

Coleopteran diversity, its distribution and the influence of environmental factors on them in the Barak river basin of Assam, India

Ankur Nandi and Sarbani Giri*

Department of Life Science and Bioinformatics, Assam University, Silchar 788011, Assam, India.

Email: giris111aus@gmail.com; sarbani.giri@aus.ac.in

ABSTRACT: The research aimed to assess beetle diversity across ecologically protected, semi-protected, and forested areas of Barak river basin area of Assam, India, with a focus on identifying species diversity and analysing its association with a variety of environmental parameters such as pH, temperature and precipitation. A total of 83 beetle species were identified, with *Adoretus sinicus* emerging as the most dominant species. Several rare species were also documented. Shannon-Wiener Diversity Index (H') calculated to be 3.663, indicating a relatively high species diversity. Simpson's diversity index (0.9704) indicated a well-balanced community. Shannon's Equitability Index 0.829, indicate a fairly even distribution. Pielou's Evenness Index (0.829) showed that species in the community are evenly distributed. Low value of Berger-Parker index (0.0725) explains that most abundant does not dominate the community, which complements the high diversity and evenness values. Whittaker's Beta Diversity Index calculated (3.34), points towards significant species turnover, suggesting that each site has a relatively unique community composition and that overall biodiversity is high across the study sites. The CCA data variation in the community. In the first axis CCA1, soil pH and precipitation have strong but opposing influences. Soil pH positively contributed whereas precipitation negatively contributed towards variation. In the second axis CCA2, specific humidity showed an important role in determining the variation, suggesting that environmental parameters play a crucial role in shaping the spatial patterns of species assemblages. *Adoretus sinicus* and *Anomala marginipennis* were exceptionally common on the highly invasive plant *Melastoma malabathricum* and seemed to be frequently feeding on the nectar and leaves of this plant, though *A. marginipennis* is a non-specific consumer of most flowering plants. During late autumn months when the activity of these beetles was at the highest, not a single undamaged *M. malabathricum* was found in the study sites. Many species from families like Cerambycidae, Scarabaeidae and Chrysomelidae were collected during the post-monsoon and early summer months, from March to August, indicating a coherent seasonal pattern. © 2025 Association for Advancement of Entomology

KEY WORDS: Biodiversity, diversity index, coleopteran key species

INTRODUCTION

The Eastern Himalayas ranging from eastern Nepal, north east India, Bhutan, part of Tibet and part of

China, is major biodiversity hotspot (Tordoff *et al.*, 2012). The river Barak basin of southern Assam, India, is a part of eastern Himalayas and represents a complex, rich and river-based ecosystem that has

* Author for correspondence

a lot of economic and conservation values. Barak Valley is characterized by a diverse array of forest types, microhabitats, floral and faunal diversity and ecological interactions (Baruah *et al.*, 2013). No dedicated documentation of the coleopteran diversity from Barak river basin has been undertaken so far which creates a gap in the existing knowledge on coleopteran biodiversity. However, compositions of Scarabaeidae have been evaluated for the state of Assam (Das *et al.*, 2016; Bhattacharya *et al.*, 2017). Aquatic beetles have also been evaluated and reported from selected wetlands such as Sonduba Beel, Deepor Beel and Hakama Beel (Ahmed *et al.*, 2025; Choudhury and Gupta, 2015; Mahanta *et al.*, 2024) as well as the Majuli River island (Borkataki *et al.*, 2018). Cerambycid beetles have also been evaluated at a state level (Mitra *et al.*, 2017). Small scale checklists of selected regions such as Chakrashila Wildlife Sanctuary and Jorhat District (Barman and Gupta, 2016; Bhattacharyya *et al.*, 2021). Due to climate change, global warming, anthropogenic activities and habitat loss, the insect diversity is at great threat. Recent studies have highlighted that beetles are one of the most significant pollinators (Muinde and Katumo, 2024). Decline of beetle population is an indicator of over-intensified land degradation leading to reduced agriculture turnover of the agriculture based economy (Bianchi *et al.*, 2007; Fiser *et al.*, 2025). Yet, while beetles play an essential role in maintaining ecological balance, little is known about the distribution and diversity and the threats of beetles from this region. The current study aims to quantify beetle diversity, analyse habitat associations and identify indicator species by employing active and passive sampling methods alongside environmental data collection to capture insights into habitat preferences, seasonal patterns and species richness and to establish the stability of the coleopteran community.

MATERIALS AND METHODS

The insect samples were documented during field survey and the data was collected using a combination of active sampling methods such as hand-picking and opportunistic encounters as well as passive sampling methods such as light traps,

pitfall traps and litter sampling. Survey information from snowball sampling of the locals regarding the description and location of insect samples were incorporated along with publicly available distribution data of animals from expert-curated databases such as university to decide the optimal study area selection. Environmental data such as temperature, humidity, vegetation type, and canopy cover, undergrowth density, soil moisture and microhabitat features were noted down. Identification of insects was done using morphological keys using field guides and existing literature (Vazirani, 1968; Stibick, 1980; Maulik, 1910; Marshall, 1916; Pal, 1992; Rajagopal and Kumar, 1993; Leschen and Węgrzynowicz, 1998; Chakraborty and Chakraborty, 2000; Poorani, 2002, 2019; Douglas, 2011; Johri *et al.*, 2010; Ghosh and Nilsson, 2012; Jadhav and Sharma, 2012; Jolivet *et al.*, 2012; Thakare *et al.*, 2012; Gupta *et al.*, 2014; Hegde *et al.*, 2014; Geiser, 2015; Kumawat *et al.*, 2015; Masek *et al.*, 2015, 2018; Arya and Tamta, 2016; Kushwaha *et al.*, 2017; Jadhao and Bhongade, 2018; Kumar, 2018; Kariyanna *et al.*, 2019; Prathapan *et al.*, 2019; Chandra *et al.*, 2021; Makarov and Kazantsev, 2022; Deb and Subramanian, 2023; Maquart *et al.*, 2023; Sreedevi *et al.*, 2023).

Study area: Existing literature on beetle distribution and habitat preference (Chung *et al.*, 2000; Driscoll and Weir, 2005) were followed to determine the ideal locations for the study. Six sites were selected (Table 1).

Sampling design: The sampling work was carried out over a two-year period in the afore mentioned 6 locations, from the autumn of 2022 to the autumn of 2024, with special attention to the active seasons of beetles. Sampling efforts were intensified during the post-monsoon and monsoon months, which align with the peak periods of beetle activity which occur between March and June as well as September and November. This strategy was adopted to maximize the likelihood of capturing a representative sample of the beetle populations during their most active phases in the subtropical forest ecosystems under study. Random sampling was conducted to study different habitats. Sampling was carried out

across various forest types and altitudes, ensuring a wide spatial representation of the study area. Species that were difficult to identify in the field were photographed or collected and identified later with the aid of taxonomic keys.

Key environmental parameters such as temperature and humidity were measured using portable digital devices at the time of each collection to capture the immediate microclimatic conditions in which beetle populations were observed.

Vegetation characteristics were also meticulously documented, with vegetation type, canopy cover, and undergrowth density being recorded for each sampling location.

In addition to the environmental data collected, broader climatic data were recorded at each sampling site to account for weather influences on beetle activity and distribution.

From the gathered data, Shannon-Weiner Diversity Index (H') and Simpson's Diversity Index were used to understand the diversity of the beetle species. Additionally, Shannon's Equitability Index, Simpson's Evenness Index and Pielou's Evenness Index were calculated to understand the species evenness. Margalef's Richness Index was calculated to adjust species richness for sample size. Berger-Parker Dominance Index was calculated to understand the dominance of the most abundant species in the community. Whittaker's Beta Diversity Index was calculated to understand the species turnover rate. Effective Number of species (ENS) was calculated. Finally, the effect of environmental variables on the variance was calculated using Canonical Correspondence Analysis and Distance-based Redundancy Analysis. One-way ANOVA was used to compare significance of relevant data, with a significance threshold set at $p < 0.05$.

1) Shannon-Weiner Diversity Index

$$H' = - \sum_{i=1}^S P_i \ln(P_i)$$

Where, S = Total number of species.

P_i = Proportion of individuals of species "i" relative

to the total number of individuals.

$\ln(P_i)$ = Natural logarithm of the proportion of species "i".

2) Simpson's Diversity Index

$$D = 1 - \sum P_i^2$$

Where, P_i = Proportion of individuals of species "i" relative to the total number of individuals.

3) Shannon's Equitability Index

$$E = \frac{H'}{\ln(S)}$$

Where, H' = Shannon-Weiner Diversity Index; S = Species richness.

4) Simpson's Evenness Index

$$ED = \frac{1/D}{S}$$

Where, D = Simpson's Diversity Index; S = Species richness.

5) Pielou's Evenness Index

$$J' = \frac{H'}{H'_{\max}}$$

Where, H' = Shannon-Weiner Diversity Index.

$H'_{\max}$ = Maximum possible Shannon-Weiner Diversity Index if all species were equally common (i.e., $= \ln(S)$).

6) Margalef's Richness Index

Where, S = Species richness; N = Total number of individuals.

7) Berger-Parker Dominance Index

Where, N_i = Number of individuals in the species with the highest abundance.

N = Total number of individuals.

8) Effective Number of Species

Where, H' = Shannon-Weiner Diversity Index.

9) Whittaker's Beta Diversity Index

Where, $\tilde{\alpha}$ = Gamma diversity, i.e., total species richness across all the communities.

= Average alpha diversity for all the communities.

10) Canonical Correspondence Analysis, was calculated.

11) Distance-based Redundancy Analysis, a constrained ordination method that correlates beta diversity with environmental variables using a dissimilarity matrix (Bray-Curtis Dissimilarity).

RESULTS AND DISCUSSION

A total of 83 beetle species were identified under 17 families during different seasons Pre-monsoon (March, April, May), Monsoon (June, July, August), Post-monsoon (September, October, November) and Winter (December, January, February). Cerambycidae had the highest diversity, followed by Chrysomelidae (Table 2, 3).

Shannon-Wiener Diversity Index (H') calculated to be 3.663, indicating a relatively high species diversity and a complex community where individuals are spread across many species, with no single species overwhelmingly dominant. Simpson's Diversity Index calculated was 0.9704. This emphasizes species dominance, indicating a low probability that any two randomly encountered individuals belong to the same species. This suggests high diversity, with many species contributing equally to the community structure.

Shannon's Equitability Index 0.829, indicate a fairly even distribution (where 1 would be perfect evenness). This mean no species is dominant in

the community. Simpson's Evenness Index (0.9704) showed high evenness in the community. Pielou's Evenness Index was calculated to be 0.829, showing that species in the study community are evenly distributed. Margalef's Richness Index was calculated to be 14.727. Margalef's richness index adjusts species richness for sample size and a moderately rich community with 83 species. It accounts for the sample size (262 individuals), showing a high richness compared to the number of individuals sampled. Berger-Parker Dominance Index was calculated to be 0.0725. The Berger-Parker index explains the ratio of the most abundant species (19 individuals) to the total number of individuals (262). A low value of 0.0725 suggests that the species that most abundant does not dominate the community, which complements the high diversity and evenness values.

Effective Number of Species (ENS) was calculated to be 38.978. This value translates the Shannon-Wiener index into a real number, showing that the diversity in the study community is equivalent to having approximately 39 equally abundant species. Given the actual richness of 83 species, this suggests that certain species are more common than others, but the community is still diverse. Whittaker's Beta Diversity Index calculated (3.34), points towards significant species turnover, suggesting that each site has a relatively unique community composition and that overall biodiversity is high across the study sites.

With the total constrained inertia accounting for 100 per cent of the variation (2.761), the CCA data shows that the first two axes explain 50.03 per cent

Table 1. Different sites of the study along with their respective GPS and Altitudinal data

Site	Location	GPS Coordinates	Altitude
Site A	Assam University Campus	24.687201, 92.752392	67.4m
Site B	Assam University (Ecoforest)	24.682907, 92.754419	72m
Site C	Irongmara village	24.694397, 92.736169	22.3m
Site D	Duwarbond	24.629053, 92.698161	37m
Site E	Bhaga	24.544872, 92.767693	75.1m
Site F	Garultala	24.431203, 92.827408	58.3m

Table 2. Distribution and diversity of coleopterans belonging to different families in the sites of Barak river basin, Assam

No.	Species	No. of observations	Season
Cerambycidae			
1.	<i>Aristobia approximator</i> (Thomson, 1865)	6	Monsoon
2.	<i>Aristobia reticulator</i> (Fabricius, 1781)	1	Post-Monsoon
3.	<i>Baralipion maculosum</i> Thomson, 1857	2	Pre-Monsoon
4.	<i>Batocera rubus</i> (Linné, 1758)	3	Pre-Monsoon
5.	<i>Chlorophorus annularis</i> (Fabricius, 1787)	4	Pre-Monsoon
6.	<i>Epepeotes uncinatus</i> Gahan, 1888	2	Pre-Monsoon
7.	<i>Nepiodes bowringi</i> (Gahan, 1894)	1	Pre-Monsoon
8.	<i>Oberea</i> sp.	2	Monsoon
9.	<i>Olenecamptus bilobus</i> (Fabricius, 1802)	2	Monsoon
10.	<i>Palimna</i> cf. <i>annulata</i> (Olivier, 1797)	1	Pre-Monsoon
11.	<i>Prionomma</i> (<i>Ancyloprotus</i>) <i>bigibbosum</i> (White, 1853)	1	Monsoon
12.	<i>Sthenias tonkineus</i> Pic, 1925	1	Post-Monsoon
13.	<i>Stromatium barbatum</i> (Fabricius, 1775)	5	Pre-Monsoon
14.	<i>Thylactus simulans</i> Gahan, 1890	1	Monsoon
15.	<i>Xylorhiza adusta</i> (Wiedemann, 1819)	1	Pre-Monsoon
16.	<i>Xystrocera globosa</i> (Olivier, 1795)	2	Post-Monsoon
Coccinellidae			
17.	<i>Cheilomenes sexmaculata</i> (Fabricius, 1781)	4	Winter
18.	<i>Chilocorus nigrinus</i> (Fabricius, 1798)	3	Pre-Monsoon
19.	<i>Coccinella transversalis</i> Fabricius, 1781	7	Winter
20.	<i>Diekeana</i> sp.	16	Pre-Monsoon
21.	<i>Henosepilachna vigintioctopunctata</i> (Fabricius, 1775)	2	Pre-Monsoon
22.	<i>Micraspis discolor</i> (Fabricius, 1798)	14	Pre-Monsoon
23.	<i>Micraspis univittata</i> (Hope, 1831)	9	Pre-Monsoon
Scarabaeidae			
24.	<i>Adoretus</i> (<i>Lepadoretus</i>) <i>sinicus</i> Burmeister, 1855	19	Pre-Monsoon
25.	<i>Anomala bilobata</i> Arrow, 1912	1	Pre-Monsoon
26.	<i>Anomala marginipennis</i> Arrow, 1912	7	Pre-Monsoon
27.	<i>Apogonia</i> sp.	2	Pre-Monsoon
28.	<i>Catharsius molossus</i> (Linnaeus, 1758)	2	Pre-Monsoon
29.	<i>Copris</i> sp.	1	Pre-Monsoon
30.	<i>Dicheros</i> (<i>Coryphe</i>) <i>bimacula</i> (Wiedemann, 1823)	2	Post-Monsoon
31.	<i>Holotrichia</i> sp.	5	Pre-Monsoon
32.	<i>Lepidiota</i> sp.	1	Monsoon

33.	<i>Onitis</i> sp.	1	Post-Monsoon
34.	<i>Onthophagus</i> sp.	1	Post-Monsoon
35.	<i>Popillia</i> sp.	1	Post-Monsoon
36.	<i>Schizonycha</i> sp.	4	Pre-Monsoon
Chrysomelidae			
37.	<i>Altica</i> sp.	5	Winter
38.	<i>Basiprionota decemmaculata</i> (Boheman, 1850)	1	Monsoon
39.	<i>Cassida (Crepidaspis) circumdata</i> Herbst, 1799	2	Post-Monsoon
40.	<i>Cassida (Crepidaspis) diomma</i> Boisduval, 1835	1	Monsoon
41.	<i>Aspidomorpha sanctaecrucis</i> (Fabricius, 1792)	16	Monsoon
42.	<i>Aspidomorpha miliaris</i> (Fabricius, 1775)	7	Post-Monsoon
43.	<i>Aulacophora indica</i> (Gmelin, 1790)	17	Pre-Monsoon
44.	<i>Dercetina</i> sp.	2	Pre-Monsoon
45.	<i>Galerucella placida</i> Baly, 1878	1	Monsoon
46.	<i>Lilioceris</i> sp.	1	Monsoon
47.	<i>Luperomorpha</i> sp.	1	Pre-Monsoon
48.	<i>Monolepta</i> sp.	8	Pre-Monsoon
49.	<i>Platycorynus peregrinus</i> (Herbst, 1783)	2	Pre-Monsoon
50.	<i>Podontia</i> sp.	2	Pre-Monsoon
51.	<i>Craspedonta</i> sp.	1	Monsoon
Carabidae			
52.	<i>Cicindela assamensis</i> Parry, 1844	1	Monsoon
53.	<i>Clivina</i> sp.	2	Post-Monsoon
54.	<i>Macrocheilus</i> sp.	1	Monsoon
55.	<i>Cicindela (Cosmodela) virgula</i> Fleutiaux, 1894	2	Pre-Monsoon
56.	<i>Craspedophorus mandarinus</i> (Schaum, 1854)	1	Monsoon
57.	<i>Cylindera (Ifasina) spinolae</i> (Gestro, 1889)	1	Pre-Monsoon
58.	<i>Scarites</i> sp.	1	Monsoon
59.	<i>Orthogonius</i> sp.	1	Pre-Monsoon
60.	<i>Pheropsophus (Stenaptinus) jessoensis</i> A.Morawitz, 1862	1	Monsoon
Tenebrionidae			
61.	<i>Cistelomorpha</i> sp.	1	Pre-Monsoon
62.	<i>Strongylium</i> sp.	5	Monsoon
Curculionidae			
63.	<i>Acicnemis</i> sp.	1	Pre-Monsoon
64.	<i>Desmidophorus hebes</i> Gyll. in Schoenh., 1837	2	Pre-Monsoon
65.	<i>Ectatorhinus</i> sp.	1	Post-Monsoon
66.	<i>Myllocerus</i> sp.	7	Monsoon

67.	<i>Phytoscaphus fractivirgatus</i> Marshall, 1923	1	Monsoon
68.	<i>Sternuchopsis</i> sp.	1	Post-Monsoon
Elateridae			
69.	<i>Agrypnus</i> sp.	1	Post-Monsoon
70.	<i>Cryptalaus sordidus</i> (Westwood, 1848)	1	Monsoon
71.	<i>Melanotus</i> sp.	1	Pre-Monsoon
Dytiscidae			
72.	<i>Cybister</i> sp.	8	Winter
73.	<i>Sandracottus chevrolati</i> (Aubé, 1838)	1	Pre-Monsoon
Lucanidae			
74.	<i>Prosopocoilus biplagiatus</i> (Westwood, 1855)	3	Pre-Monsoon
75.	<i>Prosopocoilus girafa</i> (Olivier, 1789)	1	Post-Monsoon
Lycidae			
76.	<i>Lycostomus similis</i> (Hope, 1831)	2	Post-Monsoon
77.	<i>Platerodrilus</i> sp.	1	Monsoon
Staphylinidae			
78.	<i>Platydracus</i> sp.	1	Winter
Prionoceridae			
79.	<i>Prionocerus bicolor</i> Redtenbacher, 1868	4	Winter
Lymexylidae			
80.	<i>Melittomma</i> sp.	1	Pre-Monsoon
Cleridae			
81.	<i>Tenerus</i> sp.	1	Monsoon
Endomychidae			
82.	<i>Eumorphus quadriguttatus</i> (Illiger, 1800)	1	Monsoon
Erotylidae			
83.	<i>Tetraphala</i> sp.	1	Monsoon

of all variation in the community. In the first axis CCA1, soil pH and precipitation have strong but opposing influences. Soil pH positively contributes whereas precipitation negatively contributes towards variation. In the second axis CCA2, specific humidity plays an important role in determining the variation. Sites and species showed distinct distributions across these gradients, reflecting the influence of habitat heterogeneity on community structure. These findings suggest that environmental parameters play a crucial role in shaping the spatial patterns of species assemblages. It revealed that the environmental variables fully

explain the variation in species composition, with the total inertia (1.76) entirely accounted for by the constrained model (100% explained variance). The first three canonical axes (CAP1, CAP2, and CAP3) together capture 76 per cent of the variance, with CAP1 alone contributing 35.22 per cent, thus emphasizing its key role in determining variance. Environmental parameters such as temperature and specific humidity positively influence CAP1 and CAP2, while soil pH is dominant in CAP1, and soil moisture as well as precipitation contribute negatively to CAP1. Sites cluster based on ecological similarity, with A (Site

1) distinctly influenced by CAP2 and CAP5. The biplot further shows the strong influence of environmental gradients; indicated by arrow lengths and directions; on species composition, with temperature and humidity being positively correlated (Fig. 1). The use of Bray-Curtis dissimilarity captures species turnover, and it also demonstrates the dominant role played by the selected environmental factors in driving biodiversity patterns. This data suggests that the forests of Barak Valley is highly diverse in terms of the beetle population inhabiting it, with a large number of species (83) spread relatively evenly across the total documented individuals (262). No single species dominates the ecosystem, as reflected by the low Berger-Parker dominance index and high evenness

values across different indices (Pielou's, Shannon's equitability, and Simpson's evenness). High evenness suggests that niche differentiation is well established, reducing the likelihood of competitive exclusion. This balance often contributes to ecosystem stability, making it less susceptible to disturbances, as the community doesn't rely on just a few dominant species for its overall functioning.

The effective number of species (ENS of ~39) shows that despite having 83 species, the community functions as though there are approximately 39 equally common species. This highlights a slight skew toward some species that are more abundant than others, but overall diversity is maintained. This is important because ecosystems with high

Table 3. Number of species, families, their habitat and time of occurrence in the sites of Barak river basin, Assam

Family	Genera	Species	Guild	Habitat	Occurrence
Cerambycidae	15	16	Herbivores (wood/stem borers)	Tree bark, leaves	Nocturnal/ diurnal
Chrysomelidae	13	15	Herbivores (leaf feeder)	Leaves, foliage	Diurnal
Scarabaeidae	12	13	Detritivores, Coprophagous, Root feeder	Leaf litter, under stones	Nocturnal
Carabidae	8	9	Predators (opportunistic ground hunters)	Leaf Litter, under Stones	Nocturnal
Coccinellidae	6	7	Predators (aphidophagous, coccidophagous)	Leaves, foliage	Diurnal
Curculionidae	6	6	Herbivores (phytophagous)	Tree bark, leaves	Diurnal
Elateridae	3	3	Larvae: Soil/root feeders; Adults: Herbivores (occasionally predators)	Tree bark, leaf litter	Nocturnal
Tenebrionidae	2	2	Detritivores	Leaf litter, under stones	Nocturnal
Dytiscidae	2	2	Aquatic Predators	Streams, Ponds	Diurnal
Lucanidae	1	2	Larvae: Wood borers; Adults: Herbivores (occasionally predators)	Tree bark	Diurnal
Lycidae	2	2	Fungivores / Nectar & pollen feeders (some larvae detritivores)	Leaves, foliage	Diurnal
Lymexylidae	1	1	Wood-borers	Tree bark	Diurnal
Staphylinidae	1	1	Predators / Scavengers	Leaf litter	Nocturnal
Erotylidae	1	1	Fungivores	Leaf litter	Nocturnal
Endomychidae	1	1	Fungivores	Tree bark	Nocturnal
Cleridae	1	1	Predators	Leaves	Diurnal
Prionoceridae	1	1	Larvae: Predators; Adults: Pollen feeders	Leaves	Diurnal

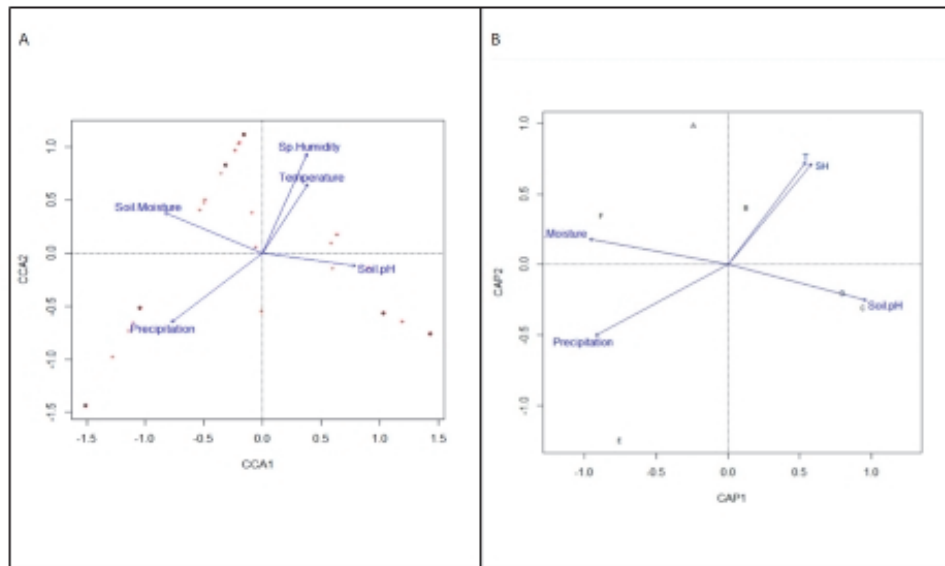


Fig. 1 A) CCA plot showing the impact of different environmental factors across the axes and DB-RDA plot showing the impact of different environmental factors on the beta diversity of the population across the axes

B) DB-RDA plot showing the impact of different environmental factors on the beta diversity of the population across the axes CAP1 and CAP2. T refers to Temperature and SH refers to Specific Humidity. Here, A, B, C, D, E and F correspond with Site 1, Site 2, Site 3, Site 4, Site 5 and Site 6 in a Bray-Curtis distance relationship respectively.

effective species numbers are typically more resilient to disturbances such as climate change, habitat fragmentation, or invasive species introduction. The species diversity across different sites was also significantly varied, with the large Whittaker's Beta Diversity index value suggesting a large environmental variability across the studied sites. This could mean differences in habitat types, microclimates, or resources available at each site, promoting distinct species assemblages. It suggests that each site contributes uniquely to the overall diversity (gamma diversity) of the region. However, it is of note that the small sample size increases the potential for inaccuracies in this data. Of particular note were the overwhelming presence of Cerambycidae in site 5 and of Chrysomelidae, Lucanidae and Lycidae in site 2. Site 2 also had the highest alpha diversity, hinting towards the faunal health of this forest.

The results of both Canonical Correspondence Analysis (CCA) and distance-based Redundancy Analysis (db-RDA) display the critical role of environmental variables in shaping the species

composition and biodiversity patterns. The extremely high explanation of variance by environmental factors in both analyses highlights the influence of these factors in structuring ecological communities. Soil pH and precipitation consistently emerged as dominant drivers of species turnover, emphasizing their ecological importance in the studied sites. Conservation strategies should, therefore, focus on maintaining and restoring these two critical environmental variables and mitigate anthropogenic activities that alter soil pH in this region.

The clustering of sites based on species composition relative to environmental gradients helps to provide a framework for understanding habitat heterogeneity. Site 1 and Site 5 exhibit distinct scores on the axes, which may represent ecological outliers with unique microhabitats or resource availability present in these sites, possibly pointing out the observed presence of water bodies in both. These site-specific distinctions highlight the diversity of environmental variables within the study area and the corresponding variability in ecological

communities. This spatial differentiation is essential for identifying habitats that may support unique or specialized species. The clustering of sites based on species-environment relationships can guide the establishment of ecological corridors and conservation areas to promote connectivity and ecosystem resilience.

Of particular note are several interesting habit and habitat patterns observed during this work. *Adoretus sinicus* and *Anomala marginipennis* were exceptionally common on the highly invasive plant *Melastoma malabathricum* and seemed to be frequently feeding on the nectar and leaves of this plant, though *A. marginipennis* is a non-specific consumer of most flowering plants. During late autumn months when the activity of these beetles was at the highest, not a single undamaged *M. malabathricum* was found in the study sites. This indicates the potential of *A. sinicus* and *A. marginipennis* for biological control of this invasive plant.

Longhorn beetles (Cerambycidae) proved to be the most diverse group in this region and many of these species dependent on a particular group of plants or forest conditions, such as *Stromatium barbatum* being dependent on teak (*Tectona grandis*) and other timber plants, making them sensitive to changes in the forest plant diversity caused by deforestation and fragmentation. This indicates their potential as bioindicators. *Calotropis gigantea* was observed to be the most common host plant for *Platycorynu speregrinus*. These beetles form a complex with the toxic milkweed plant, consuming it despite its toxic latex. This highlights the presence of specific beetle-plant feeding complexes that might prove to be key points of interest for conservation in this region. High diversity of Lady beetles (Coccinellidae), like *Cheilomenes sexmaculata* and *Coccinella transversalis*, are natural pest controllers. Their high numbers, such as *Diekeana admirabilis* (16 individuals), suggest a healthy population of predators that feed on aphids and other small pests, pointing to an ecosystem balance.

Many species from families like Cerambycidae, Scarabaeidae and Chrysomelidae were collected

during the post-monsoon and early summer months, from March to August, indicating a coherent seasonal pattern. This aligns with known periods of increased beetle activity when temperatures rise and food resources (like fresh vegetation and decomposing organic matter) become more abundant (Datta, 1982; Latha, 2019). Particularly for longhorn beetles and scarabs, there's a noticeable uptick in observations during the monsoon/post-monsoon months (June to August), corresponding with increased humidity, which encourages tree decay and forms nutrient-rich environments. These are ideal conditions for these beetles. Further analysis could link these trends to local climatic changes, offering a model for how beetles might respond to climate variability.

Certain species, like *Prosopocoilus girafa* (Giraffe stag beetle) and *Platerodrilus* sp. (Trilobite beetle), are important because of their rarity and distinctive biology (Dong *et al.*, 2014; Makarov and Kazantsev, 2022). Their presence could point towards specific microhabitats as well as conservation importance due to their specialized ecological roles.

A few beetles, such as *Anomala bilobata*, are potential agricultural pests, with scarab beetles sometimes causing damage to crops (Koppenhöfer and Fuzy, 2009). Lebbek borer (*Xystrocera globosa*), mango longhorn beetle (*Batocera rubus*), and Chinese rose beetle (*Adoretus sinicus*) are pest potential in agricultural settings (Spafford *et al.*, 2016; Mani, 2022; Singh *et al.*, 2022). The recorded data on these species can be used to model potential pest outbreaks and help design sustainable pest management strategies. Relatively high count of *Adoretus sinicus* (19 individuals) and other scarabs shows a stable system that promotes organic material breakdown and soil enrichment, likely supporting plant growth and soil fertility. Scarab beetles, such as *Catharsius molossus* (dung beetles), are essential for soil health as they help aerate the soil and improve nutrient cycling by burying dung (Singh *et al.*, 2021). The presence of multiple wood-boring beetles, including *Aristobia reticulator* and *Oberea* sp., suggests that the study area might consist of some fragmented or degraded forest patches (Saint-Germain and Drapeau, 2011). Wood-boring beetles thrive in areas where trees

Table 4. Environmental parameters in the sites of Barak river basin, Assam

Sites	Temperature (°C)	Specific humidity (g/kg)	Mean soil Moisture (%)	pH of soil	Mean precipitation
1	16.95 - 28.1	8.09 - 20.64	22.92	5.4 - 5.81	8.62mm/day
2	16.34 - 27.21	8.09 - 20.64	28.43	5.79 - 6.35	8.62mm/day
3	15.48 - 27.19	7.53 - 19.9	17.15	5.34 - 7.47	8.62mm/day
4	17.15 - 27.91	7.53 - 19.9	13.61	6.72 - 7.82	8.62mm/day
5	14.97 - 26.33	6.83 - 18.84	26.94	5.53 - 5.87	12.18mm/day
6	15.04 - 27.22	6.83 - 18.84	33.82	4.89 - 5.71	12.18mm/day

are stressed or dying, which could result from habitat fragmentation or other anthropogenic pressures. Comparing current data with historical records, changes in the distribution and abundance of certain species due to climate change might be observed. For example, species typically associated with warmer climates, such as *Aspidimorpha sanctaecrucis* could be expanding their habitat range into this region as temperatures increase (Muhaimin *et al.*, 2019).

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REFERENCES

- Ahmed G., Das A., Das A.N. and Gogoi B. (2025) Entomofaunal diversity of aquatic insects in Hakama Beel wetlands: a study in Assam, India. Wealth of Northeast India. XYZ Publishers, Guwahati. 220pp.
- Arya M. K., and Tamta P. (2016). Study on distribution and diversity of beetles (Insecta: Coleoptera) in different elevational zones of Binsar Wildlife Sanctuary, Almora, Uttarakhand, India. Journal of Entomology and Zoology Studies 4: 311–316.
- Barbhuiya H. A., Dutta B. K., Das A. K., and Baishya A. K. (2013). An annotated checklist of the Grasses (Poaceae) of Southern Assam. Check List 9(5): 980–986.
- Baruah M., Chakraborty G. and Choudhury M.D. (2013) Contribution to the flora of Barak Valley: conservation status and economic potential of herbaceous plant resources of Cachar District of Assam, India. International Journal of Bioresource and Stress Management 4 (2): 137–146.
- Bhattacharyya B., Bhagawati S., Manpoong N.S., Das P.P.G. and Devi E.B. (2021) Species diversity and relative abundance of scarab beetles in Jorhat district of Assam, India. Journal of Entomology and Zoology Studies 9 (3): 123–131.
- Bhattacharyya B., Handique G., Pujari D., Bhagawati S., Mishra H., Gogoi D. and Debnath H. (2017) Species diversity and relative abundance of scarab beetle fauna in Assam, northeast India. Journal of Entomology and Zoology Studies 5 (1): 711–716.
- Borah N. and Garkoti S.C. (2011) Tree Species composition, diversity, and regeneration patterns in undisturbed and disturbed forests of Barak Valley, South Assam, India. International Journal of Ecology and Environmental Sciences 37(3): 131–141.
- Borah N., Rabha D. and Athokpam F.D. (2016) Tree species diversity in tropical forests of Barak valley in Assam, India. Tropical Plant Research 3(1): 1–9.
- Borkataki S., Bhattacharyya B., Bhagawati S., Taye R.R. and Mishra H. (2018) Aquatic insect fauna of Majuli River Island of Assam. Journal of Entomology and Zoology Studies 6 (4): 1253–1257.
- Borogayary B., Das A. and Nath A. (2018) Tree species composition and population structure of a secondary tropical evergreen forest in Cachar district, Assam. Journal of Environmental Biology 39(1): 67–71.
- Chakraborty P. and Chakraborty S. (2000) Agrypninae

- (Coleoptera: Elateridae) of India: A taxonomic review and checklist. Records of the Zoological Survey of India 98(3): 71–83.
- Chandra K., Gupta D., Ghosh J., Das P., and Bhunia D. (2021) Insecta: Coleoptera. Faunal Diversity of Biogeographic Zones of India: North-East. Zoological Survey of India, Kolkata. pp377–451.
- Choudhury D. and Gupta S. (2015) Aquatic insect community of Deepor Beel (Ramsar site), Assam, India. Journal of Entomology and Zoology Studies 3 (1): 182–192.
- Chung A., Eggleton P., Speight M., Hammond P. and Chey V. (2000) The diversity of beetle assemblages in different habitat types in Sabah, Malaysia. Bulletin of Entomological Research 90(6): 475–496.
- Datta A.K. (1982) Studies on ground beetles (Coleoptera: Insecta) of Dooars area (Jalpaiguri: West Bengal) with special reference to their taxonomy, seasonal activity and density by pitfall experiment [Doctoral thesis, University of North Bengal]. University of North Bengal, Siliguri. <https://ir.nbu.ac.in/handle/123456789/982>
- Das M., Bhattacharyya B., Pujari D. and Handique G. (2016) Faunal composition of scarab beetles and their hosts in Assam. In: Arthropod Diversity and Conservation in the Tropics and Sub-tropics (Eds. C. Chakraborty and A. Mitra), Springer Singapore, Singapore. pp335–344.
- Deb R. and Subramanian K. (2023) New Record of *Sandracottus* Species (Coleoptera: Dytiscidae) from Western Ghats of India. Uttar Pradesh Journal of Zoology 44(21): 10–15.
- Deka K., Borthakur S. and Tanti B. (2017) Distribution and population dynamics of *Calamus nambariensis* Becc. – An endemic and threatened cane of Assam. Annals of Plant Sciences, 6(12): 1829–1834.
- Dikshit K.R. and Dikshit J.K. (2014) Natural Vegetation: Forests and Grasslands of North-East India. In: North-East India: Land, People and Economy. Advances in Asian Human-Environmental Research. Springer, Dordrecht. pp213–255. doi: 10.1007/978-94-007-7055-3_9.
- Dong X.M. and Jiang L. (2024) Species-specific larval acoustic behaviour of three stag beetles (Coleoptera: Lucanidae), with emphasis on their stridulatory organs and acoustic signals. Arthropod Structure & Development 80: 101300.
- Douglas H. (2011) Phylogenetic relationships of Elateridae inferred from adult morphology, with special reference to the position of Cardiophorinae. Zootaxa 2900(1): 1–45.
- Driscoll D.A. and Weir T. (2005) Beetle responses to habitat fragmentation depend on ecological traits, habitat condition, and remnant size. Conservation Biology, 19(1): 182–194.
- Geiser M. (2015) Taxonomy, phylogeny and biogeography of the Prionoceridae (Insecta: Coleoptera: Cleroidea) in the Indochinese Subregion [Doctoral dissertation, University of Basel]. Universität Basel, Basel. <https://edoc.unibas.ch/>
- Ghosh S.K. and Nilsson A.N. (2012) Catalogue of the diving beetles of India and adjacent countries (Coleoptera: Dytiscidae). Skörvnöpparn Supplement 3: 1–77.
- Grégoire J.C. (1988) Larval gregariousness in the Chrysomelidae. In: Biology of Chrysomelidae (Eds. P. Jolivet, E. Petitpierre and T.H. Hsiao), Springer, Dordrecht. pp253–271.
- Gupta D., Chandra K. and Khan S. (2014) An updated checklist of scarabaeoid beetles (Coleoptera: Scarabaeoidea) of Pench Tiger Reserve, Madhya Pradesh, India. Journal of Entomology and Zoology Studies 2(5): 225–240.
- Hegde V., Lal B., and Chandra K. (2014). Tenebrionidae (Coleoptera) Fauna of Chhattisgarh, India. Zoo's Print 29(12): 31–34.
- Jadhao M.F. and Bhongade A.H. (2018) Occurrence of carabid beetles (coleoptera: carabidae) in rice fields during kharif season. International Journal of Researches in Biosciences, Agriculture and Technology 6(5): 168–172.
- Jadhav S. and Sharma R. (2012) Insecta: Coleoptera: Rhynchophora: Curculionidae. Zoological Survey of India, Fauna of Maharashtra, State Fauna Series 20: 527–528.
- Johri P., Vishnu Dayal V.D., and Reeta Johri R.J. (2010) Diversity of terrestrial insects around the natural wetland (Jalesar) in district Unnao, Uttar Pradesh, India. Journal of Experimental Zoology, India 13(2): 305–328.
- Jolivet P., Petitpierre E. and Hsiao T.H. (2012) Biology of Chrysomelidae. Springer Science & Business Media, Dordrecht. 465pp.
- Kariyanna B., Gupta R., Mohan M. and Vitali F. (2019) Wood-boring longhorn beetles (Coleoptera: Cerambycidae) of agroforest ecosystem in India. Indian Journal of Entomology 81(1): 108–126.

- Koppenhöfer A.M. and Fuzy E.M. (2009) Long-term effects and persistence of *Steinernema scarabaei* applied for suppression of *Anomala orientalis* (Coleoptera: Scarabaeidae). *Biological Control* 48(1): 63–72.
- Kumar S. (2018). Identification of Scarabaeid beetles (Coleoptera) in vicinity of sugarcane crop in the western plain zone of Uttar Pradesh, India. *Journal of Pharmacognosy and Phytochemistry* 7(5S): 111–115.
- Kumawat M., Singh K.M. and Ramamurthy V. (2015) A checklist of the Long-horned Beetles (Coleoptera: Cerambycidae) of Arunachal Pradesh, northeastern India with several new reports. *Journal of Threatened Taxa* 7(12): 7879–7901.
- Kushwaha R.K., Chakraborti U., Roy S., Biswas O. and Mitra B. (2017) Diversity of Ground beetles (Insecta: Coleoptera: Carabidae) from Indian Sundarban with seven new records. *Bioscience Discovery* 8(3): 335–339.
- Latha T. (2019) Seasonal activity of dung beetles (Scarabaeinae) in a forest in South Western Ghats. *International Journal of Forest, Animal and Fisheries Research* 3(2): 58–64.
- Leschen R.A. and Węgrzynowicz P. (1998) Generic catalogue and taxonomic status of Languriidae (Cucujoidea). Paper presented at the *Annales Zoologici* 48(3/4): 221–243.
- Mahanta B., Patar K., Osmani A.Q. and Kusre D. (2019) Aquatic insect community on Sonduba Beel, Morigaon District, Assam, India. *Journal of Aquatic Biology* 34 (2): 45–53.
- Makarov K.V. and Kazantsev S. (2022) Larva, pupa or adult? The female of *Platerodrilus* case (Coleoptera: Lycidae). *Diversity* 14(12): 1063.
- Mani M. (2022) Pests and their management in fig. *Trends in Horticultural Entomology*, Springer, Singapore. Doi: 10.1007/978-981-19-0343-4_26735–745.
- Maquart P.-O., Yamamoto S., Sopha S., Chhorn S., Phak S., Sinovas P. and Boyer S. (2023). Stag beetle fauna of Cambodia (Coleoptera: Lucanidae). *Journal of Asia-Pacific Entomology* 26(1): 102008.
- Marshall G. A. (1916). Some injurious Indian weevils (Curculionidae)—II. *Bulletin of Entomological Research* 6(4): 365–373.
- Masek M., Motyka M., Kusy D., Bocsek M., Li Y. and Bocak L. (2018) Molecular phylogeny, diversity and zoogeography of net-winged beetles (Coleoptera: Lycidae). *Insects*, 9(4): 154.
- Masek M., Palata V., Bray T. C. and Bocak L. (2015) Molecular phylogeny reveals high diversity, geographic structure and limited ranges in neotenic net-winged beetles *Platerodrilus* (Coleoptera: Lycidae). *PloS one* 10(4): e0123855.
- Maulik S. (1910) Named specimens of Chrysomelidae in the Indian Museum. *Records of The Indian Museum* pp202–213.
- Medhi P., Borthakur S., and Hore D. (2010). Phyto resources from North Cachar Hills of Assam, India-IV: Bamboos and Rattans. *Journal of Bamboo Rattan* 9(3): 115–125.
- Mitra B., Chakraborti U., Mallick K., Bhaumik S. and Das P. (2017) An updated list of cerambycid beetles (Coleoptera: Cerambycidae) of Assam, India. *Records of the Zoological Survey of India* 117(2): 78–90.
- Muhaimin A., Halim M., Zulaikha S. S., and Yaakop S. (2019). Habitat preferences of leaf beetles (Coleoptera: Chrysomelidae) based on abiotic factors: A study from Fraser's Hill, Pahang, Malaysia. In: *Proceedings of the IOP Conference Series: Earth and Environmental Science*, IOP Publishing. doi:10.1088/1755-1315/269/1/012035.
- Nath S.S., Beypi R. and Baruah M.K. (2024). Status of bamboo species in Cachar district of Barak valley, Assam, India. *Annals of Plant and Soil Research* 26(2): 487–491.
- Pal R. and Singh D. (2016) Endemic Orchids of Northeast India. *Bioprospecting of Indigenous Bioresources of North-East India* In: Purkayastha, J. (eds) *Bioprospecting of Indigenous Bioresources of North-East India*. Springer, Singapore. pp31–44. doi: 10.1007/978-981-10-0620-3_3
- Pal T.K. (1992) On a Collection of Passalidae and Lucanidae (Insecta: Coleoptera) from Arunachal Pradesh, India. *Records of the Zoological Survey of India* 90(1-4): 135–145. doi: 10.26515/rzsi/v90/i1-4/1992/160977
- Poorani J. (2002) An annotated checklist of the Coccinellidae (Coleoptera)(excluding Epilachninae) of the Indian subregion. *Oriental Insects* 36(1): 307–383.
- Poorani J. (2019) Coccinellidae of the Indian subcontinent. *Indian Insects: Diversity and Science*, CRC Press, Boca Raton. pp223–246.
- Prathapan K.D., Poorani J., Kumari S.A., Anuradha C., Padmanaban B. and Thanigairaj R. (2019) Species composition and diagnoses of leaf-and fruit-

- scarring beetles (Coleoptera, Chrysomelidae) infesting bananas and plantains (Zingiberales, Musaceae) in the Indian subcontinent. *Deutsche Entomologische Zeitschrift* 66(2): 179–202.
- Rajagopal D. and Kumar P. (1993) Morphological characters of predatory larvae of eight species of Indian carabid beetles (Coleoptera: Carabidae). *Journal of Entomological Research* 17(4): 319–325.
- Rajbongshi P. and Das T. (2024) High-Value Plant Resources in Riparian Areas. *High-Value Plants: Novel Insights and Biotechnological Advances* (Eds. Singh T.A., Sarangi P.K. and Singh C.B.), Apple Academic Press, Boca Raton. pp205–228.
- Saint-Germain M. and Drapeau P. (2011) Response of saprophagous wood-boring beetles (Coleoptera: Cerambycidae) to severe habitat loss due to logging in an aspen-dominated boreal landscape. *Landscape ecology* 26: 573–586.
- Singh A.P., De K., Uniyal V.P. and Sathyakumar S. (2021) An experimental study on bioturbation and dung removal activities of *Catharsius molossus* (Linnaeus, 1758) (Coleoptera: Scarabaeidae) in the Greater Himalaya. *Journal of Asia-Pacific Biodiversity* 14(2): 169–173.
- Singh A.R., Firake D., Akoijam R., Sharma S., Singh Y., Thokchom S. and Behere G. (2022) Record of three Cerambycid pests associated with tree bean (*Parkia timoriana*) decline in Northeast India. *National Academy Science Letters* 45(3): 213–217.
- Spafford H., Ching A., Manley M., Hardin C. and Bittenbender H. (2016) Management of Chinese rose beetle (*Adoretus sinicus*) adults feeding on cacao (*Theobroma cacao*) using insecticides. *Insects* 7(2): 28.
- Sreedevi K., Mahendiran G., and Chandana P. S. (2023). Ground Beetles (Coleoptera: Carabidae). *Insect Predators in Pest Management* (Ed. Omkar) CRC Press, Boca Raton. pp175–186.
- Stibick J.N. (1980) A revision of the Hypnoidinae of the world (Col. Elateridae): part/ IV. The Hypnoidinae of India (Section/ 12). *Revista Española de Entomología* 54(1–4): 247–273.
- Thakare V.G., Zade V.S., and Hegde V.D. (2012) Darkling Beetles (Coleoptera: Tenebrionidae) of Melghat Tiger Reserve, Central India. *Journal on New Biological Reports* 1(1): 29–32.
- Tordoff A., Baltzer M., Fellowes J., Pilgrim J. and Langhammer P. (2012) Key biodiversity areas in the Indo-Burma hotspot: process, progress and future directions. *Journal of Threatened Taxa* 4 (8): 2779–2787.
- Vazirani T. (1968) Notes on collection of Hispinae and Cassidinae (Coleoptera: Chrysomelidae) from NE India. *Records of the Zoological Survey of India* pp143–152.

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