with an additional feeding of proteins. This way it is also possible to raise reasonably sized specimen. Larvae can be cannibalistic at times, especially under crowded conditions and should be separated. Since males can be

very aggressive, it makes sense to pair male and female under supervision and separates them afterwards. It is also advisable to keep them in slightly cooler temperatures than the tropic species of Dorcus (https://www.beetlebreeding.ch/dorcus-antaeus/).

Fig.145.Adult- *Dorcus antaeus* (Hope,1842).

Extent of Damage/Status: Damage minor.

147.*Hemisodorcus nepalensis* (Hope,1831).
Superfamily: Scarabaeoidea
Family: Lucanidae
Subfamily: Lucaninae
Synonym :
Hemisodorcus raf flesi
Lucanus nepalensis Hope,1831.
Lucanus similis Hope,1831.
Lucanus chevrolatii Chenu,1840.
Lucanus raf flesii Hope,1840.
Lucanus parryi Hope,1843.
Distribution: Pakistan- North-West Frontier, Thobba& Murree Hills; India- Himachal Pradesh: KuluDistr; Punjab; Uttarakhand (Almora, Binsar, Kumaon, Nainital, Mussoorie, Tehri Garhwal); Balcha, Sikkim; West Bengal (Darjeeling,Tiger Hill, Kurseong, Mungphu); Assam; Meghalaya; Khasi Hills; Nepal (Hardu, Junbesi, Jubin, Jiri, DudhKosi-Tal, Kaski Distr. : Todapani: Ghandrung-Gorapani); Bhutan (Pedong, Sampo-Kotoka,W.Wangdi-Phodrang) (http://www.bionica.info/Lucanidae/HEMISODORCUS.htm). [23 specimens in NFIC, Dehradun. Mundali and Konain, Chakrata (2392m) collected by J.C.M Gardner on 22.v.1934; Mussoorie (1981 m) collected by S.N. Chatterjee on 12.vi.1934; Bhowali, Kumaon (2042 m) collected by A.D. Imms on 2.vii.1917].



(a) **(b)**

[(a) source: https://unmondeencouleurs.piwigo.com/index?/tags/1155-rhaetulus)]

Fig. 146. Adults- *Hemisodorcus nepalensis* (Hope,1831).

Species of Oak infested: *Quercus floribunda* (Beeson,1941).
Other Host plants: *Aesculus indica, Betula utilis, Cedrus deodara* (Beeson,1941).
Habit: Larva bores in the rotten wood (Mathur & Singh,1959).
Extent of Damage/Status: Minor damage.

148.*Lucanus lunifer* (Hope,1833).
Superfamily: Scarabaeoidea
Family: Lucanidae
Subfamily: Lucaninae
Synonyms:
Lucanus lunifer franciscae Lacroix,1971.
Lucanus lunifer lunifer Hope,1833.
Distribution: Western Himalaya; North East India, Bhutan, Nepal (http://www.coleoptera-atlas.com/lucanidae scarabaeoidea/lucaninae/lucanini/lucanus/Lucanus-lunifer-lunifer).
[15 specimens in NFIC, Dehradun. From Mussoorie (1981m), Uttarakhand collected by S.N. Chatterjee on 26.iv.1920].

Species of oak infested: *Quercus leucotrichophora* and *Q. floribunda* (Stebbing,1914).
Habit: Larva bores in rottenwood (Mathur & Singh,1959).
Larva: It is large, stout, fleshy, curved and corrugate with three pairs of legs on thoracic segments; abdominal segments are swollen in a bag like manner behind. Length of larva is 50 mm to 85 mm. Head of larva is large, brown and shining; mandibles are large and black (Stebbing,1914).
Adult: Male is 36 to 75 mm in length, elongate, black or greenish black, clothed with a very short greenish pubescence, elytra shining and occasionally coppery brown. Vertex of head is shield-like, the edges raised, central area depressed, the anterior margin sinuate, the outer angles and median part produced forward, front of head slopes downwards, the anterior edge produced into two median bifurcate prolongations. Eyes are large. Mandibles are enormous, developed into two long horns having a

resemblance to a stag's antlers. The antennae are long, elbowed and prominent. Prothorax is wider than long, with a median longitudinal depressed line. Elytra are convex, apex conjointly rounded. Scutellum is large, wide, anterior edge concave, posterior convex. Legs are long and tibia is spined. Under surface is pubescent, especially on metathorax. Abdominal segments are brownish in colour. Females are smaller than male and having black mandibles of normal size and front of head is coarsely rugose-punctate (Stebbing,1914).

Male (3 forms) -1

2

3

4. Female

Mating adults

Fig. 147. Adults- *Lucanus lunifer* (Hope,1833).

Life history: In the outer Himalaya, the mature beetles are to be found on the wing in June, July and later in September. The beetles probably issue irregularly throughout the summer. The length of time passed in the larval stage is unknown. It possibly exceeds a year. Before pupating the larva forms a rough kind of semi-cocoon with shreds of wood. The pupal stage is short, a month or six weeks at most; but the beetle spends some time in the resting stage whilst its outer chitinous parts are slowly solidifying. At this period the beetle is light brown in colour, this tint slowly darkening

as the outer covering hardens. The female beetle lays her eggs in crevices of the bark or creeps under projecting flakes and deposits them on the outer surface of the sapwood. The tree selected is invariably a dead one in which the wood has already undergoes considerable decay. Larvae bore in circular chambers, penetrating to the heart of the stem, winding into various passages both up and down the trunk. They eject the undigested particles through holes made for the purpose, forming lateral communication with the main tunnels; these particles may be observed at the roots of the trees so affected in the form of small lengthened chips (Stebbing, 1914).

Extent of Damage/Status: Minor damage.

149.*Basilianus cantori* (Percheron,1844).

Superfamily: Scarabaeoidea

Family: Passalidae

Distribution: It has been reported from Jaunsar, Uttarakhand in the North-West Himalaya (Stebbing,1914). [25 specimens in NFIC, Dehradun. Gwaldam, Chamoli collected by J.C.M Gardner on 10.iv.1937; Bajwar, Almora collected by J.C.M Gardner on 14.iv.1937; Mundali, Chakrata collected by J.C.M Gardner on 11.iv.193; Manali (1828 m), Himachal Pradesh collected by J.C.M Gardner on 27.vi.1942; Debrepani, Darjeeling, West Bengal collected by J.C.M Gardner on 18.ix.1929].

Fig. 148. Adult- *Basilianus cantori* (Percheron,1844).

Species of oak infested: *Quercus leucotrichophora* & *Q. floribunda* (Beeson,1941).

Other Host plants: *Betula cylindrostachys, Castanopsis tribuloides, Symplocos theafolia, Pinus roxburghii* (Beeson,1941).

Habit: Larva bores in rottenwood (Mathur & Singh,1959).

Eggs: The eggs are black, stoutly ovate and 3.5 mm long (Stebbing,1914).

Larva: It is 35 mm long. It is to be found in the larval stage in the autumn and summer months making irregular ramifying tunnels in the soft, decaying sapwood, beneath the bark of standing or fallen rotten stems (Stebbing,1914).

Adult: It is 30-34 mm in length, large, shining and black in colour. Head set with prominent pointed tubercles, the mandibles are large and toothed. Elytra is strongly striate, interspaces smooth. Under surface are black, shining, and the lateral edges of thorax with a long bright red pubescence. It emerges in April to June (Stebbing,1914).

Life history: This beetle was first taken in rotting saucer and kharani trees on 28 April,1896 at Loolagaon in Sikkim. It is plentiful in this locality between 4500 ft and 6000 ft. The beetle was never taken in sound timber. It would seem probable that the insect matures at irregular intervals in the spring and summer months. (Stebbing,1914).

Extent of Damage/Status: Damage minor.

150.*Anoplophora beryllina* (Hope,1840).
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Laminnae
Synonyms:
*Melanausterar gentife*Pic,1931
Melanausterar gentifermi cromelanauster.
Melanauster beryllinus Gahan, 1888.
Melanauster beryllinus micromelanauster
Melanauster granulipennis Breuning,1938
*Monochamus beryllinus*Kano,1933
*Monohammus melanosticticus*White,1858
Distribution: It is distributed in China, Myanmar, India, Laos and Vietnam. (https://en.wikipedia.org/wiki/Anoplophora_beryllina).
Species of Oak infested: *Quercus floribunda* (Mathur & Singh,1959), *Q. dealbata* Wall =*Q.oblongata* D.Don (Beeson,1941).

(source: https://commons.wikimedia.org/wiki/File:Anoplophora_beryllina_(10998075743).jpg)
Fig. 149. Adult- *Anoplophora beryllina* (Hope,1840)

Habit: Larva bores in living healthy branches and stems (Mathur & Singh,1959).
Larva: The larvae attack thin, living trunks (offshoots) of diameter 2-8 centimeters. It bore in one place making irregular tunnels. Trunk in this place is swollen. The larva pupates in the centre of the trunk. The development lasts for two years. The emergence hole is circular(http://coleoptera-kucera.com/bionomy/H-22.htm).
Adult: Beeson (1941), described it as Monochamus beryllinus. According to him, beetle is 12-23 mm in length, pale green with black spots or broken horizontal bands on the elytra, antennae are ashy and joints are tipped with black.

Life cycle: The beetle lays eggs on living healthy branches of young trees and larva bores round the branch between the bark and sapwood. The plant reacts by forming a corrugated cankerous swelling over the site of larva tunnel. Pupal chamber is formed in heartwood. The beetle emerges by cutting a short tunnel from the end of pupal chamber straight out of exterior. The exit hole is circular. Life cycle is annual (Beeson,1941).
Emergence period: Adults emerge in May and June (Beeson,1941).
Extent of Damage/Status: Data deficient.

151. *Batocera horsfieldi* (Hope,1839)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Laminnae
Synonyms:
Batocer ahorsfieldi Hope,1839
Batocera adelpha Thomson,1859
Batocera kuntzeni Kriesche,1915
Batocera horsfieldi m. flavicans Breuning, 1948
Distribution: Myanmar, India, China and Nepal(https://www.gbif.org/species/115931185). [25 specimens in NFIC,Dehradun. From Senchal Range, Darjeeling, West Bengal collected by J.C.M Gardner on 23.ii.1931; Naga Hills, 1676 m collected by O.C. Ollenbach on 14.v.1924; Shimla, Himachal Pradesh collected by J.C.M Gardner; Munsiyari, Pitthoragarh (1787m) collected by M.S. Bhandari on 17.ix.2017; Mussoorie,Uttarakahnd collected by C.F.C Beeson on 10.ix.1919].
Species of Oak infested: *Quercus leucotrichophora* (Beeson,1941; Mathur & Singh,1959).
Other Host plant: *Alnus nepalensis, Juglans regia, Paulorenia tomentosa, Salix tetrasperma, Trema amboinensis* (Beeson,1941).
Habit: Larva bores in deadwood (Mathur & Singh,1959).

Eggs: The eggs are laid on the bark of the living tree usually within the 120-150cm of the bole, but a tree that is very heavily attacked may have tunnels as high as 300 cm feet (rarely 600 cm) from the ground (Beeson,1941). According Rahman & Khan (1942), Eggs are oval in shape and brownish in colour with a thick and leathery chorion measuring 11mm in length and 4-5 mm in breadth.
Larva: The full grown larva is nearly 152 mm long. The larva on hatching bores down to the surface of the sapwood and excavates a shallow, more or less circular patch from which a relatively enormous tunnel is later bored upwards into the centre of the heartwood. The tunnel gradually expands in diameter and reaches a length of 45 cm or more and a width of 5 cm. The fragments of wood resulting from its construction are throws out through an ejection-hole in the sapwood chamber, which is marked by a blackened scar and some exudation of blackish sap and frass on the bark. Its upper end is considerably widened into a pupal chamber and is not very far from the bark. The shreds and fibers of wood produced by the final excavation before pupation are 3.5 cm to 15 inches long and loosely fill the heartwood tunnel (Beeson,1941). According to Rahman & Khan (1942), the larva is pale yellow in colour and when full-grown it measures 90 mm in length. The head is small in size, triangular in shape and dark brown in colour. Antenme are minute, two segmented, and are embedded in oval pits. Prothorax is the broadest segment, measuring 19 mm in width; from here the body tapers gradually to the anal segment, which is the narrowest measuring 13 mm in breadth. Prosternum is broad; dark yellow and studded with numerous tubercles. Thoracic legs absent. The newly hatched larva resembles the full-grown one but is smaller; its length being 10.5 mm and its greatest width (across the prothorax) 4.0 mm.

Pupa: The pupa is creamy white to pale yellow in colour and is 55 mm in length and 20 mm in breadth. It lies in a specially prepared pupal chamber (Rahman & Khan,1942).

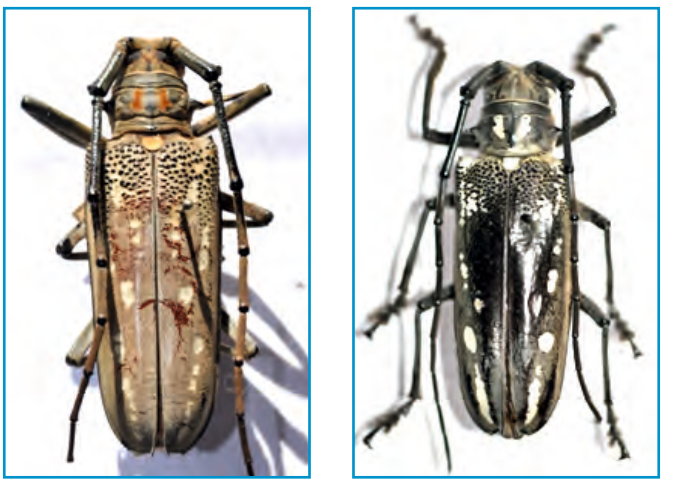


Fig. 150. Adults- *Batocera horsfieldi* (Hope,1839)

Adult: Beetle length is approx 40-60 mm, black with fine ashy or yellowish-grey pubescens, pronotum with 2 elongate white or yellowish spots, elytra with numerous shining black tubercles at the base, and several rounded or broken elongate white marks extending to the tunicate apex, scutellum white or yellowish. It is a borer of living trees and a pest in walnut and alder plantations in the Darjeeling Himalayas and of oak in the Kumaon Himalayas. The beetle escapes by boring an exit-tunnel through the intervening inch or so of wood and leaves a circular exit-hole about 1 inch in diameter (Beeson,1941). *B. horsfieldi* characterized by the presence of smoky or grayish pubescence on black elytra with multi striped whitish longitudinal pubescence bands are present on middle of each elytron. Mesepimeron covered with whitish pubescence leaving a narrow triangular mark uncovered near the juncture of mesepisternum. Lateral lobes of apical tegmen of male genitalia are narrow, long and less jointed from their base to each other. *Batocera lineolata* is closely related species possesses reddish-brown or dark brown elytra covered with brownish pubescence with cloudy striped longitudinal whitish yellow pubescence band on each elytron. Mesepimeron is covered with dense whitish pubescence without leaving a narrow triangular mark. Lateral lobes of apical tegmen are broad and their basal half jointed to each other. The median lobe of male *B.horsfieldi* is broad at base as compared to *B. lineolata* (Ponpinij,2011; Ying et al.,2012).

Biology: Adults emerge in early June and continue till July. The adults live for about four months. Adults rest on their food plants and feed on the bark of the young twigs. A single female lays 55-60 eggs in the bark. The grubs bore into the bark and reach into the sap wood. It pupates in a chamber under the bark. The life cycle completes in 22-32 months (Rahman & Khan,1942).

Life History: The length of the life-cycle is unknown; it may take two or three seasons. Beetle occurs in September-October and possibly emerges earlier. There is one generations a year in *Paulorenia tomentosa*

in Japan, the beetle emerging from June to August near Tokyo. Trees of *Juglans regia* (Walnut) of 15 cm diameter and upwards are liable to attack; ordinarily the infestation is limited to one or two tunnels near the base of the tree but as many as 16 tunnels may occur in a 600 cm length of lobe. In *Q.leucotrichophora* the tunnels are confined to the basal of 90 to 150 cm of the bole. Attacked trees are not killed and their vigour is apparently not seriously affected. Where the beetle is abundant every tree in a stable is attacked even in mixed crops. The timber is spoiled for all purposes except firewood and is heavily depreciated in values (Beeson,1941).

Extent of Damage/Status: Widespread. Data deficient.

152.*Anomophysis inscripta* (Waterhouse,1884).

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Prioninae

Synonyms: *Macrotoma inscripta* Waterhouse,1884

Macrotoma crenata Lameere,1903

Macrotoma crenata Heyrovský,1976

Macrotoma zooblax crenata Lameere,1913

Distribution: Afghanistan, Pakistan, India (Himalaya). The species occurs throughout India up to 2000m in the Himalaya (Singh & Singh,1986). [21 specimens are in NFIC, Dehradun.Kalagarh,nearCorebtt Tiger Reserve, Nanital district,Uttarakhand collected by J.C.M Gardner on 03.iii.1935; Shikarpur, Sindh, Mumbai by DFO on 28.iii.1930; Aiyur N. Salem, Madras by N.C. Chatterjee on 15.vii.1931; Karachi,Pakistan by T.B. Bell in 1905].

Fig. 151. Adult- *Anomophysis inscripta*(Waterhouse,1884)

Species of oaks infested: *Quercus leucotrichophora*, *Q. dilatata*(Beeson,1941; Mathur & Singh,1959).

Other Host plants: *Bombax malabaricum, Eucalyptus* sp., *Mangifera indica,* (Beeson,1941). *Populus spp., Shorea robusta, Tamarix articulata, T. gallica* (Singh & Singh,1986).

Habit: Larva bores in freshly felled hardwood (Mathur & Singh,1959).

Larva: The grubs bore into the stem and sometimes the trunk as well, making zigzag tunnels deep into the core; these tunnels are packed with fairly compact mass of fibers and excreta. There are no external symptoms of damage. The grubs feed inside the stem throughout summer and are full grown by October. They overwinter as such and come out as adults in July (Singh & Singh,1986). According to Beeson (1941), the larval

galleries run irregularly in the wood, penetrating deep into the wood and are about 1.5 of an inch across, packed with fairly compact mass of fibres which are finer and smaller in the earlier galleries.

Beetle: The beetle is 28 to 58 mm long, dark brown, elytra somewhat lighter becoming darker towards the posterior end having a rough pitted surface (Singh & Singh,1986).
Extent of Damage/Status: Data deficient.

153.*Dorysthenes* (*Lophosternus*) *huegelii* (Redtenbacher,1848).
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Prioninae
Synonyms:
Cyrtognathus hügelii (Redtenbacher,1848)
Cyrtognathus indicus hügelii (White,1853)
Cyrthognathus falco (Thomson,1877)
Lophosternus falco (Gahan,1906)
Lophosternus hügelii (Gahan,1906)
Lophosternus palpalis (Gahan,1906)
Dorysthenes lophosternus hugeli (Lameere,1911)
Dorysthenes lophosternus hügeli (Gressit,1950)
Dorysthenes hügeli (Heyrovsky,1976)

Fig. 152. Adult- *Dorysthenes (Lophosternus) huegelii* (Redtenbacher,1848).

Distribution: North-West Himalaya Oak Forests. India (Uttarakhand, Himachal Pradesh, Arunachal Pradesh, Assam, Darjeeling, Kashmir, Sikkim), China, Nepal (Stebbing,1914). [19 specimens are in NFIC,FRI, Dehradun. FromJakhPaithani, Garhwal collected by Balwant Singh on 14.v.1941; Katambari, Jalpaiguri by N.C. Chatterjee on 08.iv.1934; LawacherraPltn, Sylhet, Assam by R.N. Mathur on 27.iv.1927].

Species of oak infested: *Quercus leucotrichophora* and *Q. floribunda* (Beeson,1941; Mathur & Singh,1959).
Other Host Plants: It is also a serious pest of Malus domestica (Verma & Thapa,2005).
Habit:Larva bores in stumps and in dead or living roots (Mathur & Singh,1959).
Larva: Large, yellowish-white, elongate, much-corrugated, thick grub with stout black mandibles and a large hard prothoracic shield dorsally(Stebbing,1914).

Pupa: Yellowish-white, stout, with the general appearance of the beetle, the parts such as the antennae, wings, legs etc being free and pressed against the sides and breast (Stebbing,1914).

Adult: Beetle is fairly a large (51-52 mm) robust, chestnut brown cerambycinae borer. Head is large, oblique and elongated. Antenna is smaller than the body, chestnut brown, segments are small, stout, squarish, anteriorly angled and segment 3rd is longest. Pronotum is red brown, squarish, medially concave, gradually slopped laterally, anterior lateral margin flattened with two acute spines, posterior margin wavy, punctate. Elytra are large, red brown, generally converged toward apex, longitudinal striae, basally prominent, obsolete near the apex, lateral margins margined, and outer angle broadly round, sutural angle ended with acute spine. Legs are elongate, femur is flattened, serrated, tibia serrated, with apical spine, 3rd tarsal segments are bilobed, and claws are divaricate.(http://shodhganga.inflibnet.ac.in/bitstream/10603/89461/10/10).

Extent of Damage/Status: Data deficient.

154.*Sarmydus subcoriaceus* (Hope,1831)

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Prioninae

Synonyms: *Prionus subcoriaceus* (Hope,1831)

Tragosoma subcoriaceum Lacordaire,1868

(a) **(b)**

(Source(a): http://bezbycids.com/byciddb/wdetails.asp?id=44416&w=o)

Fig. 153. Adult- *Sarmydus subcoriaceus* (Hope,1831)

Distribution: India and Nepal (http://www.prioninae.eu/taxonomy/sarmydus/subcoriaceus). [6 specimens in NFIC, FRI, Dehradun. From Naldera (1981m) collected from Koti state, Shimla on 15.vii.1936; Bhowali, Nainital by B.M. Bhatia on 17.vi.1937; Gwaldam, Garhwalby J.C.M Gardner on 10.vi.1937 and Ranikhet, Kumaonby J.A. Graham on 23.vii.1938].

Species of oak infested: *Quercus leucotrichophora* (Beeson,1941).

Other Hosts plants: *Pieris ovalifolia* (Beeson,1941).

Habit: Larva bores in the dead wood (Mathur & Singh,1959).

Adult: The length of beetle is 20 mm(Beeson,1941). According to Gahan (1906), male is dark brown or reddish brown in colour; the elytra usually paler than the head and prothorax; third and following joints of the antenna are reddish or fulvous, sometimes narrowly edged with black at the apex. Head is closely, subrugosely punctured. Antennae is little longer than the body; first joint is nitid, coarsely punctured; third to tenth are opaque, oblique at apex, furnished from above and below with two or three longitudinal carina, third very little longer than the fourth. Prothorax is closely and somewhat rugosely punctured from above; the closely punctured areas on each flank are convex, extending from the median spine to the anterior margin.Elytra are more than twice as long as broad, glossy, closely and strongly punctured, the interstices between the punctures are convexly raised and form a fine net; naked above, but with the apical and postero-lateral margins fringed with very short tawny hairs; costre of elytra distinct, but not very strongly raised. Female is 17-23 mm long and 5-7 mm wide. Antennae reaching to the posterior fifth of the elytra; third and following joints are very feebly angulate behind at the apex;third is much longer, but scarcely, wider, than the fourth. The length of elytra is two and a half times of its breadth (Gahan,1906).

Extent of Damage/Status: Data deficient. Minor importance.

155.*Spinimegopis buckleyi*(Gahan,1894)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Prioninae
Synonyms:
Aegosoma buckleyi (Gahan,1894)
Megopis aegosoma buckleyi
(Lameere,1909)
Distribution: India (Arunachal Pradesh; Himachal Pradesh; Uttar Pradesh), Nepal. (Source:http://cerambycidae.org/taxa/buckleyi-%28Gahan-1894%29?country=209).
Species of oak infested: *Quercus floribunda* (Mathur & Singh,1959).
Habit: Larva borer of the rotten wood (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.Minor importance.

Male **Female**

(source: http://www.cerambycidae.cz/photo-gallery.html).

Fig. 154. Adults- *Spinimegopis buckleyi*(Gahan,1894)

156.*Spinimegopis tibialis*(White,1853).
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Prioninae
Synonyms:
Aegosoma tibiale (White,1853)
Megopis aegosoma tibialis (Lameere,1909)
Megopis spinimegopis tibialis (Hayashi,1971)
Megopis tibialis (Heyrovský,1976)
Distribution: India, China, Nepal, Tibet, Bhutan (http://www.prioninae.eu/taxonomy/spinimegopis/tibialis).

(source: http://www.prioninae.eu/taxonomy/spinimegopis/tibialis).

Fig. 155. Adult- *Spinimegopis tibialis*(White,1853).

Species of oak infested: *Quercus floribunda* (Mathur & Singh,1959).
Other host plants: *Evodia fraxinifolia, Iilex hookeri, Lindera pulcherrima, Machilus odoratissima, Symplocost heaefolia* (Beeson,1941).
Habit: Larva is borer of rotten wood (Mathur & Singh,1959). It is a borer of old or decaying wood (Beeson,1941).
Larva: According to Gardner (1931), length of larva is about 65 mm, the head capsule of larva is slightly wider than long; narrower at anterior margin, wider and somewhat swollen behind middle. Anterior margin of the frons are carinate, often weakly proturbent on each side of the median knotch. Epistoma is very slightly proturbent, with two very small teeth separated by width of clypeus. Antennae has three joints, joint 1 is partly concealed by basal connecting skin; joint 3rd is small but distinct, about two-fifth as long as 2nd. Labial palps are with two joints of nearly equally long. Labrium is cordate and about as long as wide. Ampullae of larva are smooth.
Beetle: It is 25-38 mm in length, dark brownincolour; elytra are reddish brown and glossy. Life cycle of this borer is annual with emergence in April and mainly in May (Beeson,1941).

157.Teak Trunk Borer, *Stromatium barbatum*(Fabricius,1775)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Prioninae
Synonyms:
Callidium barbatum, Fabricius,1775
Callidium funestum Boisduval,1835
Callidium variolosum Fabricius,1798
Cerambyx transquebaricus Gmelin,1790
Distribution: It is found throughout India,

Burma and Ceylon and also in Mauritius and Madagascar (Beeson,1941). India (Assam; North-West India; Central Provincs; Ravi valley, Chamba state), Ceylon, Burma, Andamans; Mauritius; Bourbon; Madagascar (Stebbing,1914). [73 specimens in NFIC, FRI, Dehradun. From Purnakot Range, Angul, Orissa collected by R.N. Mathur on 12.vii.1955; Dehradun by C.F.C. Beeson on 04.vii.1921; Kangra Div., Himachal Pradesh by D.F.O on 07.vii.1921; Koina range, Saranda, Jharkhand by Gauri Dutt on 23.vii.1951; Darjeeling,West Bengal by D.F.O on 15.vii.1929 and Dandeli, Kanara, Mumbai by B.M Bhatia on 29.vi.1930].

Fig. 156. Adult- *Stromatium barbatum*(Fabricius,1775)

Species of oak infested: Quercus leucotrichophora (Stebbing,1914). Q. floribunda, Q. semecarpifolia (Mathur & Singh,1959).

Other Host plants: Prosopis cineraria, Acacia catechu, Dalbergia sissoo, Dendrocalamus strictus (Stebbing,1914).

Habit: Larva bores in the drywood (Mathur & Singh,1959).

Eggs: Eggs are white, spindle shaped with both the ends slightly pointed, 2.4-3 mm long and 1-1.2 mm wide. Grubs hatch out of the eggs after 7-10 days of incubation (Salini & Yadav,2011).

Larva: Larva is 25 to 30 mm of length, white, thick grub with a wide, dark brown head, black mandibles, and a pale brown shining prothorax, larger in breadth than the rest of the segments. The body segments are flattish. The grub lives in the wood eating out winding tunnels, which are blocked with wood-dust and excreta. When full fed, they eat out a short length of tunnel, which curves to a certain extent and pupate (Stebbing,1914). Newly hatched grubs are pale white in colour with brown mandibles and 2-3 mm in size. The full grown grub was whitish yellow or cream in colour, thick set, 3-3.5 cm in length with brown head and black mandibles; pale brown thorax, broader than the rest of the body segments. The grubs made winding tunnels by boring their way

inside the wood. The gnawing sound could be heard in the plantations where the infestation is severe (Salini & Yadav,2011).

Pupa: Pupation occurred inside the tunnel (Beeson,1941).

Adults: It isa polyphagous pest, damaging the wood of about 350 tree species, has been found infesting *Prosopis cineraria* in Western Rajasthan (Parihar and Singh,1993). Many of the previous workers (Nair,2007) were doubtful about *S. barbatum* infesting live green trees. It makes square shaped holes in dry bamboos and damages wooden boxes and packing cases in the godowns of Museum (Stebbing,1914). Adults were reddish brown to brownish black with tawny pubescence covering all over the body including face, legs and antennae. Antennae are 11-segmented. Adult body length was 21.2 ± 4.4 mm (excluding antennae) and 47.3 ±8.4 mm (including antennae). Males can be distinguished from females by the presence of tomentose depression on the pronotum, strongly rounded or protuberant lateral margins of pronotum and antennae is 1.3 times longer than the body. In females antennae are shorter or scarcely longer than the body and are devoid of the tomentose depression on the pronotum. Head is densely and rather coarsely punctured from above and at sides. Elytra are coarsely and densely punctured, each with a sutural tooth at apex. Adults were active during June-July especially in the beginning of rainy season and a few were collected even during September. Gravid female laid eggs in small cracks and crevices on the bark of the main trunk as well as cordons with diameter exceeding 2-2.5cm of the plant. The adults came out of the plants by making oval or near rectangular holes (Salini & Yadav,2011). The beetle emerges during June and July, rarely also at the end of May (Beeson,1941).

Biology: Adults start emerging with the onset of pre-monsoon rains during the second fortnight of June and the majority of the beetles (75-80 %) emerge by the first week of July but the emergence continues up to the second week of August depending upon the frequency of rainfall (Sharma & Khajuria,2005). The eggs are placed in an interstic in the bark (Stebbing,1914). The eggs are also laid 8-12 mm below the soil surface and after hatching the grubs initially feed on organic matter and then bore into the roots of the tree. It takes up to 3.5 years for them to mature (Atwal & Dhaliwal,1997). Grubs were observed in the soil up to 10-25 cm deep below the infested trees of *Citrus* sp. in Punjab (Singh & Sreedevi,2017). The number of grubs from a single tree ranged from 10.5 to 23.5, while number of beetles per tree ranged from 20.3 to 28.3. About 39% trees in the orchard were found to be infested by the borer.

Extent of Damage/Status: Wide spread. Data deficient.

158.*Anaglyptus fasciatus* (Thomson,1857).

Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Synonyms :
Aglaophis fasciata Gahan,1906
Aglaophis fasciata Hayashi & Makihara, 1981
Aglaophis fasciata Thomson,1857
Aglaophis fasciata Thomson,1878
Anaglyptus fasciatus Holzschuh,2006
Anaglyptus fasciatus Weigel,2006

Distribution: Himalayas in India & Nepal. [26 specimens in NFIC, FRI, Dehradun. From Kaisdhar(2,600m), Kullu in Himachal Pradesh collected by C.F.C.Beeson on 24.x.1935; Dudatoli(2,700m) in Pauri Garhwal collected in June 1920; West Almora collected in 1918; Mussoorie

collected in July,1921; Chakrata by C.F.C.Beeson on 10.x.1922; Lepchaghat (2,100m),Darjeeling Dist by J.C.M.Gardner on 11.ix.1929 and Kalimpong, West Bengal by Balwant Singh on 29.iii.1934. Also collected from Deoban, Chakrata Forest Division in Uttarakhand (Singh,2011). One beetle emerged in the lab at FRI, Dehradun on 13.i.2021 from the infested Q. semecarpifolia logs which were collected during June 2020].

Adult on kharsu oak tree

Fig. 157. *Anaglyptus fasciatus* (Thomson,1857).

Species of oak infested:

Q. leucotrichophora & *Q. floribunda* (Mathur & Singh,1959); *Quercus* lamellosa (Beeson,1941).

Habits: Larva bores in dry wood (Mathur & Singh,1959).

Larva: The larva was described by Gardner (1931). According to him, the length of larva is 16 mm; the head capsule of larva is narrowly castaneous anteriorly, this colouration is extending a short way lateral to the ocellus of each side. Pronotum has anterior zone testaceous; posterior zone is shining; irregularly striate. Prothorax is laterally with long and close pubescence. Ampullae are dull. Pleural disc are evident on at least the first two abdominal segments. Thoracic spiracles are small, not as wide as labrum. Legs are small but distinct, rather large for this tribe, with three distinct joints.

Adult: Length of beetle is 10-12 mm. Emergence of adults took place in March and July 2010 from Q. dilatata logs at FRI, Dehradun which were collected in August 2009 from Deoban, Chakrata Forest Division (2700m) (Singh,2011). Life cycle is probably twice a year (Beeson,1941). However, the life cycle was determined to beannual,as beetles emerged from logs in late March from kharsu oak logs collected last June from the field Chkrat Forest Division,Uttarakhand. Courtship and mating occurred in breeding cages in late March.Females larger than males.

Extent of Damage/Status: Common in dead Kharsu oak trees.Seconary wood borer along with Xylotrechus basifuliginosus. Minor importance.

159.Oak Stem Borer, *Aphrodisium hardwickianum* (White,1853)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Callichromatini

Synonyms:
Callichroma hardwickianum White,1853
Aphrodisium hardwickianum Gahan,1906; Beeson,1941
Aphrodisium hardwickianum Podany,1971

(a) Borer infested ban oak tree

(b) Frass ejecting from the hole

(c) Grub

(d) Adult

(e) Exit hole on ban oak tree

(f) Larval gallery pattern (L.S)

(g)Larval galleries (T.S)

(h) Borer infested logs

(h)Galley made by borer in heart wood

Fig. 158. ***Aphrodisium hardwickianum*****(White,1853)**

Distribution: Western & Central Himalaya. Himachal Pradesh (Kullu, Kangra, Dharamsala), Uttarakhand (Uttarkashi, Mussoorie, Almora, Bhimtal, Nanital), Nepal, Sikkim, West Bengal (Darjeeling) (http://www.zin.ru/animalia/coleopteran/pdf/kariyanna et al 2017 checklist cerambycidaeindia.pdf). [4 specimens in NFIC, Dehradun. Sitoli (1524m, Almora collected by J.C.M Gardner on 28.vii.1937; Dhramasala, Kangra, Himachal Pradesh collected on 17.vi.1947]. The attack by this stem borer on *Q. leucotrichophora* in the Western Himalayas has been reported in the past from Dharamsala in Himachal Pradesh (1847); Bhimtal (1918) and Almora (1936-37) in Kumaon and Tehri Garhwal (1924) in Uttarakhand. Recently, during the year 2003, large scale infestation and mortality (15-20%) was reported by a team from FRI on a 2-3 km oak forest stretch along Dangan village, Mori block near Sankri in Gobind Wildlife Sanctuary, Uttarkashi District during the monsoon (Rawat et al.,2003).

Species of oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959).

Habit: Larva bores in living branches and stems (Mathur & Singh,1959). It is borer of both sapwood and heartwood. A dead tree revealed 38 larval galleries and 12 emergence holes in Dagan village, Uttarkashi district, Uttarakhand, India (Singh,2011).

Beetle: Length of beetle is 30.48-44.45 mm and metallic green in colour (Beeson,1941).

Life History: The life cycle of beetle appears to be annual (Khan & Bhatia,1946). Eggs are laid in crown and side branches and the upper portions of the stems of living trees. The larva on hatching bores along the branch towards the stem into which it enters and continues the tunnel downwards. The simple tunnel excavated in the early stages becomes more complicated as it reaches branches of greater girth. In the stem the tunneling is extensive and the accumulated attack of several years removes great portion of the wood as the dust is all ejected. The larvae pupate in the stem and the beetles begin to emerge with the onset of monsoon. Recent attack is visible by ejected frass and crescent shaped exit-holes on the stem; failed attack on branches is indicated by the formation of cankers. The attack of several years eventually kills the tree and considerably reduces the weight and value of the wood for fuel (Beeson,1941).

For the management of *Aphrodisium hardwickianum*, Beeson suggested that in coppice forests damage done is accumulation of many years. In older stands when the amount of damage done reaches a degree at which the wood increment becomes negative, i.e. the amount of wood converted into frass and thrown out from the ejection holes is greater than the current annual volume-increment of the crop then remedy is to (i) coppice the whole stand (ii) Freshly felled logs marked for fuel should be split into small pieces to ensure death of all the borers present in them and immediately taken away from the forest. In younger stands, infested trees should be immediately be removed before May (iii) lopping should be prohibited (iv) dead branches should be pruned in thickets (V) reduce rotation time for felling of oaks (Beeson,1941).

Extent of Damage/Status: Primary borer of ban oak. Infestations localized, but can cause significant damage when population in high in disturbed oak stands prone to lopping.

160. Cherry Stem Borer, *Aeolesthes holosericea* (Fabricius,1787)

Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Synonyms:
Cerambyx holosericeus Fabricius,1801
Hammaticherus holosericeus White,1853
Pachydissus velutinus Thomson,1865

*Neocerambyx holosericeus*Cotes,1889
*Pachydissus similis*Gahan,1890
*Aeolesthes velutina*Gahan,1890
*Aeolesthes holosericeus*Gahan,1891
*Aeolesthes holosericea*Aurivillius,1912
*Aeolesthes holosericea*Stebbing,1914
Aeolesthes (Aeolesthes) holosericea Gressitt& Rondon,1970

Fig. 159. Aeolesthes holosericea (Fabricius,1787)

Distribution: Indonesia (Borneo), India, Laos, Philippines, Sri Lanka, Thailand. In India it extends up to the sub-montane valleys of the Himalayas to considerable elevations, occurs in the Indus plains and in the Sunderbans, in moist forests and in dry and in Ceylon, Burma, the Andaman and Nicobar (Beeson, 1941). In India, this species was recorded from Assam, West Bengal, Bihar, Orissa, Uttar Pradesh, Punjab, Kashmir, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, TamilNadu, Andaman and Nicobar Islands (Sengupta & Sengupta,1981). [72 specimens are kept in NFIC, Dehradun. Kaisdhar (2770 m) Kulu Himachal Pradesh collected by C.F.C. Beeson on 04.vi.1934; Ramanguli Mumbai by W.D. Kanara on 05.i.1949; Lachiwala, Dehradun by J.C.M Gardner in 23.iii.1929; Gorakhpur, Paonta Range, Nahan, Himachal Pradesh collected in M.L. Roonwal in 28.iv.1950; Tarva, Angul, Orissa collected by S.N Chatterjee on 16.v.1935; Sukhpur, Raigarh, Balaghat by N.C. Chatterjee on 8.viii.1924; Jaithani range UmariaRewa (Central India collected by B.M. Bhatia on 24.x.1927; Banher, Bihar collected by J.C.M Gardner on 2.i.1922; Tista valley, Darjeeling by J.C.M Gardner on 5.v.1930, Kochgaun, Assam by A.H. Khan on 26.iii.1931; Sundapola Kurunegala Ceylon by Gauri Dutt on 5.iv.1935].

Species of Oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959).

Other host plants: *Acacia arabica, Aegle marmelos, Alnus nitida, Anogeissus latofolia, Artocarpus hirsutus, Bauhinia acuminata, B. retusa, B. variegata, Bombex malabaricum, Cedrela toona, Eucalyptus robusta, Ficus bengalensis, Grewia optiva, Mallotus philippinensis, Mangifera indica,Morus alba, Pinus longifolia,*

Tectona grandis, Shorea robusta, Terminalia tomentosa, (Beeson, 1941)and *Malus domestica* (Gupta & Tara,2013).

Habitat: The larva bores in heart wood and sap wood (Sengupta & Sengupta,1981; larva bores in deadwood (Mathur & Singh,1959).

Oviposition: Females make minute incisions on the injured edges of the bark into which they push their eggs. Single female lays upto 62 eggs under laboratory conditions. Number of eggs ranged from a minimum of 45 to a maximum of 83. Eggs are laid singly or in pair of two to five under the cracks and crevices of the bark. Earlier observations on egg laying behaviour of female Aeolesthes holosericeagiven by Rahman and Khan (1942) reveals that the eggs are laid under the cracks or crevices in the bark in clusters of 4 to 8 on cherry plant which is contrary to females of same species that lay about 200-300 eggs on *Hardwikia binata* and *Terminalia belerica* in Madhya Pradesh as reported by Khan (1989).

Hatching: The incubation period of *Aeolesthes holosericea* was observed to range between 7-12 days and 2-3 days by Rahman & Khan (1942) on cherry plants and Khan (1989) on *Hardwickia binata* and *Terminalia belerica* in Pakistan and Madhya Pradesh respectively.

Eggs: Khan & Khan (1942) found that the egg of *A. holosericea* was about 2-2.5 mm long and 1 mm wide; being broad, elliptical, and tapering towards either edge.

Larval instars and development: Full-grown larvae measured 75 mm in length and 13.5 mm. in breadth and they were yellow in color(Khan & Khan,1942). Rahman & Khan (1942) observed the larval period of *Aeolesthes holosericea* ranged between 27 to 32 months at Lyallpur on cherry and apple plants whereas Singh et al.,(1987) observed 9-10 months of larval period in *Aeolesthes holosericea* on *Shorea robusta* respectively. In contrast, observations regarding larval duration of *Aeolesthes holosericea* by Khan (1989) recorded an average larval duration of 27-32 days on teak and *Hardwikia binata.*

Pupal duration: The pupae were yellow in color and measured 42 mm long and 35 mm wide (Khan & Khan,1942).However the observations of Rahman & Khan (1942) revealed that pupation in *Aeolesthes holosericea* on cherry and apple in Pakistan takes place either in October - November or in March-April and the beetles that emerged from the pupa formed in October, remained within the tunnels throughout the winter and in spring while those beetles that emerge from puparia in April, rest for only six weeks and duration of pupal period was observed as 3 to 150 days on apple and cherry in Pakistan, however on *Hardwikia binata* and *Terminalia belerica.* Khan (1989) reported pupal duration of 40-100 days in *Aeolesthes holosericea* in Madhya Pradesh and about 40 to 100 days on cherry (Atwal and Dhaliwal,1999).

Adult: Rahman & Khan (1942) have quoted that males are smaller in size with small antennae as compared to females that are larger in size and possess big antennae. However author's observations are in support of those on the sexual dimorphism in *Aeolesthes sarta*, another longhorn beetle on poplar given by Ahmad et al.,(1977), who also recorded that males are smaller and possessed much larger antennae than females that have smaller antennae. This insect is a strongly polyphagous timber borer and is distributed throughout the greater part of the forests of India (Beeson and Bhatia,1939). This is also a well recognized pest of felled and dead or dying trees in the Oriental region (Khan and Maiti,1983). Tiwari et al.,(1980) recorded this species as heart wood borer of Andaman mangroves, *Rhizophora apiculata* and described its larval gallery pattern and pupal chamber in details. During study period, fifteen host

plants of this heart wood borer have been recorded from Andaman & Nicobar Islands. This borer is of considerable economic importance since it ruins many of commercially important timber yielding species. On few occasions it has been found from the live unhealthy trees in the forest stands of these islands (http://shodhganga.inflibnet.ac.in/bitstream/10603/89461/10/10_chapter%204.pdf).

Life Cycle: Beeson (1941) reported that *A. holosericea* has an annual life cycle under favorable conditions but in an unfavorable environment some may survive and complete 1 generation in 2 year. Khan & Khan (1942) studied the bionomics of *A.holosericea* and reported that it requires 2 years and 7 months to 3 years to complete a single generation. Adult beetles start emerging in the field through an oval emergence hole from the pupal chamber during April and continued to June in the area under investigation on apple plantations. Though earlier observations of Stebbing (1914), Rahman & Khan (1942) and Atwal & Dhaliwal (1999) reported the emergence of this beetle on *Shorea robusta*, apple and cherry from April to October, April to July, May to October and in their respective fields. However the emergence of *Aeolesthes holosericea* on *Hardwickia binata* and *Terminalia belericain* Madhya Pradesh occurred during February-March (Khan,1989).

Extent of Damage/Status:Data deficient.

161.*Demonax albicinctus*(Hope,1831)

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Cerambycinae

Synonyms:

Anthroposcope albicinctus Chevrolat,1863

Clytus albicinctus White,1855

Clytus filiformis Castelnau & Gory,1841

Distribution in India: Uttarakhand, West Bengal, Arunachal Pradesh. [7 specimens in NFIC, Dehradun. From Tista valley, Darjeeling, Bengal collected by J.C.M Gardner on 02.vi.1930; Jhajra, D.Dun by M. Bose on 20.vi.1928; Samsing (548m) Kalimpong, Bengal by A.M. Postford on 10.x.1934; Chakrata, Dehradun district by Arun P.Singh in May 2008 & 2010].

Species of oak infested: *Quercus floribunda* (Mathur &Singh,1959;Singh,2011).

Habit: Larva bores in dead twigs and logs (Mathur & Singh,1959).

Fig. 160. Adult-*Demonax albicinctus* (Hope,1831)

Beetle: According to Singh (2011), the length of bettle ranges from 4-5 mm, black with pale lines, took place from borer infested *Q. floribunda* logs in May 2008, April and May 2010 in rearing cages, collected from Dangan village, during

August 2007. There is no previous record of this beetle on West Himalayan oaks. It is also a borer of dead twigs and logs. Unlike *Demonax leucoscutellatus*, prothorax and head charcoal of this species isblack and antennal joint 2nd is longer than its width. According to Sengupta & Sengupta (1981) length of beetle is 7-9 mm and breadth 1.5-2 mm, small, narrow and somewhat cylindrical. Head and prothorax are charcoal black in colour, eyes are finely facetted. Antenna is moderately long, scape rather large and broad, joints 3rd armed distinct with apical spine.Prothorax is elongated, cylindrical, and broadest at posterior one-third, narrowed in front and slightly so posteriorly, lateral is margin smooth, pronotum is densely punctured and covered with fine whitish dlinute recumbent pubescence. Scutellum is moderately large, triangular and covered with fine, minute dense greyish pubescence. Elytra are parallel-sided, apical margin is reddish brown and with three transverse rows of whitish pubescence. Legs are long, slender, and brownish covered with greyish pubescence. (Material examined: 22 ex. Arunachal Pradesh: Kameng Division, 1.v.1966, A. N. T. Joseph ColI. 1 ex., Kameng, 3.vii.1961, S. Biswas CoIl. 1 ex., and Kameng, 13.vi.1961, K. C. J. CoIl. 1 ex., and 19 ex. also studied from various localities of West Bengal).

Extent of Damage/Status: Widespread in Kharsu oak stands. Minor importance.

162.*Demonax nigromaculatus*(Gahan,1906)

Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Synonym: *Demonax* (*grammographus*) *nigromaculatus* Gahan,1906

(a)Pinned specimen

(b) Adult (Dorsal view)

(c)Adult (Dorsal view)

(d) Adult (Frontal and lateral view)

Fig. 161. Adult- *Demonax nigromaculatus*(Gahan,1906)

Distribution: Himlayan Region. India-Uttarakhand, Sikkim, West Bengal-Darjeeling; Nepal and Bhutan (http://www.nbair.res.in/Cerambycidae/Demonax%20nigromaculatus%20dis.html).
[3 specimens in NFIC, Dehradun.Gwaldam, Chamoli collected by J.C.M Gardner on 10.vi.1937; Bhowali, Nainital (1737 m) by A.D. Imms on 09.v.1912 and by student on 10.v.1922].
Species of oak infested:*Quercus floribunda* (Mathur & Singh,1959) & *Quercus semecarpifolia*.
Habit: Larva borer in dead twigs and logs (Mathur & Singh,1959).Collected from Deoban Reserve Forest (2,850m), Chakrata on 23.iv.2018 from Kharsu oak, *Quercus semecarpifolia* tree.Adults beetle emerged on May2021 from Kharsu oak logs collected in July 2020 from Deoban Reserve Forest,Chakrata Forest Division. Courtship and mating was observed in rearing cages at FRI,Dehradun.
Beetle: According to Singh (2011), it is 15 mm, long beetle with light yellow and black margins. Emergence of this beetle took place on *Quercus floribunda* logs collected from Dangan village, Uttarkashi Dist. during May 2008 in rearing cages at FRI, Dehradun.
Extent of Damage/Status: Uncommon in Kharsu oak stands. Minor importance.

163.*Demonax* sp. (Thomson,1860)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Distribution: Uttarakhand.
Deoban(2815m) RF,Chakrata collected by Gaurav Ramola on 18.vi.2020).
Species of oak Infested: *Quercus semecarpifolia*.
Habit: Larva bores in dead wood. Two beetles of this genus were collected from the bark of a fallen kharsu oak tree. Beetle length is 12 mm, body is ashy in colour and possess three pairs black markings on the elytra.

Fig 162. Adult- *Demonax* sp. (Thomson,1860)

Extent of Damage/Status: Uncommon in Kharsu oak stands. Minor importance.

164.*Diorthus cinereus*(Fabricius,1793)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Synonyms:
Diorthus simplex Mateu,1965
Cerambyx cinereus Zimsen,1964
Diorthrus cinereus Aurivillius,1912
Diorthus simplex Gahan,1906
Diorthus simplex Gahan,1896
Pachydissus (diorthus) simplex Gahan,1891
Neocerambyx sordidus Pascoe,1888
Pachydissusinclemens Thomson,1865
Cerambyxveronicosus Pascoe,1859
Hammaticherus simplex White,1853
Cerambyx cinereus Fabricius,1801
Cerambyxholosericeus Olivier,1795
Cerambyx cinereus Fabricius,1793.
Distribution: Iran, Pakistan, Saudi Arabia, Burma, India, Java, Siam, Mauritius, Sri Lanka, and West Africa(http://www.cerambyx.uochb.cz/diorthus_cinereus.php). [83 specimens in NFIC, FRI, Dehradun. Sambhalpur Div., Orissa collected by R.N.Mathur on 07.vi.1955; Thano Range, Dehradun collected by N.C. Chatterjee on 27.iv.1921; Horai, Haldwani by C.F.C Beeson on 11.iv.1933; Barkote, Dehradun by N.C. Chatterjee on 06.v.1926; Banhar, Bihar by H. Inglis on 10.iv.1921; Daverbetta N. Salem, Bombay by N.C. Chatterjee on 29.xi.1930; Aiyar, N. Salem, Madras by N.C. Chatterjee on 24.iv.1931; Zibingyi, Maymya, Burma by R.HiaOgh on 02.v.1938].
Species of oak Infested: *Quercus leucotrichophora* (Mathur & Singh,1959).
Other Host plants: *Acacia leucophloea, Albizia odoratissima, Anogeissus latifolia, Bauhinia vahlii, Butea superba, Cassia fistula, Dalbergia fusca, D. sisso, Dichopsis grandis, Eugenia, Hardwickia binata, Heritiera minor, Lannea coromandelica, Mallotus philippinensis, Scutia indica* and *Shorea robusta* (Beeson,1941; Duffy,1968).

Habit: Larva bores in the deadwood (Mathur & Singh,1959).
Larva: According to Gardner (1925), larva is cylindrical, anterior segments are tapering from the wide prothorax and length of larva is 47 mm and 12 mm in width. Skin is soft and has body hairs. It has white with ochreous pathches on the prothorax; mandibles and anterior margins of the head capsules with gena are castaneous to black. Head capsule of larva is 4 mm in length and 3 mm in depth, rectangular slidely and wider posteriorly and posterior angle broadly rounded. Epistoma is black, strong and nearly straight. Hypostoma with anterior margin are elevated and strongly chitinised depressed in gular region. Gula is narrow. Lateral to antenna is well developed and fairly even genal carina. Length of carina is about equal to the width of clypeus; carina is parallel to the base of mandible and straight more than its own lenth distinct from it. Occipital foramen is subquadrate, sides curved, rather wider than behind, about one half of the capsule. Anterior fovea is transverse, width about one-fourth that of large foramen separated from later by very fragile thread like tentorial bridge which connect the acute tentorial arms. Antennae segment is sub-cylindrical; first segment is long; slightly constricted than distal end. 2nd segment is wider than long, bearing on its flattened extremity. 3rd joint is slightly longer than 2nd and acute, conical, accessory joint which is about one-fouth length of true terminal joint. Labrum is sub-oval, length is about three-fifth wider, anteriorly rather and densely set with setae. Maxillary palp with first joint is slightly wider than the long, 2nd joint is shorter than the 1stand almost as wide as long. 3rd joint is about the three-fouth of the 2nd joint and bluntly rounded. Mandibles are with longitudinal median sulcus and gouge shaped. Pronotum is more or less declivous, subrectangular rather than

behind. Posterior area is raised, soft rather widely striate. Middle transverse area has sparse pits and small hairs. Anterior area has two transverse chitinsed smooth, ochreous plates with complete set of hairs near anterior margin. Eusternum is separated from presternum the dividing line indistinct anteriorly, with few hairs anteriorly, presternum with soft wrinkled surface fairly even set with hairs. Alararea are with large triangular chitinsed plate. Thoracic spiracles are about as long about the 1st abdominal spiracle. Legs are small and four jointed. Abdomen has dorsal ampullae with two transverse grooves; ventral ampullae with one transverse groove; each groove separating two ill defined rows of irregular tubercles. Pleural disc is fairly distinct on segment 1, 2 and 3. Anus is tri-lobed.

(a) **(b)**

[(a)-source: http://www.cerambycidae.info/subfamily/cerambycinae/cerambycini/]

Fig. 163. Adult- *Diorthus cinereus*(Fabricius,1793): Male

Beetle: According to Majumdar et al.,(2016) body of beetle is large, measuring about 32 mm, brown to black in color, covered with velvety greyish pubescence; head is small, almost covered by the eyes, frons are small, mandibles are strong, clypeus is large and black, eyes are black, vertex is large, black, narrow in between the posterior lobe of eyes and antennal tubercles, feebly sulcated; antennae is 11 segmented, hardly surpassing the body in female, longer in male, stout, densely pubescence, segment I and III are almost equal but longer than segment IV, segment I with apical cicatrix, III to V are apically broadened, segment V to X are apically outwardly angulate; pronotum is globular shaped, longer than broad irregularly strongly wrinkled formed of crown shaped impression, densely pubescent; elytra is brown to black covered with velvety greyish pubescence, apex sub-straight with acute sutural spine; ventral side is densely pubescent, prosternum is broad, raised at the height of coxa, mesosternum is much broader at the height of coxa, coxal cavities are closed, legs are elongated covered with greyish pubescence, femorais stumpy, tarsal claw are at more than 900angle.

Life-history: Life cycle was studied by Beeson (1941) on *Bauhinia vahlii*. Felled and fallen trees of are attacked within a few months of death and eggs are laid in crevices in the bark. It also breeds in the dead crowns of stag headed trees and trunks of trees dying from drought. In timber logs the larval galleries in the sapwood groove it fairly deeply and are packed with rather finely comminuted wood and bark-dust. The pre-pupal tunnel leaves the sapwood and enters the heart wood in a full curve and terminates in a short vertical pupal chamber which is about half as long as the pre-pupal tunnel. The latter is usually cleared of excavated material. A small plug of wood fibers is retained to close the mouth of pupal chamber. The larva lines of the whole chamber with a thin layer of calcium carbonate and glazes the inner surface with a film of non-elastic material. The operculum is thus a simple hemispherical cap continuous with the lining of the pupal chamber. The beetle breaks through the partition in order to escape. The life-cycle is annual with a pre-monsoon emergence period in April-July. Under unfavorable conditions emergence may be delayed until July or until June of the second year (Beeson,1941).

Extent of Damage/Status: Data deficient.

165.*Entetraommatus quercicola* (Fisher,1940)

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Cerambycinae

Distribution: Uttarakhand [1specimen in NFIC, Dehradun. Gwaldam, Garhwal, Uttarakhand, India (Western Himalaya) collected by J.C.M Gardner on 12.vi.1937].

Species of oak infested: *Quercus leucotrichophora*(Beeson,1941).

Habit: Larva bores in dead wood (Mathur & Singh,1959).

Extent of Damage/Status: Data deficient.

Fig. 164.Adult- *Entetraommatus quercicola*(Fisher,1940)

166.*Necydalis* (*Necydalisca*) *indicola* (Gardner,1936)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Necydalinae
Synonyms:
Necydalis indica Gardner,1936
Necydalis (*Necydalisca*) *indicola* Niisato et Weigel,2006
Necydalis sp.
Necydalis indicola Gardner,1941
Distribution: Uttarakhand [2 specimens in NFIC, FRI, Dehradun. Konain (2,392 m), Chakrata, Dehradun District, Uttarakhand, India collected by J.C.M Gardner on 21.v.1934].
Species of oak infested: *Quercus floribunda, Q.leucotrichophora, Q.semecarpifolia* (Beeson,1941).
Habit: Larva bores in the drywood and stumps (Mathur and Singh,1959). It is a borer of dry wood and stumps (Beeson,1941). 3 individuals were collected on 09.vi.2020 from DeobanChakrata forest division, Uttarakhand on dead standing Kharsu oak trees.
Eggs: Eggs are white and oval shaped when freshly laid and turn yellow after sometime and pointed from both the ends. One female can laidupto 70-72 eggs.
Adult: Beetle is 10-16 mm long. Head and thorax are black, elytra almost black in colour in male whereas uniformly dark red in female (Beeson,1941).

Fig. 165. Adult- *Necydalis (Necydalisca) indicola* (Gardner,1936) on *Q. semecarpifolia* in Chakrata Forest Division, Uttarakhand, India

Male: According to Gardner (1936), the length of male beetle is 10-15 mm; the head, thorax and coxae of male are black in colour. Antennae are uniformly blackish. Abdomen from above and below are dark brown or blackish in colour. Elytra are black in colour. Legs are black in colour; the femora are dark red towards the apex, the tibias usually are reddish except at the base and apex. Wings are smoky brown, the anterior veins are dark brown or black in colour and others are paler. There is no dense pubescence, sparse and rather long pale hairs present on head, pronotum, scutellum on elytra and on under side of the thorax. Head is concave between antennae; rather short in front, wide behind the eyes and abruptly constricted into distinct neck. Eyes are finally facetted, deeply emarginated. Antennae are filiform, extending nearly to the apex of the abdomen. The first segment is rather short and stout, rather closely punctuate except an outer smooth space at apex. Prothorax is slightly longer than wide with well marked transverse groove well removed from apex and another groove near the apex. Elytra are rather longer than combined width, not extending beyond the hind coxae. Scutellum

is rather large and narrower behind. Abdomen is elongate, somewhat fusiform surface with fine punctures; posterior sternum longer than wide, convex and narrowed toward the truncate apex. Legs with femora are fusiform clavate, the middle legs with short and hind legs with longer peduncle. Tibia of hind leg is more than twice as long as first first tarsal segment which is longer than the other tarsal segments together.

Female: The length of female beetle is 14-17 mm. First five segments of antennae are dark reddish and remainder is black in colour. Elytron is uniformly dark red or dark brown and paler at shoulders. Legs are dark red except femora and tibia at the base where they are black in colour. Abdomen is dark brown to black in colour. Prothorax is not quite as long as wide. Antennae are not reaching beyond the second abdominal sternum. Last abdominal tergum and sternum are longer than wide with rounded angles (Gardner,1936).

Extent of Damage/Status: Common during summer on dead Kharsu oak trees. Minor importance.

167.*Purpuricenus montanus* (White,1853)

Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Synonyms:
Purpuricenus montanus White,1853
Sternoplistes kashmirensis Pic,1906
Purpuriscenus montanus Stebbing,1914
Purpuricenus montanus var. *kashmirensis* Pic,1910
Purpuricenus montanusmoesta Semenov
Purpuricenus (*Purpuricenus*) *montanus submontatus* Plavilstshikov,1934
Purpuricenus (*Purpuricenus*) *montanus bimarginatus* Plavilstshikov,1934
Purpuricenus (*Purpuricenus*) *montanus kaehleriformis* Plavilstshikov,1934
Purpuricenus (*Purpuricenus*) *montanus epipleuralis* Plavilstshikov,1934
Purpuricenus (*Purpuricenus*) *montanus* Gressitt,1951.

Fig.166. Adult-*Purpuricenus montanus*(White,1853)

Distribution: N.W.Himalaya [71 specimens in NFIC, Dehardun. From Konain, Chakrata, Dehradun district collected by B.M. Bhatia on 23.vi.1924; Bodyar (2,529m) by S.N. Chatterjee on 06-12.v.1922; Mussoorie by J.C.M Gardner on 15.x.1929; Mukteshwar (2,133 m) Kumaon by Fletcher on 24.iv.1923; Lolab valley Kashmir by B.M. Bhatia on 18.v.1929].

Species of oak infested: *Quercus leucotrichophora, Q. floribunda* (Stebbing,1914).

Other Host Plants: *Pinus excelsa* (Stebbing,1914).

Habit: Larva bores in the dry wood especially in branchwood (Mathur & Singh,1959).

Adult: Beetle is 10-16mm long and 3-4.5 mm wide, black, entirely or black with outer margins of elytra red or elytra red with suctural black band, prothorax with a red lateral spot or band. The life cycle is annual in branchwood or sapwood (Beeson, 1941). Antennae are twice or nearly twice as long as the body in the male, shorter than the body in the female. Prothorax is small and posses acute tubercle on each side. Elytra are long, parallel-sided and rounded at apex. In some specimen the elytra are red with a broad black band along the middle of each side in front of the lateral spine. Head, prothorax and elytra are densely rugose-punctate, the prothorax sometimes with a smooth narrow than the body in the female (Stebbing,1914). Adults emerge in April, March (Beeson,1941).

Extent of Damage/Status: Data deficient.

168.*Perissus quercus*(Gardner,1940)

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Cerambycinae

Fig. 167.Adult- *Perissus quercus*(Gardner,1940)

Distribution: India (Uttarakhand) & Nepal. [5 specimens in NFIC, FRI, Dehradun. Mundali, Chakrata collected by J.C.M Gardner on 04.v.1933; Someshwar, Almora by J.C.M Gardner on 31.v.1957 in Uttarakhand].

Species of oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959) and *Q. floribunda* and *Q.semecarpifolia*.

Habit: Larva bores in the deadwood (Mathur & Singh,1959). According to Singh (2011), this is the borer of bast and sapwood with annual life cycle.

Identification: Strongly raided anterior margin and coarse asperities of pronotum are particularly striking (Gardner,1940).

Beetle: According to Singh (2011), emergence of this 13 mm long, black beetles with pale lines from borer infested *Q. dilatata* logs collected from Dangan village, Govind Wildlife Sanctuary, Uttarkashi, Uttarakhand took place in rearing cages in July 2009 at FRI, Dehradun. Infested *Q.semecarpifolia* logs collected during July2020 from Deoban RF in Chakrata Forest Division, Dehradun district Uttarakhand showed emergence of one pair of adults on 23 May 2021, after 10-11 months, suggesting the life cycle to be annual. Gardner (1940) also described the adults. According to him, the colorof head, prothorax and ventral surface is black; antennae, legs and elytra are very dark brown. Head having very thin greyish pubescence, some longer hairs below the eyes.Antennae with basal four segments subnude, the following segments dull, with close extremely short tomentum. Prothorax is almost nude on disc with grey pubescence which is very thin laterally rather longer and denser ventrally. Scutellum is blackish and subnude. Each elytron is dull with very short brown and thin tomentum with three ashy white pubescent marks as follows: (1) A curved line bordering scutellum running along scutellum and then curving out to the external margin; (2) near the middle a patch which is actuely continued some distance anteriorly along the suture and laterally toward the margin but separated from an isolated small sub marginal spot; (3) a small elongate sutural spot between the last and the apex. Ventral surface is covered with some rather shaggy grey pubescence which is rather denser on mesepiternum and on first two or three abdominal segments. Legs have very thin hairs. Antennae of male reaching a little part the middle of the elytra, shorter in the female; 1st, 3rd, 4th and 5th segments are almost equal. Prothorax is longer than wide, more or less cylindrical with a slight rounded protuberance on each side behind the middle; the anterior margin strongly carinate, the surface rather coarsely and closely punctured and with coarse transverse asperities on rather less than the anterior half, along the median line and dorso-laterally on each side. This species appears to be quite distinct from any other known Indian species. The strongly raised anterior margin and coarse asperities of pronotum are particularly striking characters of this species(http://www.cerambycoidea.com/titles/gardner1940.pdf).

Extent of Damage/Status: Data deficient.

169.*Rosalia lateritia* (Hope,1831)

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Cerambycinae

Synonyms: *Rosalia lateritia* Boppe,1911

Distribution:India (Kerala: Travancore; Assam; Himalaya (Uttarakhand, Sikkim; Arunachal Pradesh), Indo-China & Myanmar(http://www.nbair.res.in/Cerambycidae/Rosalia%20 lateritia%20dis.html). [13 specimens in NFIC, Dehradun. Lepchajgat (2133 m), Darjeeling, West Bengal collected by J.C.M Gardner on 12.ix.1928; Debrepani, Darjeeling (1828 m) by J.C.M Gardner on 14.ix.1929; Senchal Range (2255 m) Darjeeling by M.L. Roonwal on 26.ix.1954 and Deoban, Jaunsar, Chakrata by J.C.M Gardner on 31.viii.1919.

Species of oak infested: *Quercus floribunda*, *Q. semecarpifolia*, *Q. leucotrichophora* (Beeson,1941; Mathur & Singh,1959).

Habit: Larva bores in drywood (Mathur & Singh,1959).

(a) Male adult on kharsu oak log

(b) Pinned male specimen

(c) Exit holes on kharsu oak logs

(d) Larva

(e)Borer infested stacked logs with larval galleries

(f) Infested Khasru oak tree

Fig. 168. Life history stages of *Rosalia lateritia* (Hope,1831)

Adult: Beetle is 25-35 mm in length, red from above, black from beneath, head is black with 2 red spots and elytra possess with small spots or bands (Beeson,1941). Attack of this red longhorn beetle was evident during July 2008, August 2019 and 2020 in Deoban Reserve Forest, Chakarata Forest Division, Dehradun District Uttarakhand on *Q. dilatata* and *Q. semecarpifolia* trees & logs stored in godowns. In all 28 % of the

trees of both the species were attacked in patches. Visible symptoms of attack were drying of leaves on branches and stem and accumulation of dust heap on the ground. The emergence holes of this beetle were round in shape located at 1m above the ground on the tree trunk (Singh,2011). 13 individuals (6 females & 7 males) of kharsu oak borer Rosalia lateritia were collected from borer infested site in Deoban Reserve Forest on dated 28th August, 2019 and 3 individuals (1 female & 2 male) were collected from Deoban R.F. on dated 18th August 2020. Beetles were attracted to freshly felled Kharsu oak logs stacked together along the road side for transportation during August 2018. The individuals were found mating and flying on the infested kharsu oak trees. Adults are red from above and black from beneath and having black head. The antennae of males are longer than their body whereas the antennae of females are equals to their body. The emergence holes of this beetle were round in shape and diameter of the hole was 10 mm. According to Beeson (1941) emergence period of these beetles is from May to September.

Extent of Damage/Status: Common primary borer of Kharsu oak trees in disturbed stands prone to lopping and timber yards in the forest during mosoon season. Causes significant damage to Kharsu oak timber.

170.*Rhaphuma horsfieldi*(White,1855)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Distribution: India (Darjeeling; Sikkim; Assam: Naga Hills; Manipur; Nagaland), Nepal, China, Taiwan, Myanmar, Vietnam, Laos, & Java. (http://www.nbair.res.in/Cerambycidae/Rhaphuma%20horsfieldii%20dis.html).
[13 specimens in NFIC, FRI, Dehradun. Lopchu (1524 m), Darjeeling, West Bengal collected by J.C.M Gardner on 18.v.1930; Maymyo, Mandalay Dist, Myanmar collected by D.J. Atkinson on 04.v.1930].
Species of oak infested: *Quercus* spp. (Beeson,1941).
Host plants: *Albizzia odoratissima, Dolichandrone rheedii, Litsea elongata, Juglans regia* (Beeson,1941).
Habit: Larva bores in the deadwood (Mathur & Singh,1959).

Fig. 169. Adult-*Rhaphuma horsfieldi* (White,1855)

Beetle: It is 15 mm long, elongate with dense yellow pubescense, prothorax with 2 longitudinal dark stripes, elytra with 2 narrow longitudinal bands. Emergence period of this beetle is in April and May (Beeson,1941).
Extent of Damage/Status: Data deficient.

171.*Rhaphuma quercus* (Gardner,1940)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Distribution: India, China, Myanmar [3 specimens in NFIC,FRI, Dehradun). Someshwar, Almora collected by J.C.M Gardner on 31.05.1937; Maymyo, Shan States, Myanmar by D.J Atkinson on 24.iv.1929].
Host plant: *Quercus* spp. (Mathur & Singh,1959).
Habit: Larva bores in dead wood (Mathur and Singh,1959).
Extent of Damage/Status: Data deficient.

Fig. 170. Adult-*Rhaphuma quercus*(Gardner,1940)

172.*Tetropium orienum*(Gahan,1906)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Synonyms:
*Tetropium oreinum*Gahan,1906
*Tetropium lobbichleri*Harde,1959.
Distribution: India (Kashmir; NW-Himalayas), Nepal, China (http://www.nbair.res.in/Cerambycidae/Tetropium%20dis.html). [45 specimens are kept in NFIC, Dehradun. Bodyar, Chakrata collected by C.F.C. Beeson on 21.vi.1923; Thalroch (1981 m), Shimla Hills by C.F.C. Beeson on 22.v.1924; Deoban, Chakrata by C.F.C. Beeson on 17.vi.1923; Kanasar, Chakrata (2148 m) by S.N Chatterjee on 14.v.1922; Mussoorie (2286 m) on 05.ii.1924; Matti Kocahr (2743 m), Kulu Himachal Pradesh by A.H. Khan on 08.vi.1945; Buniyar (1524 m), Jhelum valley, Jammu & Kashmir B.M Bhatia on 21.vi.1928].
Species of oak infested: *Quercus floribunda* (Beeson,1941).
Other Host plants: *Cedrus deodara, Picea smithiana, Pinus wallichiana* (Beeson,1941).

Habit: Larva bores in the drywood (Mathur & Singh,1959). *Tetropium oreinum* is definitely a secondary borer and though requiring freshly killed bark in the early larval instars which are unable to establish it in standing trees of which the vitality is high enough to withstand borers by production of resin in the initial tunnels. The vitality of a sickly tree varies in different parts of the trunk and branches and roots and it is possible for beetle to establish in one part and fail in another part of the same tree. The secondary borer fauna of deodar is determined by other factors which cause either the crown or the roots to die off first (Beeson,1941).

Eggs: Eggs are laid on newly felled green or standing sickly trees, preferably deodar. The eggs are deposited singly in cervices on the sheltered sides of the trunk or log (Beeson,1941).

Larva: The young larva bores into the inner bast and cambial region forming shallow excavated patches which are continued later as long, irregularly curving, shallow tunnels grooving bast and sapwood and filled with wood and bark-dust. After resting during the winter months, larvae resume tunneling in the spring and from April onwards bore into the sapwood more or less horizontally for a half to one and a half inches to form an elongate oval pupal cell parallel with the axis of the log and wider in diameter than the connecting tunnel. Larva make irregular, frass filled tunnels between bark and wood and then overwintering enter the wood. (Beeson,1941)

Pupa: The pupal periods lasts probably a month or six weeks. The beetle escapes by the connecting tunnel and exit hole gnawed straight through the overlying bark. In thick barked logs or in stumps the pupal chamber may lie in the bast or groove the sapwood superficially (Beeson,1941).

Fig. 171. Adult-*Tetropium orienum*(Gahan,1906)

Adult: According to Singh (2011), beetle is 10-17 mm long, dark brown to black longhorn beetles emerged from *Q. dilatata* logs in April 2008 in rearing cages at FRI, Dehradun which were collected by Arun P. Singh from Dangan village, in Govind Wildlife Sanctuary, Uttarakahi District, Uttarakhand during August 2007. Its life cycle is annual.It emerges in the month of May and June (Beeson,1941).

Extent of Damage/Status: Widely distributed. Data deficient.

173.*Trinophyllum cribratum* (Bates,1878)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Synonym: *Callidium impressipenne*, 1948
Distribution: Europe: United Kingdom, Asia: India, Pakistan (https://www.biolib.cz/en/taxon/id170269/). [18 specimens in NFIC, FRI, Dehradun.Kathian (2121m) Chakrata, collected by J.C.M Gardner on 04.vi.1934; Mundali (2562 m) Chakrata, by J.C.M Gardner on 08.iv.1934; Kanasar (1676 m), Chakrata by Dr. S.K. Pillai on 26.iv.1923; Bajwar, Almora by J.C.M Gardner on 14.iv.1937; Mussoorie, by E.A. Glennie on 14.v.1929].
Species of oak infested: *Quercus floribunda, Q. leucotrichophora* (Beeson,1941).
Other Hosts Plants: *Cedrus deodara* (Beeson,1941).
Habit: Larva bores in dry wood (Mathur & Singh,1959).

Fig. 172.Adult-*Trinophyllum cribratum*(Bates,1878)

Larva: The young larva is a tiny of about half an inch in length with a large prothorax, brownish weak mandibles and narrow body segments (Stebbing,1914). Mature larva is 25 mm in length, whitish-yellow in colour, with a brown head and powerful black mandibles. The prothorax is greatly enlarged and hard. The succeeding segments are rather corrugated and taper posteriorly. Segments 2nd to 10th have each a stigma placed laterally near the ventral surface. (Stebbing,1914).
Pupa: The pupa is elongate, whitish-yellow in colour and has the appearance to some extent of the future beetle. The antennae are pressed against the sides and the legs and wings against the chest (Stebbing,1914).
Adult: Beetle is 10-13 mm in length and 3.5-4 mm in breadth, chestnut-brown more or less nitid, sparsely furnished from above with short semi-erect flavous brown hairs. Head and basal joint of antennae are finely rugulose-punctate. Prothorax is closely and strongly punctured; marked with a feeble sinuate groove or depression near the apex and another near the base; the disk is slightly

depressed along the middle with a very narrow impunctate space behind. Elytra are closely and strongly pubescent, less strongly near the apex. Body from beneath is reddish brown, sparsely pubescent, less closely and rather finely punctured; prosternum is transversely depressed a little behind the front margin; abdomen is narrowed posteriorly, first segment is longest, second to fourth are successively shorter. Legs are reddish brown, minutely and sparsely punctuate. (Stebbing,1914).

Life History: This species is a sapwood borer of logs of oaks with an annual life-cycle, emerging in May and June. The pupal chamber is relatively long narrow tunnel (2 inches) taken vertically down half of an inch within the sapwood (Beeson,1941). It infests deodar trees, especially felled or blown-down green deodar trees. Grubs are seen during August. Beetles appear on the wing in the forest in June when oviposition also takes place on newly felled trees. On hatching out the young larvae bore down the cambium layer and feed in this for a time. As they grow bigger the gallery grooves both the bast and the sapwood. These galleries are curve about in an irregular manner and increase in width and depth with the growth in size of the grub. The larval galleries are blocked for the whole length, with the exception of the space occupied by the grub itself, with wood refuse and excreta of the grub. The larva continues to feed in the bast and sapwood until winter and then hibernate at the end of the galleries. In April the larva recommences feeding and lengthens their galleries. In may the larvae tunnel down into the sap wood and excavates a pupal chamber parallel to the longitudinal axis of the tree and changes into pupa. Pupal stage lasts for 4-6 weeks and the beetle thus formed then graws its way out of the outer bark to leave the tree and mate. The female lays eggs on fresh trees (Stebbing,1914).

Extent of Damage/Status: Data deficient.

174.Longhorn Beetle, *Xylotrechus smei* (Castelnau & Gory,1841)

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Cerambycinae

Distribution: Pakistan, India (Assam, Bengal), Srilanka (South India-Ceylon) (Beeson,1941). Bhutan, Myanmar, introduced for time in Tanzania (Duffy,1968).(https://www.cerambycoidea.com/titles/vitali2004d.pdf). [94 specimens in NFIC, Dehradun, India. Purnakot range Angul, Orissa collected by R.N.Mathur on 24.iv.1955; Nilampur Madras by C.F.C Beeson on 01.iii.1924; Bagdogra Range Kurseong Bengal by N.C. Chatterjee on 05.ix.1935; N. Shikwa R. Raipur by N.C. Chatterjee in 1923; Panduwala Dehradun by For. Ento. on 12.v.1929; Koina range Saranda, Bihar by Gauri Dutt on 30.iii.1949; Mahoya Batticaloa by Gauri Dutt on 08.xii.1934; Shahdara, Lahore Punjab by G.D. Bhasain on 18.iv.1925; Amarkantak (1066 m), Rewah Madhya Pradesh by C.F.C Beeson on 17.v.1928; Nagargalli Belgaum, Bombay by B.H. Bhatia on 15.v.1930].

Species of Oak Infested: *Quercus leucotrichophora, Q. floribunda* (Beeson,1941).

Other Host plants: *Adina cordifolia, Aegle marmelos, Anogeissus latifolia, Bauhinia retusa, Bombax malabaricum, Cassia fistula, Dalbergia latifolia, Dalbergia sissoo, Ficus religiosa, Gmelia arborea, Grewia tiliaefolia, Holoptelia integrifolia, Mallotus philippinensis, Mangifera indica, Morus indica, Pterocarpus marsupium, Shorea robusta, Tectona grandis, Terminalia tomentosa, Vitis latifolia* (Beeson,1941).

(a) Adult (Dorsal view) **(b) Pinned specimen**

Fig. 173. Adult- *Xylotrechus smei* (Castelnau& Gory,1841)

Habit: Larva bores in the inner bark and sapwood of deadwood (Mathur & Singh,1959).

Eggs: Female lay eggs only when bark is present, debarked, sawn and seasoned timber are not attacked. The maximum number of eggs laid by a female is 190 and maximum laid in 24 hours to 60. The longest recorded oviposition-period is 6 days in April. Eggs are laid in cervices and covered depressions on the surface of bark in large clusters. The eggs hatch in 4 to 5 days in April (Beeson,1941).

Larva: White, robust, head is dark with mandibles strong. The larvae on the inner aspect of the bark and outer aspect of the sapwood excavate tunnels of regular nature and ultimately proceed inwardly where they make deeper tunnels densely packed with wood dust. Such tunnels remain intercalated speaking of a crowded chamber. The rate of larval development is variable. By inoculating newly hatched larvae in the freshly cut logs between the 5th and the 14th April the emergence of beetles was obtained as early as the 14th June. The shortest larval period under these conditions was 52 days in April and May (Beeson,1941). According to Gardner (1927), the head capsule of larva is subrectangular, slightly wider behind and not strongly transverse. Antennae are prominent with second joint distinctly longer than third. Legs are hardly visible with a hand lens but under the microscope leg is seen to consist of two very short circular joints with minute apical spines. The first stage larva has biforous spiracles.

X. smei attacks newly felled trees within a month of felling and also several months after felling; grilled trees and the crowns of dying or stag headed trees are dead. Logs stored in sun are more liable to be attacked than logs stored in the shade but the preference is not very strongly marked. The larval tunnels are excavated on the surfaces of the sapwood and inner bark, are flattened-oval in section and tightly packed with bark and wood-dust; in a crowded infestation the tunnels closely interlace. In the timbers have a strongly differentiated heart-wood, the borings are confined to the sap-wood, but in homogenous wood the tunnels may run right in the centre of the log and trend irregularly or are more or less concentric with the zones of growth. The beetle escapes by the prepupal tunnel and makes a circular exit-hole in the bark (Beeson,1941).

Pupa: Length of pupa is 17 mm, head rounded, cheeks shorts, abruptly hooked at their apex and above carinate along the cutter side, pubescent at the base, labrum longitudinally striate, with short recumbent

setae, clypeus transversally striate, pubescent at sides, forehead with V-shaped carina, the tip of which reaches the level of lower margin of the eyes and the ends exceed the level of antennal supports forming an oval-elongate flat tubercle and reaches the hind margin of the head. Joints of the palpi subquadrate, their end rounded. Antennae are short, 10th joint reach the front knees. Pronotum is rounded, very feebly constricted at the base, smooth, with two little cluster of 7-8 sparse short conical spinules at each side, one at the base and another a little behind the middle of lateral margin, well visible from the ventral side; mesonotum and metanotum fairly punctate. Abdomen is fairly elongate (the hind knees reach the hind margin of 5th abdominal segment), regularly narrowed and bowed towards the tip, longitudinally finely striate; sternites without spinules, tergites 1st-6th with several acicular short spinules, 7th tergite with nine acicular spinules transversely disposed along the middle and two pair of acicular spines transversely disposed along the hind margin. Legs are smooth; front femora is fusiform, middle femora is bowed and hind femora is bowed at the base and fusiform at the apex; tibias is bowed; middle tarsi are long, their onychium reaches the hind margin of the metasternum, hind tarsi is very long; their onychium reaches hardly the level of hind knees (Beeson,1941). Pupal chamberis about 15-20 cm long formed at a short depth in the sapwood. The chamber is continuous with the larval tunnel. They however do not form any such chamber in the heart wood. (http://www.worldscientificnews.com/wp-content/2017).Vitali (2004) also described the pupa of *X. smei*.

Adult: Beetle is 10-18 mm long, brown with a greyish or yellowish pubescence on head, prothorax and forming bands or spots on elytra. The colour of marking varies from almost entirely yellow to grey and elytra pattern varies from an apical and basal band and 2 lateral spots to an apical and basal band connected to a post-median and an ante-median band and a humeral spot. The prothorax may be reddish (Beeson,1941). According to Stebbing (1914), length of beetle is 11-17 mm in length and 3-5 mm in breadth, brown from above with a grayish or yellowish pubescence covering the head and most of the prothorax and forming bands and spots on the elytra. Body from beneath is marked with spots or bands of whitish pubescence.

Life cycle: Emergence of *X. smei*(in Dehradun) begins at the end of March from overwintered broods and is at its peak in May-June and continues to the end of the November. Eggs laid in April-May give rise to short-cycle and long-cycle generations, the former taking 2 to 7 month and emerging between the beginning of July and the end of November and the later hibernating to emerge in the second year. Eggs laid at the beginning of July and later in the year do not produce a complete generation in the same year, as the immature beetle or larva passes the cold weather in resting stage and the adult emerges in the second year between the April and November. The shortest life-cycle of overwintering broods is about 6 months and the longest might be 16 months (Beeson,1941).

Extent of Damage/Status: Data deficient in oak forests. Widspread in sal forests of Shiwaliks at lower elevations in Uttarakhand.

175.*Xylotrechus stebbingi* (Gahan,1906)

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Cerambycinae

Distribution: North-West Himalaya: Kilba, Bashahr (H.P.), Nainital, Jaunsar, Almora (Uttarakhand); Tibet (Stebbing, 1914). Nepal, Bhutan, recently introduced from

Asia into Europe and Middle East: Italy, France, Greece, Crete, Germany, Liban, Israel, Pakistan, Afghanistan, Turkey, Switzerland & Slovenia (http://www.nbair.res.in/Cerambycidae/Xylotrechus%20stebbingi%20dis.html).[2 specimens are kept in NFIC, Dehradun. Kashmir, India (1584 m) collected by Fletcher in July 1923].

Species of oak infested: *Quercus leucotrichophora* and *Q. floribunda* (Stebbing,1914; Beeson,1941).

Habit: Larva bores in the inner bark and sapwood of deadwood (Mathur & Singh,1959).

Egg: The egg is deposited by the beetles on the bark of green standing sickly trees or newly felled ones (Stebbing,1914).

Larva: It is whitish-yellow in colour, elongated and decreasing gradually posteriorly. Head is black in colour. Length is about 25 mm, when full-grown. The larvae feed entirely on the bast and outer sapwood of the Moru oak. The grub grooves both bast and sapwood, eating out large irregular galleries in the long axis of the tree. The larva gallery is always tightly packed with the wood refuse and excreta ejected by the larva. On becoming full grown, the grub bores down into the sapwood at an angle for about half an inch to one inch, and then eats out a pupal chamber parallel to the long axis of the tree (Beeson,1941).

[Source: https://commons.wikimedia.org/wiki/File:Xylotrechus_stebbingi_female_up.jpg]

Fig. 174.Adult- *Xylotrechus stebbingi* (Gahan,1906)

Adult: Beetle is brown, 12-18 mm long, head and prothorax are grey with four small brown spots in a transverse row, elytra with small ashy marks in three interrupted bands. The beetle appears on the wing towards the end of July and in August (Beeson,1941). According to Stebbing (1914) length of larva is 12 mm to 18 mm; breadth 3.5 mm to 5 mm. Body from beneath is covered with grey pubescence, a rather large posterior spot on each of the metathoracic episterna which is ashy-white. Antennae are less than half the length of body, third joint is slightly longer than the first one. Femora are rather strongely thickened and hind pair extends a little past the apex of the elytra. First joint of the hind tarsi is twice as long as the second and third united. Apex also narrowly bordered with ashy-grey. Body from beneath is covered with grey pubescence. Elytra is sub-glabrous, testaceous brown, narrowly covered with grey pubescence at the base, marked with some small spots of ashy-grey pubescence which form three interrupted bands-one near the base, another just before the middle, the third midway between it and apex; the

posterior spot on each of the metathoracic episterna is ashy-white. Head with the lateral carinae oblique, slightly curved, extending below almost to a level with the lower margin of the eyes; front narrowed between the eyes, furnished with two prominent convergent carinae which are united below. Antennae are less than half the length of body; third joint is slightly narrowed in front, strongly narrowed toward the base; disk with a median aspirate carina, which is broader and more strongly raised behind than in front. Femora are rather strongly thickened; the hind pair is extending a little past the apex of the elytra. First joint of hind tarsi is twice and as long as the second and third united (Stebbing,1914).

Life History: The larva feeds entirely in the bast and outer sapwood of the *Q. floribunda.* The grub grooves both bast and sapwood, eating out large irregular galleries in the long axis of the tree. Occasionally the gallery is quite straight, but it is more often irregular and serpentine; the larva, however, appears to confine itself to the layer of wood between the long straight medullary rays, and more especially so in its young state. The larval gallery is always tightly packed with the wood refuse and excreta ejected by the larva and are about 5 inches to 8 inches in length, with an average breadth of half inch. On becoming full-grown, the grub bores down into the sapwood at an angle for about half an inch to one inch, and then eats out a pupal chamber parallel to the long axis of the tree. Both chamber and entrance-gallery in the wood are kept quite free of wood-dust and excreta. When mature, the beetle crawls up the entrance-tunnel in the wood, bores through the wood, bores through the bark which overlies it and leaves the tree. Larvae in various stages up to nearly full-grown were taken from trees in Nainital (Kumaon) towards the end of May. Several of these grubs had already bored down into sapwood and constructed and commenced to pupate. The beetle appears on the wing towards the end of July and in August, the pupal stage lasting from six weeks to two months. It is possible that the beetles issue at intervals (as the larvae mature) through a part of July, August and into September. The larval stage is thus about nine months (Stebbing,1914).

Remedial measures in the forest are somewhat difficult throughout, the area occupied by the tree. A point, however, which should always be borne in mind, is that the egg is deposited by the beetles on the bark of green standing sickly trees or newly felled ones, and that the young grub requires at first the soft bast layer to feed upon. Consequently de-barking the trees soon after felling will ensure the destruction of the *Xylotrechus* beetles, since their grubs spend the whole of the period of their existence in this stage in the bast layer and outer sapwood. The debarking of the trees leads to the drying up of the bark and the death of the grubs. Trees infested by parasitic *Loranthus vestitus* are most liable to be attacked by this beetle (Stebbing,1914).

Extent of Damage/Status: Data deficient.

176.*Xylotrechus basifuliginosus* (Heller,1926)

Superfamily: Cerambycoidea

Family: Cerambycidae

Subfamily: Cerambycinae

Distribution: India (Himachal Pradesh: Shimla, Jalratach; Uttarakhand) & Nepal (http://www.nbair.res.in/Cerambycidae/Xylotrechus%20basifuliginosus%20dis.html).

[13 specimens in NFIC, Dehradun. Kauntilani fuel depot, Deoban, Chakrata, Uttarakhand collected by J.C.M Gardner on 24.vi.1924; Mundali, Chakrata, Uttarakhand by J.C.M. Gardner on 13.vi.1933; Talrathach (3200 m), Shimla, Himachal Pradesh by C.F.C. Beeson on 27.v.1924 and Khadrala (2971m), L. Pabar Range,

Himachal Pradesh by G.D. Bhasin on 10.iv.1951. Some specimens were also collected by Arun Pratap Singh and Gaurav Chand Ramola from kharsu borer infested trees and logs in the month of June and July from Deoban, Chakrata Forest Division, Uttarakhand in 2017-2020].

Species of oaks infested: *Quercus leucotrichophora* and *Q. semecarpifolia* (Beeson,1941; Mathur & Singh,1959).

Other Host plants: *Picea smithiana* (Beeson,1941).

Habit: Larva bores in the inner bark and sapwood of deadwood (Mathur & Singh,1959).

Eggs: The eggs are elongate, transparent, elliptical in shape and milky white in colour and one end is more acutely pointed than the other. The chorion was smooth, milky white in colour. Later the eggs become slightly yellowish.The egg laying took place after the one day emergence by female beetle collected from Deoban, Chakrata, Dehradun district, Uttarakhand. In field condition, it was observed that the maximum number of eggs laid by one female is 23 and minimum laid is 5 in 24 hours in the month of July, 2020. Eggs were laid in cervices and covered depression on the surface of the bark in large clusters.

Larva: The length of mature larva is upto 22-24 mm and 4-5 mm in width, yellowish in colour, fairly stout and thick, short with a rather well developed black head, thoracic segments and decreasing gradually posteriorly. Prothorax of larva is rectangular, about twice as wide as long. Like other cerambycidae larvae, its first six to seven segments are also similar in appearance usually have a round or triangular area of contrasting texture called pleural disc, developed like large, fleshy oval protuberance which are known as ampullae. Abdominal part is ten-segmented.

It mainly helps larva in moving along in its gallery. Mandibles are short, stout and gouge like cutting edges.When larva is about to pupate, it shrink in size and stop feeding.

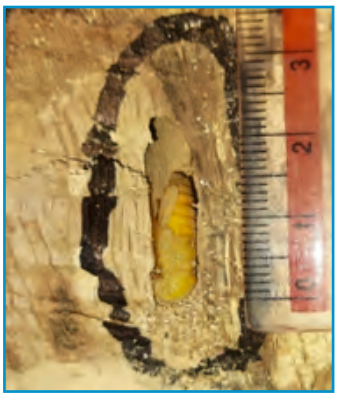
Pupa: Length of pupa is 17 mm and 6 mm in width, yellow coloured, head rounded, cheeks shorts, abruptly hooked at their apex and above carinate along the cutter side, pubescent at the base, labrum longitudinally striate, with short recumbent setae, clypeus transversally striate, pubescent at sides, forehead with V-shaped carina, the tip of which reaches the level of lower margin of the eyes and the ends exceed the level of antennal supports forming an oval-elongate flat tubercle and reaches the hind margin of the head. Joints of the palpi are subquadrate and their end rounded. Antennae are pale yellowish in colour, short, located on the lateral side of the body and 10th joint reach the front knees. A small plug of wood fibers is retained to close the mouth of pupal chamber. The chamber is continuous with the larval tunnel.Pupation occurs in winter January-February.

Adult: The beetle of *Xylotrechus basifuliginosus* is 14-15 mm in length and 4-5 mm in width, black to brownish in colour with a yellowish pubescence on the head region and almost prothorax in female and grey colour in male and forming three yellow coloured transverse bands on the elytra in females and white colour in males. Body beneath is covered with grey pubescence and having four white and four black bands in males and four yellow and four black bands in female. The legs of females are brown in colour whereas it is black in males. The emergence of beetles took place in the month of July-August and October-November (Beeson,1941). According to Singh (2011), the emergence of this beetle took place in rearing cages at FRI during March 2010 from *Q. dilatata* logs collected during July 2009 from Deoban Reserve forest, Chakrata Forest Division, Uttarakhand.

Emergence of this beetle took place from November-March but predominately in March in rearing cages at FRI from *Q. semecarpifolia* logs collected during July and August 2019 and 2020 from Deoban, Chakrata Forest Division, Uttarakhand.Life-cycle is annual with beetles emergeing in March-April2021 in Dehradun from logs collected in June2020 from Kharsu oak logs from Deoban, Chakrata Forest Division, Uttarakhand. Female larger than the male with mating lasting over an hour in breeding cages and up to 17 eggs being laid in crevices and holes on Kharsuoak, *Q. semecarpifolia* logs.

(a) Larva

(b) Larva along with gallery



(c) Pupa

(e) Female adult

(e) Mating of adults

(h) Emergence/Exit holes

Fig. 175.Life history stages of *Xylotrechus basifuliginosus* on kharsu oak tree

Nature of damage: It attacks mostly newly felled trees within a month of felling; stag headed trees are also attacked. Logs which are left in the forest after felling are also attacked by this borer. The neonate larvae start feeding on the bark initially and after few days they entered into the main stem and start feeding on sapwood. Larva scraped a portion of the wood and along with the frass turned back and with the help of head, it packed the frass into the tunnel and turned back to its normal position and continues feeding. As larva continues feeding inside the wood, the water conducting tissue was damaged and resulted in wilting and drying symptoms. While scraping the bark, the tunnel filled with frass and excreta could be noticed which was the sure symptoms of the attack.

Extent of Damage/Status: A common secondary borer of Kharsu oak trees in disturbed stands prone to lopping and fallen trees. Damage is significant when population is high.

177.*Zoodes basalis*(White,1855)
Superfamily: Cerambycoidea
Family: Cerambycidae
Subfamily: Cerambycinae
Synonyms:
Hesperophanes basalis White,1855
Trichoferus basalis Gressitt,1951
Zoodes basalis Weigel,2006

Distribution: India (N-India), China: Taiwan, Himalaya & Nepal. (http://www.nbair.res.in/Cerambycidae/Zoodes%20basalis%20dis.html). [8 specimens in NFIC, Dehradun. Ramgarh, Kumaon collected by by C.F.C Beeson in 1937; Dehradun by J.C.M Gardner in July, 1937; Almora by J.C.M Gardner on 26.vi.1937 &Bhowali, Kumaon For. Zoo. Coll. on 23.vi.1912].

Fig. 176.Adult- Zoodes basalis (White,1855)

Species of oak infested: *Quercus leucotrichophora* (Beeson,1941).

Habit: It bores in the inner bark and sapwood of dead wood (Mathur & Singh,1959).

Extent of Damage/Status: Data deficient.

178.*Autocrates aeneus* (Westwood, 1846) **Family: Trictenotomidae**
Superfamily: Tenebrionoidea

Fig.177. Adult *male-Autocrates aeneus* (Westwood, 1846)

Distribution: The genus Autocrates was described by Thomson (1860), with the type species Trictenotomaaenea Westwood, 1846, the type locality located in Northern India. It also occurs inAssam, Himachal Pradesh, Uttaranchal, Sikkim / Darjeeling in India and Nepal, Bhutan, Myanmar, West Malaysia, Thailand, South China (Xizang), South Korea (Lin et al,2007 & Pollock 2008).
Species of oak infested: *Q. leucotrichophora* in India.
Habit: Adult feed on tree sap (https: //en.wikipedia.org/wiki/Trictenotomidae). One individual was recorded in oak forest in an oak stump in Mandal (1700m), Chamoli district, Uttarakhand,India on 04.vii.2019.The larvae of Trictenotomidae live in wood and show some resemblances to those of Pyrochroidae and Cerambycidae (Lin et al,2007).
Adult: Maximum size of beetle is 83 mm (http://www.coleopteraatlas.com/TRICTENOTOMID AETenebrionoidea/Autocrates/Autocrates-aeneus).
Extent of Damage/Status: Uncommon. Damage not significant.

179.*Cryptocephalus dodecaspilus* (Suffrian,1854)
Superfamily: Chrysomeloidea
Family: Chrysomelidae
Distribution: N.W.Himalayas; Tibet (http://www.ebooksread.com/authors-eng/martin-jacoby/coleoptera-chrysomelidae-ala/page-27-coleoptera-chrysomelidae-ala.shtml). [7 specimens in NFIC, Dehradun. Chaubatia, Kumaon (1828m), collected by A.D. Imms on 13.vi.1912; Bhimtal, Kumaon For. Zoo. Coll. on 20.vi.1912 &Bhowali, Kumaon, For. Zool. Coll. collected on 25.vi.1912].
Species of Oak infested: *Quercus florid unda* (Beeson,1941).
Other host plants: *Pieris, Salix, Pyrus* etc. (Beeson,1941).
Habit: Beetles defoliate (Mathur & Singh,1959).

Fig. 178.Adult-*Cryptocephalus dodecaspilus*(Suffrian,1854)

Beetle: The size of beetle is 4 mm, antennae is longer than half of the body, third and following four joints are elongate, the rest distinctly widened appendages of terminal joint long, not much pointed, basal five joints are flavous and rest are black. Thorax is strongly convex much narrowed in front, posterior margin serrate; surface is impunctate, posterior edge is narrowly black, two large transverse spots at middle, and their posterior margins projecting outwards. Scutellum is black. Elytra are very narrowed poseriorly, epipleural lobes are indistinct: surface is strongly punctuate-striate, interstices is feebly raised, transversely wrinkled from below scutellum, margins, except at base, black: four large black spots are placed subquadrately at base (http://www.ebooksread.com/authors-eng/martin-jacoby/coleoptera-chrysomelidae-ala/page-27coleoptera-chrysomelidae-ala.shtml).
Extent of Damage/Status: Data deficient.

180.*Hoplasoma sexmaculata*(Hope,1831)
Superfamily: Chrysomeloidea
Family: Chrysomelidae
Synonyms:

Auchenia sexmaculata Hope
Haplosoma sexmaculata Jacoby
Haplosoma bifasciata Allard

Fig. 179.Adult-*Hoplasoma sexmaculata*(Hope,1831)

Distribution: North-West Frontier Province, Pakistan; Western Himalaya: Shimla (2123 m) on 12-16.v.1908, 13.v.1913 & 21.v.1916 (Annandale); Kasauli (1920 m); Dharampore, 17.v.1913 (Phaku Ram); Phagu to Kufri (2743m); Almora, Dhaulchina (1828 m) 26.iv.1923 gnawing on P. roxburghii needle (R.N.Parker); Dwarahat (1524 m), 20.iv.1923, defoliating Celtis tetrandra (R.N. Parker);

Kumaon, Bhimtal (1356 m), 02-10.v.1911 (Kemp); Muktesar, 12.v.1903 (Sen,PusaCoiL); Murree,Pakistan (2286m) April 1918 (Dutt, Pusa Col I) (Maulik,1936). [18 specimens are kept in NFIC, Dehradun. Dharmsala (1981 m), Kangra Himachal collected by A.H. Khan on 31.v.1945; Bagdogra Range, Kurseong, West Bengal by N.C Chatterjee on 24.vi.1935; Mussoorie (1981 m) by S.N Chatterjee on 23.vi.1920; Peora (1371 m), Nainital by B.M. Bhatia on 12.v.1930; Pauri Garhwal by B.S. Gusain in June 1928; Bhuin 1143m, Kulu Himachal by B.M. Bhatia on 21.v.1934].

Species of Oak Infested: *Quercus leucotrichophora* (Beeson,1941).

Other host plants: *Celtis tetrandra* and *Pinus roxburghii* (Beeson,1941).

Habit: Beetles defoliate (Mathur & Singh,1959).

Adult: Beetle colour is dark brown to pale yellow, mixed with grey; the following parts pitch-brown to black: antennae, eyes, scutellum, an antemedian and two postmedian patches on each elytron, the whole of the underside from the mesosternum to apex of the abdomen and legs; in the lighter specimens the dark parts are pitch-brown, three or four basal segments of antenna and the basal halves of the femor a yellow-brown; in some cases the basal portion of the scutellum is yellow-brown in colour; the elytral patches vary in size; all of them have the boundaries well-defined of the post median patches the outer one is almost always larger than either of the other two; the post median patches may be fused, but in such a way that they bear evidence of the process of fusion; sometimes all the patches tend to become elongate. Three elytral spots are small and almost equal to each other in size. Head with the vertex is smooth and impunctate; eyes are comparatively small and not strongly convex. Antenna is very slender, reaching to the apex of the body; third segment is distinctly shorter than fourth; fifth to eighth segment is almost equal in length; last three are equal to each other. Prothorax is somewhat broader than long, slightly constricted in the middle; the median transverse depression is very shallow and wide, so that the whole of the upper surface appears concave; upper surface is impunctate and shining. Scutellum is sharply triangular with the smooth surface and impunctate. Elytron is much broader at the base than the prothorax, narrow, parallel-sided; upper surface is confusedly punctate and transversely wrinkled; this wrinkled appearance, though not very strong, is quite distinct. No secondary sexual characters are found in several species of the genus (Maulik,1936).

Extent of Damage/Status: Data deficient.

181. *Auletobius nigrinus* (Voss,1920)

Superfamily: Curculionoidea

Family: Rhynchitidae

Synonym: *Laricobius nigrinus* Fender, 1945.

Distribution: It is found in North America (https://en.wikipedia.org/wiki/Laricobius_nigrinus). [5 specimens are kept in NFIC, Dehradun. For. Zoo. Coll.fromKangra Div. Dharamsala, Himachal Pradesh collected by O.H. Walters on 22.viii.1916].

Host plants: *Quercus leucotrichophora* (Beeson,1941).

Habit: Beetle feeds on young leaves and shoots of saplings (Mathur & Singh,1959).

Eggs: Eggs are bright yellow, shiny and oval shaped, length of 0.37-0.50 mm and width 0.24-0.33 mm. Eggs are usually laid singly within woolly ovisacs of Adelges tsugae(Zilahi-Balogh et al.,2003).

Larva: Larva is oligopod type, slightly fusiform, resembling more closely a campodeiform than a scarabaeiform larva, but without a pair of terminal abdominal

processes. Terga of thorax and abdominal segments (1-9) with paired pigmented plates. Prothoracic plate has abundant scattered setae; longer setae arising from tubercles at anterior and posterior margins. Remaining dorsal thoracic and abdominal plates has 2 rows of long setae arising from tubercles. Epipleura of meso and metathorax each with a single long seta arising from tubercle; epipleura of abdominal segments 1-6 with 5 to 6 setae on each tubercle; those of 7th and 8th abdominal segments with 4 and 3 setae, respectively. Spiracles are cone-like processes. Head with 4 pairs of long setae along posterior margin; frontal arms are lyriform; 3 pairs of long setae evenly distributed along frontal arm with scattered short setae. Front clypeal suture is indistinct, indicated by a row of 6 short setae. Frontoclypeal suture of *L. erichsonii* differs from that of *L. nigrinus* by the presence of a double line, visible in transmitted light (Franz,1958). Labrum is free; separated from clypeus by clypeolabral suture; with a pair of median setae and 3 pairs of marginal setae at apex. There are 6 stemmata, arranged in 2 arcs behind antenna, each arc with 3 evenly spaced stemmata; 2 setae are between anterior and posterior rows of stemmata. Antenna is 3-segmented, 3rd segment is longer than first 2nd combined. Unsclerotized portions of head, thorax, and abdomen with denticulate microstructure. Four larval instars were determined from frequency distributions of head capsule measurements (Zilahi-Balogh et al.,2003). Zilahi-Balogh et al.(2003) reported head capsule and body length measurements of each of the larval stages of *L. nigrinus*. The number of larval instars is consistent with *L. erichsonii*(Clark and Brown 1958; Franz 1958) and *L. rubidus* (Clark and Brown,1960). Lawrence and Hlavac (1979) and Lawrence (1991) described morphological characteristics of *Laricobius* larvae which can be differentiated from larvae of the three other genera in the family Derodontidae by lacking tergal processes or urogomphi. A neonate larva is yellow whereas a mature larva is yellow-green to yellow-brown in color. Larvae move by drawing the terminus of the abdomen toward the thorax in a looping action, attaching it to the substrate, then releasing the thoracic legs and extending the body forward. Larval cuticular secretions adheres debris and woolly adelgid flocculence to the body, which acts as a camouflage. This camouflage is lost before mature larvae migrate to the soil to pupate.

Pupa: Pupae are of an exarate type, yellow with setae. As the adult matures within the pupal skin, the tip of the abdomen darkens. The sexes can be distinguished in the pupal stage: the female genitalia have two valvifers and the male aedeagus is tri-lobed, with a median lobe and two lateral parameres. Genitalia retracts into the body when the adult ecloses (Zilahi-Balogh et al.,2003).

Adult: Body length is 2.31-2.94 mm. Body is uniformly black or piceous, shiny, covered in fine, erect hairs, dorsally convex and ventrally flattened. Head is partially concealed from above. Antennae and tarsi are testaceous to rufotestaceous. Pronotum is 1.20 to 1.54 times wider than long, widest in the middle; posterior edge is wider than anterior edge; base of pronotum is narrower than base of elytra; anterior angles are rounded and obtuse; posterior anglesare nearly quadrate and obtuse. Pronotum and elytra are wider in females than in males. No external characters were found to easily distinguish between males and females. The sexes are best differentiated by microscopic examination of the protracted external genitalia. The aedeagus of *L. nigrinusis* distinct from that of other *Laricobius species* in North America. Brown (1944) illustrated the aedeagi of *L. rubidus, L. erichsonii*, and *L. laticollis*. In contrast to what was reported

by Fender (1945), apices of parameres of the aedeagus of *L. nigrinus* are more tapered; whereas those of *L. rubidus* are more obliquely truncate (Brown,1944).
Extent of Damage/Status: Data deficient.

182.*Auletobius comsimils* (Voss,1930)
Superfamily: Curculionoidea
Family: Rhynchitidae
Adult: Specimens collected on 17.vii.2019 from ban oak acrons in a forest at Dalakhet village (1460m), Thano Range of Dehradun,Uttarakhand. Adult is red coloured while legs and rostrum are black.
Extent of Damage/Status: Occasional in ban oak forests at lower elevation. Of minor importance.

(a) Adult on ban acorn

(b) Adult (Dorsal view)

Fig. 180.Adult-*Auletovius comsimils* (Voss,1930)

Distribution: N.W. Himalaya;Uttarakhand. [7 specimens in NFIC, FRI, Dehradun. Berenag, Almora (1828m) collected by R. N. Parker on 30-31,vii.1923; Didihat (1524m) Almora collected by R.N. Parker on 28.vi.1923; Jawalagiri North Salem FRI Sandal Insect Survey collected on 31.v.1930].
Species of Oak Infested: *Quercus leucotrichophora.*
Habit: Beetle and larva bore in acorns.

183.*Dicranognathus nebulosus* (Redtenbacher,1844)
Superfamily: Cuculionoidea
Famiy: Attelabidae
Subfamily: Curculioninae
Distribution: Kumaon, Himalaya (https://www.cabi.org/ISC/abstract/19980613203). [3 specimens are kept in NFIC, Dehradun. Mussoorie collected by J.C.M Gardner on 01.x.1905 on *Quercus leucotrichophora* acorns & from Mackinson Park by C.F.C Beeson on 29.viii.1927 from Mussoorie]. One specimen was collected from Tigerfall road of ban oak forest on dated 28.viii.2019 of Chakrata Forest Division.
Species of oak infested: *Quercus leucotrichophora* (Beeson,1941).
Habit: Beetle and larva bore in acorns (Mathur & Singh,1959).
Larva: The length of larva is 9 mm (Beeson,1941). According to Gardner (1934), larval body is strongly curved, stout, fine setae and some of them are long; skin with minute skin-points; head capsule pale for the greater part, anteriorly brownish above and laterally; partly retracted into thorax, elongate and length is about 1.75 mm and 1.5 mm as long as wide; slightly wider

behind the middle, the sides are nearly straight; the lower margin produced into a rigid posterior narrower exterion, frontal suctures is not distinct. Large ocelli are near anterior margin on one side. Antennae with two distinct segments, the basal one cylindrical, brownish, longer than wide with three or four minutesensillae and an elongate conical apical segment.

Labrum is about 1.4 times as wide as long, the posterior margin nearly straight, anterior margin weakly trilobed; withy four pairs of setae, one near the middle very long, one pair very near the apex of the median lobe; three stout lateral setae near the margin ; the posterior one behind middle of labrum area. Mandibles are short and wide with ablunt apical tooth and an obtuse rounded subapical tooth. Maxillary mala obtuse, the apex with five finer setae and four flattened setae, a slight expension towards the median line with three larger flattened setae; the two palp segments, the basal nearly as long as wide; prementum covered by large testaceous, posteriorly angulate plate; the posterior zone yellowish medially. Prothoracic tergum is rather large, only moderately transverse with an anterior pale testaceous plate and posterior soft skinned zone. Abdominal terga are with two transverse subdivisions, the anterior divisions are first four segments rather strongly protuberant and bilobed anal cleft transverse. Spiracles are circular, biforous, the paired dorsal air-tubes projecting well beyond peritreme (Gardner,1934). According to Kaushal & Kalia (1989), the larvae feed on the endosperm and when they are fully developed the endosperm is completely reduced to a yellow-brown granularfrass. Extent of damage was influenced by the stage of larval development and vaned from 2% to 12.5%. Injury to the endosperm results in retardation or arrest of development and seedling growth (Hartmann & Kester,1975). Larval survival appeared to be unrelated to acorn size. The larvae pupated inside the acorn and adults emerged by cutting a hole in the seed coat.

Pupa: Pupation occurs in the hollowed acorns (Gardner,1934).

Beetle: Breeds in the acorns of *Quercus leucotrichophora* (Beeson,1941).

(a) Adult (Dorsal view)

(b) Adult feeding on ban oak acorns

Fig. 181. Adult-*Dicranognathus nebulosus*(Redtenbacher,1844)

Biology: According to Kaushal et al.,(1993), adults attacked acorns by cutting a hole through the seed coat, usually near the apical edge of the capsule. The area of puncture eventually turns black. Upon hatching, the first instar larvae fed on the outer surface of the endosperm while subsequent instar fed within the endosperm. By the time they are fully developed the endosperm is completely reduced to a yellow-brown

granular frass. There are 3 larval instars and larvae are found from the last week of July until early February. The entire development of the weevil occurs inside the acorn. The adults emerge from the acorn by chewing an exit hole (1-2 mm). Emergence of laboratory-reared weevils started on in the last week of June and continued until the first week of September.Oviposition and infestation of acorns was completed by the end of November. There is a single generation in a year.

Extent of Damage/Status: Common in ban oak forests. Causes significant loss to oak acorns

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184.*Tropideres bolinus*(Jordan,1924)

Superfamily: Cuculionoidea

Famiy: Anthribidae

Distribution: Occurs through out India. [11 specimens in NFIC, FRI, Dehradun. Dehradun, Uttarakhand collected by J.C.M. Gardner on 27.ix.1939; Thano range, D.dun Uttarakhand by S.N. Chatterjee on 4.x.1933; Ramanguli, Mumbai, Maharashtra by C.F.C Beeson on 24.ix.1920; Kasaragad, Mangalore, Karnataka by W.D. Kanara on 19.x.1948 & 26.x.1926].

Species of Oak infested : *Quercus leucotrichophora* (Beeson,1941).

Other Host plants: *Artocarpus hirstuta, Gmelina arborea, Mallotus philippinensis, Shorea robusta, Terminalia tomentosa* (Beeson,1941).

Habit: Larva bores in dead sapwood (Mathur & Singh,1959).

Egg: The eggs laid in Sept-October give rise to beetles in March, April or in the monsoon (Beeson,1941).

Adult: Length of beetle is 2.8-3.4 mm. Rostrum flat, in basal half with vestiges of carinae, only the lateral carina being fairly distinct. Male frons is twice as wide in female, in the latter one-fourth as wide as the rostrum measured between the antennae; groove below eye distinct. Antennae are rufous, paler at the base, 10th segment is shorter than 9th. Elytra are strongly punctate-striate, with the alternate interstices somewhat raised; sub-basal swelling distinct, brown or blackish, this spot separate from the black-brown lateral area or merged together with it; in this area a few pale dots; the pale sutural area, which posteriorly extends to the lateral margin, bears a number of brown dots. Pygidium is with brown median stripe (Hartert& Jordan, 1924). The adult live for some months and attack logs a month or more after felling but not freshly felled material (Beeson,1941).

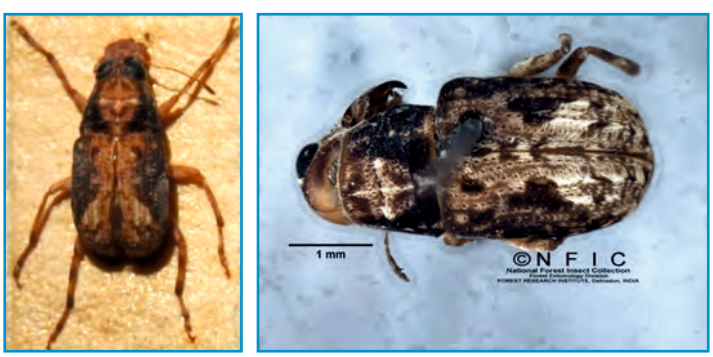


Fig. 182.Adult- ***Tropideres bolinus*** **(Jordan,1924)**

Emergence period: There are two generations per year. The beetles emerge in August-December but preponderantly in September and October (Beeson,1941).

Extent of Damage/Status: Data deficient.

185.Long-horned Weevil, *Tropideres securus* (Boheman in Shoenherr,1839)
Superfamily: Cuculionoidea
Famiy: Anthribidae
Synonyms:
Litocerus ana Jordan,1903.
Litocerus rufescens Roelofs,1879
Distribution: Korea, China, Japan, Russia (Far East), Taiwan (Park et al.,2012). Uttarakhand& Assam [35 specimens in NFIC, Dehradun. Dehradun, Uttarakhand collected by C.F.C Beeson on 06.vi.1923, B.M. Bhatia on 9.x.1925, J.C.M Gardner on 15.vi.1936, 12.iv.1936 & 31.x.1939; HaflongChachar, Assam collected by C.F.C Beeson on 16.v.1925].
Species of Oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959).
Other Host plants: *Albizzia* sp., *Dalbergia sissoo, Euphorbia pulcherrima, Lannea grandis, Shorea assamica, S. robusta, Terminalia tomentosa* (Beeson,1941).
Habit: Larva bores in dead sapwood (Mathur and Singh,1959).
Larva: According to Gardner (1936), larva is about 6 mm in length and posses middle terga with fine asperities. Smaller claws like seta. Spiracles are small with more prominent air tubes.
Adult: Body is elongate-oval, about 2.0 times as long as wide, black; antennomeres except club, several parts of elytral derm, tibial band and tarsi reddish-brown. Rostrum and ventral side of body is covered with whitish-yellow pubescence.

Fig. 183. Adult-*Tropideres securus* (Boheman in Shoenherr,1839)

Rostrum is longer than wide and slightly broadening anteriorly. Interocular width is 1/6 times as wide as rostrum at narrowest point. Antennae are with thick scape and pedicel, 3rd antennomere is 2 times as long as pedicel; each antennomere of club is longer than wide. Pronotum is wider than long, dorsal carina is gently arched anteriorly, lateral carina is reaching middle of lateral margin. Basal angle is rapidly arched and basal carinula directed posteriorly. Pronotal declivity is somewhat horizontal with dorsum of pronotum. Before scutellum there is whitish, quadrate, pubescent patch at middle. Scutellum is small and covered with white pubescence. Elytra is 1.2 times longer than wide, reddish and derm spots located near scutellum and behind middle. The reddish derm spot behind middle are extending to 5th interval. Femur is stout and clavate, tibiae are with two whitish bands, and 1st tarsomere is 2 times as long as 2nd, 3rd

tarsomere is narrowly but clearly bilobed. Pygidium is as long as wide in male but 1.2 times as wide as long in female (Park et al.,2012).
Emergence period: May to October (Beeson,1941).
Extent of Damage/Status: Data deficient.

186.*Apoderus bihumeratus*(Jekel,1860)
Superfamily: Cuculionoidea
Famiy: Attelabidae
SubFamily: Apoderinae
Subf Distribution: N.W. Himalaya [20 specimens in NFIC, Dehradun. Chakrata (2562m & 2844m) collected by J.C.M Gardner on 26.v.1934 and by Dr. Marshall on 3.v.1916; Almora, Uttarakhand collected by J.C.M Gardner on 27.v.1937; Kangra, Himachal Pradesh by O.H. Walters in August 1916; Debrepani (1828 m) Darjeeling, West Bengal by J.C.M Gardner on 15.ix.1929].
Species of Oak infested: *Quercus leucotrichophora*(Beeson,1941).
Other Host Plants: *Alnus nepalensis* (Beeson,1941).
Habit: Beetle rolls the leaf larva feeds within the rolled leaf (Mathur & Singh,1959). Adults collected from Ban oak trees in New Forest, Dehradun on17.iv.2018.
Adult: Beetle is yellow with several black spots, 4 of which are on the elytra (Beeson,1941).

Fig. 184.Adult-*Apoderus bihumeratus*(Jekel,1860)

Extent of Damage/Status: Uncommon in ban oak forests. Minor importance.

187.*Apoderus bistriolatus*(Faust,1898)
Superfamily: Cuculionoidea
Famiy: Attelabidae
Subfamily: Apoderinae
Synonyms:
Apoderus incana Stebbing,1903
Paracompsus bistriolatus Faust,1898
Distribution: North-West Himalaya. Jaunsar-Barwar, Tehri Garhwal, Jubal &Balsan (H.P.) (Stebbing,1914) [37 specimens in NFIC, Dehradun. Chakrata, Bodyar (2057-2529 m),Uttarakhand collected by S.N. Chatterjee on 3-12.v.1922

& by J.C.M Gardner on 20.x.1934; Taranda (2133m), Bashahr state, Himachal Pradesh by R.N. Parker on 18.v.1928].

Species of Oak infested: *Quercus leucotrichophora* and *Q. floribunda* (Stebbing,1914; Beeson,1941).

Other Host plants: *Juglans regia, Prunus padus*(Stebbing, 1914; Beeson,1941).

Habit: Beetle rolls the leaf; larva feeds within the rolled leaf (Mathur & Singh,1959). Adults collected from Ban oak trees in New Forest, Dehradun on 15.v.2018.

Egg: Yellow, shining, elliptical in shape and about 1.6 mm in length. The insect oviposit during a period of three weeks in May (Stebbing,1914).

Larva: A small grub hatches from the egg and feeds on the decaying tissues, becoming full grown within 10 days to a fortnight. The grub then rolls the leaves, which will reached the forest floor and pupates in the soil (Stebbing,1914).

Adult: The female beetle is small, shining, dark yellow with black markings on the elytra. Rostrum is brown, short, broad and armed at the end with a pair of large mandibles (Stebbing,1914).

Fig. 185.Adult-*Apoderus bistriolatus*(Faust,1898)

Life History: The beetles appear on the wing about the first week of May. The female lays eggs in the left-hand corner of the apex of the leaf. The leaf of Q. leucotrichophora is then either cut two-thirds of the way down, the cut being made on both sides from the exterior edge horizontally inwards till it meets the midrib, or the leaf is cut right across from one side to very near the edge of the other, only a small piece of tissue being left. The cut portion of the leaf is folded down the midrib and then rolled up from the apex downwards, the outer edges being tucked in so as to form a neat little cylinder which remains which remains suspended to the lower part of the midrib or leaf uncut portion. In Q. floribunda the leaf is cut invariably lower down but in a similar way. The tree is heavily defoliated when the weevil is numerous. Throughout Jaunsar-Barwar and adjacent Native states of Tehri Garhwal (Uttarakand), Jubal and Balsan (Himachal Pradesh), this insect was very plentiful in 1901 and 1902. The peculiar method of laying its eggs adopted by the insect results in the trees attacked being very heavily defoliated when the weevil is numerous. Trees of all ages are infested and it is the newly unfold leaves which are

primarily treated in this manner, the older ones being only resorted to after the newer ones have been all occupied. (Stebbing,1914).
Extent of Damage/Status: Uncommon in ban oak forests. Minor significance.

188.Leaf-rolling weevil, *Apoderus dentipes* (Faust,1883)
Superfamily: Cuculionoidea
Famiy: Attelabidae
Subfamily: Apoderinae
Distribution: Kumaon, Himalaya (Beeson,1941). [23 specimens in NFIC, Dehradun. Almora (1525 m, collected by R.N. Mathur on 22.vii.1923 &24.vi.1923; Chaubatia (1981 m) by R.N Parker on 21.iv.1923].
Species of Oak infested: *Quercus floribunda* (Beeson,1941).
Other Host plants:*Desmodium sambuense, Pieris ovalifolia* (Beeson,1941).
Habit: Beetle eats the young leaves (Mathur & Singh,1959).
Beetle: It is a bluish-black beetle which feeds on the young leaves (Beeson,1941).

Fig. 186.Adult-*Apoderus dentipes*(Faust,1883)

Extent of Damage/Status: Data Deficient.

189.Acorn Weevil, *Curculio glandium* (Marshall,1920)
Superfamily: Cuculionoidea
Famiy: Curculionidae
Subfamily: Curculioninae
Distribution: North-West Himalaya (Stebbing,1914). It is native to Eastern North America(https://en.wikipedia.org/wiki/Curculio_glandium). [25 specimens are kept in NFIC, Dehradun. Airadeo, Almora collected by J.C.M Gardner on 09.vii.1937 on *Q. leucotrichophora*; Mundali (2561 m) Chakrata collected by J.C.M Gardner on 07.viii.1934 on *Quercus seeds*; Mussoorie (1981 m) collected by R.N. Chatterjee on 19.iv.1941 on *Q. leucotrichophora*; Mussoorie collected by J.C.M Gardner on 14.vi.1928 and on *Q. floribunda* in Nainital on 14.iv.1950].
Host plants: *Quercus leucotrichophora, Q. floribunda, Q. glauca, Q. lanata*(Stebbing, 1914; Beeson,1941).
Habit: Beetle and larva bore in acorns (Mathur & Singh,1959).

Eggs: The eggs are laid on the young acorn above the cupule; the early mines of the young larva run throughout the acorn but later work is concentrated at the basal portion often leaving the tip entirely untouched.(Beeson,1941). The number of eggs per punctured acorn varied from 0 to 8 (mean 5.2 f 0.47; n = 200). No eggs were found in 45 (23 %) of the 200 acorns having at least one puncture mark. The absence of eggs in 23 % of the acorns with puncture marks indicates that adult feeding occasionally is not accompenied by oviposition (Kaushal et al.,1993).

Grub: The larvae are short, and cylindrical in shape, and move by means of ridges on the underside of the body. It reaches a length of 4-8mm. Larva is small, white, short, stunted, legless grub, almost as broad in the centre as long, with a small pale-brown head. Throughout its life, the larva is a fat conical grub but becomes cylindrical just before pupating. A larva feed inside, reducing the kernel to a powdery mass, no external opening being visible in the outer skin of the fruit. The acorns fall to the ground during the attack about the time the larvae become full-fed. Many individual (up to 10) reaches maturity in one acorn (Stebbing,1914). There are four larval instars. The larvae fed on endosperm completely reduced it to a yellow-brown granular frass at the end of development. As many as 8 first instar larvae in one acorn, and 1 to 5 in several other acorns were found. An average of 3.8 f 0.3 (n = 200) larvae developed per acorn through the last instar (Kaushal et al.,1993).

Fig. 187. Adult-*Curculio glandium* (Marshall,1920)

Pupa: White, of usual weevil type, and about same length as larva. Pupation takes place in an elongated cell formed on the outer part of the acorn near its base. The walls of the cells are smooth and lined with the particles of silky hairs derived from outer skin of the acorn. Pupal cells are crowded closely and oriented at all angles (Stebbing,1914).

Adult: The whole surface is covered with small punctures. The proboscis is curved and about one-sixteenth of an inch long. The antennae are elbowed and spring from near base of proboscis. Thorax is covered with punctures whicg are irregularly scattered. The tibiae of the legs are ribbed and bear hooped spines, and punctures are in longitudinal rows. The elytra do not quite cover the abdomen and have broadly rounded ends. The elytra are about half the length of the body. It is easily distinguished by a very long, thin, shiny rostrum of a length that is not inferior to the length of the body.

At its end are small, but very strong jaws, turning it into a very perfect drilling device. In the autumn, when acorns on oak begin to ripen, female tubercles begin to lay eggs. This is where the proboscis becomes necessary and without it the female does not get to the internal parts of the fetus. Beginning this difficult work, the female rises on her legs, gradually bending the proboscis under her and fixing it vertically. Its short front and middle legs do not reach the surface of the acorn by the beginning of drilling, and the beetle is held only by the hind legs and rests on the proboscis. It takes about 6-8 hours of continuous work and the hole is ready (Stebbing,1914). This species is recorded as *Calandra sculpturata* Gyll. by Stebbing in 1914 (Beeson,1941). The whole developmental process is completed within the acorn. The adults emerge in the last week of August by chewing an exit hole from the inside of the shell. The number of exit holes was one and two of the 175 acorns observed. Maximum number of adults emerging from a single acorn was 7 and in several acorns varied from 3 to 5. There are two generations in a year. It causes 60 % of total infestation in ban acorns (Kaushal et al.,1993).

Emergence Period: This weevil first begins to emerge from the acorns about the middle of June and continues to do until the end of the month. When ready to emerge a hole is bored through the shell to the outside (Stebbing,1914). Emergence occurs by means of a circular hole, before which the acorn shows no signs externally of being attacked (Beeson,1941).

Generations: There are at least two generations a year one of which overwinters in fallen acorns. This species is occasionally responsible for the destruction of nearly the whole crop of acorns (Beeson,1941).

Extent of Damage/Status: Data deficient.

190.Acorn Weevil, *Curculio sikkimensis* (Heller,1927)

Superfamily: Cuculionoidea

Famiy: Curculionidae

Subfamily: Curculioninae

Distribution: India (Kumaon region, Uttarakhand) (Kaushal et al,1993);Japan (Aoki et al.,2009).

Species of oak infested: *Quercus leucotrichphora* & *Q. floribunda* (Kaushal et al,1993); *Q. acuta, Q. myrsinaefolia, Q. gilva, Q. variabilis, Q.crispula, Q. glauca, Q. serrata, Q. salicina* (Aoki et al.,2009).

Habit: Larva bore in acorns (Kaushal *et al*.,1993).

Biology: The adults lay a single egg by making a puncture usually near the apical edge of the acorn. Upon hatching, the young larvae feed on the surface of the endosperm. As they developed the feeding area extended inward. By the time, the larvae were fully developed; they had consumed almost the entire endosperm. There are 4 larval instars. Larvae emerged from acorns in November to January by cutting a hole slightly larger than the head capsule, and quickly bury in the soil at varying depths of 10-55 cm. The adults gradually emerge from the soil in the last week of May and continue until third week of June. Oviposition was first recorded on the 10 June and was completed till third week of July. There is only a single generation in a year It causes 5 % total infestation in ban acorn (Kaushal et al,1993).

191.Ban acorn weevil, *Curculio* sp.

Superfamily: Cuculionoidea

Famiy: Curculionidae

Subfamily: Curculioninae

Distribution: N. W. Himalaya (Uttarakhand)

Species of oak infested: *Quercus leucotrichophora.*

Habit: Beetle and larva bore in acorns. Pupates in the soil.
Larva: In 2017, weevil infested acorns were collected from ban oak trees on 22.xii.2017 in Chakrata Forest Division, Dehradun District and life cycle was studied in the lab at FRI, Dehradun. Creamishcoloured larvae measure 5-10 mm.
Pupa: Length of pupal chamber was 20 mm and width 15 mmm. Emergence of weevils took place on 15 & 16.v.2018.
Adult: Brown coloured weevil with grey markings and black rostrum which is half of the body length.
Extent of Damage/Status: Common in Ban oak forests. Causes significant loss in oak regeneration.

(a) Grub

(b) Pupal chamber

(c)Adult (Lateral view)

(d) Adult (Dorsal view)

Fig. 188. Life history stages of *Curculio* sp. on ban oak acorns.

192.*Pagiophloeus malignus*(Marshall Dalla Torre & Schenkling,1932)
Superfamily: Culculionoidea
Famiy: Curculionidae
Subfamily: Curculioninae
Distribution: N.W.Himalayas.6 specimens in NFIC, Dehradun. Rangirum (1828m), Darjeeling, West Bengal collected by J.C.M Gardner on 15.x.1929.
Species of Oak infested: *Quercus* sp. (Beeson,1941).
Host plants: *Pyrus malus & Prunus*

nepalensis (Beeson,1941).
Habit: Beetle and larva bores in the acorns (Mathur & Singh,1959).

Eggs: The pearl-white egg is large for the size of beetle, about 1.25 mm in diameter (Beeson,1941).

Fig. 189. Adult-*Pagiophloeus malignus* (Marshall Dalla Torre & Schenkling,1932)

Larva: It is 12 mm long, bores in the interior of the fruits and damage it considerably (Beeson,1941). According to Gardner (1934), the larva resembles that of Pagiophloeus longiclavis. The length of larva is about 12 mm and width of head is 2.25 mm. Mandibles with two apical teeth. Basal segments of labial palp are transverse. Spiracles are about twice as long as wide. Larva of this species was found in the acorns of Quercus sp. in Darjeeling. Apparently there is no posterior ocellar spot in this larva. The differences in the mandibular structures in the two species of the one genus are remarkable.
Pupa: Pupation takes place inside an attacked fruit which in the initial stage of the attack is externally scarcely distinguishable from a healthy fruit (Beeson,1941).
Beetle : It is brownish-black with a grey patch near apex of the elytra, which feeds on fruits, e.g., apples, acorns of Quercus sp., eating small punctures in them and to oviposits in small excavations along the edges of such patches (Beeson,1941).
Extent of Damage/Status: Data deficient.

193.*Dereodus pollinosus* (Redtenbacher,1848)
Superfamily: Cuculionoidea
Famiy: Curculionidae
Subfamily: Curculioninae
Distribution: North-West India (Beeson,1941); Jubal (H.P.); Suleman Range, Pakistan (Stebbing,1914). [72 specimens are kept in NFIC, Dehradun. Somheswar (1478m), Almora collected by Parker on 22.vi.1923; Nilambur, S. Malabar, Madras collected in 1919; Udhampur, Kashipur,Uttarakhand by D.F.O on 23.vi.1954; Katarmal, Almora by J.C.M Gardner on 19.vii.1929 & Mohan Rau, Shiwalik,Uttar Pradesh by Dr. Cameron on 23.iii.1922].
Species of Oak infested: *Quercus leucotrichophora* (Stebbing,1914; Beeson,1941).
Other host plants: *Calotropis, Euphorbia prolifera, Pyrus malus, Robinia pseudacacia, Shorea robusta, Zizyphus jujuba* (Stebbing, 1914; Beeson,1941).
Habit: Beetle defoliates (Mathur & Singh,1959).

Beetle: Length of beetle is 12 mm to 17 mm, elongate, body is rather thick; male is smaller than female. Mottled-greyish or black in colour, the grayish coloring on living beetles is due to a pubescence. Head is truncate in front; antennae are placed near upper end, a longitudinal median channel down front bifurcating into several offshoots near upper end; sparsely punctate. Prothorax is widest behind, anterior margin is straight, depressed on disk, corrugate and finely punctuate. Scutellum is small. Elytra are wider than thorax, basal outer angles is rounded, sides are straight to posterior coxae, thence sharply constricted to apex; rugose-punctate, the rugosities appearing as transverse ridges laterally. Under-surface is black, covered with the greyish purulescence and rugose. Legs and antennae are black (Stebbing,1914). According to Beeson (1941), it is an elongate, black weevil dusted with yellowish or pinkish scales, length about 10 mm, feeds on the foliage of host trees.

Fig. 190.Adult-*Dereodus pollinosus* (Redtenbacher,1848)

Life History: Towards the end of May,1991, Stebbing found this large weevil engaged in seriously defoliating *Zizyphus* sp. in the Shalu Valley near Piuntra in the North-West Himalaya. In many cases, the small thorny trees were loaded with weevils and were quite leafless under the attack. The weevil was coupling (Stebbing,1914).
Extent of Damage/Status: Data deficient.

194.*Myllocerus setulifer* (Desbrochers,1899)
Superfamily: Cuculionoidea
Famiy: Curculionidae
Subfamily: Curculioninae
Distribution: N.W. Himalaya (Uttarakhand). [32 specimens are kept in NFIC, Dehradun. Dehradun collected by J.C.M Gardner on 27.iii.1924 and G.D. Bhasin on 25.iv.1935 on *Q. dilatata*].
Species of oak infested: *Quercus leucotrichophora, Q. dilatata* (Beeson,1941).
Other host plants: *Dalbergia sissoo, Diospyros embryopteris, Wistaria* sp. (Beeson,1941).
Habit: Beetle defoliates (Mathur & Singh,1959).

Adult: Beetle is yellowish-green; length is 3 mm that appears suddenly in large swarms on a variety of trees and shrubs which causes complete defoliation in a day. Its emergence took place in the month of April (Beeson,1941).

Extent of Damage/Status: Occasional in Ban oak forests. Damage not significant.

Fig. 191.Adult-*Myllocerus setulifer*(Desbrochers,1899)

195.*Episomus lacerta*(Fabricius,1781)
Superfamily: Cuculionoidea
Famiy: Curculionidae
Subfamily: Curculioninae
Synonyms:
Curculio lacerta Fabricius,1781
Episomus nubeculosus Boheman in Schoenherr,1842
Episomus ?avarus Fabricius,1801
Episomus crenatus Guerin in litt Faust,1897

Distribution: India & Indonesia (Sanas& Ramamurthy,2009). [29 specimensare kept in NFIC, FRI, Dehradun. Mukk Baihar Balaghat, Madhya Pradesh collected by B.M. Bhatia on 29.vi.1927; Devaratta North Salem by N.C. Chatterjee on 13.vi.1930; Jawalagiri North Salem Tamilnadu FRI Sandal Insect survey collected on 15.vi.1930; Madras by M.L. Upadhiya on 19.vii.1961].

Species of oak infested: *Quercus leucotrichophora.*

Habit: Grub damages the roots (Venkateshan and Geetha,2003). Beetle defoliates.Recorded infesting ban oak plantation of New Forest,FRI, Dehradun on 15.v.2018.

Other host plants:*Acacia cyanophylla, Dalbergia paniculata, Erythrina indica* and *Tectona grandis*(Beeson,1941).

Eggs: Eggs are laid in a batch on the leaf which is folded over as a protection and gummed in position by a sticky secretion (Beeson,1941).

Larva: The larvae on hatching gnaw through the leaf and drop to the ground and entering the soil feed on the rootlets of plants (Beeson,1941).

(a) Adult (Dorsal view)

(b) Adult

Fig. 192.Adult-*Episomus lacerta*(Fabricius,1781)

Adult: The weevil has the abdomen much swollen and elytra convex, dirty brown above and lighter coloured below, length 10 mm (Beeson,1941). According to Sanas& Ramamurthy (2009), colour of weevil varies from greyish brown above, pale brown beneath, prothorax with darker lateral stripe, and rarely two broad whitish dorsal stripes continued on base of elytra. Elytra are with not that well defined broad oblique paler stripe behind middle followed by a large darker patch on declivity. Small pale round, slightly raised spots present: one on top of declivity at third interval, and on interval seven beyond first spot and third at apex of fifth interval. Head is 1.49x as long as rostrum, 2.63x as long as apical emargination, base 1.02x as broad as rostrum, 1.63x as much as distance between scrobes and 2.37x as broad as apical emargination. Central furrow is deep and narrow, 1.43x as long as apical emargination. Rostrum is 1.05x as broad as long, slightly dilated towards apex, 2.04x as long as distance between base of rostrum and base of head, dorsal costae distinctly sulcate. Eyes are 1.9x as long as broad from above and 1.35x as long as broad from sides; distance between anterior margin 1.08x as distance between middle of eyes; distance between posterior margins is 1.19x as that between middle and 1.1x as that between anterior margins; space between eyes at middle 1.31x as distance between scrobes. Antennae are with scape broader at middle and narrowing at apex, 2.32x as long as club. Funicle is 1.67x as long as scape and 3.88x times as long as club, first segment longest, 1.33x as long as second, 1.66x as long as third, 1.81x as long as fourth and sixth, 2x as fifth, 1.11x as seventh. Fourth and sixth segments are equal in terms of breadth, seventh segment broadest of all, dilated anteriorly, 1.36 x as broad as first and second, 1.25x as broad as third, fourth, fifth and sixth; first and second equally broad and third to sixth equally broad. Club is 1.38x as long and 1.13x as broad as seventh segment of funicle, 1.38x as long as first segment of funicle, third longest, 1.14x as long as first, 1.33x as long as second and 2x as long as fourth; in terms of breadth, second broadest, 1.06x as broad as first, 1.21x as third, 2.43x as fourth. Prothorax is plicate, subparallel from base to middle and narrow at apex, 1.03x as long as head, 1.54 x as long as and 1.55x as broad as rostrum, 1.06x broader than long at middle. Elytra is without humeral angle, broadly ovate, shoulders rounded, not acuminate at apex.

Extent of Damage/Status: Occasional in Ban oak forests. Damage not significant.

196.*Stenoscelis himalayensis* (Stebbing,1914).
Superfamily: Cuculionoidea
Famiy: Curculionidae
Subfamily: Curculioninae
Synonym: *Brachytemmus himalayensis*
Distribution: This species was originally described as a *Hylastes* and later transferred to *Brachytemmus*. [43 specimens are kept in NFIC, Dehradun. Deoban (2743m), Chakrata collected by Dr. S. K. Pillai on 6.iv.1923; Mundali, Chakrata by J.C.M. Gardner on 13.iv.1933; Patharia, Almora by J.C.M. Gardner on 20.v.1937; Kulu, Himachal Pradesh by H.G. Champion on 31.v.1932; Kathian, Jaunsar,Uttarakhand by E.P. Stebbing in April, 1902 & in Tehri Garhwal by E.P. Stebbing on 14.vi.1902].
Species of Oak infested: *Quercus dilatata* (Beeson,1941).
Host plants: *Abies pindrow, Aesculus indica, Alnus nitida, Betula utilis, Cedrus deodara, Picea smithiana, Pinus excelsa, P. roxburghii* (Beeson,1941).

Fig.193.Adult-Stenoscelis himalayensis(Stebbing,1914).

Habit: Larva bores in the deadwood (Mathur & Singh,1959).
Larva: According to Gardner (1934), the length of larva is about 4 mm. Labrum is sub circular, the posterior margin is very slightly extended into clypeal zone. Epipharnyx is with two median sub apical setae transversely arranged. Mandibles are with only one apical tooth. Labial is trident faint but apparently complete. Thoracic spiracle are with circular peritreme and paired air-tubes; abdominal spiracles with only one air-tube. The larval tunnels are constructed from egg-pits in the mother tunnel.
Beetle: It is a black cylindrical beetle having length 3-3.5 mm (Beeson,1941). Stebbing (1914) described this beetle as *Hylastes himalayensis*. According to him, the beetle is elongate, shinning, dark red-brown to black punctuate. The third tarsal joint is wider than the preceding joints. Head is smooth, with scattered rather large punctures on vertex; a transverse median depression below vertex not reaching the sides; rostrum somewhat constricted, widest at base, not cainate; front roughly rugose-punctate, the punctures finer medianly and the rugosities more ptominent on the rostrum. Prothorax is constricted at apex, the sides angulate and sinuate. Elytra is wider than thorax and twice as long, widest at apex, sides very slightly rounded to basal fourth and thence slightly sinuare to base; striate-punctate, the striae prominent and punctured, the interstics rugose with short

hairs. Under surface is black, covered with scattered fine white hairs. Middle coxae are fairly wide apart. Legs are dark reddish-black in colour. Antennae are yellow and tibiae are red brown.

Emergence period: Beetle appears on the wing about the second week in the May at the higher altitudes at which it lives and is to be found in the trees at various elevations up to the middle of June. Another generation makes its appearance in Sept-Oct (Stebbing,1914).

Life History: The male and female pair in the tunnel inside the tree and male appears to help the female in boring a portion at least of the long gallery into the wood. It is not improbable that the first portion of the tunnel as far as the pairing spot inside the tree is the work of the male beetle. The female continue tunneling into the heart-wood after fertilization. In pairing the male mounts on the back of the female. The beetle is apparently a wood borer only and enters the trees when it is dying or nearly dead (Stebbing,1914).

Extent of Damage/Status: Data deficient.

197.*Phaenomerus sundevalli* (Boheman,1836)
Superfamily: Cuculionoidea
Famiy: Curculionidae
Subfamily: Curculioninae

Fig. 194.Adult-*Phaenomerus sundevalli* (Boheman,1836)

Distribution: India, Myanmar [80 specimens are kept in NFIC, Dehradun. Digboi Reserve Forest, Lakhimpur Assam by collected by C.F.C Beeson on 6.iv.1936; Thano Range, Dehradun by C.F.C Beeson on 04.v.1920; Dharamsala, Kangra, Himachal Pradesh by DFO on 23.iv.1921; Mawahankanda, Ratanpura, Srilanka by Gauri Dutt on 29.xii.1934; Sunderban, West Bengal by C.F.C Beeson on 21.v.1921; Kannoth range, Malabar Chennai by R.O on 07.v.1921; Inthabaung Res. Insein Div., Myanmar by C.F.C Beeson on 02.v.1922].

Species of Oak Infested: *Quercus* sp. (Beeson,1941).

Host plants: *Albizzia stipulata, Bauhinia retusa, Buchanania latifolia, Butea frondosa, Castanopsis tribuloides, Dalbergia sisoo, Dipterocarpus pilosus, D. turbinatus, Doona zeylanica, Ehretia acuminata, Ficus asperrima, F. glomerata, Heritiera fomes. Machilus odoratissima, Mallotus albus, Mangifera indica, Mesua ferrea, Shorea robusta, S. assamica, Swietenia mahagoni, Terminalia belerica, T. tomentosa* (Beeson,1941).

Habit: Larva bores in the deadwood (Mathur & Singh,1959).

Beetle: The life cycle appears to be annual but the emergence period is prolonged sometime extending for 12 months, which thus require an extreme larval life of nearly 2 years. In all the above listed host trees the presence of P. sundevalli is associated with the previous arrival of shot hole and pinhole borers of numerous species (Beeson,1941).
Extent of Damage/Status: Data deficient.

198.*Crossotarsus fairmairei* (Chapuis,1865)
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae
Distribution: Himalayas & Northeast. Nepal & Bhutan (Roger & Liu,2018). [35 specimens in NFIC, Dehradun. Jaunsar, North-West Himalaya collected by Stebbing,1914; Mundali (2561m), Chakrata by J.C.M Gardner on 30.v.1934; Deoban (2743 m), Chakrata by Dr. S.K. Pillai on 26.iv.1923 on Q. semecarpifolia; Konain (2392 m) by J.C.M Gardner on 26.v.1934; Sitapahar, Chittagong, Bangladesh by C.F.C Beeson on 09.v.1925; Jubbal (1828 m), Shimla, Himachal Pradesh by C.F.C Beeson on 17.v.1924.
Species of oak infested: *Quercus leucotrichophora, Q. floribunda* and *Q. semecarpifolia,* (Beeson,1941).
Other Host plants: *Abies pindrow, Acer caesium, Cedrus deodara, Juglans regia, Picea morinda, Pinus excelsa, Prunus pardus* (Beeson,1941).

Fig. 195.Adult-*Crossotarsus fairmairei*(Chapuis,1865)

Habit: Beetle bores in newly felled or fallen wood (Mathur & Singh,1959).
Adult: The beetle is elongate, parallel, large and stout and length of beetle is 5.5 mm. It is moderately shining, ferruginous brown, darker on head and apical half of elytra. Head is smooth and finely punctuate on front more coarsely so on vertex. Prothorax is squarish, strongly and finely punctuate with scattered larger punctures, a narrow longitudinal median channel on basal third; elytra is punctuate-striate, striae are most prominent basally, suturally and apically, the intervals shinning; the apices ending in a small curved caliper; the surface is furrowed towards the apex and rugose. Abdominal segments are densely punctuated; the first armed with a long spine directed backwards (Stebbing,1914). According to Beeson (1937), female beetle is similar to male except more flattened just below the vertex. Elytra is feebly towards base; declivity with the striae less impressed and intervals only weakly aciculate punctuate, and all obsolete

before reaching the terminal depression; 3rd interval is nearly as twice as 4th and subsequent intervals are uniseriate; terminal depression is scarcely, lateral angle are broadly rounded; externo-process is shorter in male. Abdominal sternite is convex, reticulate, punctuate; shorter spines are on the 1st sternite; last sternite feebly tumescent in middle where it is infuscate, matte, sparsely punctuate. Fortibia on the external face for the greater part granulate with not more than 2 complete oblique carinae apically. This species is closely allied to C. wimoti from which it is differs by its larger size, more quadrate and relatively shorter pronotum and seriate arrangement of the hairs on the declivity. In the males, the 3rd interval is not so much widened on the declivity being less than twice as the 4th. In the females, the height of terminal depression along the sucture is relatively less than in *C. wilmoti.*

Extent of Damage/Status: Data Deficient. Widespread.

199.*Crossotarsus lobacanthurus* (Beeson,1941)
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae
Synonym: *Platypus lobacanthus*Schedl.
Distribution: India (Uttarakhand), Laos, Thailand.(http://treatment.plazi.org/id/03CB87C4FFA5FFF0FF2C5F59FEEF1DF2).
Species of oak infested: *Q. leucotrichophora* (Mathur & Singh,1959).
Habit: Beetle bores in newly felled or fallen wood (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

200.*Crossotarsus wilmoti* (Stebbing,1911)
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae

Fig. 196.Adult-*Crossotarsus wilmoti* (Stebbing,1911)

Distribution: N.W. Himalaya Himalaya [19 specimens are kept in NFIC, Dehradun. Mussoorie collected by C.F.C. Beeson on 05.iii.1927 on *Quercus* sp.; Kanasar (1676 m), Chakrata by Dr. S.K Pillai on 26.iv.1923; Putshai (1828 m), Lolab valley, Kashmir by C.F.C Beeson on 23.v.1928].
Species of oak infested: *Quercus leucotrichophora* (Stebbing,1914).
Habit: Beetle bores in newly felled or fallen wood(Mathur & Singh,1959). Emergence period of this beetle took place in breeding cages during July to August in Dehradun from logs brought from Deoban, Chakrata, Uttarakhand (Singh,2011). Again emergence of these beetles took place on 28.ix. 2020 in breeding cages at FRI, Dehradun from the borer infested kharsu logs which were collected during June 2020 from Deoban, Chakrata Forest

Divison,Uttarakhand.

Eggs: The eggs are laid at the bottom of the tunnel (Stebbing,1914).

Larva: It feeds on fungus growths with which the walls of the tunnel are discolored. The tunnels are as much as 23-30.5mm in length (Stebbing,1914). Gardner (1932) described the Crossotarsus sp. larva. According to him, labrum with basal width distinctly greater than length, trapeizodal, gradually widened posteriorly; the disc with one pair of setae; coinciding with the apex of each labral rod is narrow and rather deep incision of anterior margin; the median portion of anterior margin with six sockets, each with number of anterior directed setae; immediately lateral to each incision is a socket with one or more rather large setae and lateral to that are two small unisetiderous sockets. Pronotum is with small plates with each side which posteriorly has a pattern of fine raised brown line.

Adult: The beetle is dark red, thorax being entirely of black colour, as are the legs, with the exception of the tarsi, which are lighter brown. Beetle is 5 mm to 5.4 mm in length. The front of the head is only very finely pitted in the male, but strongly punctured in the female. The thorax is strongly constricted at the sides behind the middle and has no median line. The apical margin of elytra is concave in male and in female truncate with the outer edges produced into teeth curving inwards. The abdomen is concave behind in the female. The beetle appears to prefer trees which are dead but not yet absolutely dry, and it bores down through the thickest bark into the heartwood, making circular tunnels, the sawdust eaten out being ejected at the surface of the entrance hole. A tree attacked can be easily detected by the presence of small heaps of sawdust piled on the outside bark. Both male and female beetles are to be found in the tunnel, and pairing probably takes place inside. The female insect appears to live for some time after egg-lying is completed, finally dying in the mouth of the tunnel and so blocking it to predaceous enemies (Stebbing,1914). According to Gardner (1937), the beetle is reddish to dark brown, elytra with discoidal portion lighter brown and apex infuscate. Males from front are similar in sculpture to that of C. *fairmairei*, flat smooth behind epistome with a few large and small umblicate punctures drawn out in acutely pointed sulci; vertex with shinning smooth areas alternating with coarse umblicate punctuation.

Life history: The insect is to be found on the wings at the commencement of June at elevation of 1828 m. It tunnels into the oak trees for egg laying purposes. The beetle appears to prefer trees which are dead but not yet absolutely dry, and it bores down through the thickest bark into the heartwood, making circular tunnels, the sawdust eaten out being ejected at the surface of the entrance hole (Stebbing,1914).

Damage committed in the forest: Damage is done entirely to the timber of the tree, since small portion of bast platypid beetles eat through on their way to the heartwood is a negligible quantity. When plentiful the beetles entirely ruin the wood of a tree for timber purpose and greatly reduce the value of fuel stacks (Stebbing,1914).

Protection and Remedies: When the wood is badly attacked by these wood boring beetles the only safe method of destroying them and endeavoring to lessen their numbers in an area is to burn the whole of infested timber and fuel. The actual hole or tunnel in the wood is of small diameter and therefore in itself of no great consequences. The damage done however, when the beetles are numerous is economically very similar to that of the *Xylebori* (Stebbing,1914).

Extent of Damage/Status: Common. Damage to timber is significant when population is high.

201.*Diapus/Diacavus impressus* (Janson,1893)
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae
Distribution: N.W.Himalaya (Stebbing, 1914) [55 specimens in NFIC, Dehradun. Mundali (2562m), Chakrata collected by J.C.M Gardner on 29.v.1934; Bhali (1524m), Bashahr State by Parker on 15.vi.1928; Antigad (1982 m), Chachpur, Chakrata by C.F.C Beeson on 02.vi.1924; Deoban (2744 m), Chakrata by C.F.C Beeson on 16.vi.1923].
Species of oak infested: *Quercus leucotrichophora* (Stebbing,1914); *Q. incana, Q. semecarpifolia*(Beeson,1941).
Other host plants: *Alnus nepalensis* (Beeson,1941).

Fig. 197. Adult-*Diapus / Diacavus impressus*(Janson,1893)

Habit: Beetle bores in newly felled or fallen wood (Mathur & Singh,1959).
Larva: It is white, legless and straight with a light orange-yellow head and black mandibles (Stebbing,1914).
Adult: Elongated, cylindrical, with a vertical head, broader than thorax, weak legs and length of beetle is 3.5 mm to 5 mm. Red-brown, shining, basal margin of the thorax and elytra are brownish yellow, apical posterior of the latter are red-brown. Legs and antennae are pale yellow in colour. Thorax is oblong, strongly emarginated at sides before the middle, base finely and closely punctured and with a slight median line. Elytra are punctuate-striate, the second striae from sucture and the outer marginal one broader and more strongly punctured. Under surface is light orange-yellow between the second and third pairs of legs, brown anteriorly to this and dark brown to black on abdominal segments which are very short. Abdomen is densely pubescent at apex in male whereas in female it is concave and regulose (Stebbing,1914). According to Gardner (1932), the larva of *Diapus* sp. differs in being less transverse, the disc has two pairs of setae; anterior margin entire with median rows of four setiferous sockets; single setae near apex of each labrum rod and between that of middle lateral margin has three small setae. The protuberant part of epipharnyx is laterally with very fine almost longitudinal striae which break up into granules or minute teeth apically. Pronotum has transverse brownish roughened zone on each side.The only specimen of this insect taken appears to have been sent to the Indian Museum, Calcutta from Deoban, Jaunsar, in December,1891. The insects were reported as tunneling into ban-oak stumps, but nothing appears to be known about them (Stebbing,1914).
Extent of Damage/Status: Data Deficient.

202.*Diapus capitalis*(Beeson,1941).
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae
Distribution: Darjeeling, Eastern Himalaya & N.W. Himalaya (Stebbing,1914).
Species of oak infested: *Quercus floribunda* (Mathur & Singh,1959); *Q.lamellosa* (Beeson,1941).
Habit: Beetle bores in newly felled or fallen wood (Mathur & Singh,1959).
Adult: Beetle is small, elongate, narrow and shining. The length of beetle is 2.7 mm to 3 mm (Beeson,1941). Head is black, thorax is dark ferruginous brown; elytra yellow, base and apex brown; under surface is brown, legs are yellow; antennae yellow, the scape edged with a conspicuous fringe or brush of yellow-brown hairs forming a prominent bunch on either side of the front of the head. Head is concave in front, with coarse punctures and two deep impressions on either side of median line extending half-way to vertex; two tuff of yellow hair just above the epistoma turn slightly upwards, four other tufts arising close behind. Prothorax is oblong, deeply indented at sides with a slight median line from base to centre, basal half punctuate, rest smooth. Elytra are finely striate-punctate and the apices are separately rounded (Stebbing,1914).
Life History: In July, 1901 Mr. C.G. Rogers obtained a few of these beetles from the wood of a railway sleepers of *Quercus lamellosa* cut in the Darjeeling forests. The insect evidently oviposits in the timber of this tree, but nothing further is at present known about its life history(Stebbing,1914).
Extent of Damage/Status: Data Deficient.

203.*Diapus aculeatus*(Blanford,1894)
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae
Distribution: India, Bhutan, Vietnam, Japan and Taiwan\(https://taieol.tw/pages/81908).
Species of oak infested: *Quercus leucotrichophora & Q. semecarpifolia* (Mathur & Singh,1959).
Habit: Beetle bores in newly felled or fallen wood(Mathur & Singh,1959).

Fig. 198.Adult-*Diapus aculeatus*(Blanford,1894)

Adult:Male body length is 2.8-3mm, about 4 times the body width; body color is brown to dark brown and the end of the wing sheath is reddish brown. The length of the pronotum is about 1.2 times the width and it is hairless and shiny.The midline extends from the base toward the front and approaches the center. The thoracic dorsal plate has two three rows of cysts arranged laterally. The surface of the wing sheath is smooth. Only the first hair column is depressed from the base. The ridges between the third, fifth and seventh

hair columns form thorn-like protrusions at the ends of the wing sheaths. The ridges between the seventh hair columns are short. The fourth section has a small tooth on each side of the posterior edge of the abdominal web.

Female body length is 2.9-3.1mm, about 4 times the body width, body color is brown to dark brown, and the end of the body is darker. Young females have long hairs curved inwardly on the outer edges of the upper lip. The length of the pronotum is about 1.2 times the width and it is hairless and shiny. The midline extends from the base toward the front and approaches the center. The thoracic dorsal plate has two three rows of cysts arranged laterally. The surface of the wing sheath is smooth, only the first hair column is sunken, and the trailing edge is arc-shaped (https://taieol.tw/pages/81908).

Extent of Damage/Status: Data Deficient.

204.*Diapus himalayensis*(Beeson,1941)
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae

Fig. 199.Adult-*Diapus himalayensis*(Beeson,1941)

Distribution: N.W. Himalaya. [60 specimens are kept in NFIC, FRI, Dehradun. Mussoorie collected by C.F.C Beeson on 20.viii.1927; Almora by J.C.M Gardner on 08.vii.1937].

Species of oak infested: *Quercus leucotrichophora* & *Q. semecarpifolia* (Mathur & Singh,1959).

Other host plants: *Alnus nitida* (Beeson,1941).

Habit: Beetle bores in newly felled or fallen wood(Mathur & Singh,1959).

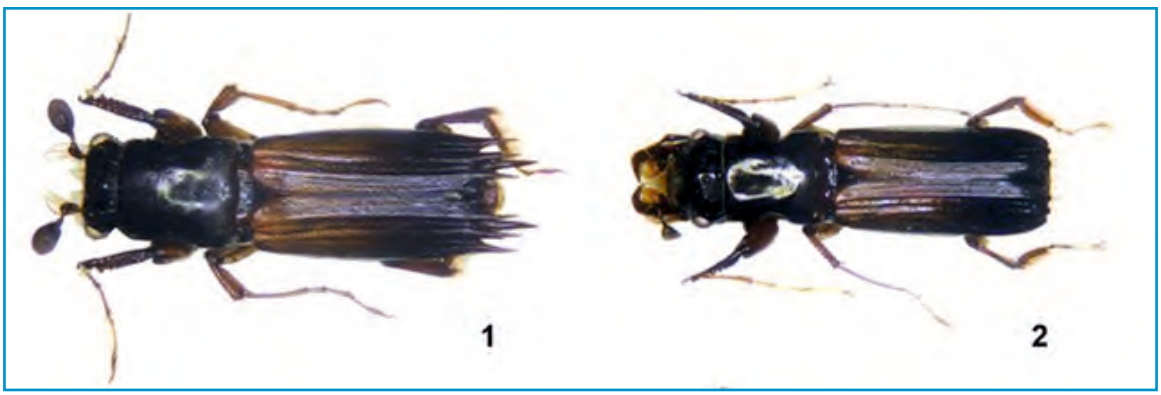
Extent of Damage/Status: Data deficient.

205.*Diapus quadrispinatus* (Chapuis,1865)
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae

Distribution: Darjeeling, West Bengal (Gardner,1932). Nepal & Bhutan, India (Uttarakhand) & Myanmar (Roger & Liu,2018). [1 specimen in NFIC, Dehradun. Antigad (1981 m), Chachpur, Chakrata collected by C.F.C Beeson on 02.vi.1924].

Habit: Larva bores in the newly felled or fallen wood (Mathur and Singh,1959).

Species of Oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959).



(a) Male **(b) Female**

[Source: (https://www.researchgate.net/publication/328900655_A_synopsis_of_the_powder-post_beetles_of_the_Himalayas_with_a_key_to_the_genera_Coleoptera_Bostrichidae_In_Hartmann_M_Barclay_MVL_Weipert_J_Eds_Biodiversitat_und_Naturausstattung_im_Himalaya_VI_Verein).Authors: Rodger & Liu, 2018]

Fig. 200.Adults-*Diapus quadrispinatus*(Chapuis,1865)

Other host plants: *Symplocos theaefolia* (Gardner,1932). Polyphagus: Betulaceae, Fagaceae, Lauraceae, Pinaceae, Rosaceae (Roger & Liu,2018).

Larva: According to Gardner (1932), the length of larva is 8 mm and the spiracles of the six, seven and eight abdominal segments are distinctly larger than the first five. Fifth spiracle is very small. The caudal face has a very distinct brown corneous rounded tubercle medially near ventral margin. The first, third and fifth lateral sub-divisions of an abdominal segments have smoother protuberance.

Extent of Damage/Status: Data Deficient.

206.*Platypus abruptus*(Sampson,1923)
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae
Distribution: N.W. Himalaya.
Species of oak infested: *Q. leucotrichophora* (Mathur & Singh,1959).
Habit: Beetle bores in newly felled or fallen wood(Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

207.*Platypus sexualis*(Beeson,1937).
Superfamily: Curculionidea
Family:Curculionidae
Subfamily: Platypodidae
Distribution: N.W.Himalaya [Mundali (1828 m), Chakrata Forest Division Uttarakhand collected by J.C.M Gardner on 29.v.1934].
Species of oak infested: *Quercus floribunda* (Mathur & Singh,1959).
Habit: Beetle bores in newly felled or fallen wood (Mathur & Singh,1959).
Beetle: Beeson (1937) described this as Crossotarsus sexualis. According to him, length of male C. sexualis is 5 mm; front-plano is convex, reticulate-punctate, the interstices elongate, becoming weaker towards the vertex and replaced by small punctures; impunctate on the either side of the impressed median line, depressed behind middle of epistome. Pronotum is 1.1 times as long as wide with scattered fine punctures, some larger one along with apical border; median line incised flanked by 3 large circular pores immediately anterior to which is cluster of minute pores irregular in size.

Elytra is 2.2 times as long as pronotum with interspaces and striae of the same pattern as in *sexfenestratus*; on the declivity the 1stb interspace, which is linear throughout, joins with 2 in a sharp projecting spines, 3rd is shorter than 2nd and acute ended, the rest converging into truncate narrow-ended projection, considerably longer than the 2nd interspace. Its lower corner is acute; terminal depression is oblique, surface is very uneven, coarsely rugose, an apical margin nearly straight, at its outer corner and separated from the lateral process is a large obtuse flat tooth directed downwards and backwards. Posterior coxa with ventral face continuously curved on its inner and posterior edge and ended in acute external acute angle.

Female is 5 mm in length, similar from front with male. The reticulate sculpture is weaker and nor extended so far upwards leaving a finally punctuate zone below the summit. Smooth space near median line is obsolete. Pronotum is similar, pore groups immediately anterior to which are a cluster of minute pores. Elytra, declivity with scrabate area of the convexity bounded by shallow sulcus at the vertical terminal depression, the latter granulate-rugose and its apical margin is straight (Beeson,1937).

Extent of Damage/Status: Data Deficient.

208.*Scolytoplatypus raja* (Blanford,1893)

Superfamily: Curculionidae

Family: Curculionidae

Subfamily: Scolytinae

Distribution:N.W.Himalaya. Nepal, China (Xizang), India (Assam, Himachal Pradesh, Uttarakhand, W. Bengal), Kashmir, Pakistan, Taiwan, Thailand, Vietnam, West Malaysia (Roger & Liu,2018). [152 specimens in NFIC, Dehradun. Dhauli Ganga, Almora, Uttarakhand collected by S.N.Parker on 21.vi.1923; Makinnon Park, Mussoorie, Dehradun, Uttarakhand by C.F.C Beeson on 04.ix.1927; Almora, Uttarakhand by H.G.Champion on 10.iv.1917; Lepchajagal (2133 m), Darjeeling, West Bengal by J.C.M Gardner on 11.ix.1929; Konanin (2392 m), Chakrata by J.C.M Gardner on 26.v.1934; Debrepani (1828 m), Darjeeling, West Bengal by J.C.M Gardner on 14.ix.1929; Bajwar, Almora by J.C.M Gardner on 15.vi.1937; Pathari, Almora by J.C.M Gardner on 10.v.1937; Samsingh (548 m), Kalimpong, West Bengal by Mohan Lal in 1933; Batote (1676 m), Udampur Div., Kashmir by C.F.C. Beeson on 06.v.1928].

Species of Oak Infested: *Quercus leucotrichophora, Q. lamellosa* (Stebbing,1914); *Quercus leucotrichophora* (Beeson,1941).

Other Host plants : *Abies webbiana* (Stebbing,1914), *Acacia decurrens, Cedrus deodara, Cornus macrophylla, Engelhardita spicata, Litsea elongata, Macaranga denticulata, Machilus odoratissima, Picea smithiana, Prunus nepalensis, Symplocos thaefolia* (Beeson,1941).

Habit: Beetle bores in freshly felled or fallen wood (Mathur & Singh,1959).

Beetle: Stebbing (1914), described this species as *S. himalayensis* whereas Beeson (1941) described this as *S. raja*. According to Stebbing (1914), male is dull, head and thorax are black, elytra is dul,l rufous brown apically and having length upto 4 mm. Head with front deeply concave to eyes very densely, tinely and uniformly punctuate; antennal club pubescent rest almost hairless. Thorax with apical margin evenly rounded with median cleft, sides rounded and produced outwards medinaly. Elytra is with basal margin raised and bisinuate; striate deeply impressed, the two inner ones obsolete towards basal margin, the third not quite reaching the margin, the surface irregular with few scattered punctures, the interstices broad, finely reticulate with irregularly transverse punctures, strongest

apically. Apical declivity is light reddish brown with a very short sparse yellow pubescence and under surface is black. Whereas in female, the length is 3.5 mm; head and elytra are shinning, red-brown, and thorax black and dull. Head is globose, shinning and smooth on vertex, dull and tinely and closely punctuate on front and sides; a slight brush of hairs over mandibles. The median line is less prominent, not extending beyond the median pore, which is moderate in size and filled with a short golden tuft of pubescence, the punctures similar to disk below pore but above it and laterally they merge into a fine dense reticulation. Elytra is smooth, shinning with interstices similar throughout, broad, rather flat, uniformly and finely reticulate with a few scattered punctures (Stebbing,1914).

Fig. 201.Adult-*Scolytoplatypus raja*(Blanford,1893)

Life history: The beetle matures and leaves the tree in June at high elevation (2438 m and over). Stebbing was fortunate enough to discover it infesting a blown silver fir pole which was still partly green. A few larva and pupae were taken but the insect was mostly in mature beetle stage and some of the generation had already left the tree. The male beetle tunnel into the tree through the bark and on reaching the sapwood eats out the short gallery gallery in the bast and wood usually completely in the latter. This is the pairing chamber and female enters to him here and fertilized. After fertilization female tunnel downs into the sapwood at an angle for about an inch and then eat out a straight gallery parallel to the long axis of the tree. From this main gallery she gnaws out little offshoot tunnel at intervals on either side from one-fourth to one-third of an inch in length. These little offshoot tunnels are usually from six to eight in number and are made alternately on either side. In these the eggs are laid. On hatching out, the grub feed upon the sap walls of the tunnel or on fungus outgrowths growing there. By the time the grubs are mature the walls of the offshoot tunnels are deep black in colour to the depth on one-twentieth of an inch. When full feed, the grub pupate in situ in offshoot tunnels, there being at least two eggs laid in the each of the latter. On maturing, the beetle leaves the tree by crawling out of the offshoot tunnel into main gallery and up this to the pairing chamber and then burrow out through the bark (Stebbing,1914).

Damage to Tree: This scolytid is one of the most injurious insect infesting the wood of silver fir. The tree appears to be singularly free from a number of bark and wood beetles which infest the other conifers of the Himalayan region top so serious an extent. To the forester the importance and interest of the genus lies in the fact that it forms a connecting link between Scolytidae and Platypoidae and that its habits are wood boring, it thus resembling the *Xylobori* and platypids in this respect (Stebbing,1914).

Extent of Damage/Status: Data Deficient.

209.*Scolytoplatypus kunala* (Strohmeyer,1908)
Superfamily: Curculionidae
Family: Curculionidae
Subfamily: Scolytinae

Fig. 202.Adult-*Scolytoplatypus kunala* (Strohmeyer,1908)

Distribution: *S. kunala*, were recorded only in Eastern Himalaya, Kashmir Province and Western Himalaya (Michail& Alexander,2010) [143 specimens are kept in NFIC, Dehradun. Mundali, Chakrata collected by B.M Bhatia on 19.vi.1924; Deoban, Chakrata (2743 m) by S. K. Pillai on 06.vi.1924; Tharoch (3200m) Shimla, Himachal Pradesh by C.F.C Beeson on 28.v.1924; Dhauliganga, Almora by R.N. Parker on 21.vii.1923; Afan (1676 m), Lolab valley, Kashmir by C.F.C Beeson on 21.v.1928; Gulmarg, Jhelum valley, Kashmir by C.F.C Beeson on 27.v.1928].

Species of oak infested: *Quercus leucotrichophora, Q. floribunda* and *Q. semecarpifolia* (Mathur & Singh,1959).

Other host plants: *Abies pindrow, Acer caesium, Cedrus deodara, Hedera helix, Parrottia Jacquemontiana, Picea smithiana, Prunus padus, Pyrus lanata* and *Taxus baccata* (Beeson,1941).

Habit: Beetle bores in freshly felled or fallen wood (Mathur & Singh,1959).

Adult: Malelength is 2.7 mm, body stout and twice long as wide. General colour is pale brown, elytra with only slightly darkened suture, lateral margins and apices; each elytron with a large yellow spot extending from anterior margin up to two thirds of elytral length. Legs and antennae are yellowish-brown. Elytra are 1.38 times as long as wide, twice as long as pronotum and clearly widened posteriorly. Elytral surface is minutely punctured, shining and without signs of reticulation. Elytral punctures are not organized in rows and interstriae invisible besides at declivity where all interstriae with exception of the first one are finely carinate. First declivital interstriae at declivity are broadly elevated, not carinate and bear 9-10 tubercles of median size, towards elytral apex evidently divergent. Underside of beetle is uniformly light yellow. Fourth and fifth abdominal sterna are with abundant long, yellowish hair-like setae protruding are beyond abdominal apex (Michail& Alexander,2010). Femalelength is 2.8-2.96 mm, body stout, 2.15 times as long as wide. Body is pale brown, elytral colour pattern essentially as in male and body surface faintly shining. Head is brown and darker as compared to other body parts. Frons is faintly convex and dull. Frontal surface is gently sharpened. Elytra are light brown and faintly shining and 1.4 times as

long as wide. Elytral base are 1.2 times as wide as pronotum base. Elytral surface is covered with microscopic light hair-like setae. Abdomen is light brown coloured and legs are light yellow in colour (Michail& Alexander,2010).

According to Maiti&Saha (2009), malebody is of medium size, brownish yellow in colour, head is dark, body length is 2.88 mm; frons are weakly concave, rugose, dull with fine granules all through. Postero-lateral margin has tuft of long hairs, tips are touching each other; epistomal margin strongly chitinized, almost straight; eyes entire and not emarginate. Pronotum is broader than long, convex, devoid of any distinct summit and asperities, dorsal surface somewhat smooth with sparse minute pilosity. Elytra with anterior portion are yellowish in colour and posterior one are chestnut brown in colour; striae & interstriae hardly distinguishable but with minute granules; interstriae at the commencement of declivity with longitudinal ridges marked with fine granules; declivity commencing on posterior fourth, surface convex; striae 1 and 2 somewhat visible, rest confused; inter striae sutural and adjurning to well marked, lined with few granules; elytral apex is with distinct carina. Female is very similar to male except frons are strongly convex with a feeble longitudinal median groove, either side of which minutely punctuate with sparse minute hairs; commencement of declivity of elytra devoid of any distinct longitudinal ridge's and striae and interstria is not well marked but with few minute and scattered granules (Maiti& Saha,2009).

Extent of Damage/Status: Data Deficient.

210.Bark Beetle, *Scolytoplatypus pubescens* (Hagedorn,1914).
Superfamily: Curculionidae
Family: Curculionidae
Subfamily: Scolytinae

Distribution: N.W.Himalayas and N.E.India. [106 specimens in NFIC, Dehradun. Kalimpong, West Bengal collected by C.F.C Beeson on 08.ii.1934; Shillong (1828 m), Assam by C.F.C Beeson on 22.v.1925; Lopchu (1524 m), Darjeeling, West Bengal by J.C.M Gardner on 14.xi.1929; Rangirum (1828 m), Darjeeling, West Bengal by J.C.M Gardner on 04.ix.1929; Sivakhola (1066 m), Kurseong, West Bengal by C.F.C Beeson on 22.vii.1935; Shillong (1828 m), Assam by C.F.C Beeson on 22.v.1925; Patharia, Almora, Uttarakhand by J.C.M Gardner on 10.v.1937]. Nepal, India (Assam, Uttarakhand, W. Bengal), Myanmar, Taiwan, Thailand, Vietnam. The species also occurs in China (Sichuan, Yunnan) (Roger & Liu,2018).

Species of Oak infested: *Quercus leucotrichophora* (Beeson,1941).

Other host plants: *Acer campbelli, Alnus nepalnesis, Amoora wallichii, Engelhardtia spicata, Evodia fraxinifolia, Litsea elongata, Prunus nepalensis*(Beeson,1941). The species is known to attack at least 12 different families of trees (Beaver & Gebhardt 2006).

Habit: Beetle bores in freshly felled or fallen wood (Mathur & Singh,1959).

Larva: The larva is 5 mm in length (Beeson,1941). According to Gardner (1934), larval body is rather strongly curved, stout, especially in thoracic area, the pedal lobes are swollen and proturbent, narrowing weakly to the bluntly rounded posterior extremity. Large head capsule, colourless and the frons anterior very faintly tinged with brown and slightly longer than wide; the sides strongly curved anteriorly, slightly narrowed, rounded posteriorly and 1.12 mm width. Frontal sucture are vague. Labrum is sub rectangular, about three-fifth as long as wide, the anterior margin is trilobed. Epipharynx is with two long convergent rods

which fuse into an acute point posteriorly; three setae near apex of each rod; two pair of anterio-median setae, one apical, one sub apical and two pairs between the rods. Mandibles are brown, black at apex with blunt apical tooth separated by mark indentation from an oblique chisel-shaped edge. Labial palp are stout, basal segments are strongly transverse, apical segment is slightly longer than wide; labial sclerome is represented by two parallel brown line rinning back a short distance, one from each palp; there are no brown line in between them. Pronotum is strongly transverse and unpigmented. Abdominal terga have two sub-divisions and the dividing line not very distinct. Spiracles are annular, without paired marginal air tubes; thoracic spiracles are broadly elliptical, nearly as wide as labrum and abdominal spiracles are circular. The greater part of the body, skin, which is very soft and delicate is densely covered with extremely small skin points; the pedal lobes are smooth. One very small larva, probably of first stage, was found in this which the apical tooth of the mandible is sharper and indentation separating it from chisel edge is deeper than in mature larva. The body is globular and abdomen is reflexed onto thoracic sterna and width of head capsule is 0.48 mm. According to Beeson (1941), larva constructs the cell in which it lives, feeding on ambrosia. The mandibles seem to be compromise between the entire chisel type and dentate mandibles of the ambrosia feeding but non *Xyleborus*.

Fig. 203. Adult-*Scolytoplatypus pubescens* (Hagedorn,1914).

Beetle: The length of beetle ranges from 4-5 mm (Beeson,1941). According to Maiti&Saha (2009), male beetle head is subrostrate, flattened dorso-ventrally, frons are concave up to vertex with a transverse sub oval area covered with dense coat of short hairs placed somewhat at the level of eyes; surface smooth and shiny with punctures and fine pubescence of hairs; upper level of eyes with tuft of long hairs curving above the frons and touching each other, a few long hairs along the lateral margin and increasing in density towards epistoma. Eyes are elongate and weakly convex, placed along lateral margins. Antennal scape is short and stout; funicle with 6 segments, club laceolate, flattened with fine pubescence of hairs and a few long curved hairs on anterior face. Pronotum is subtrapizoid, 1.1 times as wide as long, basal margin feebly bisinuate, lateral sides gradually broadening from base towards apex, margin distinctly ridged early upto apex, basal emargination not distinct; anterior margin is substraight with weak emargination; anterior margin of foveae confluent with the pronotal margin, less than twice as long as wide; surface feebly convex,

finely reticulate with minute punctures and dense pubescence. Scutellum is visible only on anterior declivious portion of elytral base. Elytra is 1.4 times long and much wider than pronotum, 1.3 times as long as its own width; basal margin is truncated and weakly carinate; lateral sides parallel up to half, thence slightly widening posteriorly and apex broadly rounded, postero-lateral margins are carinate and confluent with interstria 9; disc is smooth and shiny with minute punctures throughout; strial punctures are hardly marked, with a few sparse, small and erect hairs. Declivital slope is gradual, face is opaque and convex; striae 1, 2, 3 and 4 are feebly impressed, marked by minute confluent punctures, each with a microhair; interstriae at the commencement of declivity with short longitudinal ridges either generally terminating with a short spine or more than one when interrupted, ridge either obsolete within declivity or feebly marked by spines at places, spines comparatively strongly developed laterally; entire declivital surface is reticulate and roughened; declivital surface is with fine dense small hairs and single row of erect hairs along interstriae.

Females are very similar to males, but differ from them as follows: Frons is convex; surface is finely reticulate with distinct close punctures. Pronotum is with distinct mycetangium below the anterior one-third; elytral interstriae is without any ridge at the commencement of declivity, but with comparatively smaller granules; declivital face is with vestiture of fine dense hairs, but devoid of any long erect hairs; protibiae is more dilated and with distinct tubercles on posterior face (Maiti& Saha,2009).

Extent of Damage/Status: Data Deficient.

211. *Taphrorychus hewetti* (Stebbing,1908)

Superfamily: Curculionidae

Family: Curculionidae

Subfamily: Scolytinae

Synonym: ***Dryocoetes hewetti*** (Stebbing,1908).

Distribution: Kumaun, N.W.Himalaya (Stebbing,1914); Nepal & Bhutan (Roger & Liu,2018). [19 specimens are kept in NFIC, Dehradun. Nainital collected by B.M.Bhatia in 1937; Mundali, Chakrata by C.F.C Beeson on 17.vi.1924; Bajwar, Almora by J.C.M Gardner in 1937; Jakh, Paithani, Garhwal by Balwant Singh on 14.v.1941; Katambari, Jalpaiguri by N.C.Chatterjee on 08.iv.1934; Lawacherra Plantation, Sylhet, Assam by R.N. Mathur on 27.iv.1927].

Species of oak infested: *Quercus floribunda*, *Q. leucotrichophora* (Stebbing,1914); *Quercus* spp. (Wood & Bright,1992).

Habit: The species attacks weakened trees, especially those parasitized by mistletoe, *Loranthus* (Loranthaceae)(Stebbing,1914). Beetle and larva bores in bark and sapwood (Mathur & Singh,1959).

Larva: It is a small, white, elongate worm with a yellowish head. The grub instead of being curved as is usual with bark-boring scolytid grubs, is more or less straight and tapers slightly posteriorly (Stebbing,1914). Larva described by Gardner (1934), the larva is about 5 mm. Head capsule is almost circular, width is about 0.7 mm; a short distance behind the mandibles is a very distinct patch of surface irregularities; colour rather dark reddish except for large circular discal area which is paler. Mandibles are with blunt apex with only traces of second tooth. Labial palp has apical segment sub globular very slightly longer than wide but not longer than basal segment.

Pupa: It is whitish yellow in colour (Stebbing,1914).

Beetle: The length of beetle ranges from 2.5 mm to 3 mm. It is small, oblong black insect with a reddish-chestnut tinge. Head from front is slightly convex, shining punctate,

very finely transversely straiate at sides, with long scattered hairs on front and a fringe of hairs on mouth. Prothorax is slightly broader than long, base truncate, humeral angles rounded, sides and apex forming a blunt ellipse; surface is convex, raised into a point maidenly and depressed posteriorly, granulose, the granulation coarse on anterior half, especially on disk and much finer posteriorly. Scutellum is rather large, shining, convex, rounded. Elytra is slightly broader than prothorax and a fourth as long again; truncate at base, apex strongly and edged with long shining hairs; rest of surface with rows of punctures which are fine basally and laterally and confluent and rugose medianly. Under-surface is reddish brown maidenly with longish hairs dense laterally (Stebbing, 1914). According to Singh, (2011) these are tiny (3-4 mm) light brown coloured beetles emerged in October 2009 from borer infested Q. dilatata branches collected during July 2009 from Deoban Reserve forest, Chakarata. Previously it was collected from Q. dilatata from Deoban and Mundali (1924 and 1933) in Chakarata. Emergence of beetles took place in the lab at FRI, Dehradun in October 2020 from borer infested Q. semecarpifolia logs collected during August 2020.

(a) Adult (Dorsal view)

(b) Beetles emerged from kharsu log

Fig. 204. Adult- ***Taphrorychus hewetti*** **(Stebbing,1908)**

Life history: The male insect flies to and settles on the outer bark of the oak-tree and then bores into the bark, eating out a straight tunnel of the same diameter as itself down to the bast layer and sapwood of the tree. On reaching the latter, it gnaws out a small chamber which grooves both the bast and sapwood and is squarish in appearance. When this work is complete or before the male has finished the pairing-chamber, a female enters the orifice of the entrance-tunnel of the male in the bark and works her way downwards, enlarging the tunnel as she goes in till she reaches the male in the pairing chamber. After pairing with the male the female commences to eat out a gallery in the sapwood and bast; this gallery takes a direction away from the pairing chamber and is always more or less at right angles to the long axis of the tree in which the gallery bored by the female is parallel to the long axis of the tree. As she eats out this tunnel, the female makes little indentations in the edges on both sides and places an egg in each. When she has completed the gallery, which is the egg-gallery, i.e, when she has laid all her eggs, she dies in situ at the head of the gallery. Before the gallery is completed, however, the larvae from the first-laid eggs commence to hatch out. The larva eats out a narrow tunnel in a direction at right angles from the egg-gallery and this larval gallery appears to be invariably straight. This may be due to the hard straight fibers of the oak

wood; but whatever the cause, this habit of the grub distinguishes it at once from other known Indian scolytid bark-boring grubs, whose tunnels invariably serpentine; also, owing to the fact that the egg-galleries are at right angles to the long axis of the tree. The larval galleries increases in diameter with the growth of the grub, but do not groove the sapwood as deeply as the egg-galleries. The larva when fully grown eats out a depression in the sapwood at the end of its gallery and pupates. On maturing from the pupal stage the beetle eats its way through the bark which covers it, making a small circular exit-tunnel in it and escapes to seek out a good tree in which to oviposit and carry on the attack. The presence of these numerous exit-holes on the outside of the bark serves as an indication that the beetle bred in it has left the tree. The pupating-chamber is one-fifth by one-seventh of an inch in size; the egg-gallery from one and a half to two inches in length and the larval galleries from one and quarter to two quarter inches; the number of eggs laid is usually about twenty (Stebbing,1914).

Extent of Damage/Status: Common on dead Kharsu oak trees. Damage significant when population is high.

212.*Sphaerotrypes tectus* (Sampson,1921)

Superfamily: Curculionidae

Family: Curculionidae

Subfamily: Scolytinae

Distribution: China,India: Maharasthra, Punjab & Uttarakhand (KathianChakrata, Uttarakhand, India) (Maiti& Saha,2009).

Species of oak infested: *Quercus leucotrichophora, Q. floribunda* & *Q. semecarpifolia* (Maiti& Saha,2009). *Q.leucotrichophora*(Mathur & Singh,1959).

Habit: Beetle and larva bores in the bark (Mathur & Singh,1959).

Beetle: Body is globular, head and pronotum are blackish to brown in colour and head is blacker. Elytra are chestnut brown. Antennae are light brown in colour. Body is of medium size having length of 3.46 mm, 2.23 mm width and body is 1.4 times as long as wide. Frons is plano-convex fringed with dense whitish pubescence roughened with longitudinal granules and hairs with small median tubercules which are below the epistomal margin; epistomal margin is substraight with a feeble ridge with some erect long hairs. Vertex is distinctly convex with minute granules. Antennal scope are curved, funicle is seven jointed and club with 8-9 distinct sutural lines marked by microhairs, other sutures confused at the tip. Pronotum is wider, one and a half times as broad as long, broadest at the base, thence converging anteriorly with weak convex lateral margins. Anterior margin is somewhat straight with some minute granules, median line distinct but not forming any ridge. Dorsum is minutely granulated and punctuates, covered with dense scale-like setae as well as with some scattered erect hairs. Posterior margin has distinct ridge forming somewhat V-shaped divergence, laterally. Elytra are somewhat globose slightly longer than broad and almost double the pronotum. Basal margin of each elytron is outcurved with more than a dozen of crenulations. Lateral margins are strongly outcurve, gradually narrowing posteriorly and terminating into a angularly rounded apex; striae distinctly depressed marked with shallow punctures and reaching almost tip of elytra except straie 5 and 6; interstriae much wider, flat except basal one-fifth becoming convex with distinct regular asperities; discal striae with three to four rows of granules and covered with scale like minute setae throughout. Declivity is commencing on the posterior third, gradually slopping posteriorly with convex face. Declivital interstria has somewhat distinct minute tubercles which are

somewhat prominent towards apex (Maiti & Saha,2009).
Extent of Damage/Status: Data Deficient.

213.*Sphaerotrypes querci* (Stebbing,1914)
Superfamily: Curculionidae
Family: Curculionidae
Subfamily: Scolytinae
Distribution: Kumaun, N.W. Himalaya (Stebbing,1914).
Species of oak infested: *Quercus floribunda* and *Q. leucotrichophora* (Stebbing,1914).
Habit: Beetle and larva bores in bark (Mathur & Singh,1959).
Larva: It is 4 mm in length, small, white, oval, very concave from above and much corrugated and channeled. (Stebbing,1914).
Adult: Beetle is short, oval, very convex and 3mm in length. Head is punctuate, more strongly at sides and hairy at vertex. Prothorax is one and half times as broad as long, base bordered and produced backward to form an obtuse angle, the angle truncate, concave on either side, emarginated anteriorly and sides rounded and narrowed anteriorly, a narrow elevated line down centre more prominent and shining at the base and not reaching to anterior margin. Elytra are slightly wider than thorax. Under surface is black with a scattered yellow pubescence. The beetle matures about the first or second week in June. Beetle bores straight down into the wood of newly felled green trees to oviposit. The presence of insect can be easily recognized owing to the fact that little cylinders of ejected wood-dust are to be seen projecting from the entrance holes in the bark (Stebbing,1914).According to Stebbing (1909), the head of beetle is punctuated, more strongly at sides and hairs on vertex. Prothorax is 1.5 times as broad as long, base bordered and produced backward to form an obtuse angle, the angle truncate, concave on either side. Scutellum is squarish, oblong and punctuate. Elytra are slightly wider than thorax and sides are rounded from base to apex and almost black with a dull reddish tinge on them. Under surface is black with a scattered yellow pubescence, abdominal segments 1 and 5 are large and equal to one another. Beetle emerges in the month of May (Stebbing,1914).
Nature of attack: The female beetle eats out an egg gallery in the bast and sapwood of the tree, laying eggs in indentations on either side. The larva on hatching out mine out galleries in the bast in the direction at the right angle or which trend downward or upward in the upper and lower part of egg-gallery. When numerous, the bast layer is entirely destroyed and tree attacked dies (Stebbing,1909).
Life History: Stebbing (1914) took nearly full grown larvae in their galleries in the tree towards the end of May 1908, these being the larvae of the first generation of the year. Beetle matures in the first or second week of June. The number of generations of the insect in the year has yet to be ascertained. It is possible that it has at least three life cycles in a season. It is important that this fact should be definitely and accurately determined. The damage it is capable of doing to the tree and methods of combating its attack are similar to these detailed for the *Dryocoetes*.
Extent of Damage/Status: Data deficient.

214.*Ozopemon hewetti* (Stebbing).
Superfamily: Curculionidae
Family: Curculionidae
Subfamily: Scolytinae
Distribution: N.W.Himalaya.
Species of oak infested: *Quercus leucotrichophora*(Mathur & Singh,1959).
Habit: Beetle and larva bores in the bark (Mathur & Singh,1959).
Extent of Damage/Status: Data deficient.

HEMIPTERA

3.HEMIPTERA
(Bugs: Sapsuckers): 16 species

Sap feeding insects suck liquid or semi-liquid material from succulent parts of the oak trees. Example Psyllids, Mirid bugs, Aphids and coccids They inject a toxic saliva into their hosts, causing necrosis of plant tissue. Moreover, they excrete clear, sugary liquid cause sooty mould fungi. Reduced photosynthetic efficiency results in stunting, distortion or wilting.

215.*Kermes himalayensis* (Green,1909)

Superfamily: Coccoidea

Family: Kermesidae

Synonyms:

Coccus himalayensis, Cockerell,1929.

Talla himalayensis, Lindinger,1933.

Distribution: According to Stebbing (1909), it was only reported from the ban oak forest on the hills to the north of Bhimtal in the Nainital district of Uttarakhand in the North West Himalaya, India. Olsa(2500m), on way to Hari-Ki-Dun, Uttarkashi, Uttarakhand during 06.iii.2009 on lopped Ban oak trees.

Species of oak infested: *Quercus leucotrichophora* (Stebbing,1909).

Other host plants: *Lithocarpus dealbatus* (http://scalenet.info/catalogue/Kermes%20himalayensis/).

Habit: Adults and Nymphs feed on sap (Stebbing,1909).

Eggs: Elongate, tiny, white with a filamentous papery shell covering; enclosed in a considerable numbers beneath the dome shaped scale forming a white mass of elongate of bodies (Stebbing,1909).

Newly hatched small scale: Very small, reddish brown in colour, consisting of head and 12 segments.The antennae are short and small and there are a pair of long anal appendages (Stebbing,1909).

Young female insect: Small, flat, elongate, elliptical with blunt ends, the posterior extremity, broadly rounded; segmented with ridged tubeculate reddish grey smoke coloured segment and from 1-8 to 1-12 inches in length. They have no scale covering and are almost indistinguishable from bark colouring (Stebbing,1909).

Old female scale: Black, shinning with white streaks and specks on it giving the scale a mottled grey appearance. Spherical or elliptical in shape, very convex above and flat beneath and a transverse one slightly less; the shape often disguised by crowding. Skin is smooth, shinning, milky white or reddish, marbled and spotted, marking, black, punctate. Antenna are short, two jointed with 4 short hairs. Scale when full grown greatly resembles at a little distance the pupae of predaceous coccinellid beetle *Vedalia guerini* which is predaceous upon the sal monophlebus scale insect (Stebbing,1909). According to Green (1909), adult female are approximately hemispherical, sometimes slightly oblong, with a broad base of attachment, often much distorted by crowding. Ground color varies from milky-white to fulvous or pale castaneous, closely marbled and spotted and the markings varying from dark castaneous to black. To the naked eye, the pattern appears to be in the form of 3 longitudinal series of large irregular spots.

Life History: According to Stebbing (1909), at the time of its discovery the scales were mature and the female insects inside them were engaged in egg laying or the scales consisted simply of masses of eggs surrounded by a dries shrivelled female skin.

The larva on swarming are minute little active creatures and appear to at first confine themselves to the young twigs of the tree. As they grow older they go down to the larger branches and are to be found encrusting quite thick branches.

Extent of Damage/Status: Data Deficient.

216.*Kerria lacca* (Kerr,1782)

Superfamily: Coccoidea

Family: Kerriidae

Synonyms:

Coccus lacca Kerr,1782
Coccus ficus Fabricius,1787
Chermes lacca Roxburgh,1791
Carteria lacca Signoret,1874
Lakshadia indica Mahdihassan,1923
Tachardia lacca Chamberlin,1923
Laccifer lacca Cockerell,1924

Distribution: India. In India major lac producing regions are Assam, Bengal, Bihar, Delhi, Gujarat, Hyderabad, Kashmir, Madhya Pradesh, Chennai, Coimbatore, Mysore, Rajasthan and Uttar Pradesh (https://www.studyandscore.com/studymaterial-detail/lac-culture-introduction-history-distribution-lac-culture-in-India-and-life-cycle-of-lac insect).

Host plants: *Quercus* sp. (Mathur & Singh,1959).Three plants are used for the majority of commercial cultivation of the lac insect: Pallas (*Butea monosperma*), kusum (*Schleichera oleosa*) and ber (*Ziziphus mauritiana*) (Mohanta et al., 2014).

Habit: Adults and Nymphs feed on sap(Mathur & Singh,1959).

Life cycle of Insect: Lac insects are ovoviviparous types. The females get attached to the host plant inside the resinous mass. The male insect comes out of its resinous mass by pushing the operculum of the anal opening and then walks over the resinous covering of the female. This walking fertilizes the female within. One male lac insect is capable of fertilizing many females(https://www.studyandscore.com/studymaterial-detail/lac-culture-introduction-history-distribution-lac-culture-in-India-and-life-cycle-of-lac-insect).

Egg lying: After the fertilization, the female grows rapidly until it begins to lay eggs. By the time female starts to lay the eggs, its body contracts on the ventral side and gradually vacating the place for the eggs to be accommodated inside the resin cell. After laying the eggs the female secrets the lac resin at a faster rate. After about 14 weeks, female completely shrinks in size allowing the light to pass into the cell and onto the eggs. At this stage, two yellow spots appear at the rear end of the resin cell. These spots gradually enlarge and turn orange in color. This indicates the completion of egg-laying by the female lac insect. After laying the eggs the female lac insect dies. Now the resin cell with eggs is called as ovisac. The ovisac appears orange in color due to the crimson fluid called the lac dye. This indicates that eggs are about to hatch in a week (https://www.studyandscore.com/studymaterial-detail/lac-culture-introduction-history-distribution-lac-culture-in-India-and-life-cycle-of-lac-insect).

Egg hatching: After six weeks, the eggs are hatched into first instar larvae called crawlers. These larvae emerge our in very huge numbers and this emergence is termed as swarming. The first instar larva is broad, red-coloured and boat-shaped. It has paired antennae, ocelli and sucking type of mouth parts with proboscis. These larvae prefer succulent shoots as their host. The settled larvae suck the sap from the host and start to secrete resinous substance all over their body (https://www.studyandscore.com/studymaterial-detail/lac-culture-introduction-history-distribution-lac-culture-in-India-and-life-cycle-of-lac-insect). Larvae in this stage crawl along the branches of their host plants and feed on the phloem. As they pierce

the branches to reach the phloem, they cover the holes with their wax secretions (Mohanta*et* al.,2014).

Pupa: As the resinous secretions come in contact with the air, it becomes hard and forms a coating over the body of the larva and now this covering is called cell. Within the cell various life processes like the growth of larva and morphological changes takes place. Inside the cell, the larvae undergo three moults. After the first moult, both the female and male nymphs lose their appendages, eye and become degenerate. The female once inside the cell will not come outside on the other hand the male comes out through the operculum of the anal opening (https://www.studyandscore.com/studymaterial-detail/lac-culture-introduction-history-distribution-lac-culture-in-India-and-life-cycle-of-lac-insect).

Adult: After about 6-8 weeks the stationary life of larva metamorphoses into adults having cast-off the second and the third moults. Only the male undergoes complete metamorphosis, it loses its proboscis, develops antennae, legs and a pair of wings. The females undergo incomplete metamorphosis. They retain her mouth parts but fail to develop any wings, eyes or appendages. Female becomes an immobile organism with little resemblance to an insect. They become little more than egg producing organisms. The sex can be determined even during the early stages of development. As in case of males the growth is more on the longitudinal axis and in females the growth is more in vertical axis. The life span of the female is longer than that of the males. Most of the lac is secreted by the females. The life cycle occurs twice in one year on the same plant(https://www.studyandscore.com/studymaterial-detail/lac-culture-introduction-history-distribution-lac-culture-in-India-and-life-cycle-of-lac-insect). According to Beeson (1941), a part of the population is male; the males mature quickly and leave their cells, the lac forming which is small and of no commercial value (emergence of males). There are two kinds of adult males, winged and wingless; both kinds are sexually potent and fertile the females within the cells through the anal tubercular openings (fertilization). In the absence of a male it is possible for a female to reproduce asexually and to yield abundant progeny and good lac (parthenogenesis). The pregnant female continues to grow and secrete lac until the period of oviposition at the end of her life (crop maturity). In the wall of the cell of a single female there are 3 openings, the respiratory or brachial pores and the anal tubercular pore, through which white filaments of wax protrude; the function of the filaments is to keep the pore open while the lac is being added and their presence indicates the lac insect is alive and healthy but if they are broken off it does not mean that the insect is unhealthy. Through the tubercular pore honeydew is ejected and is the attraction for ants.

Extent of Damage/Status: Data deficient.

217.*Pseudopulvinaria sikkimensis* (Atkinson,1889).

Superfamily: Coccoidea

Family: Coccidae

Synonym: *Lefroyia castaneae* Green,1908.

Distribution: China and India (Assam). (http://scalenet.info/catalogue/Pseudopulvinaria%20sikkimensis/).

Species of oak infested: *Quercus leucotrichophora* (http://scalenet.info/catalogue/Pseudopulvinaria%20sikkimensis/) &Q. serrata (Mathur & Singh,1959).

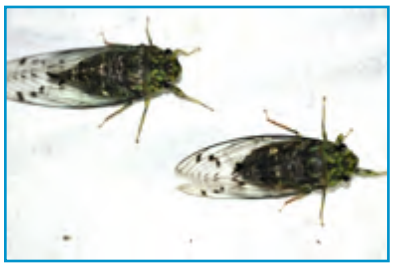
Other host plants: *Castanea* sp., *Castanopsis indica*, *Castanopsis tribuloides* (http://scalenet.info/catalogue/Pseudopulvinaria%20sikkimensis/).

Habit: Feed on sap of leaves (Mathur &

Singh,1959).
Extent of Damage/Status: Data deficient

218. *Macrosemia saturata* (Walker,1858).
Superfamily:Cicadoidea
Family: Cicadidae
Subfamily: Cicadinae
Synonyms:
Dundubia obtecta Walker,1850.
Dundubia saturata Walker,1858.
Cosmopsaltria saturata Distant,1891.
Cosmopsaltria saturata var. a Distant,1891.
Cosmopsaltria saturata var. b Distant,1891.
Platylomia saturata Distant,1906.
Meimuna saturata Ôuchi,1938.
Platylomia satura Chatterjee & Ghosh, 1978.
Cosmopsaltria saturata Ahmed, Siddiqui, Akhter & Rizvi,2005.
Macrosemia saturata Boulard,2008.
Distribution: Continental India (Uttarakhand, Sikkim, Assam); Nepal; Sylhet (Bangladesh) (Distant,1889-91); Northern Bengal; Assam; Java; Sikkim; Indochina; Malay Peninsula (Metcalf,1963); Bhutan (Duffels and van der Laan,1985); Manipur, Assam, Naga Hills,Pakistan, Vietnam,Indonesia(Sanborn,2014)(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5018104 /).Arunachal Pradesh (Rapum, West Siang District), Uttarakhand (Dhanaulti, Tehri Garhwal district; Deoban, Chakrata, Dehradun district).(https://www.indiancicadas.org/sp/300/Macrosemia-saturata). [9 specimens are kept in NFIC, Dehradun collected from Mussoorie (1676 m), by S.N. Chatterjee on 05.vii.1920 and Nainital, by Dr. S.K. Pillai in June,1919 from Uttarakhand].
Species of oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959); *Q.floribunda, Q. semecarpifolia.*
Other Host plants: *Cedrus deodara.*
Habit: Adult and nymph feed on sap (Mathur & Singh,1959).Quite common in Chakrata Forest Division, Dehradun district, Uttarakahnd between 2100-2800m during the rainy season (July-August 2017-2020) when large congregations can be seen on oak and deodar trees making loud noise, sucking sap, flying around and mating & also during autumn (November 2020).
Adult: Head and thorax from above is olivaceous; pronotum is with two central longitudinal fascia (inwardly curved and united posteriorly), the incisures, and a small spot on lateral margins which is black; mesonotum is with a central longitudinal fascia connected with two large anterior fused spots, a very broad oblique fascia on each lateral area, and two spots in front of cruciform elevation black; abdomen is shining and the segmental margins at lateral areas are somewhat broadly ochraceously pilose; head from beneath, sternum, legs, and opercula is olivaceous, the last with ochraceous tint; abdomen from beneath is ochraceous; femora with a short black line on inner margin; tegmina and wings are hyaline, venation is ferruginous; tegmina with a bright olivaceous tinge most pronounced on the basal half, the extreme base and claval area ferruginous, costal membrane and postcostal area is fuscous, transverse veins at bases of second, third, fifth, and seventh apical areas broadly infuscate, and a series of marginal spots at apices of longitudinal veins to apical areas; wings with extreme base and margins of anal area ferruginous.

(a) Adults mating on kharsu oak tree



(b) Adults on moth screen

(c) Pinned specimen

(d) Exoskeletons

Fig. 205. ***Macrosemia saturata*****(Walker,1858) on Kharsu oak tree.**

This is a variable species as regards the tinting of the tegmina, which are sometimes clear and not shaded on the basal lialves; it is even apparently more unusually variable in the position of the opercula, which in some specimens examined, probably owing to a shrinkage of the abdomen, reach its apex; in other examples the apices of the opercula are much less angularly produced than in typical species (Distant,1906). According to Distant (1889), male and female are ferruginous-tawny. Head is with two interrupted black bands. Prothorax is with eight irregular black stripes; the middle pair is curved and dilated hindward. Mesothorax is with a black line, and with four broader black stripes, which are more or less excavated; the inner pair is shorter than the outer pair, and joining the line; the outer pair joining has two black hind spots. Abdomen is having whitish tomentum on each side towards the base. Wings are with a slight testaceous tinge, ferruginous-tawny at the base; veins are tawny and partly black. Fore wings are with a brown streak at tip of each of the marginal veins; transverse veins isclouded with brown; first transverse vein is longer and more oblique than the second, from which it is parted by more than twice its length.

Extent of Damage/Status: Most common cicada in oak forest in the state.Widespread. Causes damage to young shoots of associated species like *Cedrus deodara, Picea smithiana* and also Kharsu oak.

219.*Platypleura assamensis* (Atkinson,1884).
Superfamily: Cicadoidea
Family: Cicadidae
Subfamily: Cicadinae
Synonym: *Platypleura repanda* Distant, 1889.

(a) Adult **(b) Pinned Specimen (Dorsal view)**

Fig. 206. Adult- *Platypleura assamensis*(Atkinson,1884).

Distribution: India: Uttarakhand, Assam (Tinsukia dist., Margherita), Meghalaya (South Garo hills district, Balpakram NP), Arunachal Pradesh (Mandla, West Kameng District)(https://www.indiancicadas.org/sp/326/Platypleura-assamensis). [5 specimens are kept in NFIC,FRI, Dehradun collected from Nambor Sagar, Assam by C.F.C Beeson on 15.v.1921 and from Mussoorie, Uttarakhand]. Two individuals collected from Ban oak trees in Vinayak Khal, near Buddha Kedar, Tehri Garhwal District,Uttarakhand on 21.ix.2017].
Species of oak infested:*Q. leucotrichophora* (Mathur & Singh,1959).
Habit: Adult and nymph feed on sap (Mathur & Singh,1959).
Adult: Head, pronotum, mesonotum, tympanal coverings, sternum, rostrum, and legs are pale olivaceous-brown; abdomen is black and the segmental margins is olivaceous; opercula is piceous, their margins are pale olivaceous-brown, sparingly ochraceously pilose from above, more thickly from beneath; head with the area of the ocelli, a discal, central, triangular spot and the incisures to pronotum, four obconical spots (the two central much the shortest), a central lanceolate spot and two small rounded basal spots to mesonotum which are black; tegmina with more than basal half is pale brownish, opaque, with darker spots and markings; radial area is grey at base and hyaline at apex, a hyaline spot in lower apical area and an obscure hyaline spot near the base of third and centre of fourth ulnar areas, an oblique broad fuscous fascia crossing bases of first to fifth apical areas, some small apical spots and still smaller fuscous spots at apices of longitudinal veins to apical area; wings are ochraceous, outer margins (particularly broad at apices) are castaneous brown and apical margin to anal area is hyaline (Distant,1906).
Extent of Damage/Status: Data deficient.

220. Butterfly Cicada, *Sulphogaeana sulphurea* (Westwood,1839)
Superfamily: Cicadoidea
Family: Cicadidae
Subfamily: Cicadinae
Synonym:
Cicada sulphurea Westwood,1839
Cicada pulchella Westwood,1839
Gaeana sulphurea White, A.,1846
Gaeana pulchella Graber, V,1876
Cicada pulcilla Kirkaldy,1907
Sulphogaeana sulphurea Chou & Yao,1985
Sulphogaeana sulphura Sanborn, 2013

Distribution: India(Western Himalaya: Uttarakhand).Bangladesh, Bhutan, China and Nepal(https://www.cicadamania.com/cicadas/sulphogaeana-sulphurea-westwood-1839/).
Species of oak infested: *Quercus leucotrichophora.*
Habit: Adult and nymph feed on sap. Collected from Ban oak forest around Anusuya Devi- Mandal (1700-2000m), Chamoli District, Uttarakhand in April 2010 and also from Devalsari (1780m), Tehri Garhwal,Uttarakhand on 31.i.2020.

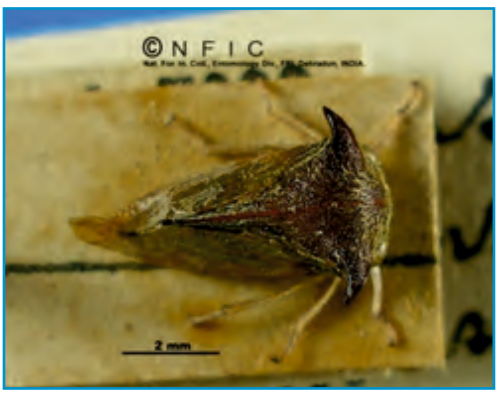
Fig. 207. Adult-*Sulphogaeana sulphurea* (Westwood,1839)

Adult: According to Distant (1892), male body is black from above, lateral margins of the vertex of head- continued to eyes, pronotum (excluding the fissures, margins and central hour glass shaped fascia), four linear spots to mesonotum (sometime united in pairs) and margins of anal appendages, reddish-ochraceous. Body from beneath and legs are black; a fascia on each side of face, sterna streak and a spot at base of tegmina, posterior segmental margins are obliterated centrally and anal appendages are ochraceous. Tegmina and wings are sulphurous; tegmina with inner margins of the costal membrane, a curved and inwardly angulated fascia crossing centre and the whole apical area including the upper ulnar area which is blackish; costal membrane is ochraceous, postcostal area is blackish; wings with apical area broadly and narrowing to the anal angle which is blackish. Face with narrow nut distinct central sulcation; the rostrum reaching the posterior coxae.
Extent of Damage/Status: Occasional on Ban oak forests.

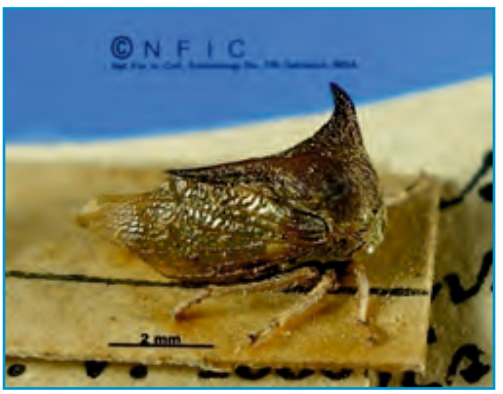
221.*Tricentrus kamaonensis* (Distant,1916).
Superfamily: Membracoidea
Family: Membracidae
Synonyms: Otaris kumaonensis Goding

(a) Male adult (Dorsal view)

(b) Male adult (Lateral view)



(c) Female adult (Dorsal view)



(d) Female adult (Lateral view)

Fig. 208. Adults- ***Tricentrus kamaonensis*** **(Distant,1916).**

Distribution: India: Uttarakhand (Nainital, Kumaon); Rajasthan (Ramgarh) (Ananthasubramanian,1996). [4 specimens are kept in NFIC,FRI Dehradun. Ramgarh (2133 m), Nainital collected by B.M. Bhatia on 07& 11.v.1930].
Species of oak infested: *Quercus floribunda* (Mathur & Singh,1959).
Habit: Adult and nymph feed on sap (Mathur & Singh,1959).
Female: General colour is pale brown. Head is reddish brown, finely punctuate with sparse, short, golden pilosity, 2.5 times as wide across extremities of eyes as the length of vertex, vertex is 1.7 times as wide as long, upper margin is strongly arcuate, lower margins are rounded. Eyes are moderately large, light brown; ocelli are vitreous, closer to eyes than to each other and situated well above line; front clypeus are extending two-thirds of its length above lower margins of vertex, densely pilose, apex truncate. Pronotum is grayish brown with hue of red, finely punctuate sparsely pilose, metopidium 2 times as wide as high, convex, very gently sloping backward to disc; suprocular callosities subprominent, inconspicuously divided, humeral angles are subprominently produced lateral, their apics are subacute; suprahumeral horns are robust, darker and

more blackish than pronotum, as long as the space between their bases, viewed from above rugose and finely punctuate, transversely and a little upwardly extended, their apics are oblique, slightly curved; posterior process are broad at base, somewhat attenuated, tricarinate, median carina is strongly percurrent through pronotum, posterior half is darker, apex is acute just reaching or slightly passing the posterior angle of the inner margin of tegmina; tegmina is 2.6 times as long as wide, subhyaline, wrinkled, veins are dark brown, 1st apical cell is 3.5 times as long as wide, 1st discoidal cell is nonpetiolate apical limbus broad. Legs are ochraeous and densely pilose. Length from the frontal margin to tips of tegmina is 6 mm and to tip of posterior process is 4 mm. Width across tips of suprahumeral horns is 4 mm and at humeral angles 2.4 mm. *T. kamaonensis* is closely related to *T. cinereus* Ananthasubramanian in the disposition of the horns and in the subhyaline tegmina, but differs by the attenuated posterior half of the posterior process and the obliquely directed suprahumeral horns; the tegmina are also broader (Ananthasubramanian,1996).

Extent of Damage/Status: Data deficient.

222.*Tricentrus subangulatus* (Distant,1908).

Superfamily:Membracoidea

Family:Membracidae

Synonyms:

Otaris subangulatus Goding,1934.

Otaris subangulata Metcalf & Wade,1965.

Distribution: India: Tamil Nadu (Nilgiri Hills, Mudumalai); Uttarakhand (Dehra Dun, Naini Tal); West Bengal (Darjeeling); Pakistan; Bangladesh; Burma (Ananthasubramanian,1996). [2specimens are kept in NFIC, Dehradun.Rangirum (1828 m), Darjeeling, West Bengal collected by J.C.M Gardner on 04.ix.1929 and by C.F.C Beeson on 07.v.1931].

Species of oak infested: *Quercus floribunda* (Mathur & Singh,1959).

Habit: Adult and nymph feed on sap (Mathur & Singh,1959).

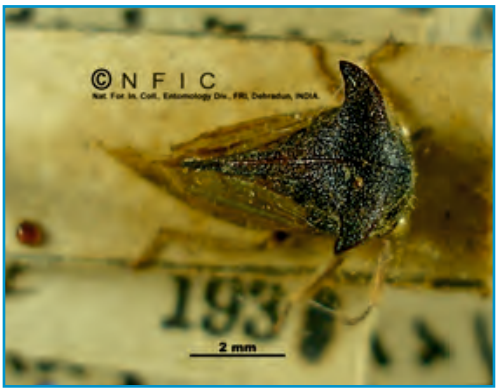
Female: General colour is black. Head is about 3.3 times as wide across extremities of eyes as length of vertex, finely punctate, covered with dense, short, golden hairs; vertex is 2.3 times as wide as long, upper margin saretrongly arcuate and sinuate, lower margins are horizontally continued to front clypeus; eyes are large, reddish brown; ocelli are black, closer to eyes than to each other and situated above line; front clypeus is extending for half its length below lower margins of vertex, densely pilose, apex truncate. Pronotum is black, thickly punctate, with short depressed golden pilosity metopidium 3.4 times as wide as high, convex, slightly sloping backward to disc; supraocular callosities, inconspicuous; humeral angles prominent, coarsely punctate at base, apices subacute; suprahumeral horns are short, as seen from above broad, recurved, 0.75 times as long as the space between their bases, anterior margin are rounded, posterior margin is substraight, apices are subacute; posterior process is robust, tectiform, coarsely punctate, sparsely pilose, tricarinate, median carina percurrent through pronotum, apical area is gradually tapering, apex is gently elevated, not impinging on tegmina, not reaching the posterior angle of the inner margin of tegmina; tegmina is 3 times as long as wide, pale bronzy hyaline, veins piceous, base black, punctate, a distinct transverse fascia on outer margin, 1st apical cell is 5 times as long as wide, 1st discoidal cell is petiolate, shorter than the 2nd, apical limb are broad. Body from beneath and legs are black.

Length from frontal margin to tips of tegmina is 5.5 mm and to tip of posterior

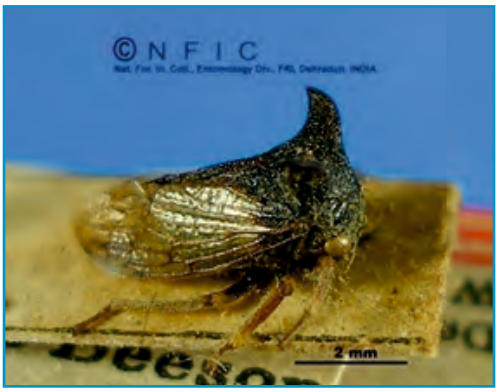
process is 4 mm; width across tips of suprahumeralhorns is 3 mm and humeral angles is 2.4 mm (Ananthasubramanian,1996).
Male: Smaller than female; general colour is dark brown; suprahumeral horns are shorter than those of female (Ananthasubramanian,1996).
Extent of Damage/Status: Data Deficient.

(a) Female adult (Dorsal view)

(b) Female adult (Lateral view)



(c) Male adult (Dorsal view)



(d) Male adult (Lateral view)

Fig. 209. Adults- Tricentrus subangulatus (Distant,1908).

223. Mallotus Shield Bug, *Cantao ocellatus* (Thunberg,1784)
Superfamily: Pentatomoidea
Family: Scutelleridae
Subfamily: Scutellerinae
Synonyms:
Climex ocellatus (Thunberg,1784).
Callidea ocellata (Thunberg,1784).
Cantaoconscitus (Walker,1868).
Cimex dispar (Fabricius,1794).
Callidea dispar (Fabricius,1794).
Cantao dispar (Fabricius,1794).
Cantao inscitus (Walker,1868).
Cantao rufipes (Dallas,1851).
Distribution: It is a species of shield bug in the family Scutelleridae found across Asia(Distant,1902).Asia: Bangladesh, China, India, Indonesia, Japan, Malaysia, Myanmar, North Korea, Pakistan, Philippines, Singapore, South Korea, SriLanka, Taiwan, Thailand, Vietnam, Oceania: Papua New Guinea (https://www.biolib.cz/en/taxon/id899900/) .[21 specimens are kept in NFIC,

Dehradun.Mackinnon's Park, Mussoorie collected by C.F.C Beeson on 02.ix.1927; Khasi Hills Assam by M. Bose on 03.vi.1927; AiradeoAlmoraby J.C.M Gardner on 27.v.1937; Dehradun by M.Bose on 29.vi.1931; Dehradun F.Z. Coll on 07.viii.1919; DeobanChakrata (2956m) by B.M.Bhatia on 7.vi.1932; Biharigarh Sharanpur U.P collected on 26.xi.1908; Sabhawala, Dehradun collected on 30. iv.1902].

Pinned specimen (Dorsal view)

Fig. 210.Adult- *Cantao ocellatus* (Thunberg,1784)

Species of oak infested: *Quercus leucotrichophora* (Mathur & Singh,1959).

Other host Plants: *Macaranga, Kigelia, Mallotus, Bischofia javanica* and *Broussonetia papyrifera*(https://en.wikipedia.org/wiki/Cantao_ocellatus).

Habit: Adult and nymph feed on sap (Mathur & Singh,1959).

Morphology: A highly variable elongate triangular bug of moderate size, easily distinguished by its sharply pointed prothroacicpronotal angles and colorful body, generally ochraceous or reddish ochraceous; head with a central black vertical line, pronotum with black spots, scutellum with 6-8 black spots that are surrounded by pale circles, overall body with fine punctures, body from underneath and parts of sternum showing bluish black tinge, part of the femur and entire tibio-tarsus shining bluish. Head with lateral margins are sinuate and lobes of almost equal length. Antennae have five joints. Rostrum is of moderate length, not extending beyond the base of the abdomen. Pronotum is much broader than long. Scutellum is longer than abdomen and its apex is truncate, abdomen with median basal sulcation (https://indiabiodiversity.org/species/show/225039). *Cantao ocellatus* is reddish or ochre in overall colour. It has dark legs and bluish black antennae. A dark bluish black stripe is present along the central line of the head. The pronotum has sometimes two black spots on the front margin and sometimes has eight spots. The scutellum has eight or six black spots of variable size but with yellowish borders. The lateral angle of the pronotum is elongated into a curved spine but this can be much reduced (Distant,1902). Maternal care of eggs and nymphs has been noted in this species (Takahashi,1921). The female covers the eggs after they are laid but eggs on the edge that she cannot cover are often parasitized by wasps (Ayyar,1920).

Extent of Damage/Status: Data deficient.

224.*Heteroptere chinosis*
Superfamily: Pentatomoidea
Family: Tessaratomidae
Distribution: China (https://www.insecte.org/forum/viewtopic.php?t=126830)
Western Himalaya: Uttarakhand.
Species of oak infested: *Quercus leucotrichophora.*

(a)Adult sucking sap from tender shoot of ban oak **(b) Pinned specimen (Dorsal view)**

Fig. 211. Adult- *Heteroptere chinosis*

Habit: Sucks sap from tender branches causing injury to growing shoot tips of Ban oak trees (near Vinayak Khal (1200m), Tehri Garhwal on 21.ix.2017 &Devli Village (1462m), Thano Range, Dehradun, Uttarakhand on 17.vii.2019).
Extent of Damage/Status: Occasional in Ban oak forests. Can cause drying up of new oak shoots when in large numbers.

225.Lychee Giant Stink Bug, *Tessaratoma papillosa* (Drury,1770)
Superfamily: Pentatomoidea
Family: Tessaratomida
Subfamily: Tessaratominae
Synonym: *Cimex papillosa*
Distribution: India, Australia, Bangladesh, Brunei, Cambodia, China, East Timor, Indonesia, Japan, Laos, Malaysia, Manchuria, Myanmar (ex Burma), Pakistan, Philippines, Sierra Leone, Singapore, Sri Lanka, Thailand, Vietnam(https://www.thailandnatureproject.com/tessaratoma-papillosa.html). Western Himalaya: Uttarakhand.
Species of oak infested: *Quercus leucotrichophora.*
Other host plants: *Canarium album, Canavalia sp., Carica papaya, Citrus limon, Citrus maxima, Citrus sp., Coffea sp., Euphoria longana, Ficus sp., Fortunella sp., Koelreuteria formosana, Litchi chinensis, Litchi sp., Musa sapientum, Nephelium sp., Nicotiana tabacum, Pinus sp., Prunus mume, Prunus persica, Prunus salicina, Ricinus communis, Saccharum sinense, Solanum melongen*(https://www.thailandnatureproject.com/tessaratoma-papillosa.html).
Habit: Sucks sap from tender branches of Ban oak trees (New Forest Campus, Dehradun on 22.ii.2018 and Chakrata,

Chakrata Forest Division, Uttarakhand on 18.viii.2020).

Adult:Adult is yellow-brown and shield-like in shape. The females are 24-28 mm long and 15-17 mm wide and are larger than the males (https://www.cabi.org/isc/datasheet/53273).

Life history:The life cycle of T. papillosa consists of three stages including egg, nymph and adults. The eggs hatch into the nymph stage. These immature nymphs has brightly coloured appearance. Nymphs are smaller in sizes but shape &colouris just like adults. In order to grow larger, each nymph must shed its outer covering to make space for their larger body.

Nymphs moults as many as five times for attaining adulthood.An adult develops from last instar nymphs and finally wings are developed in adults. Nymphs are wingless (http://izfs.net/tessaratoma-papillosa-giant-litchi-stink-bug/).

Extent of Damage/Status: Uncommon.

Fig. 212.Adult- Tessaratoma papillosa (Drury,1770)

226.*Urostylis pallida* (Dallas,1851)

Superfamily: Pentatomoidea

Family: Urostylididae

Distribution: Western and Central Himalaya. [77 specimens are kept in NFIC, Dehradun. Mussoorie (1828 m), collected by S.N. Chatterjee in June,1920; Kalsi, Forest Zoological Coll. in June,1921; Ramgarh, Nainital (2133 m), by C.F.C Beeson on 07.v.1930; Peora(1371 m), Nainital by B.M. Bhatia on 11.v.1930; Mukteshwar(2133 m), Nainital by B.M. Bhatia on 09.v.1930; Ranikhet, Almora(1524 m), by R.N. Parker on 06.viii.1923; Sivakhola(1066 m), Kurseong, Bengal by C.F.C Beeson on 22.vii.1935].

Species of oak infested: *Quercus leucotrichophora* (Beeson,1941).

Habit: Adult feed on sap(Beeson,1941). (3 specimens are collected from banj oak forest of Lansdowne (1780m), Pauri Garhwal, Uttarakhand on 11.vi.2018 and one specimen fromDevli Village (1462m), Thano Range, Dehradun, Uttarakhand on 03.ix.2019).

Adult: According to Distant (1902) length of bug is 13.5 mm to 14mm, pale greenish and yellow from above; head is brownish; pronotum is finely punctured with brown lateral margins waved; scutellum is more strongly punctured with brown than the pronotum; corium is thickly and finely punctured with inner and outer portion of apical margins which is black and yellow from the central portion; membrane are transparent, whitish with black spot in the

inner basal angle; body from beneath is orange in colour; abdomen is with disk smooth and shinning, the sides are reddish and fainted wrinkled; legs are testaceous; femora is covered with brown points, which are towards the apex form a short line on each side; rostrum is yellow with black tip; antennae are with basal joint testaceous and remainder is pale brown.

(a) Pinned specimen (Dorsal view)

(b) Pinned speciemens (Dorsal view)

Fig. 213. Adults- *Urostylis pallida* (Dallas,1851)

Extent of Damage/Status: Local infestation. Not significant.

Superfamily: Pentatomoidea
Family: Urostylididae
Synonym: Urostylis grayi

227.*Urolabida grayi*(White,1839)

Fig. 214. Adult- *Urolabida grayi* (White,1839)

Distribution: Western Himalaya: Uttarakhand.
Species of oak infested: *Quercus leucotrichophora*.
Habit: Adult feed on sap in small groups. Three specimens collected from ban oak forest on 03.ix.2008 at Mandal (1800m) near Mandal (Kedarnath Sanctuary), Chamoli District, Uttarakhand.

Adult: According to Distant (1902), it is greenish-luteous or pale ochraceous having length upto 14-16mm; two large basal sub triangular spots on the pronotum and a large elongate spot on each basal angle of scutellum which are purplish-red in colour; corium is often much darker in hue; the clavus, anterior and apical margins are pale luteous; membrane with a basal piceous line and rostrum is just passing the anterior coxae.
Extent of Damage/Status:Data deficient.

228.Unidentified Urostylididae Stink Bug
Superfamily: Pentatomoidea
Family: Pentatomidae

Fig. 215. Adult-Unidentified bug

Distribution: Western Himalaya (Chakrata Forest Division, Dehradun, Uttarakhand)
Species of oak infested: *Q. leucotrichophora.*
Habit: Adult feed on sap.
Extent of Damage/Status: Data Deficient.

229.*Physatocheila dryadis* (Drake & Poor,1936)
Superfamily: Miroidea
Family: Tingidae
Subfamily: Tinginae
Distribution: Ramgarh, Nainital, Uttarakhand, India(https://artsandculture.google.com/asset/physatocheila-dryadis/xQFs_OpFBJBSfg). 1 specimen collected from 12.vi.2020from Chakrata Forest Division, Dehradun district, Uttarakhand 2100m.
Species of oak infested: *Quercus floribunda*(Beeson,1941).
Habit: Adult feed on sap.
Adult: According to Drake & Poor (1936), its head is dark brown with five short, blunt, testaceous spines. Length is 3.40 mm and width is 1.50 mm. Antennae are testaceous, apical segments are mostly black; First segment is short, slightly stouter and little longer than second; third segment is moderately slender, three times as long as fourth. Body from beneath is brown. Rostrum is extended to the metasternum. Pronotum is sharply tricarinate, closely pitted, transversely convex; median carina is slightly more elevated, uniserate; lateral carinae is parallel and minutely uniserate. Paranota is moderately wide, reflexed back on the sides of the pronotum but with the outer margin slightly turned up from the pronotum with two rows of areole visible

from above and one below. Collum is distinctly raised, hood like, faintly produced in front and reticulate. Elytra is yellowish-brown with a few fuscous markings, sometime with more or less distinct transverse fascia at the middle; costa area are moderately large and hyaline; subcostal area is narrow and biseriate; discoidal area is large extending beyond the middle of elytra; the outer boundary is slightly sinuate and widest near middle. Pronotum is yellowish-brown, the triangular portion is sometime fuscous black. Legs are testaceous and tips of tarsi are dark in colour.
Extent of Damage/Status: Data deficient.

230.Rice Ear Bug, *Leptocorisa oratoria* (Fabricius,1764)

Superfamily: Coreoidea.
Family: Alydidae
Subfamily: Micrelytrinae
Synonyms:
Leptocorisa bengalensis Westwood,1842
Leptocorisa maculiventris Dallas,1852
Leptocorisa trinotata (Herrich-Schäffer, 1846)
Distribution: Western Himalaya: Uttarakhand. It is a widely distributed in southern and south-eastern Asia and Australia (Pathak,1968).
Species of oak infested: *Q. leucotrichophora.*

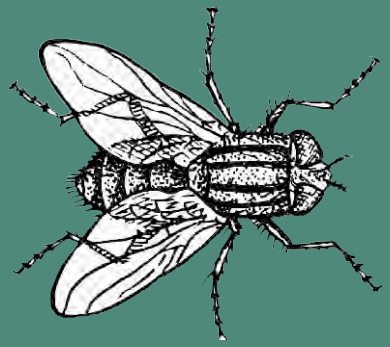
Fig.216. Adult- *Leptocorisa oratoria*(Fabricius,1764)

Other host plants: This bug has a wide range of host plants includes mostly Graminae (cultivated or wild), such as sorghum, grasses (viz. Cenchrus, Digitaria, Echinochloa and Panicum) and legumes (Li,1985).
Habit: Adult recorded feeding on sap of ban oak trees in New Forest, FRI Dehradun, Uttarakhand on 22.ii.2018.
Eggs: The mated female laid an average of 98.9±27.02 eggs which ranges from 75-135. Eggs were laid singly, in clusters or in linear fashion on the tip of the upper leaf surface and sometime on petiole and as many as 17 eggs were found in a batch. The newly laid eggs were pinkish black, oval in shape and glossy in appearance, which latter turned into deep black in colour. Each egg was placed on the surface in contact with the previous egg and cemented (Kunal et al.,2020).
Nymph: There were five nymphal stages

where the insects moulted between each stage. Freshly hatched nymphs (first instar) were pale greenish in colour and had long reddish antennae with whitish bands. The duration of the first instar nymph lasted for 2-4 days with an average of 3.4±0.84 days. Second instar nymph was similar to that of first instar in appearance except for the size. The duration of second and third both instars were lasted for 3-5 days with an average of 3.9±0.87 days but the third instar nymph was dark greenish in colour. The duration of fourth instar nymph ranged between 3-6 days with an average of 3.9±1.10, having greyish green in colour with reddish to reddish brown eyes. The fifth instar nymph was larger and pale brown in colour with well-developed wings. The duration of this instar ranged from 3-6 days with an average of 4.2±1.03 (Kunal et al.,2020).

Adult: The adult females were measured to be 15.8 to 17.5 mm (16.58±0.57) in length and 2.00 to 3.00 mm (2.69±0.34) in width whereas the length and width of males were observed to be slightly smaller and were varied from 14.00 to 15.50 mm (15.06±0.49) and 1.6-1.8 mm (2.36±0.27) respectively (Kunal et al.,2020). It has a slender body, around 2 cm in length, with long legs and a long proboscis. It is yellow-brown in color(https://en.wikipedia. org/wiki/ Leptocorisa_oratoria).

Extent of Damage/Status: Uncommon in ban oak forests.



DIPTERA

4.DIPTERA
(Flies & midges: Gall makers)-1 species

These insects are capable of forming galls (leaf or stem) on plant tissues that are unusual plant growths which develop as a result of abnormal cell division or cell enlargements after infestation of plants by these insects. Galls provide food and shelter for the invading insects.

231.Gall midge-Unidentified Cecidomyiidae Fly
(Genus: *Asphondylia, Lasioptera* and *Dasineura*)
Super family: Sciaroidea
Family: Cecidomyiidae/ Itonididae

New leaf galls on Ban oak in monsoon

Old leaf galls during autumn

LS of leaf gall with fly larva

LS of leaf gall with fly

Fig. 217. Leaf and Stem galls on Ban oak,*Quercus leucotrichophora*.

Distribution: Worldwide-North & South America, Asia (China and India) (Gagne &Jaschhof,2004).Temperate Himalaya-Uttarakhand [Mussoorie(Mishra & Patni,2008) &Chakrata Forest Division, Dehradun district].

Species of oak infested: *Quercus leucotrichophora* (Mishra & Patni,2008).

Other host plants: *Acacia*(Fabaceae), *Aster* (Asteraceae) and *Salsola* (Chenopodiaceae) (Gagne & Jaschhof, 2004).

Habit: Fly larvae make leaf and stem galls on oak trees. Larvae of Cecidomyciidae family were found feeding upon the nutritive tissues inside the ban oak leaf galls on 25 May2018 in Chakrata Forest Division (2100 m), Uttarakhand and the larvae feeding continued until winter (Dec2018). Larvae were creamish in colour and feeding within the gallery inside the galls. Up to 50 galls may occur on a single leafwhich are two chambered or bilocular. The gall provides a source of food for the insect where it takes shelter and completes its life cycle. One larva develops and grows inside a single leaf gall during summer and emerges as an adult in the following spring.Fresh ban oak leaf galls are pale green in colour but later turn light brown. The galls are resistant, hard, and woody and persist for long period and serve for hibernation and pupation of the gall midge. Also, rounded shaped stem galls were recorded on thin stems on the same tree with leaf galls on 25 May2018. These galls had many holes all over suggesting that the emergence of adult flies had already taken place.

Larva: Larvae are apodous maggots, characterized by the presence of a peculiar sclerotic sternal spatula. The larval chambers were superficial and formed by tissue projections. These chambers are not completely separated. The nutritive zone is present lining the gall chambers. (Mishra & Patni,2008).

Extent of Damage/Status: Wide spread all over the state on ban oak forests. Local infestations not significant.

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The book on "Insect Pests of Western Himalayan Oaks in Uttarakhand" gives a comprehensive account of 231 species of insects infesting 5 species of Oaks (*Quercus* spp.) found across the state of Uttarakhand, India. Information is presented on their classification, life history stages depicted with colour photographs, distribution range, host plants spectrum, habits and habitat, seasonality, extent of damage and pest status. A handy guide for researchers, forest managers, NGO's and local communities for identification and knowing these insect pests in a much better way, for their management.

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Insect Pests of Western Himalayan Oaks in Uttarakhand

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