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RESEARCH ARTICLE

DIVERSITY OF LONGHORN BEETLES (COLEOPTERA: CERAMBYCIDAE) OF HOWRAH DISTRICT, WEST BENGAL, INDIA

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ABSTRACT

Cerambycidae is one of the biggest families of Coleoptera. Members are popularly known as Longhorn Beetles, world-widely distributed from sea level to mountains. In the districts of West Bengal diversity, detailed ecology of many species is inadequately documented. Thus, main aims of the present study were documentation of species, habitats and other ecological behaviors in District Howrah, West Bengal, India through regular field survey method. A total of 13 species of Longhorn Beetles belonging to 12 genera of two sub families' viz., Cerambycinae and Lamiinae were documented in between February 2013- October 2017 from the district Howrah, West Bengal, India. Among 13 Cerambycid species five species are newly recorded from the area, viz., *Xystrocera globosa* (Olivier, 1795), *Apomecyna saltator* (Fabricius, 1787), *Cremnosterna* Aurivillius, 1920, *Pseudanaesthetis langana* (Pic, 1922) and *Rondibilis* J. Thomson, 1857. We can conclude from our study that as a non forest district Howrah contain a good number of species of Longhorn Beetles. Our study gives a baseline data for the Longhorn Beetles of Howrah district which will help for further study on them.

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INTRODUCTION

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 36,000 species described in more than 5,000 genera from eight subfamilies (Monné *et al*., 2017). 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). 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). Despite its immense economical and ecological importance, Cerambycidae is one of the least studied families of the order Coleoptera in India (Kariyanna *et al*., 2017). In India the pioneer work on cerambycids was initiated by Westwood (1848). He described seven species for the first time from India. Then Gahan (1906), Stebbing (1914), Beeson (1941) and Breuning (1960–62, 1963, 1964, 1965, 1966) have made detailed studies and valuable contributions to various aspects of this group. Till date, the most comprehensive information on Indian Cerambycidae is 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. As for the number of species, over 1200 species were known to occur in Indian region by 1940's (Beeson 1941). Over 300 species were added by Breuning (1960–66) by another three decades. Initial works in West Bengal were accelerated by Gahan, Breuning, Fisher and Gardner in the early twentieth century. Major consolidated works were initiated by Saha and Raychaudhuri (2000, 2013), who made first consolidated publication on Cerambycidae of West Bengal. They 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 were new records from the state of West Bengal. Besides these, Raychaudhuri and Saha reported cerambycid fauna of Buxa Tiger Reserve in 2000 and cerambycid fauna of Dooars in 2013. At last Mitra *et al*. (2015) reported three new records of

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Cerambycidae from West Bengal and a list of already reported and newly recorded cerambycid species (146 species) of West Bengal has also been made along with their valid scientific names.

MATERIAL AND METHODS

Study Area and Monitoring

Howrah is one of the small districts (467 km^2) of the southern West Bengal (Fig 1) located between 22°48′ N and 22°12′ N latitudes and between 88°23′ E and 87°50′ E longitudes.

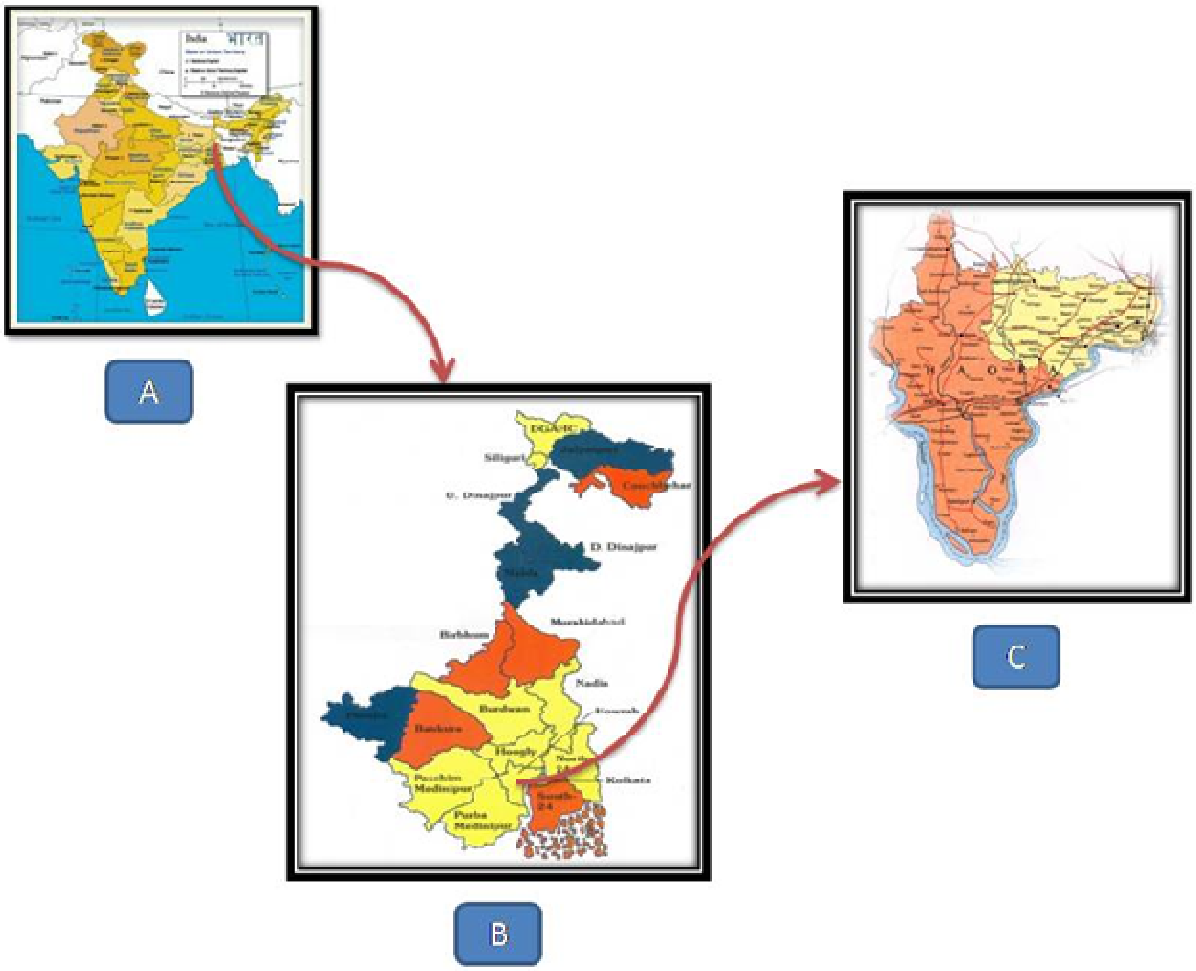

Figure 1. Study area [India (A), West Bengal (B), Howrah District (C)]

Rupnarayan River and Bhagirathi-Hooghly River present on the west and east borderline of this district whereas Bally canal and Damodar River are situated north-east and north-west boundary. Annual average rainfall is 1461 millimetre and temperature varies between 9-42°C.

Sampling techniques and species identification

Diverse habitats of this district was surveyed during February, 2013 to December, 2017 through transect method. In this method 2 permanent 400 m lines (One straight and another one curved) transects was setup in each 15 block of this district. By using these transects walked once a month to follow Pollard Walk Method (Pollard 1977; Pollard and Yates 1993) for documenting the long horn beetles. A slow 180 degree visual sweep was carrying out during walking. Records were done on the whole the seasons viz., summer (March to May), monsoon (June to October), and post monsoon (November to February). Collection of samples was avoided to the extent possible. Generally photographic documentation was done. Photographs were taken using Cannon EOS 550D with 18-55 mm lens. "Identification of Cerambycid species was done with the help of these authentic literatures like Kariyanna *et al*., 2017, Mitra *et al*., 2015 and by some Cerambycid experts.

Data analysis

Data analyses were performed by PAST software Version 3.02 (Hammer *et al*., 2001).

Measurement of diversity

The type of diversity used here is α- diversity which is the diversity of species within a community or habitat. The diversity index was calculated by using the Shannon – Wiener diversity index (1949).

Diversity index = $H = -\sum Pi \ln Pi$, where $Pi = S / N$

S = number of individuals of one species

N = total number of all individuals in the sample

In = logarithm to base e

Measurement of species richness

Margalef's index was used as a simple measure of species richness (Margalef, 1958).

Margalef's index = $(S - 1) / \ln N$

S = total number of species

N = total number of individuals in the sample

In = natural logarithm

Dominance and Simpson Index

$D = \sum (ni/n)^2$ where ni is number of individuals of taxon i. Dominance = 1-Simpson index. Ranges from 0 (all taxa are equally present) to 1 (one taxon dominates the community completely). Simpson index 1-D. Measures 'evenness' of the community from 0 to 1. Dominance and Simpson indices are often used interchangeably.

PCA (Principle Component Analysis)

Principal components analysis (PCA) finds hypothetical variables (components) accounting for as much as possible of the variance in multivariate data (Davis 1986, Harper 1999). Two variables were choosing based on higher variance and eigenvalue scale. Density was plotted as component 1 and frequency was plotted on component 2.

Species Accumulation Curve

Species accumulation curve is a method to show the cumulative number of species recorded against the sampling years (2013-2017). From the year 2013, the species accumulation curve of whole district sampled individually, increased from 2013 to 2016 sampling through the number of new records added slowly but after 2016 number of new records were same in 2017.

RESULTS

A total of 13 species of Long horned beetles (Table 1) belonging to 12 genera of two sub families viz., Cerambycinae and Lamiinae were recorded from the district Howrah, West Bengal, India. Among 13 species (Figure 2 and 3) of cerambycid beetles 8 (61.53%) species were from sub family lamiinae and 5 (38.46%) species from sub family cerambycinae (Fig 4). Under these 2 sub families' 12 tribes (Clytini, Stenopterini, Hesperophanini, Xystrocerini, Apomecynini, Batocerini, Lamiini, Saperdini, Dorcaschematini, Desmiphorini, Pteropliini and Acanthocinini). were present.

Documented Species description

***Stromatium barbatum* (Fabricius, 1775) (Fig 2A)**

Long in size and blackish in colour. Antennae were punctuate, blackish in colour, sometimes colorless. Antennae were slightly longer than body, 9- segmented, segment 1 was very short than segment 2, 3, 4.. Legs (tibia and femora) were also blackish in colour. Elytra were punctures. Often found on bushy plants, camouflaged with surroundings, also found in domestic buildings in night.

***Stromatium longicorne* (Newman, 1842) (Fig 2B)**

Long in size and blackish to dark brownish in colour with white markings in the end of body. Antennae were punctuate, blackish in colour, sometimes colorless. Antennae were too longer than body (nearly double of the body), 9- segmented, segment 1 was long. Femora of legs were blackish in colour and rest parts also blackish with white markings. Often found on bushy plants, camouflaged with surroundings, also found in domestic buildings in night, for rest prefers wooden substances.

***Chlorophorus annularis* (Fabricius, 1787) (Fig 2C)**

Small in size and yellowish in colour with black markings on the whole body. Antennae were blackish in colour, shorter than body. Femora of legs were blackish in colour and rest parts colorless. Often found on bushy plants, gardens.

***Kunbir telephoroides* (Lameere, 1890) (Fig 2D)**

Medium sized and brownish in colour, end part of body was blackish. Antennae were very much punctuate, blackish in colour and shorter than body, 10- segmented, segment 3, 4 were long. Parts of hind legs (tibia and femora) are black and with flatten bulges. Rests of four legs are brownish in colour. Elytra are also punctures but not closely. Often found on bushy plants, surroundings of agricultural lands also, camouflaged with surroundings.

***Xystrocera globosa* (Olivier, 1795) (Fig 2E and 2F)**

Long sized and was brownish in colour with blackish markings. Antennae were punctuate, brownish in colour and longer than body, segment 3, 4 were long. Legs were brownish in colour and femora with flatten bulges. Often found on bushy plants, camouflaged with surroundings, also found in domestic buildings in night, for rest prefers wooden substances.

***Apomecyna saltator* (Fabricius, 1787) (Fig 2G)**

Body was elongated, large, dark brown in colour, head elongated, eyes emarginated; Abdomen with white markings. Antennae were punctuate, brownish in colour and shorter than body, segment 2 was very short and segment 3, 4 were very long. Legs were brownish in colour and femora with flatten bulges. Often found on bushy plants, camouflaged with surroundings, also found in domestic buildings in night.

***Batocera rufomaculata* (Degeer, 1775) (Fig 2H and 2I)**

Body was elongated, large, dark brown in colour with various coloured markings, head elongated.

Table 1. List of Longhorn beetle fauna of Howrah district (West Bengal, India)

Sl No.	Name of the Species	Tribe	Subfamily	Status
1	*Stromatium barbatum* (Fabricius, 1775)	Hesperophanini	Cerambycinae	C
2	*Stromatium longicorne* (Newman, 1842)	Hesperophanini	Cerambycinae	C
3	*Chlorophorus annularis* (Fabricius, 1787)	Clytini	Cerambycinae	C
4	*Kunbir telephoroides* (Lameere, 1890)	Stenopterini	Cerambycinae	R
5	*Xystrocera globosa* (Olivier, 1795)	Xystrocerini	Cerambycinae	UN
6	*Apomecyna saltator* (Fabricius, 1787)	Apomecynini	Lamiinae	R
7	*Batocera rufomaculata* (Degeer, 1775)	Batocerini	Lamiinae	C
8	*Cremnosterna* Aurivillius, 1920	Lamiini	Lamiinae	UN
9	*Nupserha bicolor* (Thomson, 1857)	Saperdini	Lamiinae	C
10	*Olenecamptus bilobus* (Fabricius, 1801)	Dorcaschematini	Lamiinae	C
11	*Pseudanaesthetis langana* (Pic, 1922)	Desmiphorini	Lamiinae	R
12	*Pterolophia* Newman, 1842	Pteropliini	Lamiinae	C
13	*Rondibilis* J. Thomson, 1857	Acanthocinini	Lamiinae	UN

[C: Common (>15), U: Uncommon (5-15), R: Rare (<5)] (Applicable in result section)

Figure 2. A) ***Stromatium barbatum*** **B)** ***Stromatium longicorne*** **C)** ***Chlorophorus annularis*** **D)** ***Kunbir telephoroides*** **E)** ***Xystrocera globosa*** **(Top view) F)** ***Xystrocera globosa*** **(Side view) G)** ***Apomecyna saltator*** **H)** ***Batocera rufomaculata*** **(Top view) I)** ***Batocera rufomaculata*** **(Front view)**

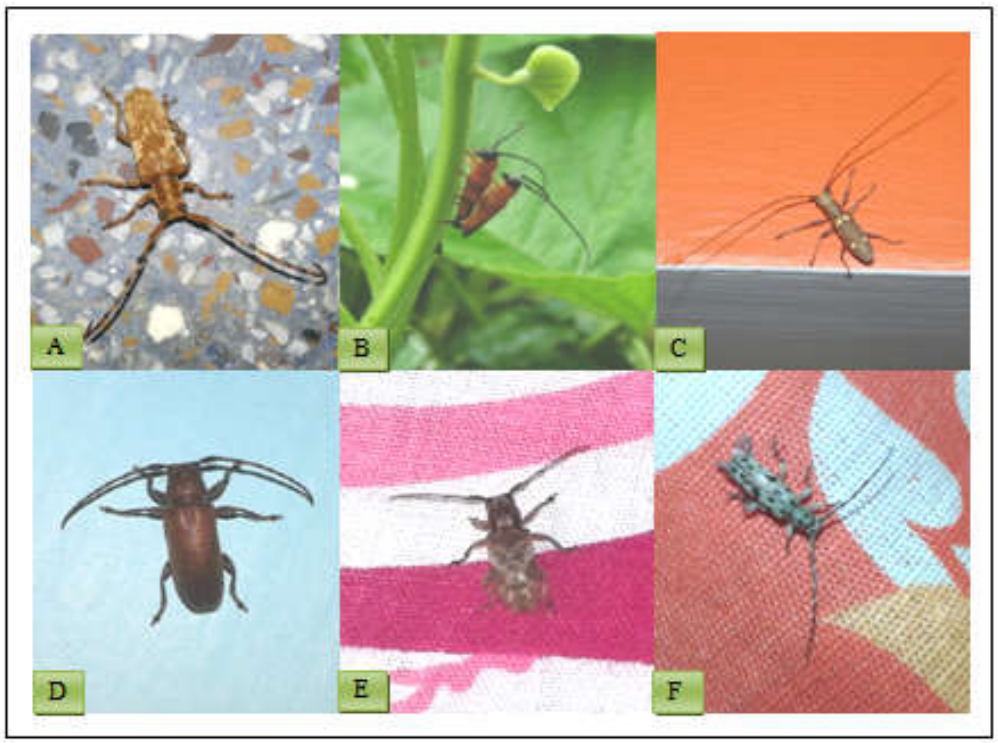

Figure 3: A) ***Cremnosterna*** **sp. B)** ***Nupserha bicolor*** **(Copula) C)** ***Olenecamptus bilobus*** **D)** ***Pseudanaesthetis langana*** **E)** ***Pterolophia*** **sp. F)** ***Rondibilis*** **sp.**

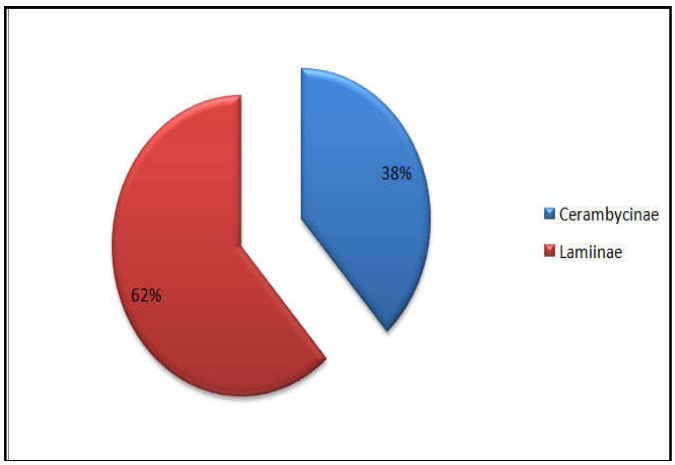

Figure 4: Sub family wise graphical representation of Cerambycid species

Antennae were punctuate, brownish to blackish in colour and near about same sized with body, 10 segmented, segment 2 was long. Legs were also brownish to blackish in colour and femora were slightly thicker than other parts. Often found on mango plants, camouflaged with surroundings.

***Cremnosterna* Aurivillius, 1920 (Fig 3A)**

Body was elongated, large, dark brown in colour with various coloured markings, head elongated. Antennae were punctuate, brownish to blackish in colour and near about same sized with body, 10 segmented, segment 2 was long. Legs were also brownish to blackish in colour and femora were slightly thicker than other parts. Often found on mango plants, camouflaged with surroundings.

***Nupserha bicolor* (Thomson, 1857) (Fig 3B)**

Body was elongated, medium sized, reddish in colour with blackish elongated head. Antennae were blackish in colour and longer than body. Legs were also reddish in colour. Often found on bushy plants, well camouflaged with surroundings.

***Olenecamptus bilobus* (Fabricius, 1801) (Fig 3C)**

Body was elongated, large, pale brown in colour with various yellowish to whitish markings, head elongated. Antennae were punctuate, brownish in colour and longer than body. Legs were also brownish colour and femora with flatten bulges. Often found on bushy plants, camouflaged with surroundings, also found in domestic buildings in night.

***Pseudanaesthetis langana* (Pic, 1922) (Fig 3D)**

Body was elongated, medium sized, dark brown in colour, head elongated. Antennae were punctuate, brownish to blackish in colour and near about same sized with body, segment 1 was in bulge, segment 2 was very short and segment 3, 4 were long. Legs were also brownish to blackish in colour and femora with flatten bulges. Often found on bushy plants, camouflaged with surroundings, also found in domestic buildings in night.

***Pterolophia* Newman, 1842 (Fig 3E)**

Body was elongated, small sized, brownish in colour with white markings. Antennae were punctuate, brownish in colour and smaller than body, segment 1 was in bulge. Legs were also brownish in colour and femora with flatten bulges. Often found on bushy plants, camouflaged with surroundings, also found in domestic buildings in night.

***Rondibilis* J. Thomson, 1857 (Fig 3F)**

Body was elongated, small sized, whitish brown in colour with black markings, head elongated. Antennae were punctuate, brownish to blackish in colour and near about same sized with body, segment 1 was in bulge. Femora, tibias were brownish and tarsus, claws were blackish in colour. Femora with flatten bulges. Often found on bushy plants, camouflaged with surroundings, also found in domestic buildings in night.

Measurements of diversity related indices were represents in the table 2. Principal component analysis (PCA) of longhorn beetles of Howrah district, West Bengal based on Density and Frequency data (these two variables are taken based on higher Variance and Eigenvalue scale) were presented in figure 5.

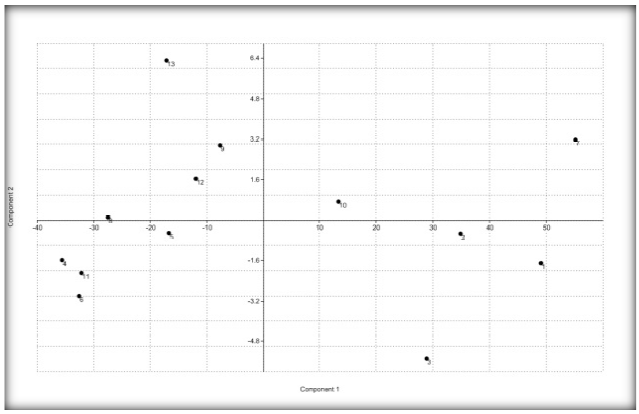

Figure 5. PCA (Principle component analysis) of species of Cerambycidae created through PAST software. (Used characters: Number of individuals, density and frequency)

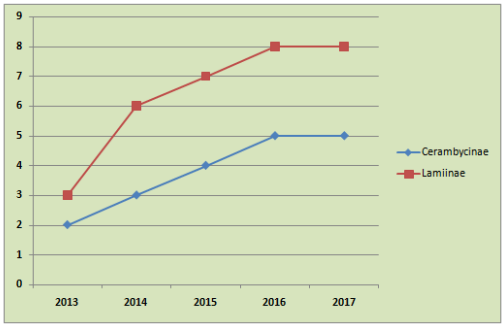

Figure 6. Graphical representation of cumulative number of species collected against the sampling years (2013-2017)

On both the cases, X axis (component 1) i.e. Density and on the Y axis (component 2) i.e. Frequencies were plotted which show similarities between different species.

Table 2. Measurements of diversity related indices (Applicable in result section)

SL. No.	Diversity related indices	Calculated result
1	Taxa_S	10
2	Simpson_1-D	0.8577
3	Dominance_D	0.1423
4	Shannon_H	2.035
5	Evenness_e^H/S	0.7654
6	Margalef	1.6

DISCUSSION

The present study, for the first time ever, aims at evaluating longhorn beetles in the district of Howrah, West Bengal, India. The results accumulated so far clearly indicate that the overall diversity of long horn beetles in this district is quite good as in Howrah no major forests and protected areas are absent and density of human population is high whereas from district. Among 13 Cerambycid species five species are newly recorded from the area, viz., *Xystrocera globosa* (Olivier, 1795), *Apomecyna saltator* (Fabricius, 1787), *Cremnosterna* Aurivillius, 1920, *Pseudanaesthetis langana* (Pic, 1922) and *Rondibilis* J. Thomson, 1857. Initial works on longhorn beetle in West Bengal confined in North Bengal region. Saha and Raychaudhuri worked on Buxa Tiger reserve and Dooars region in the year of 2000 and 2013. They reported 12 species of Cerambycidae from Buxa Tiger Reserve of which 7 were new report from whole West Bengal. Then Mitra *et al*., 2015 documented 3 new cerambycid beetles from North Bengal for the first time and published a list of already reported and newly recorded cerambycid species (146 species) of West Bengal has also been made along with their valid scientific names. Of them subfamily Lamiinae shared maximum number of species (79), followed by Cerambycinae (56), Prioninae (10) and Lepturinae (1). This was the first consolidated report on the cerambycid fauna of West Bengal. They also reported Xylorhiza *adusta* from Puruliya previously reported from Jalpaiguri, Saha *et al.* 2013. But very few works on Cerambycidae are available from South Bengal. In the year of 2015 Mitra *et al.* documented 8 species belonging to 8 genera and 7 tribes of 3 sub families from Sundarban Biosphere Reserve. Of them, four species are recorded for the first time from this mangrove ecosystem. Mitra *et al*. (2015) said the Longhorn beetle fauna of West Bengal was mostly studied from high altitude areas (Darjeeling district) and Dooars (Jalpaiguri district) of North Bengal. Comparatively, the fauna is unexplored or under explored from southern Bengal or from mangrove belts (North, South 24 Pargana and Purba Medinipore districts), Gangetic plains (Malda, Murshidabad, Nadia, Howrah and Hoogly districts) and semi-arid zones (Paschim Medinipore, Bankura, Puruliya and Birbhum districts) of West Bengal. So, this is the first attempt of documentation of cerambycid beetle from Howrah, a district of South Bengal. 146 species and 84 genera of longhorn beetles have so far been recorded from all over West Bengal whereas a small district Howrah contains 13 species and 12 genera alone.

Among the 13 species *Xystrocera globosa*, *Apomecyna saltator*, *Cremnosterna* sp., *Pseudanaesthetis langana*, *Rondibilis* sp. first time recoded from West Bengal on the basis of last updated list of Cerambycidae of West Bengal. *Kunbir telephoroides* recoded from this district first time for whole Eastern India (Dwari and Mondal, 2018). *Stromatium barbatum, Stromatium longicorne, Chlorophorus annularis, Batocera rufomaculata, Nupserha bicolor* and *Olenecamptus bilobus* are common species in this district. *Xystrocera globosa, Cremnosterna* sp. and *Rondibilis* sp. are uncommon; *Kunbir telephoroides, Apomecyna saltator* and *Pseudanaesthetis langana* are rare species of this district. Until today works on longhorn beetles in India generally deals with preparation of checklist of a particular places or states (Gahan, 1906; Stebbing, 1914; Beeson, 1941; Mitra *et al*., 2015; Kariyanna *et al*., 2017) very few deals with their behaviors so, this work help to understand behaviours of some species. The studies reveal that high species richness and evenness and low dominance at study area. The biodiversity (diversity index, species richness and evenness) of longhorn beetles fauna in Howrah district, West Bengal is mainly due to the rich roadside vegetation and vegetation around agricultural fields as vegetation plays an important role for the existence of insect fauna in a community as it provides the resources for insects. For instance, the occurrence of a rich and diversified fauna in the district was largely attributed to the conservation of vegetations in this region (Larsen, 1987). PCA analysis shows that species with similar distributional pattern are come into the same coordinate. *Stromatium barbatum, Stromatium longicorne* and *Chlorophorus annularis* are present in same coordinate due to their similar distributional pattern in this district. Likewise *Batocera rufomaculata* and *Olenecamptus bilobus* are present in another same coordinate. Species accumulation curve is represented in the figure 6.

The species accumulation curve of whole district sampled individually increased from 2013 to 2016 sampling through the number of new records added slowly but after 2016 number of new records were same in 2017. Rapid development, urbanization and industrialization are the potential causes of declining Mantid species richness, diversity and abundance in this district.

Conclusion

Our study give a baseline data for the Longhorn Beetles of Howrah district which will help for further study on role in ecosystem, abundance and also help to identify the potential threats. We can conclude from our study that as a non forest district Howrah contain a good number of species of Longhorn Beetles. But rapid industrialization, habitat loss and uncontrolled anthropogenic activities are the main present threats of Cerambycid Beetles.

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7. Conflict of Interest Statement: There is no such conflict of interest in this study and manuscript.

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