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Biodiversity assessment of Rongo Forest, Kalimpong, West Bengal, India: An integrated study on flora, avifauna, insects, butterflies, and moths

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Abstract
Biodiversity assessments are central to ecological research and vital for framing conservation strategies, especially in ecologically sensitive regions such as the Eastern Himalayas. This study was conducted in Rongo Forest, Kalimpong, West Bengal, from April 16 to April 23, 2024, with the objective of documenting the diversity of plant and animal groups using standardized ecological protocols. Quadrat sampling was applied for vegetation analysis, while bird populations were surveyed through line transects and point counts. For terrestrial insects, pitfall traps, bush beating, and light trapping methods were utilized, whereas butterflies were sampled through Pollard Walks, line transects, and swing net collections. A total of 27 plant species representing 18 families were identified, with Fabaceae emerging as the dominant family. Avifaunal assessment yielded 25 bird species from 15 families, with Passeriformes being the most species-rich order. Terrestrial insects comprised 30 species from 10 different orders; pitfall traps accounted for 9 species, bush beating 13, and light traps 8. Lepidopterans were notably diverse, with 31 butterfly species across 5 families and 22 moth species from 8 families, including several globally threatened taxa such as *Parotis marginata*, *Alpha nivea*, and *Chasmina candida*. Compared with other surveys in the Eastern Himalayas, Rongo Forest supports a significant proportion of rare and threatened Lepidoptera, highlighting its conservation value. This baseline inventory emphasizes the need for continuous monitoring and targeted conservation planning to safeguard the biodiversity of the region.

Keywords: Rongo Forest, Kalimpong, Eastern Himalayas, biodiversity, flora, fauna, lepidoptera, insect diversity, conservation

Introduction

Biodiversity is a cornerstone of ecosystem stability, functioning, and resilience, providing essential resources and ecosystem services necessary for the survival and prosperity of human civilization. The Himalayas, particularly the Eastern Himalayas, constitute one of the world's most significant biodiversity hotspots, recognized for their extraordinary species richness and high levels of endemism (Myers *et al.*, 2000) [20]. This region supports unique assemblages of flora and fauna due to a combination of factors, including varied topography, altitudinal gradients, and climatic diversity (Mani, 1994; Choudhury, 2013) [5, 6, 13, 14].

Located near the Indo-Bhutan border in the western Dooars, the village of Rongo lies at an elevation of 450 feet within the Kalimpong subdivision of West Bengal. Positioned along the banks of the Jholong River, Rongo is renowned for its scenic views of surrounding hills, forests, and the Jaldhaka river valley. The area is notable for its Cinchona plantations and serves as one of the gateways to Neora Valley National Park. The lush green vegetation, vibrant Himalayan flora, and presence of numerous bird species make Rongo an ecologically important patch of intact forest, acting as a refuge for forest-dependent species while also supporting organisms adapted to disturbed habitats.

India is recognized as a megadiverse country, harboring over 46,000 plant species, 518 reptile species, approximately 472 amphibian species (50% endemic), 1,371 bird species (81 endemic), and 63,760 insect species across 27 orders, with Coleoptera (beetles) being the most diverse. In 2002, India added 664 animal species and 339 new plant taxa to its national biodiversity database, highlighting the dynamic and still incompletely documented nature of the country's biodiversity (Union Minister for Environment, Forest, and Climate Change, 2022) [15].

Despite this richness, biodiversity assessments in Kalimpong remain fragmentary. Previous studies have focused on specific groups such as butterflies (Mondal *et al.*, 2024) [18, 19], but comprehensive surveys integrating plants, birds, insects, butterflies, and moths are scarce. Insects, particularly Lepidoptera, serve as bioindicators of ecosystem health (Bonebrake *et al.*, 2010) [4], while birds reflect habitat structure, food availability, and climatic conditions (Bibby *et al.*, 2000) [3]. Plants, as primary producers, define habitat structure and directly influence faunal diversity. Multi-taxa surveys thus provide a more holistic assessment of ecosystem health than single-group studies.

The objectives of this study were therefore:

1. To document the diversity of plants, birds, terrestrial insects, butterflies, and moths in Rongo Forest, Kalimpong.
2. To analyse species richness, abundance, and conservation status using a combination of field methods.
3. To compare the results with other studies from the Eastern Himalayas and discuss the implications for conservation.

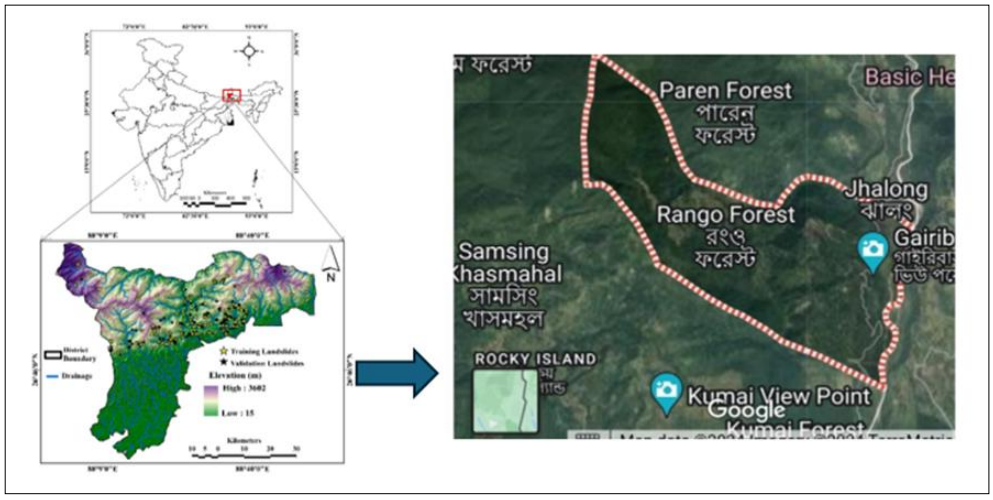

Fig 1: Location of study area Rongo forest, Kalimpong, West Bengal.

Materials and Methods

Study Area

The study was conducted in Rongo Forest, Kalimpong district, West Bengal, from April 16–23, 2024. The area lies at an elevation of 800–1,500 m above sea level within the Eastern Himalayan foothills. The climate during the study was humid subtropical, with temperatures ranging from 24–28 °C and occasional pre-monsoon rainfall. Vegetation is dominated by moist deciduous and broadleaf species, interspersed with secondary growth and cultivated patches. The heterogeneous habitats provided suitable niches for a diverse array of flora and fauna (Hooker, 1872–1897; Gamble & Fischer, 1915–1936) [7, 9].

Flora Sampling

Floral diversity was examined across three selected study sites in Rongo Forest. Areas were chosen based on the abundance of trees, shrubs, and bushes. Vegetation was analysed using a modified quadrat method: 1 m × 1 m quadrats were established at representative locations; each divided into four sub-quadrats of 0.25 m². Photographs of trees, shrubs, and bushes were taken within each quadrat to aid in later identification through visual reference. Species were identified using regional floras and verified with herbarium records, noting species abundance and frequency (Hooker, 1872–1897; Gamble & Fischer, 1915–1936) [7, 9].

Avifaunal Survey

Bird diversity was assessed using line transects, point counts, and opportunistic observations (Bibby *et al.*, 2000; Ali *et al.*, 1983; Grimmett *et al.*, 2016) [1, 3, 8]. Routes were selected for accessibility while minimizing double-counting, spaced at appropriate intervals. Surveys were conducted during peak activity periods in the early morning (06:00–10:30 hrs) and late evening (15:30–17:30 hrs), with a walking speed of approximately 2 km/h maintained in open habitats. At each point count station, all birds seen or heard within a 50 m radius over 15 minutes were recorded. IUCN conservation status for each species was referenced from the eBird India database. Opportunistic sightings were also included to produce a comprehensive avifaunal checklist.

Butterfly Sampling

Butterflies were surveyed over four days between 7:00–10:00 AM and 4:00–6:00 PM. Three complementary sampling techniques were employed: Pollard Walk, Direct Searching, and Time-Constrained Methods (Pollard, 1977; Kunte, 2000) [12, 21]. Three study sites were selected:

- **Site A:** Riverine and forest area along the Jal Dhaka River (GPS: 27.0423625, 88.83504692RRP+W2V)
- **Site B:** Woodland and forest area near Rongo waterfall (GPS: 27.0423625, 88.83504692RRQ+Q7M)
- **Site C:** Shrubby and grassland plain near Rongo waterfall (GPS: 27.0423625, 88.83504692RRP+H6R)

Butterflies were observed along fixed routes and opportunistically captured using hand nets when identification in the field was challenging. Specimens were photographed and released immediately to minimize disturbance.

Insect Sampling

Terrestrial insects, excluding Lepidoptera, were collected using sweep nets, pitfall traps, bush beating, and light traps:

- **Sweep Nets:** Canvas nets were used to sweep through vegetation to collect random insects such as flies, bugs, and small beetles.
- **Pitfall Traps:** Twenty pitfall traps (12 cm diameter cups with 70% ethanol) were buried flush with the ground to capture active, surface-dwelling invertebrates, including ants (*Camponotus compressus*, *Solenopsis* sp.) and rove beetles (*Paederus* sp.).
- **Bush Beating:** Vegetation was beaten with sticks over a white sheet to collect dislodged insects, including mantids (*Schizocephala bicornis*) and phasmids (*Ramulus Artemis*).
- **Light Traps:** UV tube lights placed against a white cloth between 6:30–10:00 PM attracted nocturnal insects, yielding species such as *Abscondita perplexa* and *Holotrichia* sp.

Moth Sampling

Moths were primarily collected using light traps operated over seven consecutive nights. Additional records were

obtained via pitfall traps and bush beating. Specimens were identified using reference collections and taxonomic keys (Kirti & Gill, 2005) [10, 11].

These multi-taxa approach, combining flora, birds, butterflies, moths, and terrestrial insects, provided a comprehensive assessment of biodiversity across the three selected sites in Rongo Forest.

Results

The biodiversity survey conducted in the Rongo Forest of Kalimpong revealed a rich assemblage of flora and fauna across multiple taxa, reflecting the varied microhabitats and ecological conditions within the study area. The area encompassed riverine zones, woodland forests, and shrubby grasslands, each supporting distinct communities of plants, birds, insects, butterflies, and moths. The following sections summarize the diversity observed for each group.

Flora

A total of 27 plant species representing 18 families were recorded (Table-1, Fig-1). Fabaceae emerged as the dominant family, followed by Lamiaceae and Asteraceae. Common tree species included *Shorea robusta*, *Mangifera indica*, and *Azadirachta indica*, while herbs such as *Hyptis suaveolens* and *Spilanthes paniculata* were characteristic of disturbed areas. The flora also included regionally restricted taxa such as *Barleria strigosa*, *Clerodendrum fargesii*, and *Pogostemon benghalensis*, alongside widely distributed species like *Ficus* sp., *Aegle marmelos*, and *Azadirachta indica*. This composition highlights a mixture of widespread and habitat-specific plant species across the study sites.

Birds

The avifaunal survey recorded 25 species across 15 families and six orders (Table-2, Fig-3). Passeriformes was the most diverse order, followed by Columbiformes and Piciformes. The most frequently observed species included *Passer domesticus*, *Acridotheres tristis*, and *Columba livia*. Species with more restricted distributions, such as *Psilopogon virens* and *Oriolus traillii*, reflected the Himalayan foothill and northeastern biogeographic influences. Some species showed clear habitat preferences; for example, *Copsychus saularis* and *Myophonus caeruleus* were mostly observed in riverine zones, whereas *Gracula religiosa* and *Eumyias thalassinus* were associated with forested habitats.

Terrestrial Insects

A total of 30 terrestrial insect species were documented across three sampling methods (Table-3, Fig-6). Bush beating yielded 13 species, including coccinellids (*Harmonia testudinaria*, *Cheilomenes sexmaculata*), mantids (*Schizocephala bicornis*, *Anaxarcha* sp.), and phasmids (*Ramulus artemis*, *Orxines* sp.). Pitfall traps captured nine species, mainly ants (*Leptogenys* sp., *Camponotus* sp.) and soil-dwelling taxa (*Bradysia* sp., *Isotoma* sp.). Light traps attracted eight species, including beetles (*Abscondita perplexa*, *Holotrichia* sp.), orthopterans (*Gryllotalpa orientalis*), and dipterans (*Musca domestica*). Coleoptera and Hymenoptera were well-represented, reflecting both surface-active and nocturnal insect communities.

Butterflies

Thirty butterfly species from five families were recorded (Table-4, Fig-4). Nymphalidae was the most species-rich family, followed by Papilionidae, Pieridae, Lycaenidae, and Hesperiidae. The Great Eggfly (*Hypolimnas bolina*), Rose Windmill (*Byasa latreillei*), and Golden Sapphire (*Heliophorus brahma*) were notable species within the survey. Different habitats supported variable species compositions, with shrubby grasslands hosting the highest number of species, while riverine and forest areas also contributed unique records. Most species are widespread in India, while a few are restricted to the Eastern Himalayas or northeastern regions.

Moths

Twenty-two moth species were documented across eight families (Table-5, Fig-5). Light traps captured the majority of species, including several of conservation concern such as *Parotis marginata* and *Alpha nivea* (Critically Endangered), *Pericyma cruegeri* (Globally Endangered), and *Macotasa nubecula* (Threatened). Additional species were recorded from pitfall traps (*Piarosoma arunachalensis*) and bush beating (*Palthis asopialis*). The diversity of moths reflects the habitat heterogeneity of the study area and emphasizes its ecological significance for nocturnal Lepidoptera.

Table 1: list of plants in the study area

Sl. No.	Scientific Name	Common Name	Order	Family	Geographic Distribution in India
1	*Alternanthera tenella* (Colla, 1829)	-	Caryophyllales	Amaranthaceae	Throughout India, especially moist habitats
2	*Barleria strigosa* (Willd., 1800)	Philippine violet	Lamiales	Acanthaceae	Eastern India, Northeast
3	*Clerodendrum fargesii* (Dode, 1907)	-	Lamiales	Lamiaceae	Northeastern India
4	*Hyptis suaveolens* [(Linnaeus) Kuntze, 1891]	Bushmint	Lamiales	Lamiaceae	Pan-India, common in disturbed areas
5	*Pogostemon benghalensis* [(Burm.f.) Kuntze, 1891]	Bengal pogostemon	Lamiales	Lamiaceae	Northeastern India
6	*Bridelia* sp. (Linnaeus, 1753)	-	Malpighiales	Phyllanthaceae	Northeastern India
7	*Shorea robusta* (Roth, 1821)	Sal tree	Malvales	Dipterocarpaceae	Northern and Central India
8	*Dioscorea* sp. (Linnaeus, 1753)	Yam	Dioscoreales	Dioscoreaceae	Pan-India, mostly in forests and hills
9	*Cassia* sp. (Linnaeus, 1753)	Senna	Fabales	Fabaceae	Throughout India
10	*Phaseolus* sp. (Linnaeus, 1753)	Bean	Fabales	Fabaceae	Cultivated throughout India
11	*Rubicaulis* sp. (Linnaeus, 1753)	-	Fabales	Fabaceae	Northeastern India
12	*Tephrosia* sp. (Linnaeus, 1753)	Tephrosia	Fabales	Fabaceae	Northern and Central India
13	*Acacia auriculiformis* (A. Cunn. ex	Earleaf	Fabales	Fabaceae	Southern India

	Benth., 1842)	acacia			
14	*Albizia lebbeck* (Linnaeus) Benth., 1842	Siris tree	Fabales	Fabaceae	Throughout India, common in plains
15	*Chromolaena odorata* (Linnaeus) R.M. King & H. Rob., 1971	Siam weed	Asterales	Asteraceae	Northeastern India, introduced elsewhere
16	*Elephantopus scaber* (Linnaeus, 1753)	Elephant's foot	Asterales	Asteraceae	Pan-India
17	*Spilanthes paniculata* (Wall. ex-DC., 1832)	Toothache plant	Asterales	Asteraceae	Northeastern India
18	*Combretum decandrum* (Roxb., 1832)	Bushwillow	Myrtales	Combretaceae	Eastern and Northeastern India
19	*Lagerstroemia parviflora* (Roxb., 1832)	Small-flowered Crape Myrtle	Myrtales	Lythraceae	Peninsular India
20	*Lagerstroemia* sp. (Linnaeus, 1753)	Crape myrtle	Myrtales	Lythraceae	Northeastern India
21	*Lophomyrtus* sp. (Linnaeus, 1753)	-	Myrtales	Myrtaceae	Northeastern India
22	*Ficus* sp. (Linnaeus, 1753)	Fig	Rosales	Moraceae	Pan-India
23	*Aegle marmelos* (Linnaeus) Corrêa, 1829	Bael	Sapindales	Rutaceae	Pan-India
24	*Murraya paniculata* (Linnaeus) Jack, 1820	Orange jasmine	Sapindales	Rutaceae	Southern India
25	*Azadirachta indica* (A. Juss., 1842)	Neem	Sapindales	Meliaceae	Pan-India
26	*Mangifera indica* (Linnaeus, 1753)	Mango	Sapindales	Anacardiaceae	Pan-India
27	*Eragrostis gangetica* (Roxb.) Steud., 1841	Lovegrass	Poales	Poaceae	Northeastern India

Table 2: list of birds in the study area

Sl. No.	Scientific Name	Common Name	Order	Family	Geographic Distribution in India
1	*Columba livia* (Gmelin, JF, 1789)	Rock Pigeon	Columbiformes	Columbidae	Pan-India
2	*Spilopelia chinensis* (Gmelin, JF, 1789)	Spotted Dove	Columbiformes	Columbidae	Pan-India
3	*Psilopogon virens* (Boddaert, 1783)	Great Barbet	Piciformes	Megalaimidae	Himalayan region, Northeast India
4	*Gryllotalpa orientalis* (Linnaeus, 1758)	-	Orthoptera	Gryllotalpidae	Pan-India
5	*Pericrocotus speciosus* (Latham, 1790)	Scarlet Minivet	Passeriformes	Campephagidae	Pan-India
6	*Argya striata* (Latham, 1790)	Jungle Babbler	Passeriformes	Leiothrichidae	Pan-India
7	*Oriolus traillii* (Jardine & Selby, 1830)	Maroon Oriole	Passeriformes	Oriolidae	Himalayan foothills, Northeast India
8	*Passer domesticus* (Linnaeus, 1758)	House Sparrow	Passeriformes	Passeridae	Pan-India
9	*Anthus hodgsoni* (Jerdon, 1845)	Olive-backed Pipit	Passeriformes	Motacillidae	Himalayas, Northeast India
10	*Dendrocitta formosae* (R. Swinhoe, 1863)	Gray Treepie	Passeriformes	Corvidae	Himalayan region, Northeast India
11	*Dendrocitta vagabunda* (Latham, 1790)	Rufous Treepie	Passeriformes	Corvidae	Pan-India
12	*Dicrurus leucophaeus* (Vieillot, 1817)	Ashy Drongo	Passeriformes	Dicruridae	Pan-India
13	*Hirundo rustica* (Linnaeus, 1758)	Barn Swallow	Passeriformes	Hirundinidae	Pan-India
14	*Lanius schach* (Linnaeus, 1758)	Long-tailed Shrike	Passeriformes	Laniidae	Pan-India
15	*Cyornis unicolor* (Hodgson, 1836)	Pale Blue Flycatcher	Passeriformes	Muscicapidae	Himalayas, Northeast India
16	*Niltava sundara* (Hodgson, 1836)	Rufous-bellied Niltava	Passeriformes	Muscicapidae	Northeastern India
17	*Phoenicurus frontalis* (Hodgson, 1836)	Blue-Fronted Redstart	Passeriformes	Muscicapidae	Himalayas, Northeast India
18	*Saxicola ferreus* (Hodgson, 1845)	Gray Bushchat	Passeriformes	Muscicapidae	Himalayas
19	*Eumyias thalassinus* (Swainson, 1837)	Verditer Flycatcher	Passeriformes	Muscicapidae	Northeastern India
20	*Hypsipetes leucocephalus* (Jardine & Selby, 1830)	Black Bulbul	Passeriformes	Pycnonotidae	Himalayan foothills, Northeast India
21	*Pycnonotus cafer* (Linnaeus, 1758)	Red-vented Bulbul	Passeriformes	Pycnonotidae	Pan-India
22	*Acridotheres tristis* (Linnaeus, 1766)	Common Myna	Passeriformes	Sturnidae	Pan-India
23	*Acridotheres javanicus* (Jardine & Selby, 1839)	Javan Myna	Passeriformes	Sturnidae	Northeastern India
24	*Gracula religiosa* (Linnaeus, 1758)	Common Hill Myna	Passeriformes	Sturnidae	Pan-India
25	*Tephrodornis pondicerianus* (Gmelin, JF, 1789)	Large Woodshrike	Passeriformes	Vangidae	Peninsular India

Table 3: list of terrestrial insects in the study area

Sl. No.	Scientific Name	Order	Family	Geographic Distribution in India
List of Insects Collected from Bush Beating				
1	*Harmonia testudinaria* (Mulsant, 1850)	Coleoptera	Coccinellidae	Widespread in India
2	*Oenopia sexareata* (Fabricius, 1781)	Coleoptera	Coccinellidae	Northeastern and Eastern India
3	*Cheilomenes sexmaculata* (Fabricius, 1781)	Coleoptera	Coccinellidae	Pan-India
4	*Propylea dissecta* (Mulsant, 1850)	Coleoptera	Coccinellidae	Pan-India
5	Unidentified species	Coleoptera	Curculionidae	Various regions
6	*Schizocephala bicornis* (Linnaeus, 1758)	Mantodea	-	Northern and Eastern India

7	*Anaxarcha sp.* (Stål, 1877)	Mantodea	Hymenopodidae	Northeastern India
8	*Leptomantella sp.* (Burmeister, 1838)	Mantodea	Leptomantellidae	Northeastern India
9	*Orxines sp.*	Phasmida	Lonchodidae	Western Ghats, Northeastern India
10	*Asceles sp.*	Phasmida	Lonchodidae	Northeastern India
11	*Lopaphus sp.*	Phasmida	Lonchodidae	Northeastern India
12	*Sipyloidea sp.*	Phasmida	Lonchodidae	Northeastern India
13	*Ramulus artemis* (Westwood, 1859)	Phasmida	Phasmatidae	Northeastern India
14	*Camponotus compressus* (Fabricius, 1793)	Hymenoptera	Formicidae	Pan-India
15	*Monomorium pharaonis* (Linnaeus, 1758)	Hymenoptera	Formicidae	Pan-India
16	*Dysdercus sp.*	Hemiptera	Pyrrhocoridae	Northeastern and Central India
List of Insects Collected from Pitfall Trap				
17	*Bradysia sp.*	Poduromorpha	-	Northeastern India
18	*Leptogenys sp.*	Hymenoptera	Formicidae	Pan-India
19	*Camponotus sp.*	Hymenoptera	Formicidae	Pan-India
20	*Solenopsis sp.*	Hymenoptera	Formicidae	Pan-India
21	*Paederus sp.*	Coleoptera	Staphylinidae	Northeastern India, Western Ghats
22	*Agathidium sp.*	Coleoptera	Agathidiidae	Northeastern India
23	*Hydatothrips sp.*	Thysanoptera	Thripidae	Pan-India
24	*Isotoma sp.*	Collembola	Isotomidae	Pan-India
25	*Xenylla sp.*	Poduromorpha	-	Pan-India
List of Insects Collected from Light Trap				
26	*Abscondita perplexa* (Wiedemann, 1828)	Coleoptera	Tenebrionidae	Northeastern India, Western Ghats
27	*Holotrichia sp.*	Coleoptera	Scarabaeidae	Pan-India
28	*Gryllotalpa orientalis* (Linnaeus, 1758)	Orthoptera	Gryllotalpidae	Pan-India
29	*Musca domestica* (Linnaeus, 1758)	Diptera	Muscidae	Pan-India
30	*Physopita gutta* (Fabricius, 1794)	Hemiptera	-	Northeastern India

Table 4: list of butterflies (Order- Lepidoptera) in the study area

Sl. No.	Scientific Name	Common Name	Family	Geographic Distribution in India	IUCN Status
1	*Anthene emolus* (Godart, 1824)	Ciliate Blue	Lycaenidae	Arunachal Pradesh, Assam, Meghalaya, Uttar Pradesh	Not Evaluated
2	*Heliophorus brahma* (Moore, 1857)	Golden Sapphire	Lycaenidae	Eastern Himalayas	Not Evaluated
3	*Heliophorus epicles* (Godart, 1823)	Purple Sapphire	Lycaenidae	Himalayas (Kumaon to southern Myanmar)	Not Evaluated
4	*Acraea issoria* (Hübner, 1819)	Yellow Coster	Nymphalidae	Uttar Pradesh, Meghalaya	Not Evaluated
5	*Ariadne ariadne* (Linnaeus, 1763)	Angled Castor	Nymphalidae	Throughout India	Not Evaluated
6	*Danaus chrysippus* (Linnaeus, 1758)	Plain Tiger	Nymphalidae	Pan-India	Least Concern
7	*Danaus genutia* (Cramer, 1779)	Common Tiger	Nymphalidae	Pan-India	Not Evaluated
8	*Euploea core* (Cramer, 1780)	Common Crow	Nymphalidae	Pan-India	Least Concern
9	*Hypolimnas bolina* (Linnaeus, 1758)	Great Eggfly	Nymphalidae	Pan-India	Not Evaluated
10	*Junonia iphita* (Cramer, 1766)	Chocolate Pansy	Nymphalidae	Pan-India	Not Evaluated
11	*Lethe confuse aurelius* (Fabricius, 1775)	Lethe Confuse Aurelius	Nymphalidae	Western Ghats, Northeast India	Not Evaluated
12	*Lethe verma* (Kollar, 1844)	Straight-banded Treebrown	Nymphalidae	Western Ghats, Northeast India	Not Evaluated
13	*Melanitis leda* (Linnaeus, 1758)	Common Evening Brown	Nymphalidae	Pan-India	Not Evaluated
14	*Neorina hilda* (Moore, 1857)	Yellow Owl	Nymphalidae	Western Ghats, Northeast India	Not Evaluated
15	*Neptis hylas* (Linnaeus, 1758)	Common Sailer	Nymphalidae	Pan-India	Not Evaluated
16	*Phaedyma columella* (Cramer, 1780)	Short-Banded Sailor	Nymphalidae	Pan-India	Not Evaluated
17	*Stibochiona nivea* (Moore, 1872)	The Popinjay	Nymphalidae	Western Ghats, Northeast India	Not Evaluated
18	*Ypthima baldus* (Fabricius, 1775)	Common Five-Ring	Nymphalidae	Pan-India	Not Evaluated
19	*Byasa latreillei* (Donovan, 1826)	Rose Windmill	Papilionidae	Eastern Himalayas, Northeast India	Not Evaluated
20	*Byasa polyeuctes* (Doubleday, 1842)	Common Windmill	Papilionidae	Eastern Himalayas, Northeast India	Not Evaluated
21	*Graphium agamemnon* (Linnaeus, 1758)	Tailed Jay	Papilionidae	Pan-India	Not Evaluated
22	*Graphium macareus* (Godart, 1819)	Lesser Zebra	Papilionidae	Western Ghats, Northeast India	Not Evaluated
23	*Papilio helenus* (Linnaeus, 1758)	Red Helen	Papilionidae	Western Ghats, Northeast India	Not Evaluated
24	*Papilio polytes* (Linnaeus, 1758)	Common Mormon	Papilionidae	Pan-India	Not Evaluated
25	*Appias lalage lalage* (Doubleday, 1842)	Spot Puffin	Pieridae	Western Ghats, Northeast India	Not Evaluated
26	*Eurema sp.* (Linnaeus, 1758)	Grass Yellow	Pieridae	Pan-India	Not Evaluated
27	*Ixias marianne* (Cramer, 1779)	White Orange Tip	Pieridae	Western Ghats, Northeast India	Not Evaluated
28	*Pieris canidia* (Sparrman, 1768)	Indian Cabbage White	Pieridae	Pan-India	Not Evaluated
29	*Celaenorrhinus dhanada* (Moore, 1865)	Yellow-banded Flat	Hesperiidae	Western Ghats, Northeast India	Not Evaluated
30	*Telicota bambusae* (Moore, 1878)	Dark Palm-Dart	Hesperiidae	Pan-India	Not Evaluated

Table 5: list of moths (Order- Lepidoptera) in the study area

Sl. No.	Scientific Name	Family	Distribution in India	IUCN Status
List of Moth Collected from Light Trap				
1	*Parotis marginata* (Hampson, 1893)	Crambidae	Sikkim, West Bengal, and the Nicobar Islands	Critically endangered
2	*Conogethes sp.* (Linnaeus, 1767)	Crambidae	Northern part of India	Not evaluated
3	*Udea ferrugalis* (Hübner, 1796)	Crambidae	Northeast part of India	Not evaluated
4	*Spoladea recurvalis* (Fabricius, 1775)	Crambidae	Northeast Himalaya	Not evaluated
5	*Pericyma cruegeri* (Butler, 1886)	Erebidae	West and south India including Jharkhand	Globally endangered
6	*Psilochira lineata* (Toxopeus, 1948)	Erebidae	Northeast India	Not evaluated
7	*Macotasa nubecula* (Moore, 1879)	Erebidae	Northwest Himalayas, Sikkim, Arunachal Pradesh, Jammu	Threatened
8	*Arctornis sp.* (Germar, 1810)	Erebidae	Uttarakhand, West Bengal, Meghalaya, Darjeeling, Himalayas	Near threatened
9	*Leucania sp.* (Hübner, 1821)	Fabaceae	Cold parts of the country	Least concerned
10	*Antipercnia belluaria* (Walker, 1855)	Geometridae	Sikkim, Arunachal Pradesh, Meghalaya, and Mizoram	Near threatened and very rare
11	*Percinia felinaria* (Walker, 1855)	Geometridae	Sikkim, Arunachal Pradesh, Meghalaya, and Mizoram	Near threatened and very rare
12	*Alpha nivea* (Walker, 1865)	Limacodidae	Northern Himalaya	Critically endangered
13	*Spodoptera litura* (Fabricius, 1775)	Noctuidae	Uttarakhand, Nainital, Almora, Pithoragarh, Chamoli	Not evaluated
14	*Mythimna sp.* (Hübner, 1821)	Noctuidae	Northeast part of India	Not evaluated
15	*Agrotis sp.* (Hübner, 1821)	Noctuidae	West Bengal, Kashmir, Darjeeling	Least concerned
16	*Ctenoplusia tarassota* (Walker, 1857)	Noctuidae	Almost everywhere	Not evaluated
17	*Chasmina candida* (Fabricius, 1775)	Noctuidae	Islands of Indian Ocean	Endangered
18	*Plodia interpunctella* (Hübner, 1813)	Pyralidae	Usually, warm areas but sometimes in colder areas	Not evaluated
19	*Antheraea pernyi* (Guérin-Méneville, 1855)	Saturniidae	Northeast India	Not evaluated
20	*Epiplema fuscifrons* (Moore, 1878)	Uraniidae	Northeast Himalaya	Not evaluated
	List of Moth Collected from Pitfall trap			
21	*Piarosoma arunachalensis* (Sondhi, Efetov, Tarmann & Kunte, 2023)	Zygaenidae	Arunachal Pradesh (Tale Wildlife Sanctuary, Lower Subansiri District)	Not evaluated
List of Moth Collected from Bush beating				
22	*Palthis asopialis* (Guenée, 1854)	Erebidae	Arunachal Pradesh; also reported in Myanmar, Thailand, China, Vietnam	Not evaluated

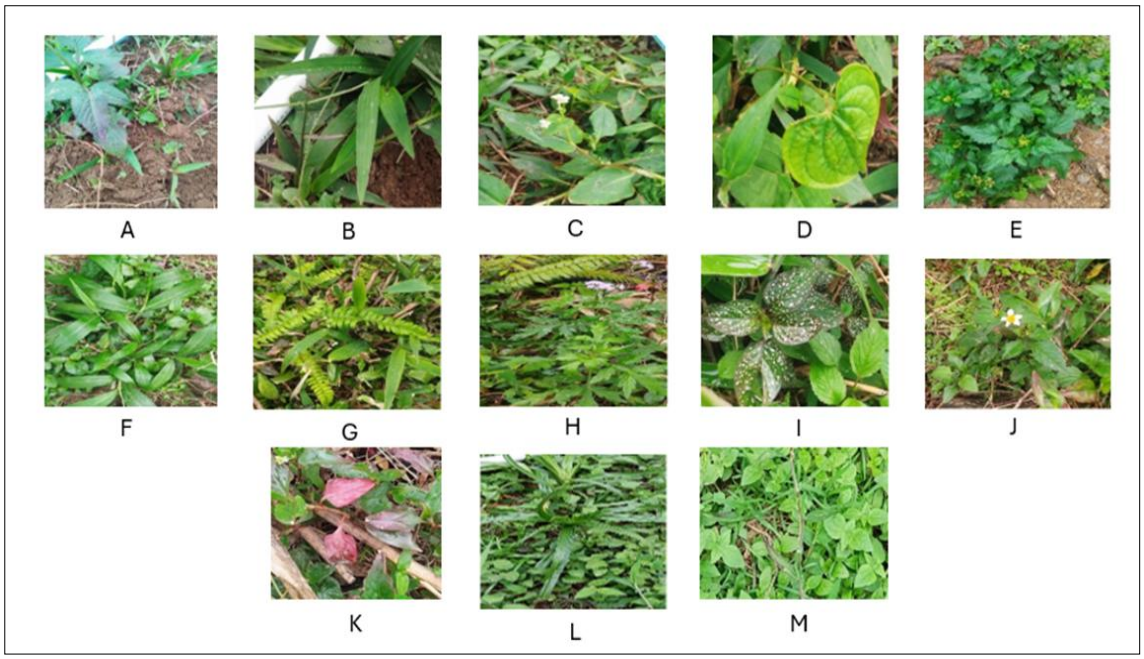

Fig 2: Some Pictures of plants observed during the present study; A. *Bidens Pilosa*, B. *Paspalum conjugatum*, C. *Persicaria chinesis*, D. *Dioscorea bulbifera*, E. *Sanculata odorata*, F. *Setaria palmifolia*, G. *Asplenium excisum*, H. *Conoclinium ggreggii*, I. *Hypoestes phyllostachya*, J. *Galinsoga parviflora*, H. *Nandina domestica*, I. *Nandina domestica*, J. *Carex arctala*, K. *Ocimum basilium*, L. *Sanicula oodorata*, M. *Ruellia repsus*

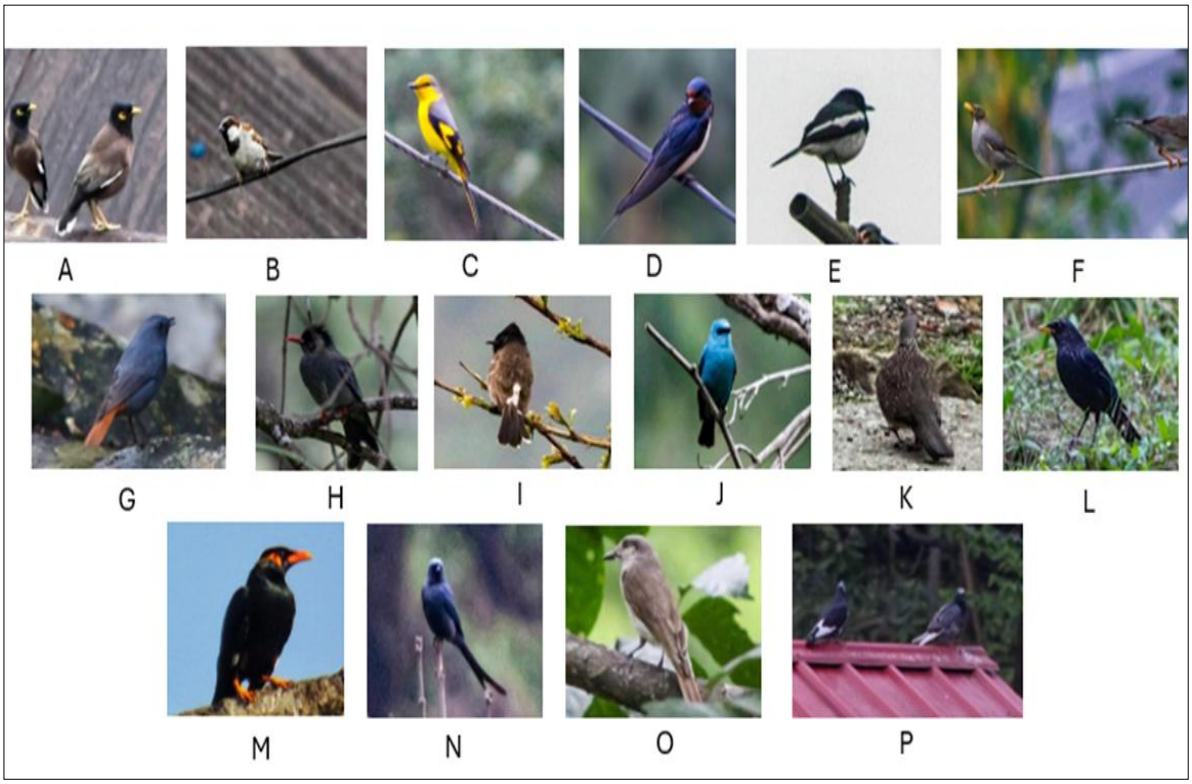

Fig 3: Some pictures of birds observed during the present study; A. *Acridotheres tristis,* B. *Passer domesticus,* C. *Pericrocotus speciosus,* D. *Hirundo rustica,* E. *Copsychus saularis,* F. *Acridotheres javanicus,* G. *Rhyacornis fuliginosus,* H. *Hypsipetes leucocephalus,* I. *Pycnonotus cafer,* J. *Eumyias thalassinus,* K. *Spilopelia chinensis,* L. *Myophonus caeruleus,* M. *Gracula religiosa,* N. *Dicrurus leucophaeus,* O. *Tephrodornis pondicerianus,* P. *Columba livia*

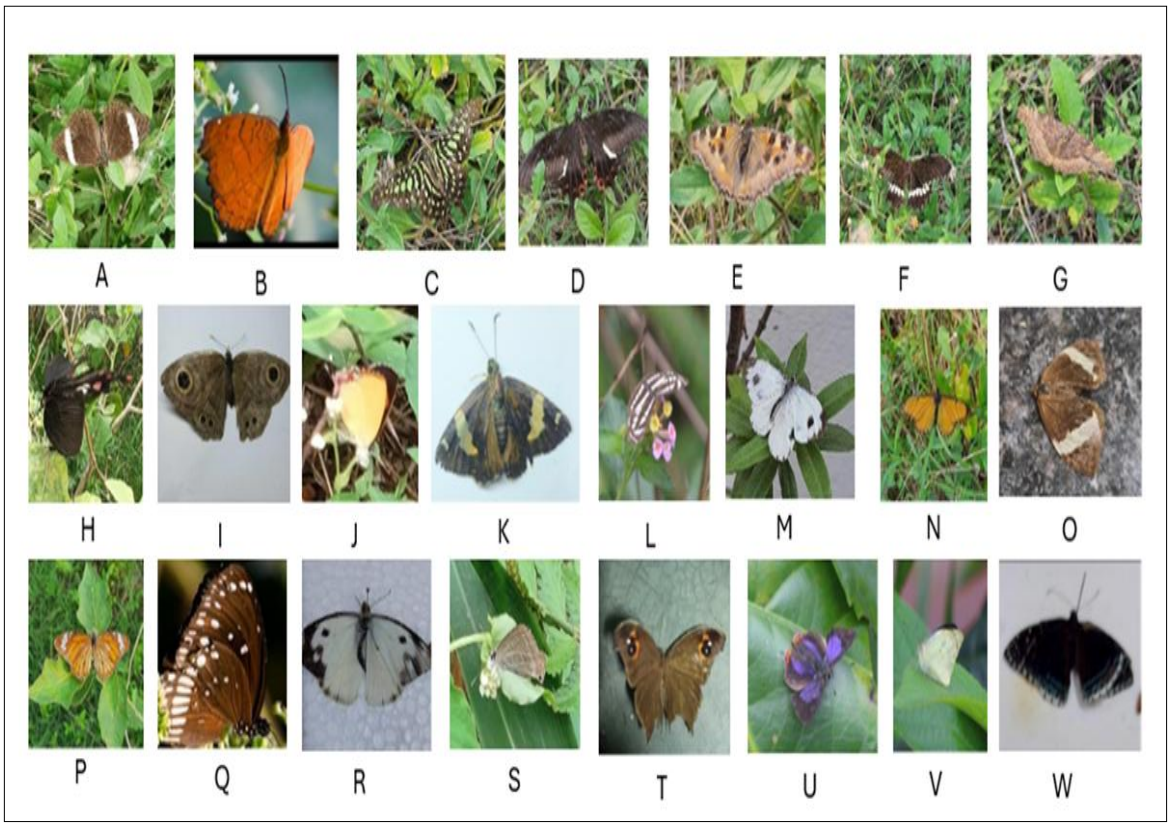

Fig 4: Some Pictures of butterflies observed during the present study A. *Lethe confusa,* B. *Ariadne Ariadne,* C. *Graphium agamemnon,* D. *Papilio helenus,* E. *Junonia iphita,* F. *Papilio polytes,* G. *Aglais caschmirensis aesis,* H. *Byasa polyeuctes,* I. *Ypthima baldus,* J. *Heliophorus epicles,* K. *Celaenorrhinus Dhanada,* L. *Phaedyma columella,* M. *Pieris canidia,* N. *Acraea issoria,* O. *Lethe verma,* P. *Danaus genutia,* Q. *Euploea core,* R. *Appias lalage Lalage,* S. *Anthene definta,* T. *Melanitis leda,* U. *Anthene emolus,* V. *Eurema sp.* W. *Stibochiona nicea.*

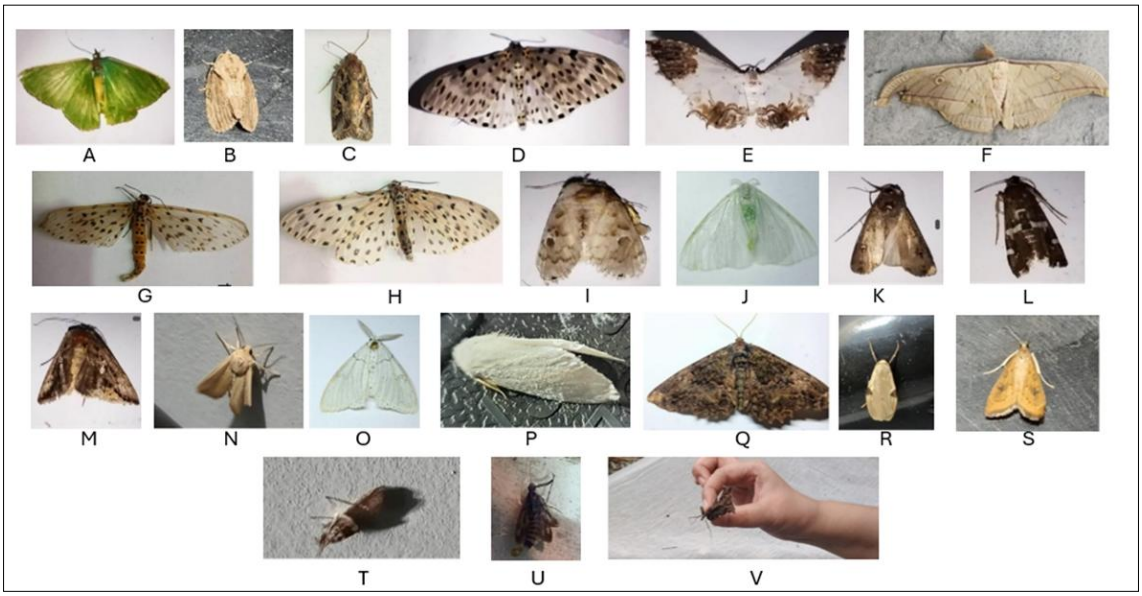

Fig 5 : Pictures of some moth species in the study site [during light trap (A-T), pitfall trap technique (U) and bush beating (V)], A. Par*otis marginata,* B. *Leucania sp.*, C. *Spodoptera litura,* D. *Percinia felinaria,* E. *Epiplema fuscifrons,* F. *Antheraea pernyi,* G. *Conogethes sp.*, H. *Antipercnia belluaria,* I. *Alpha nivea,* J. *Arctornis sp.*, K. *Agrotis sp.*, L. *Spoladea recurvalis,* M. *Ctenoplusia tarassota,* N. *Mythimna sp.*, O. *Psilochira lineata,* P. *Chasmina candida,* Q. *Pericyma cruegeri,* R. *Macotasa nubecula,* S. *Udea ferrugal,* T. *Plodia interpunctella* U. *Piarosoma* sp**.** V. *Palthis asopialis*

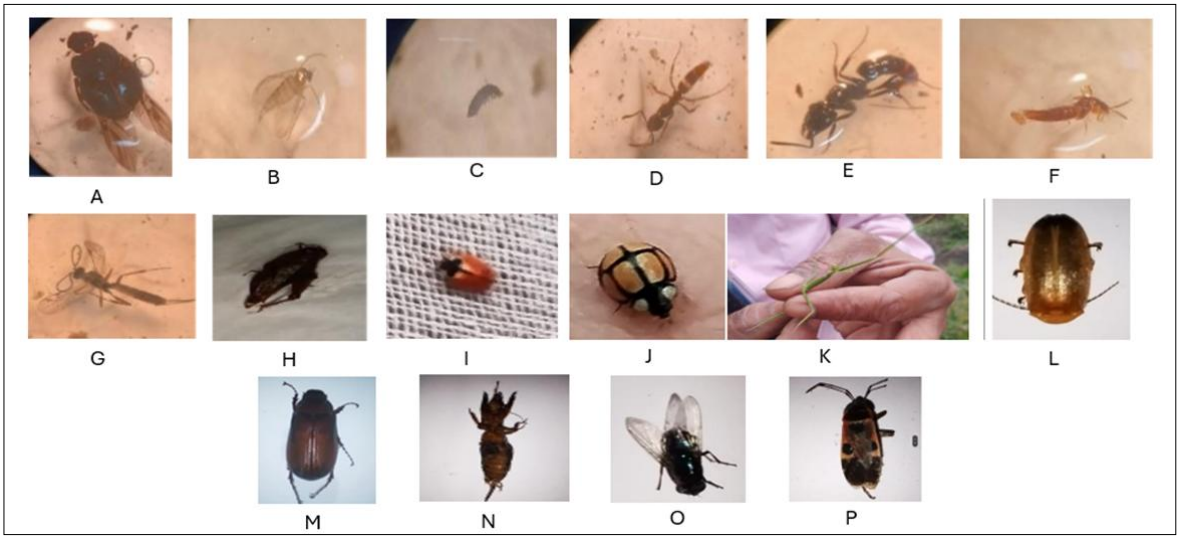

Fig 6 : Some Pictures of terrestrial insects observed during the present study [during pitfall trap (A-H), bush beating and (I-K) light trap technique (L-P)]; A. *Agathidium* sp., B. *Hydatothrips sp. C. Isotoma sp. D. Solenopsis* sp., E.*Camponotus* sp., F. *Paederus sp.*, G. *Leptogenys sp.*, H. *Xenylla sp.* I. *Propylea dessecta,* J. *Harmonia testudinaria,* K. *Schozocephala bicornis,* L. *Abscondita perplexa,* M. *Holotrichia sp.*, N. *Gryllotalpa orientalis,* O. *Muscat domestica,* P. *Physopita gutta*

Discussion

The present study provides a comprehensive account of the biodiversity of Rongo Forest, Kalimpong, encompassing plants, birds, terrestrial insects, butterflies, and moths. The forest supports a moderately diverse flora, with 27 plant species representing 18 families, dominated by Fabaceae. Widespread species such as *Shorea robusta*, *Mangifera indica*, and *Azadirachta indica* were observed alongside regionally restricted taxa like *Barleria strigosa* and *Pogostemon benghalensis*, indicating a mix of generalist and habitat-specific plants that reflect varied microhabitats and ecological conditions (Hooker, 1872–1897; Gamble & Fischer, 1915–1936) [7, 9].

Avifaunal diversity included 25 species across 15 families, with Passeriformes as the dominant order. The presence of common, widespread species such as *Passer domesticus* and *Acridotheres tristis*, together with Himalayan foothill and northeastern species like *Psilopogon virens* and *Oriolus traillii*, suggests that Rongo Forest serves as both a refuge for generalist species and a habitat for regionally restricted birds. Riverine and forested habitats supported distinct bird assemblages, emphasizing the role of habitat heterogeneity in maintaining avian diversity (Ali *et al.*, 1983; Bibby *et al.*, 2000; Grimmett *et al.*, 2016) [1, 3, 8].

Terrestrial insects, with 30 species documented across bush beating, pitfall, and light trap methods, demonstrated considerable taxonomic variety. Coleoptera and Hymenoptera were particularly well represented, indicating a healthy assemblage of soil-dwelling and surface-active taxa (Bonebrake *et al.*, 2010) [4]. Species such as *Isotoma* sp. and *Bradysia* sp. were abundant, reflecting both habitat suitability and microclimatic conditions in the forest floor

and shrub layers. The presence of mantids, phasmids, and coccinellids highlights the ecological complexity and potential for natural pest regulation within the ecosystem.

Butterfly diversity was high, with 31 species recorded from five families. Nymphalidae dominated, and rare species including *Byasa latreillei* (Rose Windmill) and *Heliophorus brahma* (Golden Sapphire) were observed, indicating the ecological value of Rongo Forest for Lepidoptera conservation (Kunte, 2000; Pollard, 1977) [12, 21]. Shrubby grasslands were particularly important, supporting the majority of butterfly species, while riverine and forest areas contributed complementary assemblages, reinforcing the importance of habitat mosaics for sustaining diverse butterfly populations.

Moths, represented by 22 species from eight families, included several globally threatened taxa (*Parotis marginata*, *Alpha nivea*, *Pericyma cruegeri*, and *Macotasa nubecula*), further underscoring the conservation significance of Rongo Forest (Kirti & Gill, 2005) [10, 11]. The presence of these species emphasizes the forest's role as a refuge for sensitive Lepidoptera. Moth diversity, combined with the richness of other insect taxa, suggests that the forest maintains relatively intact ecological processes supporting nocturnal and diurnal insect communities.

Overall, the biodiversity patterns observed in Rongo Forest highlight the importance of habitat heterogeneity in sustaining species richness. The occurrence of both widespread and regionally restricted taxa across plants, birds, insects, and Lepidoptera aligns with reports from previous studies in similar Eastern Himalayan habitats (Bhujel *et al.*, 2024; Mishra *et al.*, 2020) [2, 16,17], confirming the forest's ecological significance. The findings emphasize the need for conservation strategies that protect a mosaic of habitats, including riverine zones, woodlands, and grasslands, to maintain ecological balance and support species of conservation concern.

Conclusion

The Rongo Forest of Kalimpong supports: 27 plant species, with Fabaceae as the dominant family. 25 bird species, dominated by Passeriformes. 30 terrestrial insect species, with Coleoptera and Hymenoptera most diverse. 31 butterfly species, dominated by Nymphalidae, including rare and habitat-specific species. 22 moth species, including several globally threatened taxa.

These findings establish Rongo Forest as a biodiversity hotspot within the Eastern Himalayas, emphasizing its ecological significance across multiple taxa. The forest's mosaic of habitats—riverine, woodland, and shrubby grassland—supports both generalist and specialist species, highlighting the need for targeted conservation measures. Protecting this region is crucial for maintaining ecological integrity, safeguarding threatened Lepidoptera, and ensuring the long-term stability of its rich biological communities (Bonebrake *et al.*, 2010; Kirti & Gill, 2005; Kunte, 2000; Pollard, 1977) [4, 10, 11, 12, 21].

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