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A report on the diversity and abundance of insect fauna in Rongo and Paiengaon forests, Kalimpong District, West Bengal, India

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Abstract
Insects represent the most diverse class of organisms on Earth and are key components of forest ecosystems. Their role in pollination, decomposition, nutrient cycling, soil turnover, and as prey and predators underscores their ecological significance. Yet, insect diversity remains poorly documented in many subtropical forest habitats of the Eastern Himalayas. The present study investigates the insect fauna of two forests in Kalimpong district, West Bengal, India: Rongo Forest (RF; 27.0334°N, 88.8018°E) and Paiengaon Forest (PF; 27.1514°N, 88.5541°E). Sampling was conducted using pitfall traps, handpicking, bush beating, aerial nets, and light traps. A total of 89 species belonging to 13 orders were recorded. *Lepidoptera* was the most species-rich order (53 species; 43.21% of individuals), followed by *hymenoptera* (6 species; 35.06% of individuals), *Coleoptera* (8 species), and *Hemiptera* (3 species). Other orders included *Diptera*, *Isoptera*, *Orthoptera*, *Mantodea*, *Neuroptera*, *Phasmida*, *Collembola*, *Poduromorpha*, and *Thysanoptera*. Rongo Forest recorded higher species richness and diversity indices (Shannon index H′ = 2.9041; Margalef R1 = 8.915), while Paiengaon showed greater evenness (J′ = 0.7262). Sorensen similarity (0.4915) and Bray–Curtis dissimilarity (0.5669) indicated moderate overlap in species composition between the sites. The dominance of *Lepidoptera* and *hymenoptera* reflects the availability of floral resources and nesting habitats, while unique taxa such as *Ramulus artemis* (*Phasmida*), *Neotermes kalimpongensis* (*Isoptera*), and *Hemerobius* sp. (*Neuroptera*) underscore habitat specialisation. The application of classical diversity metrics (Shannon, 1948; Simpson, 1949; Margalef, 1958; Pielou, 1966) [11, 17, 19, 20] provided robust ecological insights. This study contributes valuable baseline data on Himalayan insect fauna and highlights the importance of conserving both common and rare taxa in forest ecosystems under growing anthropogenic pressures.

Keywords: Insect diversity, *lepidoptera*, *hymenoptera*, shannon index, simpson index, Eastern Himalayas, Rongo Forest, Paiengaon Forest

Introduction

Insects, belonging to Class Insecta under Phylum Arthropoda, constitute the most species-rich and ecologically important group of terrestrial organisms. Estimates suggest that more than five million insect species exist globally, of which around one million have been formally described. Insects provide a wide range of ecological services including pollination [16, 22], herbivory [18], seed dispersal [10], decomposition and nutrient cycling [7, 15], and biological control of pests [12]. Their abundance, diversity, and ecological plasticity make them sensitive bioindicators of environmental change [9].

The Eastern Himalayas, a global biodiversity hotspot [14], harbor high insect diversity due to complex terrain, varied vegetation, and altitudinal gradients. Within this region, the forests of Kalimpong district (West Bengal) represent a unique ecological transition between lowland tropical forests and high-altitude Himalayan ecosystems. Despite this, systematic studies on insect diversity in Kalimpong are scarce, with most efforts restricted to butterflies [2, 8, 13]. A comprehensive multi-order insect diversity survey of these forests is lacking.

Quantifying insect diversity requires robust indices to capture both species richness and distribution. Foundational ecological indices such as the Shannon index [19], Simpson's diversity index [21], Margalef's richness index [11], and Pielou's evenness index [17] are widely applied to describe insect assemblages. These metrics not only summarize diversity patterns but also allow for inter-site comparisons.

In the present study, two forests of Kalimpong district were chosen: Rongo Forest (RF), relatively less disturbed and rich in dense vegetation, and Paiengaon Forest (PF) also known as Silarigaon, a moderately disturbed forest with greater human activity. Previous localized butterfly studies have hinted at high diversity in these forests [13] but no study has attempted a holistic insect survey across orders.

The objectives of this study were:

1. To document the insect fauna across multiple orders in RF and PF.
2. To compare richness, abundance, and diversity indices between forests.
3. To analyze ecological roles of dominant and unique species.
4. To contribute baseline data to insect biodiversity conservation in the Eastern Himalayas.

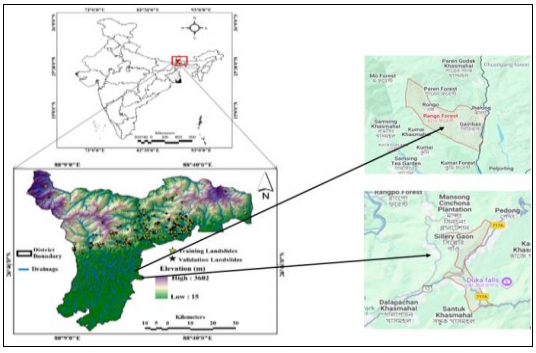

Fig 1: Study sites, Rongo forest (above) and Paiengaon forest (below)

Materials and Methods

Study Area

The study was carried out in Kalimpong district, West Bengal, India, at two forest sites (Fig. 1).

- **Paiengaon Forest (PF):** Situated at 27.1514°N, 88.5541°E, PF lies at moderate elevation and experiences anthropogenic disturbance due to nearby settlements and agriculture. Sampling was conducted in October 2023, coinciding with the retreating monsoon period, when the forest supports abundant insect emergence due to residual moisture and moderate temperatures.

- **Rongo Forest (RF):** Located at 27.0334°N, 88.8018°E near the Bhutan border, RF is a subtropical broadleaf forest with elevations from 450–1130 m. Sampling was conducted in April 2024, when post-spring vegetation and favorable climatic conditions supported high insect activity. Dense canopy cover, moist soils, and minimal disturbance create a favorable environment for insect diversity.

Both forests experience a subtropical climate with monsoonal rainfall between June and September, which enhances insect abundance and diversity, particularly in the months immediately following rainfall.

Sampling Techniques

Multiple collection methods were used to target different orders (Table 1):

- Handpicking and bush beating for *Coleoptera*, *Hemiptera*, *Orthoptera*, *Mantodea*, *Phasmida*.
- Pitfall traps for *Collembola*, *Poduromorpha*, *hymenoptera* (ants), *Coleoptera*, *Thysanoptera*.
- Aerial nets for *Lepidoptera*, *Diptera*, *hymenoptera*.
- Light traps for nocturnal *Lepidoptera* and *Neuroptera*.

Identification and Data Analysis

Specimens were identified using standard taxonomic keys [6, 8]. Species richness, abundance, and relative composition were calculated. Shannon (1948) [19], Simpson (1949) [20], Margalef (1958) [11], and Pielou (1966) [17] indices were applied (Tables 3, 5). Inter-site comparisons used Sorensen similarity and Bray–Curtis dissimilarity.

Table 1: Varieties of equipment used for different insects.

List of insect orders	Equipment/Technique
Coleoptera	Handpicking, bush beating, pitfall trap.
Collembola	Pitfall trap.
Diptera	Aerial net, bush beating.
Hemiptera	Handpicking, bush beating, pitfall trap.
hymenoptera	Aerial net, bush beating, hand picking, pitfall trap.
Isoptera	Hand picking.
Lepidoptera	Aerial net (butterfly), light trap (moth).
Mantodea	Bush beating, handpicking.
Orthoptera	Handpicking, bush beating, pitfall trap.
Neuroptera	Light trap.
Phasmida	Bush beating, hand picking.
Poduromorpha	Pitfall trap.
thysanoptera	Pitfall trap.

Results

Species Composition

A total of 3088 individuals of 89 species across 13 insect orders were recorded (Table 2). *Lepidoptera* (53 species) was the richest order, followed by *Coleoptera* (8), *hymenoptera* (6), and *Hemiptera* (3). Other orders such as *Mantodea*, *Neuroptera*, *Phasmida*, *Collembola*, *Poduromorpha*, and *Thysanoptera* had fewer representatives but contributed to overall diversity.

- ***Coleoptera*** **(Beetles):** Eight species including *Agathidium sp.* and *Holotrichia sp.* contributed to decomposition and nutrient recycling.

- ***Lepidoptera*** **(Butterflies & Moths):** Fifty-three species recorded, with both diurnal butterflies (e.g., *Danaus chrysippus*, *Graphium agamemnon*) and nocturnal moths (*Abraxas martaria*, *Spoladea recurvalis*) abundant (Figs. 6, 7).

- ***hymenoptera*** **(Ants, Wasps):** Six species, notably *Camponotus compressus*, *Leptogenys sp.*, and *Solenopsis sp.*, dominated leaf litter and pitfall trap collections.

- ***Diptera*** **(Flies):** Two species (*Musca domestica*, *Holorusia sp.*) were encountered, playing roles as decomposers and prey.

- ***Hemiptera*** **(True Bugs):** Plant-feeding insects like *Platypleura sp.* and *Dysdercus sp.* were observed, indicating herbivore presence.

- ***Isoptera*** **(Termites):** *Neotermes kalimpongensis* was abundant in decaying logs, emphasizing its ecosystem engineering role.

- ***Orthoptera*** **(Grasshoppers, Crickets):** Three species, including *Gryllotalpa orientalis*, highlighted their herbivorous and prey roles.

- ***Mantodea*** **(Mantids):** Three predatory species, such as *Schizocephala bicornis*, were restricted to RF.

- ***Neuroptera*** **(Lacewings):** *Hemerobius sp.* was rare and limited to PF.

- ***Phasmida*** **(Stick Insects):** Five species (*Ramulus artemis*, *Asceles sp.*) found in RF, indicating habitat specialization.

- ***Collembola*** **&** ***Poduromorpha*****:** Soil-dwelling taxa like *Isotoma sp.* and *Xenylla sp.* were indicators of healthy leaf litter (Fig. 8).

- ***Thysanoptera*** **(Thrips):** *Hydatothrips sp.* was present in both forests, associated with understory shrubs.

Diversity Indices

- RF had higher Shannon index (2.9041) and Margalef richness (8.915).
- PF showed greater evenness (0.7262).
- Sorensen index (0.4915) and Bray–Curtis dissimilarity (0.5669) showed moderate overlap.

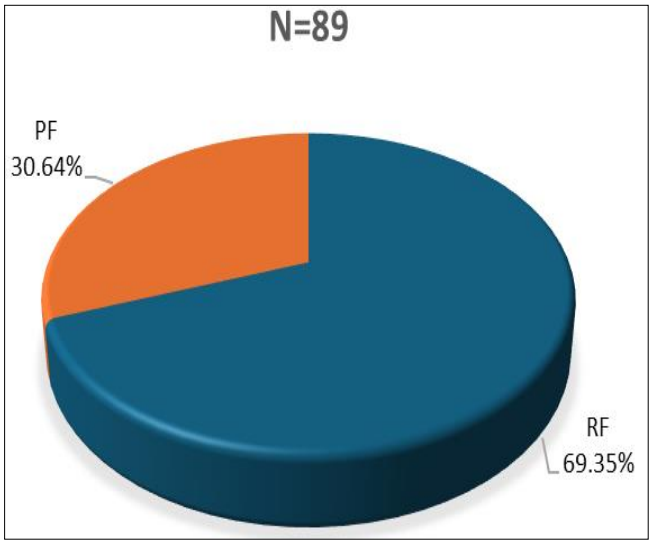

Fig 2: The relative composition of species, RF: Rongo Forest, PF: Paiengaon Forest

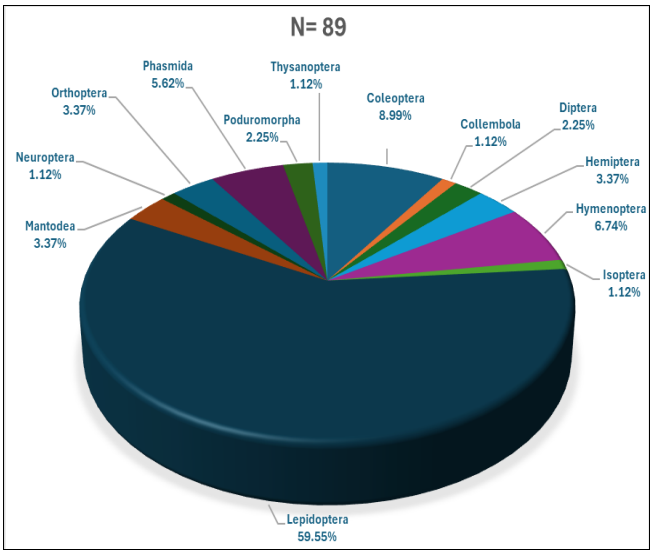

Fig 4: Relative abundance of the species of different orders.

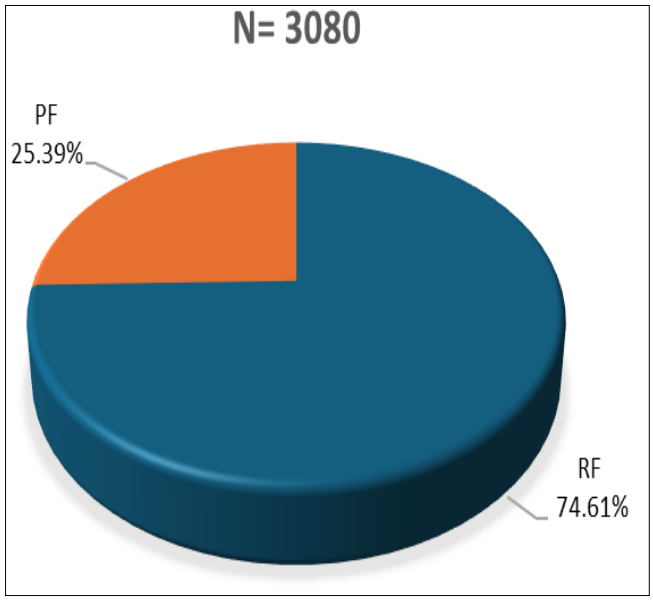

Fig 3: The relative composition of insects, RF: Rongo Forest, PF: Paiengaon Forest

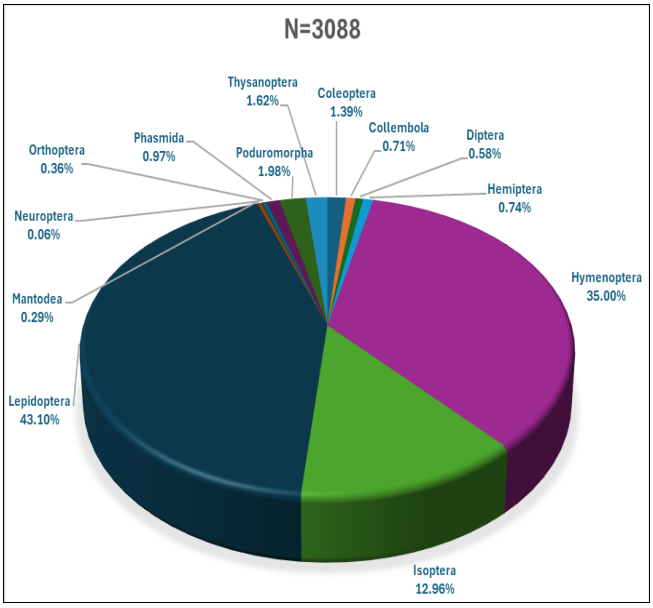

Fig 5: Relative abundance of the insects of different orders.

Table 2: Diversity of insect fauna in Rongo and Paiengaon Forests with species richness. RF= Rongo Forest, PF= Paiengaon Forest

Sl. No.	Order	Family	Common Name	Species	Habitat	Species Richness
1	*Coleoptera*	Agathidiidae	Darkling Beetle	*Agathidium* sp.	RF, PF	0.0541
2		Coccinellidae	Six-spotted Ladybird	*Cheilomenes sexmaculata* (Fabricius, 1781)	RF	0.0312
3		Coccinellidae	Tortoise-shell Ladybird	*Harmonia testudinaria* (Mulsant, 1850)	RF	0.0403
4		Coccinellidae	Six-spotted Zigzag Ladybird	*Oenopia sexareata* (Fabricius, 1781)	RF	0.0255
5		Coccinellidae	Spotted Ladybird	*Propylea dissecta* (Mulsant, 1850)	RF	0.0541
6		Scarabaeidae	Rove Beetle	*Holotrichia* sp.	RF, PF	0.0477
7		Staphylinidae	Round Fungus Beetle	*Paederus* sp.	RF, PF	0.0312
8		Tenebrionidae	Weevil	*Abscondita perplexa* (Wiedemann, 1828)	RF	0.0403
9	*Collembola*	Isotomidae	-	*Isotoma* sp.	RF	0.0845
10	*Diptera*	Muscidae	Housefly	*Musca domestica* (Linnaeus, 1758)	RF, PF	0.0743
11		Tipulidae	Giant crane fly	*Holorusia* sp.	PF	0.018
12	*Hemiptera*	Cicadidae	Cicada	*Platypleura* sp.	PF	0.0441
13		Largidae	Gutta bug	*Physopita gutta* (Fabricius, 1794)	RF	0.051
14		Pyrrhocoridae	Cotton stainer	*Dysdercus* sp.	RF	0.0541
15	*hymenoptera*	Formicidae	Indian black ant	*Camponotus compressus* (Fabricius, 1793)	RF, PF	0.1765

16		Formicidae	Carpenter ant	*Camponotus* sp.	RF, PF	0.4249
17		Formicidae	Razor-jaw ant	*Leptogenys* sp.	RF, PF	0.2673
18		Formicidae	Pharoah ant	*Monomorium pharaonis* (Linnaeus, 1758)	RF, PF	0.1802
19		Formicidae	Fire ant	*Solenopsis* sp.	RF, PF	0.1838
20		Ichneumonidae	Ichneumon wasp	*Netelia* sp.	RF, PF	0.036
21	*Isoptera*	Kalotermitidae	Termite	*Neotermes kalimpongensis*	RF, PF	0.3604
22	*Lepidoptera*	Hesperiidae	Yellow-banded Flat	*Celaenorrhinus dhanada* (Moore, 1865)	RF	0.0255
23		Lycaenidae	Ciliate Blue	*Anthene emolus* (Godart, 1824)	RF	0.0255
24		Lycaenidae	Golden Sapphire	*Heliophorus brahma* (Moore, 1857)	RF	0.0312
25		Lycaenidae	Purple Sapphire	*Heliophorus epicles* (Godart, 1823)	RF	0.051
26		Lycaenidae	Dark Cerulean	*Jamides bochus* (Stoll, [1782])	PF	0.0477
27		Nymphalidae	Yellow Coster	*Acraea issoria* (Hübner, [1819])	RF	0.036
28		Nymphalidae	Tawny Coster	*Acraea terpsicore* (Linnaeus, 1758)	PF	0.057
29		Nymphalidae	Angled Castor	*Ariadne ariadne* (Linnaeus, 1763)	RF, PF	0.0312
30		Nymphalidae	Plain Tiger	*Danaus chrysippus* (Linnaeus, 1758)	RF, PF	0.0826
31		Nymphalidae	Common Tiger	*Danaus genutia* (Cramer, 1779)	RF, PF	0.1348
32		Nymphalidae	Common Crow	*Euploea core* (Cramer, 1780)	RF	0.0764
33		Nymphalidae	Great Eggfly	*Hypolimnas bolina* (Linnaeus, 1758)	RF	0.1235
34		Nymphalidae	Chocolate Pansy	*Junonia iphita* (Cramer, 1766)	RF, PF	0.057
35		Nymphalidae	Lethe Confuse Aurelius	*Lethe confuse aurelius* (Fabricius, 1775)	RF, PF	0.0477
36		Nymphalidae	Straight-banded Treebrown	*Lethe verma* (Kollar, 1844)	RF, PF	0.0541
37		Nymphalidae	Common Evening Brown	*Melanitis leda* (Linnaeus, 1758)	RF	0.0826
38		Nymphalidae	Yellow Owl	*Neorina hilda* (Moore, 1857)	RF	0.0255
39		Nymphalidae	Common Sailer	*Neptis hylas* (Linnaeus, 1758)	RF	0.0441
40		Nymphalidae	Short-Banded Sailor	*Phaedyma columella* (Cramer, 1780)	RF, PF	0.0624
41		Nymphalidae	The Popinjay	*Stibochiona nivea* (Moore, 1872)	RF	0.0312
42		Nymphalidae	Blue Tiger	*Tirumala limniace* (Cramer, 1775)	PF	0.0403
43		Nymphalidae	Common Five-Ring	*Ypthima baldus* (Fabricius, 1775)	RF, PF	0.018
44		Nymphalidae	Common Four-Ring	*Ypthima huebneri* (Kirby, 1871)	PF	0.0541
45		Papilionidae	Rose Windmill	*Byasa latreillei* (Donovan, 1826)	RF, PF	0.0255
46		Papilionidae	Common Windmill	*Byasa polyeuctes* (Doubleday, 1842)	RF	0.0312
47		Papilionidae	Tailed Jay	*Graphium agamemnon* (Linnaeus, 1758)	RF, PF	0.0806
48		Papilionidae	Lesser Zebra	*Graphium macareus* (Godart, 1819)	RF	0.0477
49		Papilionidae	Princep daravidarum	*Papilio dravidarum* (Wood-Mason, 1880)	PF	0.057
50		Papilionidae	Red Helen	*Papilio helenus* (Linnaeus, 1758)	RF, PF	0.0764
51		Papilionidae	Common Mormon	*Papilio polytes* (Linnaeus, 1758)	RF	0.0441
52		Pieridae	Spot Puffin	*Appias lalage lalage* (Boisduval, 1836)	RF	0.1709
53		Pieridae	Common Emigrant	*Catopsilia pomona* (Fabricius, 1775)	PF	0.0441
54		Pieridae	The Common Gull	*Cepora nerissa* (Fabricius, 1775)	PF	0.051
55		Pieridae	Common Jezebel	*Delias eucharis* (Drury, 1773)	PF	0.0624
56		Pieridae	Grass Yellow	*Eurema* sp.	RF	0.1066
57		Pieridae	White-Orange Tip	*Ixias marianne* (Cramer, 1779)	RF	0.036
58		Pieridae	Indian Cabbage White	*Pieris canidia* (Sparrman, 1768)	RF, PF	0.2611
59		Crambidae	Jasmine Moth	*Palpita vitrealis* (Rossi, 1794)	PF	0.018
60		Crambidae	Crambid Moth	*Parotis marginata* (Walker, 1859)	RF	0.0403
61		Crambidae	Beetwebworm Moth	*Spoladea recurvalis* (Fabricius, 1775)	RF, PF	0.0785
62		Geometridae	Magpie Moth	*Abraxas martaria* (Walker, 1862)	PF	0.057
63		Geometridae	Lesser, Black-spotted Geometer	*Antipercnia belluaria* (Walker, 1862)	RF	0.4029
64		Geometridae	-	*Calletaera obliquata* (Walker, 1861)	PF	0.0403
65		Geometridae	-	*Harutalcis vialis* (Walker, 1860)	PF	0.0441
66		Geometridae	Emerald Moth	*Mexates* sp.	PF	0.0403
67		Geometridae	-	*Ozola* sp.	PF	0.0255
68		Geometridae	-	*Percinia felinaria* (Walker, 1861)	RF, PF	0.0441
69		Geometridae	-	*Petelia* sp.	PF	0.051
70		Geometridae	Bordered Duster	*Pingasa ruginaia* (Walker, 1861)	PF	0.0255
71		Noctuidae	Cutworm	*Agrotis* sp.	RF	0.0441
72		Noctuidae	Candid White Glyph	*Chasmina candida* (Walker, 1865)	RF	0.018
73		Noctuidae	-	*Ctenoplusia tarassota* (Walker, 1858)	RF	0.1348
74		Uraniidae	Swallowtail Moth	*Epiplema fuscifrons* (Walker, 1862)	RF	0.0255
75	*Mantodea*	–	Grass Mantis	*Schizocephala bicornis* (Linnaeus, 1758)	RF	0.0312
76		Hymenopodidae	–	*Anaxarcha* sp. (Stål, 1877)	RF	0.0255

77		Leptomantellidae	–	*Leptomantella* sp. (Burmeister, 1838)	RF	0.036
78	*Neuroptera*	Hemerobiidae	-	*Hemerobius* sp.	PF	0.0255
79	*Orthoptera*	Gryllotalpidae	-	*Gryllotalpa orientalis*	RF, PF	0.0312
80		Tettigoniidae	-	*Sathrophyllia rugosa*	RF	0.0441
81		Tettigoniidae	Hooded katydid	*Siliquofera grandis*	RF	0.0255
82	*Phasmida*	Lonchodidae	Stick Insect	*Asceles* sp.	RF	0.0441
83		Lonchodidae	Stick Insect	*Lopaphus* sp.	RF	0.051
84		Lonchodidae	Stick Insect	*Orxines* sp.	RF	0.0255
85		Lonchodidae	Stick Insect	*Sipyloidea* sp.	RF	0.0441
86		Phasmatidae	Stick Insect	*Ramulus artemis* (Westwood, 1859)	RF	0.051
87	*Poduromorpha*	–	fungus gnat	*Bradysia* sp.	RF	0.0255
88		–	springtails	*Xenylla* sp.	RF	0.1384
89	*Thysanoptera*	Thripidae	Thrips	*Hydatothrips* sp.	RF, PF	0.1274

Table 3: Comparison of the diversity of insect oders between Rongo (RF) and Paiengaon (PF) Forests

Metric	RF value	PF value
Shannon index (H')	2.9041	2.8112
Simpson index (1 - λ)	0.8983	0.8898
Margalef (R1)	8.915	7.0551
Evenness (J')	0.6836	0.7262
Dominance index (DI)	0.1017	0.1102
Sorensen similarity (2C/(A+B))	0.4915	
Bray-Curtis dissimilarity	0.5669	

Table 4: Relative abundance of the species of different insect Orders in the Rongo (RF) and Paiengaon (PF) Forests

Order	No. species	Total individualsws	RF individuals	PF individuals	% of total individuals
Coleoptera	8	43	37	6	1.4%
Collembola	1	22	22	0	0.71%
Diptera	2	18	11	7	0.58%
Hemiptera	3	23	17	6	0.75%
hymenoptera	6	1080	721	359	35.06%
Isoptera	1	400	267	133	12.99%
Lepidoptera	53	1331	1080	251	43.21%
Mantodea	3	9	9	0	0.29%
Neuroptera	1	2	0	2	0.06%
Orthoptera	3	11	10	1	0.36%
Phasmida	5	30	30	0	0.97%
Poduromorpha	2	61	61	0	1.98%
Thysanoptera	1	50	33	17	1.62%

Table 5: Diversity indices of different insect order

Order	S (no. species)	n (no. individuals)	Shannon Wiener index (H′)	Simpson diversity index (λ)	Margalef index (R1)	Pielou's Evenness Index (J′)	Simpson's Dominance index (DI)
Coleoptera	8	43	1.9648	0.8469	1.8611	0.9449	0.1531
Collembola	1	22	0.0000	0.0000	–	–	1.0000
Diptera	2	18	0.2146	0.1049	0.3460	0.3095	0.8951
Hemiptera	3	23	1.0850	0.6578	0.6379	0.9876	0.3422
hymenoptera	6	1080	1.3475	0.6677	0.7158	0.7520	0.3323
Isoptera	1	400	0.0000	0.0000	–	–	1.0000
Lepidoptera	53	1331	2.5717	0.8217	7.2286	0.6477	0.1783
Mantodea	3	9	1.0609	0.6420	0.9102	0.9656	0.3580
Neuroptera	1	2	0.0000	0.0000	–	–	1.0000
Orthoptera	3	11	0.9949	0.5950	0.8341	0.9056	0.4050
Phasmida	5	30	1.5292	0.7733	1.1761	0.9502	0.2267
Poduromorpha	2	61	0.1443	0.0634	0.2433	0.2082	0.9366
Thysanoptera	1	50	0.0000	0.0000	–	–	1.0000

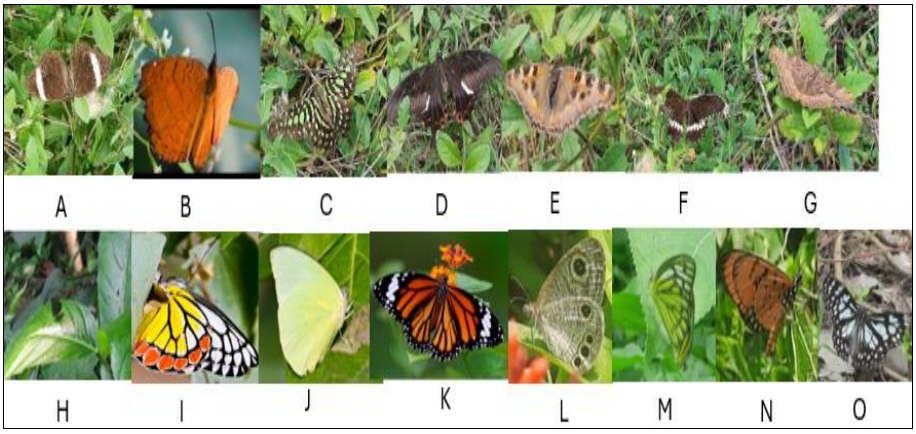

Fig 6: Some Pictures of butterflies observed during the present study (A-G: Rongo forest, H-O: Paiengaon Forest)- A. *Lethe confusa,* B. *Ariadne Ariadne,* C. *Graphium agamemnon,* D. *Papilio helenus,* E. *Junonia iphita,* F. *Papilio polytes*, G. *Aglais caschmirensis aesis,* H. *Jamides bichus*, I. *Delias eucharis*, J. *Catopsilia pomona*, K. *Danaus genutia*, L. *Ypthima huebneri*, M. *Cepora nerissa*, N. *Acraea terpsicore*, O. *Tirumala limniace*.

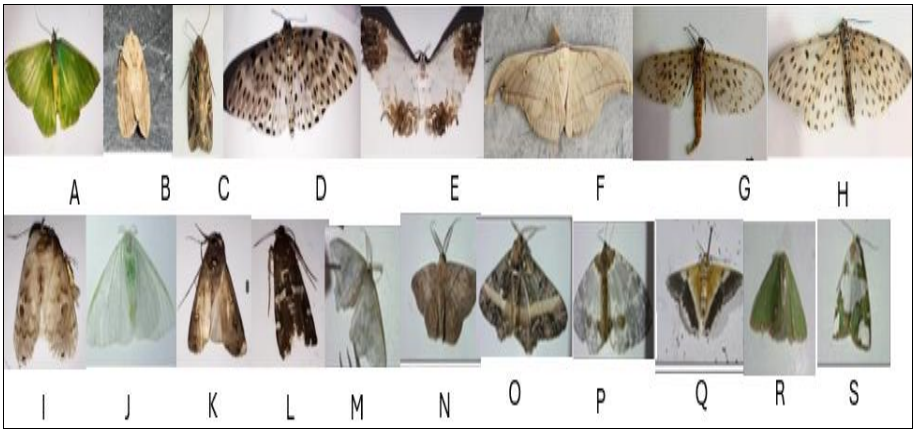

Fig 7: Some Pictures of moths observed during the present study (A-L: Rongo forest, M-S: Paiengaon Forest)
A. Pa*rotis marginata*, B. *Leucania* sp., C. *Spodopteralitura*, D. *Percinia felinaria*, E. *Epiplema fuscifrons*, F. *Antheraea pernyi*, G. *Conogeth es sp.*, H. *Antipercnia belluaria*, I. *Alphanivea*, J. *Arctornis* sp., K. *Agrotis* sp., L. *Spoladea recurvalis*, M. *Mexates* sp., N. *Petelia* sp., O. *Harutalcis vialis*, P. *Abraxas martaria*, Q. *Pingasa rugiR. Argyrocosmaocosma inductania*, S. *Ariolica pulchella*.

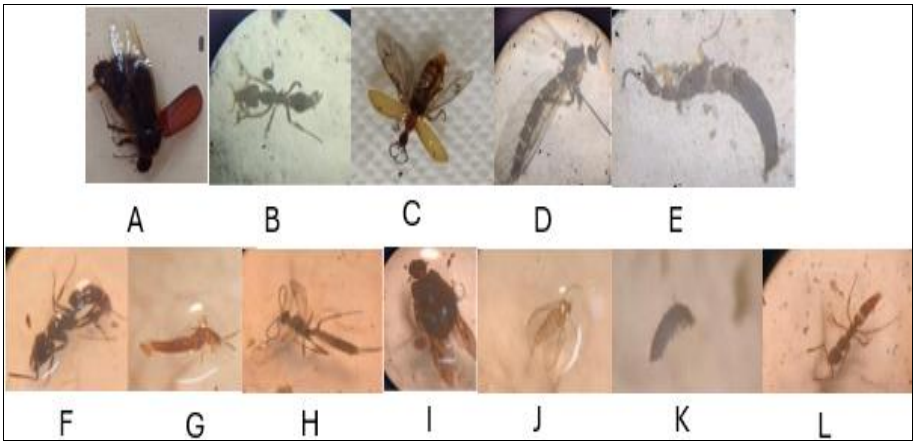

Fig 8: some of the insects collected from pitfall trap (A-E: Rongo forest, F-L: Paiengaon Forest) - A. *Agathidium* sp., B. *Solenopsis* sp., C. *Leptogenys sp.*, D. *Hydatothrips sp.* E. *Paederus sp.*, F. *Agathidium* sp., G. *Hydatothrips* sp. H. *Isotoma* sp. I. *Solenopsis* sp., J. *Camponotus* sp., K. *Paederus* sp., L. *Leptogenys sp.*

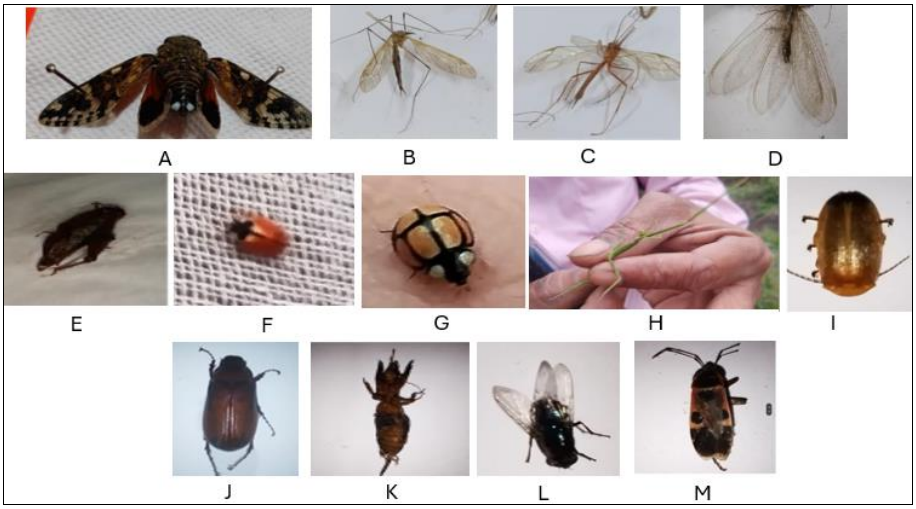

Fig 9: Pictures of some other insects observed during the present study (A-D: Paiengaon forest, E-M: Rongo Forest) - A. *Platypleura sp.*, B. *Holorusia* sp., C. *Netelia* sp., D. *Hemerobius* sp., E. *Xenylla sp*. F. *Propylea dessecta*, G. *Harmonia testudinaria*, H. *Schozocephala bicornis*, I. *Abscondita perplexa*, J. *Holotrichia sp.*, K. *Gryllotalpa orientalis*, L. *Muscat domestica*, M. *Physopita gutta*

Discussion

This study demonstrates that the forests of Kalimpong harbor remarkable insect diversity, consistent with global observations that tropical and subtropical forests support the highest arthropod richness [1, 4].

The dominance of *Lepidoptera* aligns with earlier butterfly studies in RF [13] and PF (Das *et al*., 2024), confirming their role as reliable bioindicators [3]. High butterfly richness suggests diverse floral resources and minimal pesticide pressure. Moth diversity further indicates the availability of nocturnal nectar sources and larval host plants.

hymenoptera abundance, especially ants, reflects their ecological importance in nutrient turnover and seed dispersal [2, 10]. Their high numbers in pitfall traps demonstrate strong ground-dwelling communities that regulate soil ecosystems.

The presence of *Isoptera* highlights the importance of decomposing logs in sustaining termite colonies, confirming Eggleton's (2000) [5] assertion that termites are vital ecosystem engineers.

Rare taxa such as *Ramulus artemis* (*Phasmida*) and *Hemerobius* sp. (*Neuroptera*) underline the conservation value of microhabitats. Their restricted occurrence suggests vulnerability to disturbance.

Quantitative diversity indices reveal differences in community structure: RF had higher richness, while PF had greater evenness. This corresponds with the Shannon index's sensitivity to both richness and abundance [19], Simpson's emphasis on dominance [21], Margalef's measure of richness relative to sample size [11] and Pielou's focus on species distribution [17] These indices together provide a holistic view of insect diversity and complement species counts.

Conservation Implications

Maintaining habitat heterogeneity in RF and PF is crucial for sustaining insect assemblages. Anthropogenic disturbances in PF must be monitored, while RF's relatively intact canopy and litter layers should be conserved. Insect diversity is directly linked to ecosystem resilience, and studies like this provide baseline data critical for conservation planning in the Eastern Himalayas.

Conclusion

The present study provides a comprehensive account of the insect diversity in Rongo and Paiengaon forests of Kalimpong district, documenting 89 species across 13 orders. The results highlight the dominance of *Lepidoptera* in terms of species richness and *hymenoptera* in terms of abundance, while unique taxa such as *Phasmida* (*Ramulus artemis*), *Neuroptera* (*Hemerobius sp*.), and *Isoptera* (*Neotermes kalimpongensis*) emphasize the significance of conserving microhabitats that support specialized species. Diversity analysis revealed that Rongo Forest exhibited greater richness, while Paiengaon showed higher evenness, indicating that both sites play complementary roles in sustaining regional biodiversity. The application of classical indices by Shannon (1948) [19], Simpson (1949) [20], Margalef (1958) [11], and Pielou (1966) [17] provided robust ecological insights, showing that insect communities here are structured by both richness and distributional balance. Overall, the study underscores the ecological importance of Eastern Himalayan forests as reservoirs of insect biodiversity and highlights the urgent need to conserve these habitats in the face of increasing anthropogenic disturbance.

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