Chapter-2 REVIEW OF LITERATURE

A voluminous literature contributed by several authors is being available relating to cerambycid taxonomy and bio-ecology, but it is hardly possible to mention all the papers concerned with different aspects in this regard. Therefore, in this text only the pertinent literatures relating to this matter are presented hereunder.

2.1. Taxonomy:

The history of the classification of Cerambycidae or Longicornia as a hole dated back to the middle and late nineteenth century by Leconte (1850, 1851 and 1852), White (1853 and 1855), Thomson (1860), Lacordaire (1869, 1872 and 1876) and Pascoe (1864-1869). Leconte was the first worker who put forward the philosophical arrangement of longicorn beetles but his knowledge was restricted to the North American taxa (Pascoe 1869a, b, c; Fragoso et al., 1987). Thomson (1860) later treated all the longicorn genera of the then accepted families, namely, Prionidae, Cerambycidae and Lamiidae in the “Essai d’une Classification de la Famille de Cerambycides”.

Taxonomy of the family Cerambycidae sensu stricto is not well established (Hunt et al., 2007; Lawrence and Newton, 1995; Napp, 1994; Odzdikmen, 2008; Sykorova, 2008). Some authors recognized Cerambycidae as a separate superfamily Cerambycoidea (Svcha and Danilevsky, 1986). This family is currently classified under the superfamily Chrysomeloidea along with the families Vesperidae and Disteniidae (Hunt et al., 2007; Szeoke and Hegyi, 2002). Cerambycidae sensu stricto is divided into several subfamilies. These are Parandrinae, Prioninae, Lepturinae, Nectyalinae, Spondylidinae, Apatophyseinae, Cerambycinae and Lamiae.

The most comprehensive and fundamental taxonomic work on Cerambycidae was first published (1869, 1872 and 1876) in the eighth volume of Lacordaire’s
“Genera des Coleopteres”. Works on cerambycid taxonomy owed much to the contributions by Gressitt. His numerous papers (1935, 1936, 1940a and b, 1951a and c and 1959) and monographs (Gressitt, Rondon and Breunuing, 1970) which dealt mainly with Prioninae and Cerambycinae thoroughly documented the diversity of Oriental and Australian (Papuan subregion) cerambycids.

Taxonomic studies of the Cerambycidae in the Oriental regions were carried out by Gahan (1890a, 1906), Aurivillius (1922c) and Fisher (1930, 1940). In the late nineties, Hyashi and Hudepohl are the only entomologists who have been actively engaged in taxonomic work on cerambycids in Borneo or nearby regions. Hayashi (1977, 1978, 1979, 1987 and 1992) and Hayashi and Villers (1985) concentrated much on cerambycids of Peninsular Malaysia and Sabah. Concurrently, Hudepohl (1983, 1987b, d, 1988a and b, 1989 a, 1990b, 1992b) worked on the cerambycid fauna of the Philippines and also described several species from Peninsular Malaysia and Sabah.

However, the most pioneering taxonomic and biological investigations on cerambycid beetles in India were initiated in the twentieth century. Gahan (1906) gave a comprehensive coverage of most of the genera represented in the Indian region and part of the Malaysian sub region. Hope (1839, 1843, 1845b) made some valuable contributions to the cerambycid fauna of Assam valley. Fletcher (1914) incorporated 13 species of Cerambycid beetles from South India in his book “Some South Indian insects and other animals of importance considered especially from an economic point of view”.

After a long gap, Sengupta and Sengupta (1981) reported 16 species of cerambycid beetle from Arunachal Pradesh which was reported for the first time from this area. Basak and Biswas (1985) also recorded 12 species of Cerambycidae from Namdapha wild life sanctuary of Arunachal Pradesh, of which 9 species were recorded for the first time from Arunachal Pradesh. They in 1993 subsequently contributed on the cerambycid fauna of the state of Orissa.
Biswas and Basak (1992) reviewed six Indian species of the genus *Apomecyna* with a morpho-taxonomic key to the genera of the Tribe Apomecynini. Raychaudhury and Saha (2001) worked out the cerambycid fauna of Buxa tiger reserve of West Bengal and reported 12 species of Cerambycidae from this area, of which 7 species are new records from the state of West Bengal.


The first record of a Cerambycid species from Andaman & Nicobar Islands dated back to 1775 when Fabricius reported *Callidium barbatum* (*Stromatium barbatum*) from the Andamans. Subsequently, the same author added a few more species, namely, *Cerembyx holosericea* (=*Aeolesthes holosericea*) in 1787 and *Apomecyna histrio* in 1792. Then after a long gap, Hope (1831) reported a Lamiinae species, *Cacia cretifera* (= *Cacia (Pericacia) cretifera*) for the first time from Nicobar Islands. Subsequently, Waterhouse (1836) described a Prioninae species *Remphan hopei* (=*Rhaphipodus (Remphan) hopei*) from Andaman.
Addition of *Sarmydus antennatus* by Pascoe (1867), *Marmaroglypha nicobarica* by Redtenbacher (1868) and *Eurypoda (Neoprion) parandraeformis* by Lacordaire (1869) further enriched the cerambycid fauna of these islands. After a gap of 8 years *Macrotoma (Zooblex) elateroides* was reported from these islands by Thomson (1877), and in the next year (1878a) the same author contributed 5 more species to the Cerambycid fauna of these islands. Further addition was also made by Thomson in the same year (1878b) by reporting 3 more species, namely, *Choeromorpha ochracca* (=*Agelasta ochracea*), *Coptops rufa* and *Pelargoderus niger*. Subsequently, the same author (1879) reported two species, one from Andaman, viz., *Glenea jacintha* and one from Nicobar, *Glenea (Macroglenea) corona*.

Pascoe (1885) reported two species, *Clytellus olesteroides* and *Artimpaza bicolor* both from the Andamans. After that Gahan (1895) added *Aeolesthes basicornis*, *Epepeotes andamanicus*, *Macrochenus atkinsoni*, *Rhaphipodus andamanicus* (=*Rhaphipodus (s.str.) andamanicus*) and *Tetraommmatus insignis* from Andaman. Further, in his fauna volume of British India (1906) enlisted a big list of Cerambycinae, Prioninae, Disteninae with their synonymical name and also reported a few new species. In that monumental work he listed 396 species of Cerambycidae of Andaman & Nicobar Islands including 113 new species.

In the early 1900 onwards enormous works of a French worker S. von Breuning enriched the Cerambycidae fauna of Andaman & Nicobar Islands. The first record by Breuning (1935) from Andaman was *Pterolophia (Ovalopraonetha) ovalis*. Subsequently, the same author in 1935, added a few species like *Blepephaeus andamanicus*, *Blepephaeus nicobaricus*, *Dihammus andamanicus* (=*Acalolepta andamanica*). Further addition took place when Breuning (1936, 1938, 1939 and 1940) reported 22 species from these Islands.

Period from 1957 to 1967 except in 1959 may be called as Breuning’s period because, all the cerambycid species known from these islands during that period were reported by Breuning only, out of which some were new to science.
Further addition remained blank until 1970 when Breuning (1970) described a new species from Nancowry Island, namely, *Pharsalia (Eopharsalia) nicobarica*. Then another new species *Coptops aedificator* was described by Lane (1972) from Andaman. The new species addition was further made by Breuning (1973) when he described *Ropica andamana n.sp.* and in 1974, he also added *Niphona andamana n.sp.*, *Pterolophia (Pterolophia) andamana n.sp.*, and *Sybra (Sybra) subunicolor n.sp.*. Subsequently, Khan (1985) recorded 28 species of cerambycid beetles from Neil Island of South Andamans. Very recently in 2000 one new species, *Macrotoma (Zooblax) nicobarensis* has been described by Lackerbeck from Nicobar island (*vide* Komiyo and Lorence, 2005).

2.2. Bioecology:

In comparison to other tropical countries of the world, the history of forest entomological research in India is considerably old. Probably, with the publication of the life history of Indian termites by Koenig (1779) the scientific work on biology of Indian insects began. Kerr also worked in India and published a study on the lac insect (Kerr, 1781). Helfer (1810-1840) may be the first collector of insect pest in India (*vide* Beeson, 1941). Early data on the food-plants and larvae of forest insects were assembled in Housefield and Moore’s Catalogue (1857-1859).

Oviposition biology of *Acanthocinus nodosus* was examined on southern pine beetle (SPB), *Dendroctonus frontalis*, infested loblolly pine trees in Alabama, U.S.A. by Dodds *et. al* (2012). Components of oviposition biology, including oviposition pit description, colonization period, average number of eggs laid per oviposition pit, use of bark beetle entrance or ventilation holes as oviposition sites, and pit density were described. In their experiment they have showed that, Colonization of trees by *A. nodosus* began within 2 days of initial SPB attack and lasted for 8 to 14 days. Females laid an average of 3.33 (SE ±0.48) eggs per oviposition pit and 99% of the pits occurred on SPB entrance and ventilation holes. All pits were on the lower bole between 18 and 163 cm above the ground. Oviposition pit density ranged from
0.22 to 0.45 pits per cm² of bark surface. Potential interactions with other phloem inhabiting species were noted.

In other works of biology, Moller and Munoz (1997) showed that Cerambycid beetles have exaggerated antennae that are usually sexually size-dimorphic. Their result suggests that antennal symmetry, but not length, is currently under sexual selection.

Investigations of the reproductive characteristics of *A. glabripennis*, including preovipositional period, age specific fecundity and survival, on Norway maple (*Acer platanoides* L.), red maple (*Acer rubrum* L.), and black willow (*Salix nigra* Marshall) were undertaken to quantify its reproductive capacity among these host-tree species under laboratory conditions by Smith *et al* (2002). Collectively, results show that in terms of adult female *Anoplophora glabripennis* survival and reproductive capacity, Norway and red maple were more suitable than black willow, with Norway maple somewhat more suitable than red maple.

Research on Forest entomology in India produced prolific literature between the mid nineteenth and mid twentieth centuries. Even then, knowledge on the biology and ecology of the cerambycid borers inhabiting the Indian subcontinent is certainly poor in considering the enormous scope of studying these insect fauna of great economic importance. Stebbing and Beeson of Forest Research Institute, Dehradun were the pioneer workers in the field of bio-ecology of the Cerambycidae in India.

In 1899, Stebbing assembled all the available information on Indian forest insects in a publication entitled “Injurious Insects of Indian Forests” which included about 100 named species. In 1914, a masterly volume on forest beetles entitled “Indian Forest Insects of Economic Importance – Coleoptera” was authored by Stebbing, the first Forest Zoologist in India. At that period distinction into forest insects and others was not very relevant and the world-renowned book by Lefroy entitled Indian Insect Life, published in 1910.
Beeson’s monumental work entitled “The Ecology and Control of the Forest Insects of India and the Neighbouring Countries”, published in 1941, is the most comprehensive and authoritative work on tropical forest insects, containing references to 4300 species of forest insects and continuing to be a very valuable reference book even today.

For the existing knowledge on the forest insects the entire credit goes to the work of Beeson and Bhatia (1939), which dealt with some 350 insect species associated with 568 species of trees, shrubs and woody climbers from the Indian region. Out of these, only some 34 species of cerambycid borers have been dealt with in greater details of biological features, while the others are limited to the distribution, duration of life cycle, emergence period, etc. They also reported that 37 species of cerambycid pests attacked Sal tree. Of these, one cerambycid species, viz., *Stromatium barbatum* (Fabricius) were found to attack as many as 311 plant species.

Discussing the distribution of forest Cerambycidae in India, Stebbing (1914) pointed out that the habitat of the same species of tree may vary from a comparatively hot, dry climate to a hot, moist one, as the sal (*Shorea robusta*) occurs in the Central Provinces and in Assam. Some of the insect species which infest the tree in the hot, dry climate have also become adapted to the hot, moist one. A comprehensive work on the Sal heartwood borer of India was carried out by Roonwal (1977). He has studied the epidemics of Sal heartwood borer *Hoplocerambyx spinicornis* in the sub Himalayan region of India. Bhandari and Singh (1988) also studied the epidemics of sal heart wood borer in Madhya Pradesh and suggested its control measure. Recently, Dey (1999) studied the behavior of *Hoplocerambyx spinicornis* in Madhya Pradesh.

Kumar *et al.*, (1996) studied the life cycle and infestation of the stem borer *Plocaederus ferrugineus* in cashew plantation in Karnataka. Ambethgar *et al.* (1999) and Ambethgar (2002) used fungal pathogen to control the *Plocaederus obesus* which is the stem and root borer of cashew plants. Sahu and Sharma (2008)


Chandy and Miller (1967) reported the occurrence of *Batocera rufomaculata* De Geer as a serious pest of Eucalyptus which is commonly known as Mango wood borer. Ralph (1986) reported *Celosterna scabrator v spinator* as pest of Eucalyptus. But Shivayogeshwara *et al.*, (1988) observed the incidence of *Celosterna scabrator* Fabricius on Eucalyptus in Malnad tracts of Shimoga. This is supported by the observation of Meshram (1995) who recorded *Celosterna scabrator* Fab as pest of this plant. Sivaramakrishnan (1986) and Sivaramakrishnan and Sarma (1989) reported the threat of this borer to the forest plantation of Karnataka and also observed the outbreak of this pest species in Eucalyptus plants. Ranga Rao *et al.* (1979) collected the pest of eucalyptus, *Coelosterna scabrator* F. from the grape vines in Andhra Pradesh as new record.

Recently, Remadevi and Muthukrishanan (2006) reported *Aristobia octofasciculata* (Cerambycidae: Coleoptera) as a serious pest of sandal wood in Southern India. This pest is reported so far from sandal only. Few species of *Aristobia* are known as wood boring pests of important trees like *Aristobia horridula* on *Dalbergia sissoo* (Mishra *et al*.1985), *Aristobia testudo* on Guava (Shylesha *et al*., 2000) and *Aristobia approximator* on teak (Kawbe and Ito, 2003).
spinosa (Cerambycidae: Coleoptera) is reported by Remadevi et al. (2000) as pest of *Casuarina equisetifolia* from Southern India, which is used in marine aquaculture farms for many purposes. *Oberea artocarpi* was reared in the green twig of *Artocarpus integrifolia* and reported by Gardner in 1941 from Kerala.


Saikia et al. (2011) in their laboratory experiment showed that the male beetle of citrus trunk borer (*Anoplophora versteegi*) lived slightly longer than female beetle. The adult female beetle lays 170.6 ± 57.46 eggs, which hatched in 5-7 days. The eggs laid in the first half (84.6 eggs /female) of their life were slightly less than in the second half (86 eggs /female). The frequency of egg laying per day per female varied from 0 to 11 eggs with the mean egg deposition frequency of 2.90 eggs per female. The egg hatching percentage was found to vary from 90 to 100 per cent with an average of 92.86%. *A. versteegi* grub completed larval period in 240 to 310 days and adult emerged from pupa in 23-31 days. Freshly emerged beetle takes 3-5 days for hardening of body parts and thereafter starts feeding on citrus leaves and bark.

Recent comprehensive publication on forest entomology pertaining to India entitled “Forest Entomology: Ecology and Management” was published by Thakur (2000).

The biological information on cerambycid borers of the Andaman & Nicobar Islands is very scanty. Duffy (1968) published the first biological description of Lamiinae species, namely, *Coptops aedificator* and *Niphona hookeri* from these islands in his monumental works on immature stages of Oriental timber beetles. Moreover, a voluminous work on cerambycid ecology was made by Linseley in 1959.

Gardner (1927, 1929, 1930, 1931, 1941, 1944, and 1948) made a series of publications on the immature stages of Indian cerambycid beetles. Beside these, the study of immature stages and larval description of Indian Cerambycid borers have been dealt by Mathur (1958).

Khan (1988) studied the biology of *Halme caerulescens* which is a monophagous shallow borer of this group of Islands. Effects of relative humidity, moisture and light on pupal development and survival of *Plocaederus obesus* Gahan are studied by Khan (1987). Besides this, Khan (1985, 1989), Khan and Maiti
(1983) published a monographic works on bio-ecology, of the cerambycid beetles of these bay Islands.

Patterns of larval galleries, pupal chambers and other biological criteria may sometimes help to identify the borer species where adult/immature stages are not found. A biotaxonomic key of cerambycid species from Andaman & Nicobar Islands have been prepared by Khan (1989). Khan and Maiti (1982) have also been studied the bionomics, life history, fecundity, development, growth rate and behavior etc., of *Olenecamptus bilobus* Fabricius in the islands of Andaman & Nicobar. Khan (1985) summarised the succession and assemblage of the round-head borers on the *Canarium euphyllum* Kurz of the Andaman & Nicobar Islands. Khan and Maiti (1981) discussed the host selection and oviposition behavior of the cerambycid borers, *Acalolepta rusticator* (Fabricius) from the Andaman & Nicobar Islands.

Various aspects of the behavior of Cerambycid adults have been dealt with by several authors. The felled logs usually constitute a non-stable ecological unit. For food, shelter and larval development different insect groups invade the wood in a distinct ecological succession. Beeson and Bhatia (1939) in India studied the developmental biology of *Olenecamptus bilobus* Fabricius. C.F.C Beeson (1919) published a voluminous list of food plants of Indian Forest Insects. Maiti et al. (1983) in their study in Andaman & Nicobar Islands showed the succession of insect borers in the felled Papita log.

While studying the mangrove borers of Andaman and Nicobar islands, Tiwari et al. (1980) reported two species of cerambycid borers, *viz.*, *Aeolesthes (s.str.) holosericea* and *Ceresium flavipes* infesting mangrove trees of these islands. Subsequently, Dev Roy et al. (1987) and Das and Dev Roy (1989) reported four species cerambycid borers, *Aeolesthes (s.str.) holosericea, Ceresium flavipes, Plocaederus obesus* Gahan and *Megopis (Aegosoma) sulcipenne* White. Out of these, first two species were reported as heart wood borers of *Rhizophora apiculata* and the last two species reported as sap wood borers of *Heritiera littoralis* and *Sonneratia alba* respectively.