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Species Composition and Distribution Pattern of Longhorn Beetles (Coleoptera: Cerambycidae) across India

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A B S T R A C T

The longhorn beetles are distributed world-wide from sea level to mountain region as high as 4,200 meter altitude wherever their host plants are found. A complete checklist of longhorn beetles includes 1555 valid species recorded so far from India. Out of these species, the region wise distribution are: 592 from North-Eastern states, 272 from Northern India, 431 from Southern India, 47 from Central India, 48 from Western India, 348 from Eastern India, 18 from North-Western India, 57 from India Orientals and 121 from Indian Islands. The maximum numbers of species were recorded from North-Eastern India (38.1%) followed by southern part (28%) and West Bengal alone accounted over 22 per cent longhorn beetles.

Introduction

The kingdom Animalia is represented by 1,552,319 species under 40 phyla. Among these, the phylum Arthropoda alone represents 1,242,040 species, or about 80 per cent of the total. The most successful group, the Insecta (1,020,007 species), accounts for about 66 per cent of all animals. The most diverse and successful insect order, Coleoptera (387,100 species), represents about 38 per cent of all insect species (Zhang, 2011). The Cerambycidae is one of the biggest families of Coleoptera represented by more than 35,000 species described under 4,000 genera (Lawrence, 1982; Švácha and Lawrence, 2014). The Family name Cerambycidae originated from the Greek word "Cerambis" meaning "a horned beetle".

The Cerambycidae beetles are distributed world-wide from sea level to mountain sites as high as 4,200 m elevation wherever their host plants are found (Bezark *et al.*, 2013). Though the members of the family Cerambycidae are cosmopolitan, the largest subfamilies like Lamiinae, Cerambycinae and Prioninae are most diverse in the tropical and subtropical parts of the world (Berkov & Tavakilian 1999, Berkov *et al.*, 2000). The beetles which are developing in timbers, are easily transported inside the timber or under

the bark of tree logs, and thus expand their geographical range. Some are unable to develop in a new area, whereas others succeed in establishing a population and can be considered as potential pests (Friedman, 2008). However, the main factors governing long-horned beetles distribution are the climatic and availability of suitable host plants. Past climate changes, result into evolution and spread of past floras, this made a profound influence on the distributional and evolutionary history of the survival representatives of Cerambycidae family in current days (Slipinski and Escalona, 2013).

Materials and Methods

Extensive surveys were carried to find out the beetles diversity and their distribution range in the natural stands in years 2015 and 2016 by IGKV, Raipur in collaboration with ICAR-NBAIR, Bengaluru from major states of India (Fig. 1).

Analysis of longhorn beetles distribution

As per the study of Kariyanna (2016), the complete checklist information of Indian longhorn beetles was analysed to understand the various parameters of the taxonomy of the group. Based on the checklist information, sub-family, tribe, genera and species distribution across the India were analysed. This analysis was primarily made to understand the general situation of the taxonomic status of the group in the country and to appreciate the need for additional work to make it more comprehensive. The ultimate goal of this analysis was to answer "How many more species of Cerambycid beetles are there to be discovered in India?"

Area covered for the study

The longhorn beetles were collected mainly by light traps operated during different periods of the year at Western Ghats of Karnataka (Bangalore, Mandya, Kolar, Mudigere, Chettahalli, Madikeri and Shimogha), Tamil Nadu (Hosur, Yercaud, Madurai, Periyakulam, Kodaikanal and Thadiyankudisai) Kerala (Trivendrum, Pattambi and Peechi), Maharashtra (Pune), Assam, Mizoram, Andhra Pradesh (Madanapalli, Chithoor and Tirupathi), Andaman and Nicobar Islands (Port Blair, little Andaman and Great Nicobar), Jammu & Kashmir (Srinagar, Gulmarg, Shalimar, Tangmarg, Kargil, and Leh) and Himachal Pradesh (Palampur, Dalhousie and Solan). The places covered in Chhattisgarh includes Ambikapur, Bastar (Jagdalpur), Bilaspur, Kawardha, and Raipur. Many specimens were obtained from students, research scholars and Scientists across the country. Museum collections of ICAR-National Bureau of Agriculture Insect Resources (NBAIR), Bangalore, Zoological Survey of India (ZSI), Calcutta, Kerala Forest Research Institute (KFRI), Peechi, Kerala and Forest Research Institute (FRI), Dehradun were also examined (Fig. 1).

Other sources of longhorn beetles used for investigation

The collections maintained at Department of Entomology, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur; R.M.D. College of Agriculture and Research Station, Raghavpuri, Ambikapur; T. C. B. College of Agriculture and Research Station, Sarkanda, Bilaspur; S. G. College of Agriculture and Research Centre, Bastar, Jagdalpur; S. K. College of Agriculture and Research Station, Ghotiya, Kawardha; University of Agriculture Science (UAS), Raichur; College of Agriculture, BhimarayanaGudi; University of Agriculture Science (UAS) GKVK, Bangalore; College of Agriculture, Mandya; College of Agriculture, Chintamani and College of Agriculture, Hassan were also consulted.

Results and Discussion

Longhorn beetles (Coleoptera: Cerambycidae) are the major pestiferous insects of perennial trees in India. They attack both perennials such as coffee, cashew, mango fruit crops *etc*. and semiperennials such as mulberry and jasmine. Larvae feed on the trunk, hardwood, softwood, deadwood and adults feed on leaves and flowers and even fruits. Although, a large number of species of Cerambycidae are considered pests, the identity of many of these species is yet to be clearly established. Majority of these longhorn species belonging to the subfamilies Lamiinae and Cearmbycinae.

Inventory of longhorn beetles of Arunachal Pradesh, Tripura, West Bengal, Meghalaya, Sikkim, Uttarakhand and Tamil Nadu were made available by Zoological survey of India in its various publications. Mukhopadhyay and Biswas (2000) consolidated the information available on Cerambycid fauna of Meghalaya. They reported 71 species under 44 genera and five subfamilies. Ofthem subfamily Lamiinae recorded the maximum number of species (47), followed by Cerambycinae (16), Prioninae (7) and Lepturinae (1). The cerambycid fauna of Sikkim is not extensively surveyed and there is only record of 75 species under 49 genera belonging to four subfamilies through the publication of Mukhopadhyay and Halder (2003).

In Tamil Nadu, 181 longhorn species constituting 10.8 per cent of Indian species, under 103 genera and five subfamilies were listed. The Western Ghats exhibited the highest degree of endemism with 84 species and five species were common to both Eastern and Western Ghats (Namboodiri and Thirumalai, 2009). A consolidated key to the tribes of Indian Lamininae has also been prepared by them for the first time. From Tripura, Agarwala and Bhattacharjee (2012) listed 14 Lamiinae, nine Cerambycinae and one Prioninae. Among these 11 were new to Tripura. Mukhopadhyay (2011) reported 41 species of Cerambycid beetles from Uttarakhand state. Of them subfamily Lamiinae shared maximum number of species (25), followed by Cerambycinae (14), Prioninae (1) and Lepturinae (1). A first consolidated list of 146 species of Cerambycidae under 84 genera of 38 tribes belonging to four subfamilies from West Bengal was prepared (Mitra *et al.,* 2015). Of them, the subfamily Lamiinae shared the maximum number of species (79), followed by Cerambycinae (56), Prioninae (10) and Lepturinae (1). A total of 49 species of cerambycids belonging to three subfamilies were recorded from Arunachal Pradesh. The subfamily Lamiinae was found to be the dominant with 28 species followed by Cerambycinae (11 species). Subfamily Prioninae included 10 species (Kumawat *et al.*, 2015).

Three species of longhorn beetles *viz*., *Acalolepta rusticatrix* (Fabricius) (Agniini), *Olenecamptus bilobus* (Fabricius) (*Doracoschematini*) and *Gnomanico barica* Breuning (Gnomini) belonging to the subfamily Lamiinae were reported as new records from the Little Nicobar Island by Mitra (2013). *Abryna regispetri* Paiva, 1860 (Lamiinae: Pteropliini) collected in Tripura is a new record to India (Ghate and Agrawala, 2015). So far known it was known only from Laos, Myanmar, Malaysia, China, Borneo and Thailand.

The longhorn beetles of Prioninae subfamily are mostly borers, whose larvae feed on rotting wood or roots. Few members of the subfamily make tunnel freely in the soil alongside the roots of trees. These beetles fall in the group of heartwood borers and thus reflecting its immense importance in the

timber economy of the country. They are cosmopolitan in distribution and include many of the largest species of the Coleoptera order. Prioninae may be readily recognized by the prothoracic possession of the sharp lateral margins. The Indian genera generally bear coarsely facetted eyes, and the species, more or less, are restricted in their range of coloration between black and lighter shades of brown which verge on red and yellow. World catalogue of prioninae was recently published by Delahaye (2012). Till date, the most comprehensive information on Indian Prioninae was provided in '*The Fauna of British India including Ceylon and Burma*' by Gahan in 1906. Subsequently, Stebbing (1914) and Beeson (1941) published literatures on biology and ecology of these beetles. The first consolidated checklist of Indian Prioninae including 47 species belonging to 23 genera and nine tribes has been provided by Majumder *et al.,* (2014).

The taxonomic work on Cerambycid beetles of Madhya Pradesh indicated a total of 18 species. The list mentioned eight species from Lamiinae, seven species from Cerambycinae and three species from Prioninae (Majumder *et al.,* 2015).

A total of 107 longhorn species were collected and preserved at the ICAR-NBAIR National Insect Repository by the author. This is accounted for about 0.8 per cent of the total longhorn taxa known from India. The collection included 56 species of Lamiinae, 34 species of Cerambycinae, 14 species of Prioninae, 2 species of Lepturinae and 1 species of Vesperinae (Vesperidae) (Table 1).

Table.1 Representation of different subfamilies, tribes, genus and species of long-horn beetles from museum collection of the ICAR-NBAIR, against total Indian species

Subfamily	Tribes in each Sub-family	Genus in each Sub-family	No. of Species in the collections	No. of species known from India	% representation of respective in the collections
Dorcasominae	2	3	0	4	0
Spondylidinae	1	4	0	6	9.7
Cerambycinae	26	109	34	350	2.1
Lamiinae	24	273	56	1103	5.1
Lepturinae	4	18	2	20	10
Necydalinae	1	1	0	3	0
Prioninae	10	29	14	57	24.6
Disteniinae (Disteniidae)	3	6	0	9	0
Philinae (Vesperidae)	1	2	1	3	3.3
All Longhorn Beetles	**72**	**445**	**109**	**1555**	**7**

Table.2 The total recorded species of longhorn beetles composition in each state and regions of the India from 1758 to 2016

Region	State	Species Composition	Species Composition against region (%)	Species composition against India (%)
North-Eastern India (592)	Assam	293	49.6	19.2
	Sikkim	269	45.2	16.5
	Arunachal Pradesh	115	19.4	7.4
	Meghalaya	47	7.92	3.0
	Tripura	27	4.56	1.7
	Manipur	68	11.4	43.8
	Mizoram	0	0	0
Northern India (271)	Jammu and Kashmir	40	14.5	2.8
	Uttarakhand	81	29.6	5.2
	Uttar Pradesh	83	30.3	5.3
	Himachal Pradesh	49	17.9	3.1
	New Delhi	1	0.36	0.06
	Haryana	0	0	0
Southern India (435)	Karnataka	93	21.5	5.9
	Tamil Nadu	293	67.2	18.7
	Kerala	61	14.1	3.9
	Telangana	5	1.2	0.3
	Andhra Pradesh	3	0.7	0.2
	Pondicherry	20	4.6	1.3
Central India (47)	Madhya Pradesh	25	53.2	1.6
	Chhattisgarh	24	51.0	1.5
Western India (49)	Maharashtra	49	100	3.1
	Gujarat	0	0	0
	Goa	2	4.2	0.1
Eastern India (351)	West Bengal	339	97.4	21.8
	Bihar	10	2.9	0.6
	Odisha	12	3.4	0.8
	Jharkhand	7	2.0	0.4
North West India (18)	Rajasthan	3	6	0.2
Indian Islands (122)	Andaman Island	122	100	7.8
	Lakshadweep	0	0	0
India Orientalis (57)	British India	57	100	3.6
Inappropriate data (159)	India	159	100	10.2

Table.3 The total recorded longhorn beetles species of the sub-family, tribes and genera in each state of India from 1758 to 2016

Sl. No	Name of the State	Number of Sub-family	Number of Tribes	Number of Genara	Genara represented (%)
1	Andaman and Nicobar Island	3	29	73	15
2	Andhra Pradesh	1	2	2	0.4
3	Assam	6	41	163	36.4
4	Arunachal Pradesh	4	27	56	12.5
5	Bihar	3	7	8	1.7
6	Chhattisgarh	3	14	16	3.6
7	Goa	2	2	3	0.7
8	Gujarat	0	0	0	0
9	Himachal Pradesh	7	23	37	8.2
10	Jammu and Kashmir	6	17	31	6.9
11	Jharkhand	2	3	4	0.9
12	Karnataka	4	25	53	11.4
13	Kerala	4	23	51	11.1
14	Madhya Pradesh	4	18	23	5.1
15	Maharashtra	5	22	28	6.2
16	Manipur	6	27	44	9.8
17	Meghalaya	3	14	19	4.2
18	Mizoram	0	0	0	0
19	Nagaland	1	1	3	0.7
20	New Delhi	1	1	1	0.2
21	Odisha	3	7	7	1.5
22	Pondicherry	3	7	11	2.5
23	Punjab	5	12	12	2.7
24	Rajasthan	1	1	1	0.2
25	Sikkim	4	41	144	32
26	Tamil Nadu	4	46	142	31.2
27	Telangana	2	3	4	0.9
28	Tripura	3	18	21	4
29	Uttar Pradesh	6	29	57	12.8
30	Uttarakhand	7	28	46	10.2
31	West Bengal	5	40	123	27.5

Fig.1 Map indicating visited places for long horn beetles collection during the current investigation

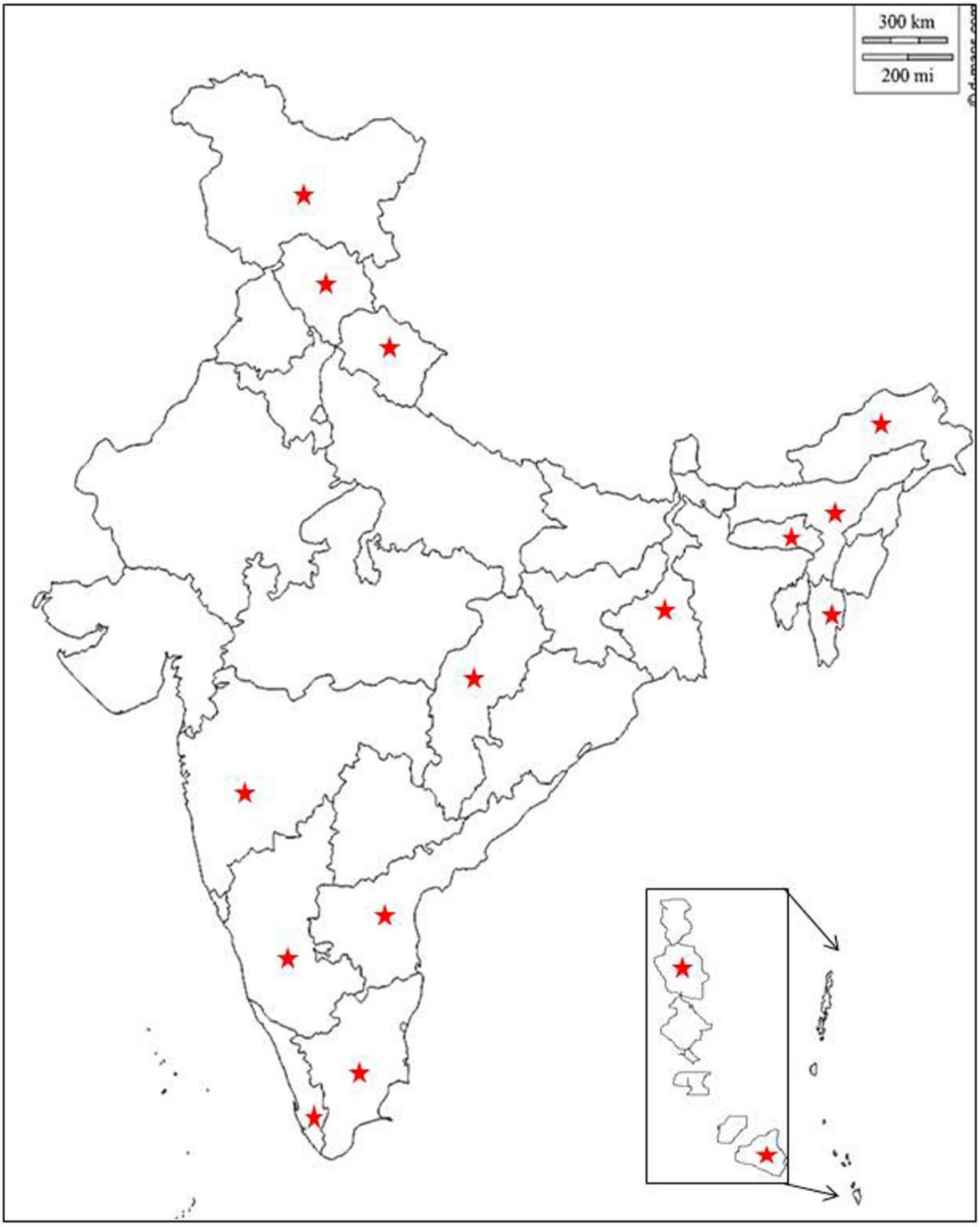


Fig.2 Region wise representation of longhorn beetles known from the India as listed in the checklist compiled

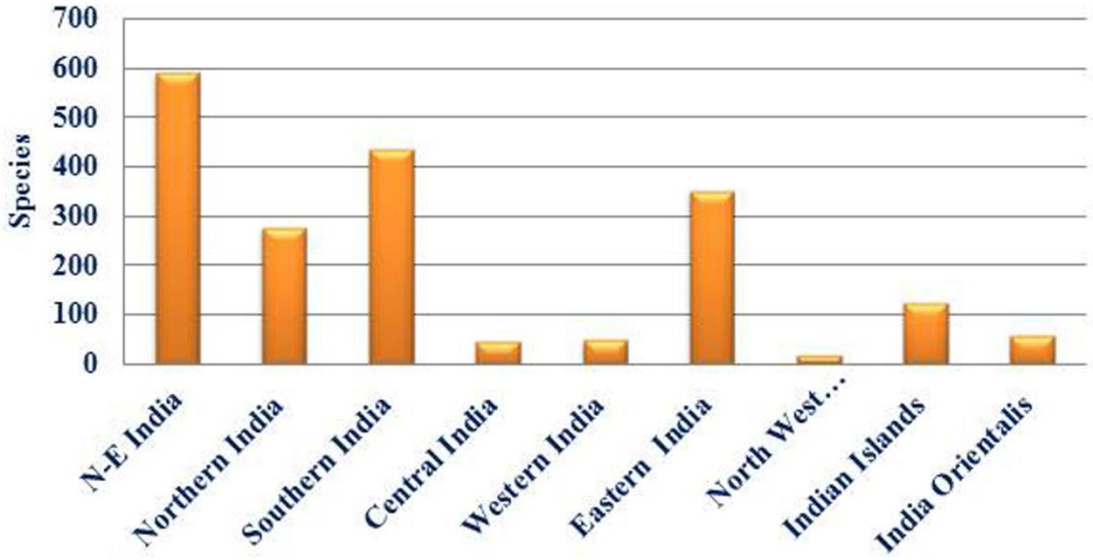


Fig.3 State wise representation of longhorn beetles known from the India as listed in the checklist compiled

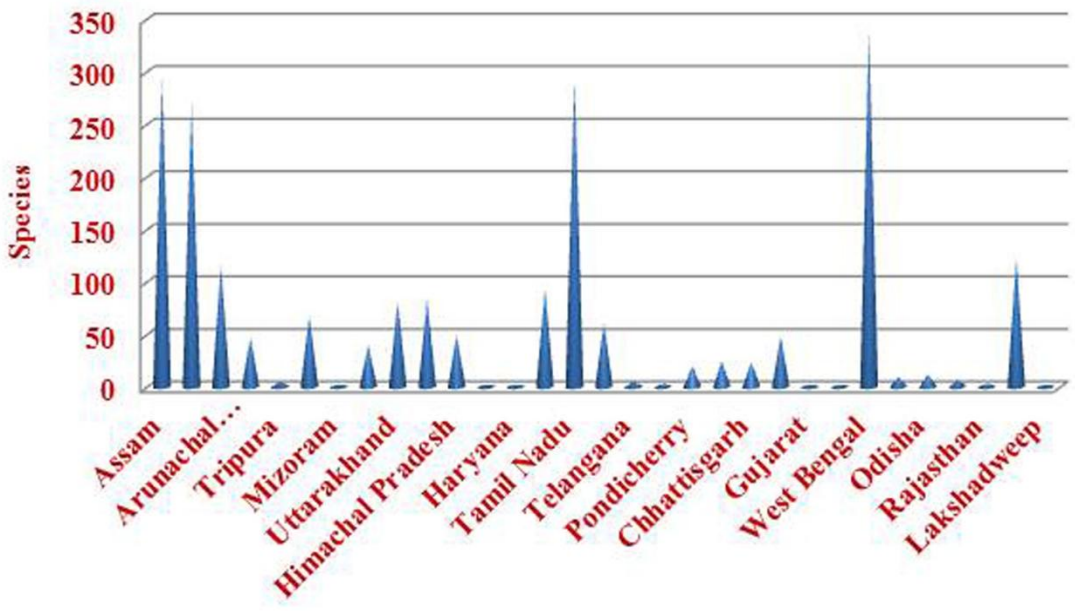
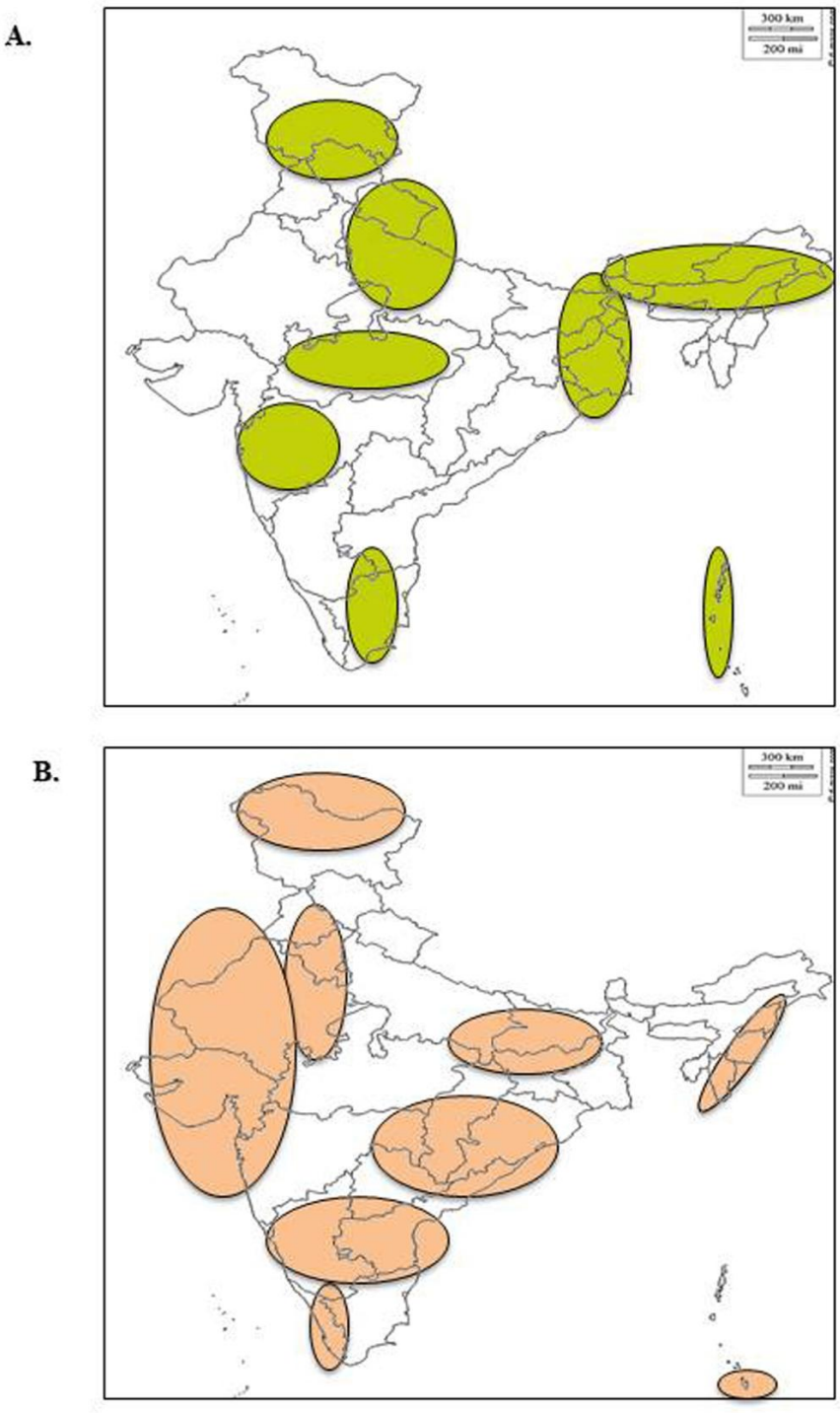


Fig.4 Area of India for better or poorly surveyed for long horn beetles as recorded up to 2016. A = Area better studied; B = Area poorly studied



A full listing of all Indian species with synonyms and bibliographic citations with complete checklist includes 1555 valid species of longhorn beetles recorded so far from India (Kariyanna, 2016). Out of these many species, the region wise distribution are: 592 from North-Eastern states, 272 from Northern India, 431 from Southern India, 47

from Central India, 48 from Western India, 348 from Eastern India, 18 from North-Western India, 57 from India Orientalis and 121 from Indian Islands (Fig. 2). The maximum number of species were recorded from North-Eastern India (38.1%) (Table 2).

North-eastern states were extensively explored for their animals and plant diversity. This region is considered as one of the mega biodiversity areas. Still, there are many more species which are yet to be discovered from this region. Similary, the southern part including Tamil Nadu, Karnataka and Kerala were also fairly well covered (28% of Cerambycid species) during British period. Nilgiris and Anamalai hill ranges were the important biodiversity hotspots for cerambycids in Tamil Nadu. Another biodiversity hotspot is Western Ghat that covering parts of Karnataka, Kerala and Maharashtra is also recorded a good number of Cerambycids species (Fig. 3).

A total of 159 longhorn species in the current checklist don't have further information (inappropriate data) on their collection locality and distribution information from India, so for the remaining species only, all further inferences were drawn (Tabl.2). Among the Indian states, the West Bengal alone accounted for over 22 per cent of the total known species of longhorns from India.

Tamil Nadu, Assam, Sikkim, Andaman and Nicobar Island, Arunachal Pradesh and Karnataka follows West Bengal and together (Fig. 3), these states accounted for more than 80 per cent of the species of Cerambycidae recorded from India. Chhattisgarh has only 24 and Karnataka has 93 recorded species of Cerambycidae on the basis of the Taxonomic records (Table 3).

Is there a real discrepancy in the way the species have been surveyed and identified? It was observed that some of the Indian region was better covered and some region was not at all surveyed for longhorn species. Hence, these regions / states require a thorough sampling of longhorns. The areas that were better sampled and those that were poorly sampled and the areas need a relook or resampling was indicated in figure 4A and B. Assam, Arunachal Pradesh and Sikkim, West Bengal, Madhya Pradesh, Maharashtra, Tamil Nadu, Karnataka, Himachal Pradesh, Uttarakhand, Uttar Pradesh and part of Jammu and Kashmir, and Andaman Island were fairly well studied (Fig. 4A). The rest of the states have only a handful of recorded species, especially from Rajasthan, Andhra Pradesh, Telangana, Bihar, Jharkhand, Goa and Nicobar Islands (Fig. 4B).

In conclusion, among the all animals longhorn beetles are more diverse and economically most important group of insects in the world. Their injury and damage to crop plant pose serious threat in agriculture production and marketing. With regarding to regional distribution, 592 are reported from North-Eastern states, 272 are from Northern India, 431 from Southern India, 47 from Central India, 48 from Western India, 348 from Eastern India, 18 from North-Western India, 57 from India Orientalis and 121 from the Indian Island region. The maximum number of the species was documented from North-Eastern states. The longhorns from West Bengal state were well studied and accounted over 22 % of the known species of Cerambycidae from India.

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