5.1. Taxonomy of the family Cerambycidae:

The occurrence of over 2000 indigenous and 500 non-indigenous angiospermic plant species in these islands (Rao, 1996) indicated a probable rich insect species diversity including cerambycid wood borers. The most notorious wood-boring family Cerambycidae is commonly known as longhorn beetles or long-horned beetles or longicorns, typically characterized by extremely long antenna.

The proper 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 classified the family Cerambycidae together with Chrysomelidae and Bruchidae under the Superfamily Chrysomeloidea. But others 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).

In this present study the classification has been followed after Gressitt, Rondon & Breuning (1970). According to Gressitt, Rondon & Breuning (1970), the family Cerambycidae belongs to the superfamily Chrysomeloidea under the suborder Polyphaga of the order Coleoptera.

5.1.1. Morphology of the family Cerambycidae:

Identification of organisms is fundamental to biodiversity studies. The recognition of the borer species by their morphological characters is the prerequisite to study diversity in all its facets. Owing to this, the discipline of taxonomy, especially scientific nomenclature, has gained immense importance.

The family Cerambycidae are separated from its closely related family Bruchidae by the normally developed last segment of the abdomen. The pygidium is usually hidden under the elytra in Cerambycidae, but it is always large and
prominent in Bruchidae, and this family separated from Chrysomelidae by the presence of apical spines on the tibiae.

The study of biodiversity cannot proceed further without the contribution of integrative taxonomy. There are different characters in the body parts which differentiate the species of this borer from other closely allied groups. Therefore, morphological description of a typical cerambycid borer was described along with the diagrammatic and photographic illustrations in this present study for easy identification of these notorious borers.

5.1.2. Morphology of the subfamily Prioninae:

The members of the subfamily Prioninae can be differentiated from the other subfamilies reported from these islands with their robust body, anteriorly forward head, large mandibles and horizontal position of head.

5.1.3. Morphology of the subfamily Cerambycinae:

The members of this subfamily are generally small to large in size, anteriorly forward head, pronotum not margined laterally. Antennae borne on raised tubercles. Lateral pronotal carinae absent. Antennae filiform; or serrate; or pectinate or bipectinate; or flabellate or biflabellate; or incrassate or clavate.

5.1.4. Morphology of the subfamily Lamiinae:

The members of this subfamily show maximum structural diversity in shapes, sizes and colours of their body. Head usually vertical, pronotum more or less prominent with lateral tubercles.

5.1.5. Cerambycidae of Andaman & Nicobar Islands reported so far:

A total of 146 species and 74 genera belonging to 26 tribes under 3 subfamilies of cerambycidae have been reported from these islands. Among them, three species, viz., Acalolepta nicobarica, Xenolea nicobarensis and Xenolea nancowriensis are scientifically not valid species according to the rules of Zoological nomenclature. Therefore, the present investigation reports a total of 143 species.
under 74 genera belonging to 26 tribes of 3 subfamilies from these islands. Among them, the subfamily Lamiinae shares maximum species (78%) followed by subfamily Cerambycinae (14% of species) and Prioninae (8% of species). It has been found that number of the species in the subfamily Lamiinae is always more than other subfamilies in India as well as in Andaman & Nicobar Islands.

5.1.6. Cerambycid borer species studied during the present work:

Out of 143 cerambycid species so far reported from these islands, only 45 species were collected and studied during this investigation. This is due to the banned on felling logs and reducing the number of extraction centers by the Administration, which directly affect on the cerambycid faunal diversity. As per Forest Statistics (2005), where 1.07, 769m$^3$ timber was extracted in the year 1996-1997, whereas from 2003-2004 onwards the timber extraction is almost nil in these islands. Among the collected cerambycid borer species, 62% of species are under the subfamily Lamiinae followed by subfamily Cerambycinae (27% of species) and Prioninae (11% of species) as corroborative with the reports of Fowler, 1912; Beeson and Bhatia, 1939; and Sengupta and Sengupta, 1981, the subfamily Lamiinae is also the predominant subfamily in Andaman & Nicobar Islands.

5.1.7. Morphological description of the borer species:

In this present study morphological characters of forty five cerambycid borer species were initially chosen based on the study under microscope binocular in the laboratory of collected materials. Diagnostic characters along with photographic views of the borer species will help to identify the species level.

5.2.  Bioecology of the Cerambycid borers:

There is no doubt that the survival potentiality of all the wood-boring insects including the cerambycid-beetles has certainly increased by the characteristic biological features and unique ecological adjustment with the physico-chemical changes of wood-hosts. The aggregation of adult beetles around freshly felled logs in the timber extraction and logging centers of the islands of Andaman is a common occurrence, particularly in the breeding season. The aim of such
aggregation seems to be secure suitable oviposition sites in the host-material. Although, the females visited all the available timber species, they only oviposited in their preferred hosts (Khan & Maiti, 1983). Males in general are hardly influenced by the presence of suitable and sufficient oviposition material and a small number of individuals of the different species are also visiting the host-logs in association with the ovipositing females (Khan and Maiti, 1982). Their occurrence may be due to the aggregation of a considerable number of females in the area for a long time (Khan and Maiti, 1982).

In these islands usually two types of oviposition of cermabycid borers have been observed. The duration of the life-cycle of the ceranbycid-borers varies within wide limits in the islands of Andaman. Sometimes, the individuals of a single progeny take much longer period to complete development in comparison with their closest allies. Although, a number of biotic environmental factors, such as inter- and intra-specific completion, and the physic-chemical set up of the host-material, seem to be the most important. Heavy infestation with the interference of more than one species, usually results in the rapid destruction of the entire subcortical tissue and eventually the larvae are forced to move into the deeper wood. As such, when the larvae are forced out of the nutritionally superior subcortical zone at an early stage of development, growth is normally checked during the later phases resulting in delayed development. Such phenomenon has also explained by Hosking and Bain (1977) and Khan and Maiti (1982). However, these borers in the insular environment of the Andamans, complete 2-4 generations per year. It can be inferred that the non-seasonal climate prevailing in these islands situated nearer Equator, favours a shorter life-cycle through frequent mating and ovipositing activities. In contrast, the predominating seasonal climate on the mainland of India favours a longer life-cycle. Moreover, the characteristic depauparate nature of the borer-fauna in the insular areas, perhaps reduces both the inter- and intra-specific competition for the same wood-hosts, which may increase the reproductive potentiality of these borers.
5.2.1. Bioecological description of borer species:

Biological features of these borers have been discussed in general along with some relevant studies made by several authors in mainland India and Andaman & Nicobar Islands. Different stages of their life cycle have also been incorporated along with a generalized life history of a typical cerambycid borer species. Because, correct identity along with bioecological peculiarities of these borers discussed in this monographic work will certainly help to keep the population of these borers below the threshold level of their damage.

Although there is remarkable uniformity in the major biological features of the borers studied in these islands, some differences are pronounced in certain species depending upon the inherent characteristic features of the borer as well as the physiographic location and micro-climate conditions of the host-material. The most obvious differences between the species are the depth of larval penetration, shape, size and orientation of the pupal chamber, poly-phagy or mono-phagy feeding habits host-range and selection, etc.

5.2.2. Life table study of Olenecamptus bilobus (Fabricius):

Though there are very little information on the biology of cerambycid borers in India and Andaman & Nicobar in particular, but fecundity and intrinsic rates of increase have been reported for some lamiine species in other parts of the globe. Daily and lifetime fecundity for Monochammus carolinensis were reported to average 2.6 to 5.7 eggs per day and 116.5 to 200 eggs per female, respectively (Walsh and Linit 1985; Akbulut and Linit 1999a, 1999b), and 6.3 eggs per day and 119 eggs per female, respectively, for E. rufulus (Donley 1978). Lifetime fecundity of Anoplophora glabripennis was previously reported to average 35 eggs/female (30 to 80 eggs) on Populus spp. (Xiao 1992), and 68 eggs/female on Anoplophora saccharum.

In India, Meshram (2009) in his study found that the female beetles of Plotaederus obesus laid eggs 40-50 eggs. The egg laying period varies from 5-7 days. In another study, Remadevi and Muthukrishnan (2006) were recorded upto 15 eggs from a single female of Aristobia octofasciculata Aurivillius under laboratory
condition. In Andaman, Khan and Maiti (1982) observed that the number of eggs laid by a single female of *Olenecamptus bilobus* was 5-13 (mean 9) per day and oviposition may continue throughout life which extends for a few days to almost three weeks and under laboratory condition, the oviposition period varies between 5 and 17 days (mean 13). Which is not supported the study of Meshram (2009) and Remadevi and Muthukrishnan (2006) in mainland India, but supported the observation of the present study.

There are a number of factors that may affect or influence reproductive success, including individual fitness and host characteristics and quality (Price 1997). In Andaman, in another study it has been found that the pollen feeding cerambycid species *Aeolesthes (Aeolesthes) holosericea* have the capability of laying eggs on average of 500 eggs by a female during the life span of only 30 days (Khan & Maiti, 1983).

It is not only the feeding habit or host quality which enhance the fecundity measures of cerambycid borers of these islands, but also the constant temperature (average Max. 30.7 to 31.3 and Min. 24.4-24.6) of these islands is also one of the major causes for enhancement of average number of eggs laid per female, in longevity, or in the percentage of females which oviposited. Dür (1954) made a study of the effect of physical factors on adults of *Hylotrupes bajulus* (Linnaeus) and concluded that effect of temperature is most striking on longevity, number of eggs per female, and the percentage of females which oviposited (females were kept with males constantly).

Mortality in cerambycid populations from biotic and physical causes may be high (Linsley, 1959). Peterson (1948) found 25 percent mortality of eggs due to infertility, climatic conditions and 18 percent loss by parasites. The mortality factors for loss of stages during the present study is also supported by the study of Khan & Maiti (1982), where they have found that the optimum humidity appears to be more than 70%, below to that none survives.
Linsley (1959) reported that among the most effective natural enemies of the cerambycid and other wood-boring beetles are predaceous Coleoptera. Khan (1990) in his study showed that parasitoid caused 16.31 to 22.20 percent mortality among the natural population of *Serixia andamanica* of these islands. Coleopterans were the most important ones causing 6.63 – 11.0 percent of the host mortality which also supported the present study.

Initially a total of 1351 and 1473 eggs were alive during the present study which laid by ten gravid females (tables- 9 & 10). Results in this study showed that the key mortality factors for *Olenecamptus bilobus* were natural enemies, low humidity and non viability and non fertility of eggs. In both the observations it has been found that the early larval stage (K value = 0.23 and 0.214) was the most vulnerable stage in the life cycle which is also supported by the work of Zhao *et.al* (1993).

### 5.2.3. Host range and host specificity of the borer species:

Host selection and host specificity, although interrelated, is not necessarily the same thing. The host selection depends on the availability of food plants, suitable place for oviposition, protection of immature stages and less number of competitors. Therefore, selection of the appropriate host is one of the most vital issues for the successful development and proper growth of borer larvae. It has been reported that, the host plant is not merely something fed on, it is something lived on. Moreover, it will be a suitable place for oviposition. Ovipositing adults are influenced to a greater degree by the nature and condition of the host plant (i.e., thickness of bark, stage of decay, moisture content, other microclimatic conditions and identity of the host species). According to Peyerimhoff (1933) host selection involves a combination of factors, including the attractiveness and condition of the host, internal factors of the plant feeder (including mutation), as well as environmental conditions.

Khan and Maiti (1981), in their experiment showed that the host selection of *Acalolepta rusticatrix rusticatrix* in these islands depends primarily upon the
condition of the host material (i.e., stage of decay) and secondarily upon the host identity. In another experiment, Khan (1987) showed that, pupal development and survival in *Neoplocaederus obesus* are greatly depend on high relative humidity and darkness of the surrounding (microclimatic conditions).

The facility with which host selection is accomplished by the females is undoubtedly a result of high development of special sense organ because ovipositing females possess a ‘botanical instinct’ that helps them to recognize their host plants. Most of these organs are found in cerambycid antenna. Loss of both the antenna greatly impairs of inhibits the host selection.

During this present investigation, 45 borer species were found to select 79 host plant species as their suitable breeding ground and enemy free space of their larvae (table-11). But, most of the borer species found in this study is not host specific. Host specificity in varying degrees is characteristic of Cerambycidae and has undoubtedly been an important factor in their evolution (Linsley, 1959). The host specificity depends on the feeding habit of the borer species. They may be satisfied with single species of host plant (monophagy) or may depend on many host plants species (polyphagy).

In this study, the majority cerambycid borers are found polyphagous (95% of species) and only two species; namely, *Halme caerulescens* and *Rhaphipodus (Remphan) hopei* are the monophagous (table-11). Bernays, E.A. and Graham, M. (1988) stated that host-plant specialization is the rule rather than the exception. According to them, less than 10% of herbivores species feed on plants in more than three different plant families. Monophagy, the other extreme, is a common feature, and in certain insect groups it is even the dominant habit.

So the data of this present investigation do not support observations made by Bernays and Graham (1988). This is due to the reason that, the host-plant specialization rule in felled logs or under storage conditions does not followed the general rule of living trees. Linsley (1959) stated that, the more primitive groups of
cerambycids are more polyphagous (e.g., Parandrinae, Prioninae, Lepturinae), although some more specialized forms of restricted host range occur among them (eg. Rhaphipodus (Remphan) hopei in this present study). Further, the polyphagous species are usually associated with such wood which has been dead for some time or is actually decomposing (Linsley, 1959). In general, those species which develop as larvae in living trees are usually the most narrowly host specific (Linsley, 1959).

Considering the number of host plants as destructive measures of a pest then, Stromatium barbatum (36 host plant species) appears to be the most destructive pest in these Islands (table-11). Earlier studies also revealed that it is the predominant wood borer in India (Beeson and Bhatia, 1939) and in Andaman & Nicobar Islands (Khan and Maiti, 1983). Probably, the unique capability of ovipositing by Stromatium barbatum in excessively dry wood and its ability to retain body moisture in the dry microclimatic conditions leads this cerambycid insect to be the predominant wood borers in all the situations. The other borer species such as, Acalolepta rusticatrix rusticatrix, Aeolesthes (s.str) holosericea, Neoplocaederus obesus, Pelargoderus niger, Olenecamptus biobus, Batocera rufomaculata var andamana, Palimna annulata, Xystrocera globosa, Coptops rufa, Epepeotes luscus v. ochreosticticus, Glenea (Stiroglenea) andamanica, Ceresium andamanicum, Epepeotes andamanicus, Pharsalia (Cycos) subgemmata and Stibara (Stibara) suturalis, etc are also known to infest large number of host plants in these islands (table-11).

There is no doubt that the survival potentiality of all the wood-boring insects including the cerambycid beetles has increased by the characteristic biological features and unique ecological adjustment with the physico-chemical changes of wood-hosts. So, those host plants would attract the wood borers more who can fulfill all the prerequisite conditions for them.

During the present study, the logs of Canarium euphllum were found to be ideal habitats for cerambycid wood borer species of these islands since logs of this host plants harbour 14 species of borers (table-12). The soft wood of Canarium
euphyllum allowed easy penetration and thick bark of this host plant retains the moisture content for longer span of time, making it a susceptible host plant for wood borers in these islands. The other susceptible host plants observed during the present study are: Ficus carica, Mangifera andamanica, Salmalia insignis, Lannea coromandelica, Mangifera indica, Pongomia pinnata, Terminalia procera, Pterocymbium tinctorium, Semecarpus kurzii, Dipterocarpus sp., Salmalia malabarica, Samanea saman and others (table-12).

Twenty seven species less susceptible host plants were found during this study, which were found to be attacked by single borer species each (table-12). Therefore, it appeared that majority (66%) of the host plant species found in this study were attracted by more than one borer species. This may be due to availability of maximum number of host plant species at a time in small area in logging centers or under storage condition.

5.2.4. Microhabitat diversity of the borer species in general:

Wood is an important renewable but easily biodegradable raw material, which is prone to attack by a large number of insect wood borers in the logging centres. So, felling of trees in the forests provide abundant food material to the insect wood borers, which under favourable conditions, multiply in large number and also protect themselves from their enemies. So, these microhabitats are very much important for each species of wood borers. Therefore, it is very much essential to know the larval gallery pattern or the microhabitats of these borer species.

During this study three major types of microhabitats have been found for all the cerambycid borers, in which different types of microclimate prevail. During this study, microhabitats of the borers have been grouped broadly as “under bark”, “sap-wood” and “heart-wood” depending upon the depth of penetration into the host plant.
Among the 45 cerambycid borers incorporated in this study, the sap wood shared maximum number of borer species (38%). The second most favourable microhabitat of these borers species was under bark (24%) and the third one is heart wood where less number of borer species (18 %) confined themselves (fig-87). Some cerambycid borers also occupy more than one micro habitat, namely bark and adjacent sap wood and sap wood and adjacent heart wood. During the present study, 9 % borer species is found in between bark and sap wood and 11% in between sap wood and heart wood. (fig-87).

Selections of such larval habitats are normally, either related to the food requirements of the species for its proper growth and development or to avoid of inter-specific competition for the same food source. The present result showed that the all these above mentioned factors or support were given to the borer community by the sap wood of host plants and therefore, the species diversity maximum in sap wood of all the host plants reported from the Andaman & Nicobar Islands.

5.2.5. Cerambycid borer diversity in important timber yielding plant species:

Among the 79 host plant species attacked by 45 cerambycid borer species, only 26 plant species were categorized by Botanical Survey of India and Andaman & Nicobar Forest department as timber yielding plant species and rest 53 species as non-timber yielding plants (table- 18).

Among the 45 borer species studied during the present work, five borer species namely, *Ceresium flavipes, Dorysthenes (Lophosternus) indicus, Mimabryna nicobarica, Acalolepta nivosa* and *Ropica honesta m. rufescens* were found as least significant due to restrict their attack only on non-timber yielding plant species of these islands (table- 18).

Among the rest, 12 cerambycid borer species can be classified as less significant borer species because they were found to attack only single timber
yielding plant species. Considering the significance of the borers species in general among the rest, the most notorious cermabycid borers were *Neoplocaederus obesus* and *Stromatium barbatum*. These borer species were found to attack 8 number of timber yielding plants species each. The rest of the borer species were also economically important as they found to attack more than one timber yielding plant species (table- 18).

On the basis of their wide uses for commercial purpose and highly priced market value these timber yielding plants were categorized by the forest department as per table-19. Apart from the criteria fixed by the forest department of Andaman & Nicobar Islands four timber yielding plant species viz., *Pterocarpus dalbergioides*, *Artocarpus chaplasha*, *Teminalia procera* and *Canarium euphyllum* were selected for the present study on the basis of their maximum felling in the extraction centers, availability of the species throughout the year and also easy access to the logging centers for study (table-20).

These four timber yielding plant species were found to attack regularly by 19 cerambycid borer species in these islands, of them, *Acalolepta rusticatrix rusticatrix* and *Batocera rufomaculat v. andamana* appears to be the predominant polyphagous species (3 host plants each).

**5.2.5.1. Microhabitat diversity of the borer species in important timber yielding plant species:**

Though this host plants has favourably supported a large diversity of cerambycid borers, the utility or the commercial potentiality of this timber plant species have got seriously affected.

The host plant species *Pterocarpus dalbergioides* harboured 5 species, namely, *Batocera rufomaculata v. andamana*, *Coptops leucostictica*, *Desisa (Desisa) subfasciata*, *Pelargoderus niger* and *Xystrocera globosa* of cerambycid borers thereby indicating comparatively poor adaptability of the borers in different microhabitats. Further, it is evident from Table. 22, that, out of 5 species, 3 species remain restricted up to the level of sap wood while only 2 species, namely,
Batocera rufomaculata v. andamana, and Xystrocera globosa extended up to the heartwood. Therefore, the most economically important heart wood of Pterocarpus dalbergioides did not support adequate environment with respect to food resources, penetrability and others for distribution of more than 2 species of borers and this finding rightly corroborates the fiscal demand of the particular timber to its maximum level in comparison to other 3 timber yielding plant species (table-20).

From Table 22, it is also evident that, Artocarpus chaplasha (Toungpeine) is having six number of borer species, of them, one species restricted up to bark, 3 species up to sap wood and 2 species extend their penetration level up to heart wood. So, Artocarpus chaplasha also did not support adequate environment with respect to food resources, penetrability and other microclimatic conditions. Thus, from economic point of view this plant species is the second most economically important timber plant of these islands (table-20).

The third economically important host plant species Terminalia procera (Badam), harboured 8 cerambycid borer species (Table 22). Of them, 4 species restricted their larval gallery up to sap wood and remain 4 species penetrated in the heart wood. Therefore, the damage causing by the cerambycid borers to this host plant species is more than earlier two host plants, which is also support the price index of this plant species as shown in table-20.

The fourth host plant of this study is Canarium euphyllum (Dhup) with 14 borer species prove itself as a most susceptible host plant species among the commercial and non-commercial plant species of these islands (Table 12, 22). Of them, only 2 species Apomecyna saltator and Olenecamptus bilobus was restricted under bark, 7 species penetrated up to sap wood and 5 species extended their gallery up to heart wood. The commercial potentiality of this timber plant species has got seriously affected, which is not only for the maximum number of borer species inhabiting in this host plant, but also all the microhabitats of this host plant are the preferable place for the borer community.
The present study revealed that the most preferable microhabitats (5 microhabitats) of these borers like in other non-timber and timber yielding plant species here in all the four host plants were sap wood. In both the year of study, the distribution of borer species was also found maximum in sap wood 67.16 % (2009-2010) and 54% (2010-2011) (fig-89).

The penetration of the immature stages in the wood very much depends on certain factors, such as, body size of the adults, their mandibular shape, time of development, food nutrients availability, condition of the host plants etc.

During this study, it has been found that, amongst cerambycid borers living under bark, 45% species are very small in size (in between 0.6-1.0cm) and 55% species are small in size (in between 1.1-1.9cm).

On the other hand, 41% of sap wood cerambycid borer species are small in size (1.1.1-1.9cm), 53% species are medium in size (2.0- 3.9cm) and those of remaining 6 % species are large in size (4.0 – 5.5cm).

Whereas, in heart wood cerambycid borer composition, 25% species are medium in size (2.0- 3.9cm), 37.5% are large in size (4.0 – 5.5cm), and those of remaining 37.5% species are very large in size (in between 5.6-7.1cm).

This observation shows that larger the size of borer species more is their penetrating capability into the wood. This clearly indicates that size of the cerambycid borers as one of the factors in determining their microhabitat.

Furthermore, mandible morphology varies between species to species; this may allow the borer optimally to penetrate different types of wood fibers. Besides this, the larvae with prolonged developmental periods usually feed at greater depths, particularly in heart wood (Khan and Maiti, 1983).
5.2.5.2. Study of the abundance of cerambycid borer species in some important timber yielding plants:

Out of 45 cerambycid borer species collected during this study, 19 species of borer (table-18) were collected from the 4 important commercial timber yielding plant species viz., *Pterocarpus dalbergioides*, *Artocarpus chaplasha*, *Terminalia procera* and *Canarium euphyllum*.

Altogether, 2969 examples of 19 species of cerambycid borer were collected from *Pterocarpus dalbergioides*, *Artocarpus chaplasha*, *Terminalia procera* and *Canarium euphyllum* in the year 2009-2010 and 4093 examples in the year 2010-2011 (table-23). These collections were made in 3 different seasons, namely, summer, pre-monsoon and post-monsoon during the 2009-2010 and 2010-2011 from 10 selected sites for bio-ecological studies (table-23).

From the Table 22, it is evident that, 19 species of borer had their preferences in distribution in the host plants and a maximum of 14 species were found to prefer *Canarium euphyllum* as their host plant. It is interesting to note that, better adaptability of the cerambycid borer in relation to availability of required food materials and shelter of the immature stages and the imagoes is found in *Canarium euphyllum* (Dhup), led to colonization of a maximum 14 species of borer in different microhabitats of this particular host species as demonstrated in Table 22.

Whereas, *Artocarpus chaplasha* and *Pterocarpus dalbergioides* harbored 6 and 5 cerambycid borer species respectively and *Terminalia procera* harboured 8 cerambycid borer species (Table.22). This is probably due to the ability of the species to utilize the resources maximally as available in their host plants and also their better adaptability in that specific microclimate of the host plant species.

5.2.5.3. Index of dominance:

The index of dominance as found in each of the 4 different host plants as shown in Tables figs- 90, 91, 92 and 93 *Xystrocera globosa*, *Olenecamptus bilobus*,
Glenea (S) andamanica and Ceresium andamanicum are the most dominant cerambycid borers on host plant species of Pterocarpus dalbergioides, Artocarpus chaplasha, Terminalia procera and Canarium euphyllum.

Whereas, the index of dominance was found to be minimum in species Batocera r. v. andamana and Batocera molitor on host plant species of Pterocarpus dalbergioides, Artocarpus chaplasha, Teminalia procera and Canarium euphyllum, indicating comparatively poor adaptability of these species in comparison to others available in these host plant species (figs- 90, 91, 92 and 93).

5.2.5.4. Percentage of availability:

Availability of the borer species depends on climate, location of sites, methodology of collection, host plant quality and some other unpredictable factors. Therefore, a little difference has been observed in the availability of the borer species in under bark and heart wood in two consecutive years study. Whereas, there was almost similar type of observations were recorded in sap wood and among the four host plant species as a whole.

5.2.5.5. Species diversity:

Data collected during the present study were subjected to the analysis of species diversity indices on the available species of cerambycid borers in 4 different host plant species following the standard process as set down earlier. The result thus achieved has been tabulated in table 28. It is evident from the said table that Canarium euphyllum harbors largest species diversity followed by Terminalia procera, Artocarpus chaplasha and Pterocarpus dalbergioides in both 2009-2010 and 2010-2011.

5.2.5.6. Species richness:

Above result were further verified from table 29, where the species richness index also indicated maximum richness in Canarium euphyllum and following the previous order, the minimum is found in Pterocarpus dalbergioides which similar in both the year of study.
5.2.5.7. Spatial distribution patterns of cerambycid borers in the important timber yielding plants:

Spatial distribution is one of the most important ecological properties of a species (Taylor, 1984) that follows a characteristic pattern depending upon their inherent properties and habitat conditions (Iwao, 1970), which provide real estimates of field population densities and essential component in pest management. Arthropod in general and insects in particular, provide a powerful opportunity to study how species distributions are shaped by different factors across the spatial scales. Sobero´n (2010) and Sobero´n and Peterson (2005) incorporates in a single formal mathematical definition of three important elements: the abiotic factors that affect the net growth rate of populations (i.e. scenopoetic factors), the biotic interactions that may affect fitness in a regulatory manner (i.e. bionomic factors), and the effects of the spatial movements of individuals and populations on species distributions (i.e. movement-related factors).

The influence of bionomic factors is often negligible at larger scales, but becomes progressively important as scale decreases. The dispersion of species is influenced by social instinct such as breeding, protection against natural enemies and heterogeneity of the environment. Individuals of a population arrange themselves in a manner that is specific to each population and these arrangements in space appear to be of considerable importance in the study of dynamics of ecosystem. The manner in which members of pest population are distributed in space is the dispersion or the distribution pattern of the species. The internal distribution patterns are important which are related with some characteristics of a population. Individuals in any population may be distributed according to three basic patterns: regular or uniform, random or poison and clumped or aggregated.

The result showed that, variance-mean ratio (VMR) in all the observations were more than one and David and Moor’s index (IDM) were always more than zero. This signifies that the distribution pattern of cerambycid borers in all the four host plants studied here in the month of August of 2009-2010 and 2010-2011 is aggregated or clumped in nature. This is also a most frequently observed pattern of distribution and cerambycid borers of these islands are also supporting this type of distribution.