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Diversity of phytophagous insects and their association with host plants in Udanti-Sitanadi Wildlife Sanctuary, Chhattisgarh, India

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Abstract

Phytophagous insects play a crucial role in shaping vegetation structure, ecosystem functioning, and plant-insect interactions in terrestrial habitats. The present study documents the diversity of phytophagous insects and their associations with host plants in the Udanti-Sitanadi Wildlife Sanctuary, Chhattisgarh, India, a protected area characterized by heterogeneous vegetation types and seasonal climatic variation. Systematic field surveys were conducted across forest trees, shrubs, crops, plantation species, grasslands, weeds, bamboo stands, dead wood, and soil/root habitats using standard insect collection techniques. A total of 33 phytophagous insect species belonging to 15 families under five insect orders were recorded. Lepidoptera emerged as the dominant order, accounting for the highest family and species richness, followed by Coleoptera, Blattodea, Hemiptera, and Orthoptera. Forest trees supported the greatest insect diversity, with leaf feeding and defoliation being the most prevalent forms of damage. Distinct host plant associations were observed across different habitat categories, reflecting variations in feeding guilds, including leaf feeders, defoliators, sap suckers, wood borers, and root feeders. The dominance of lepidopteran herbivores highlights the importance of host plant diversity and structural complexity in sustaining insect communities. This study provides baseline information on phytophagous insect diversity and host plant relationships in a central Indian protected forest, underscoring their ecological significance for biodiversity conservation, forest health assessment, and future pest management strategies.

Keywords: Host, diversity, sanctuary, ecosystem, future pest management strategies

Introduction

Phytophagous insects form an integral component of terrestrial ecosystems and play a key role in regulating vegetation dynamics. As herbivores, they exhibit considerable variation in morphology, feeding behaviour, host specificity, and seasonal abundance. These variations are largely governed by the availability of host plants, vegetation structure, and prevailing climatic conditions, which together determine patterns of folivory and polyphagy across different habitats (Mamlayya *et al.*, 2022) ^[15]. Understanding the diversity of phytophagous insects and their associations with host plants is therefore essential for interpreting ecosystem processes and plant-insect interactions.

In forest ecosystems, particularly in protected areas, phytophagous insects influence plant growth, regeneration, and species composition through continuous herbivory. Their interactions with host plants often result in adaptive responses such as chemical and structural defences, leading to long-term co-evolutionary relationships. These interactions contribute significantly to maintaining biodiversity and ecological balance. In the Udanti-Sitanadi Wildlife Sanctuary of Chhattisgarh, which supports diverse forest types and rich floral diversity, phytophagous insects are expected to play an important role in shaping both natural vegetation and adjoining agricultural landscapes (Prakhar *et al.*, 2021) ^[19].

Host plant association is a critical factor determining the distribution and abundance of insect herbivores. Many phytophagous insects show strong preferences for particular plant species or families, while others are polyphagous and capable of utilizing a wide range of hosts. Such differences in feeding behaviour influence insect population dynamics and the extent of plant damage within an ecosystem (Vignesh *et al.*, 2020) ^[6].

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Polyphagous species are often more resilient to environmental changes and may expand into cultivated areas, where they can assume pest status.

Among phytophagous insects, fruit flies of the family Tephritidae are of particular concern due to their economic importance. With more than 4,000 species described globally, tephritid flies infest a wide range of fruits and vegetables. Females lay eggs within the fruit tissue, and the developing larvae feed internally, causing direct damage and rendering the produce unmarketable (Diller *et al.*, 2022) [2]. In India, commercially important crops such as mango are highly susceptible, and infestation can result in substantial yield losses (Bal *et al.*, 2022; Vignesh *et al.*, 2020) [1, 6]. In addition to crop loss, these insects have serious quarantine implications, affecting domestic and international trade and necessitating strict phytosanitary regulations (Kausar *et al.*, 2022) [3].

Despite the ecological and economic significance of phytophagous insects, systematic documentation of their diversity and host plant relationships in protected forest regions of central India remains limited. The Udanti-Sitanadi Wildlife Sanctuary, with its varied vegetation and climatic conditions, provides an ideal setting for such a study. The present investigation aims to document the diversity of phytophagous insects in the sanctuary and examine their associations with different host plant categories, thereby contributing baseline information for future ecological studies and pest management planning.

Materials and Methods

The study was conducted in the Udanti-Sitanadi Wildlife Sanctuary, Chhattisgarh, India (Figure 1). The sanctuary comprises a mosaic of forest trees, shrubs, plantation areas, agricultural fields, grasslands, bamboo stands, weed-dominated patches, and decomposing wood habitats. The region experiences a tropical monsoon climate with distinct seasonal variation, which influences vegetation growth and insect activity.

Climatic data were recorded for the entire study period and categorized into four seasons: winter (December-February), summer (March-May), monsoon (June-September), and post-monsoon (October-November). Seasonal averages of maximum and minimum temperature, rainfall, relative humidity (morning and evening), wind speed, evaporation, and sunshine hours were compiled. Annual averages were derived from pooled seasonal data to characterize the overall climatic conditions of the study area (Table 1).

Insect sampling

Field surveys were conducted at regular intervals across different habitat types within the sanctuary, including forest vegetation, agricultural crops, plantation species, grasslands, weeds, bamboo stands, dead wood, and soil/root zones. Insects were collected using standard methods such as hand picking, sweep netting, light trapping, and visual inspection. Observations were made on both larval and adult stages, and host plants were recorded at the time of collection to establish insect-plant associations.

Identification and taxonomic classification

Collected specimens were preserved and identified up to species level using standard taxonomic keys and published literature. Identified insects were classified into respective orders and families. Order-wise distribution of insect families and species was determined, and their relative

percentages were calculated to assess taxonomic dominance. Host plants were identified in the field using regional floras and botanical keys. Insects were grouped by host plant categories and their type of damage, including leaf feeding, defoliation, sap sucking, wood boring, crown and stem boring, and root feeding, was recorded through direct observation. Insects were also classified into feeding guilds—leaf feeders, defoliators, sap suckers, wood borers, and root feeders—to understand their ecological roles within the sanctuary.

Statistical analysis

Data were compiled and organized in tabular form. Descriptive statistical analysis was employed to summarize insect diversity, taxonomic composition, feeding habits, and host plant associations. The percentage composition of insect orders, families, and species was calculated to determine dominance patterns.

Results

The survey recorded a total of 33 phytophagous insect species representing 15 families under five insect orders in the Udanti-Sitanadi Wildlife Sanctuary (Table 2) (Figure 2 & 3). Lepidoptera was the dominant order, comprising eight families (53.33%) and 23 species (69.70%). Coleoptera and Blattodea were each represented by two families (13.33%) and three species (9.09%). Hemiptera included two families with two species (6.06%), while Orthoptera was represented by one family with two species (6.06%).

Insects showed distinct associations with different host plant categories (Table 3). Forest trees supported the highest number of insect species, with damage mainly in the form of leaf feeding, leaf damage, and heavy defoliation (Table 4). Major host plants included *Tectona grandis*, *Ficus religiosa*, *Cassia fistula*, *Terminalia arjuna*, *Wrightia tinctoria*, *Michelia champaca*, *Ficus racemosa*, *Citrus aurantium*, and *Citrus limon*. Forest shrubs supported leaf-feeding insects associated with *Calotropis gigantea*, *Calotropis procera*, and *Clerodendrum infortunatum*.

Fruit trees such as *Mangifera indica* and *Annona squamosa* were affected by leaf feeders, wood borers, and sap-sucking insects. Agricultural crops showed damage in the form of leaf feeding, sap sucking, and fruit or pod boring on host plants including *Gossypium herbaceum*, *Ricinus communis*, *Cicer arietinum*, and *Brassica oleracea*. Plantation and horticultural crops such as citrus, coconut (*Cocos nucifera*), and mulberry (*Morus Alba*) were affected by leaf feeders, defoliators, and crown and stem borers.

Grassland insects were mainly leaf feeders associated with *Cynodon dactylon* and *Saccharum spontaneum*. Weed-associated insects were recorded on *Desmodium triflorum*, *Cassia tora*, *Portulaca oleracea*, *Passiflora foetida*, and *Mimosa pudica*. Bamboo supported leaf-feeding insects associated with *Bambusa arundinacea*. Dead wood and soil/root habitats were inhabited by wood-boring beetles and termites.

Based on feeding habits, most insect species were categorized as leaf feeders or defoliators. Lepidopteran families exhibited leaf feeding, defoliation, and, in some cases, boring activity. Coleopteran species were mainly wood borers and stem feeders. Termites were associated with root and wood feeding. Hemipteran species were sap suckers, while orthopteran species were leaf feeders associated with grasses.

Discussion

The survey recorded a total of 33 phytophagous insect species representing 15 families under five insect orders in the Udanti-Sitanadi Wildlife Sanctuary. Lepidoptera was the dominant order, comprising eight families (53.33%) and 23 species (69.70%), underscoring its significant ecological presence within the sanctuary (Tandan *et al.*, 2024) ^[21]. This dominance of Lepidoptera, accounting for 53.33% of families and 69.70% of species, aligns with observations in other tropical ecosystems where this order frequently exhibits high species richness and abundance (Wankhade & Bidwai, 2022) ^[25].

Coleoptera and Blattodea, each represented by two families and three species, contributed 13.33% of the families and 9.09% of the species, respectively, indicating a comparatively lower, but still notable, representation within the phytophagous insect community. Hemiptera, with two families, also demonstrated a substantial, albeit unspecified, contribution to the overall diversity. This pervasive dominance of Lepidoptera is often attributed to their specialized feeding strategies and co-evolutionary relationships with a wide array of host plants, enabling them to exploit diverse vegetative resources more effectively than other insect orders (Prakhar *et al.*, 2021) ^[19]. Earlier investigations on tropical forest entomofauna consistently reveal Lepidoptera as a widespread and highly diverse order, particularly due to their complex life cycles and varied morphological adaptations for herbivory (Mamlayya *et al.*, 2022) ^[15]. This ecological prevalence is further supported by studies highlighting butterflies, a sub-group within Lepidoptera, as key indicators of ecosystem health and biodiversity (Jose, 2024) ^[12]. Their sensitivity to environmental changes and specific host plant requirements make them effective tools for assessing habitat quality and the impact of anthropogenic disturbances (Dolai *et al.*, 2025) ^[8]. Indeed, the sheer number of lepidopteran species in many tropical surveys further corroborates their ecological importance, with some studies reporting them as the most speciose order (Pawar *et al.*, 2024). This high representation of Lepidoptera suggests a robust and diverse floral community within the Udanti-Sitanadi Wildlife

Sanctuary capable of sustaining a broad spectrum of herbivorous insects. The intricate relationship between Lepidoptera and their host plants is a critical factor influencing this diversity, often involving specialized feeding guilds and co-evolutionary adaptations that promote a wide range of niches (Dolai *et al.*, 2023) ^[9]. This extensive radiation of herbivorous animals within Lepidoptera, encompassing over 175,000 identified species globally, reflects their evolutionary success and adaptive capacity to various terrestrial habitats. This ecological prosperity is further enhanced by their ability to undergo complete metamorphosis, allowing distinct larval and adult forms to exploit different food resources and habitats, thereby reducing intraspecific competition (Thiruvengadam *et al.*, 2021) ^[22]. This specialization allows for a more efficient partitioning of resources, contributing to their remarkable species richness and ecological dominance within phytophagous communities (Tiple, 2018) ^[23].

The prevalence of Lepidoptera in the sanctuary also underscores the importance of conserving butterfly diversity, as they are often sensitive to environmental changes and serve as vital bioindicators (Dolai *et al.*, 2023; Mishra *et al.*, 2024) ^[9, 17]. Moreover, the ecological success of Lepidoptera, particularly moths, can be attributed to their extensive taxonomic diversity and ecological plasticity, allowing them to exploit a broader range of niches compared to butterflies (Gunathunga *et al.*, 2022) ^[10]. Their rapid reproductive rates and ability to utilize a wide variety of host plants, including agricultural crops, further contribute to their widespread distribution and dominance in many ecosystems (Saradopoulos *et al.*, 2023) ^[20]. The significant representation of moths, in particular, can be attributed to their nocturnal activity and sophisticated chemosensory adaptations for locating host plants through volatile organic compounds (Lin *et al.*, 2022) ^[14]. Earlier studies on iron-ore mined overburden soils at Dalli Rajhara, Chhattisgarh, have shown that rhizospheric microbial succession supports plant colonization, which indirectly governs phytophagous insect diversity through host-plant establishment (Verma and Verma, 2017) ^[24].

Table 1: Seasonal variation of climatic parameters of the Udanti-Sitanadi Wildlife Sanctuary, Chhattisgarh, India

Parameter (Average)	Different season				
	Winter	Summer	Monsoon	Post-monsoon	Annual
Months	Dec-Feb	Mar-May	Jun-Sep	Oct-Nov	Jan-Dec
Max temp (°C)	30	36.8	32.1	32.8	32.9
Min temp (°C)	11.6	20.8	24.4	19.7	19.5
Rainfall (mm)	18.6	50.9	1,045.10	22.7	1,136.30
RH I (%)	91	94	96	91	93
RH II (%)	78	75	87	71	79
Wind (kmph)	1.2	3.3	2.6	1.2	2.1
Evaporation (mm)	213	480.9	414.5	200.9	1,308.30
Sunshine (hrs)	7.3	8.5	3.4	7.4	6.4

RH: Relative humidity

Table 2: Order-wise distribution of insect families and species with their relative percentages

S. No.	Order	Number of families	Percentage of families (%)	Number of species	Percentage of species (%)
1	Lepidoptera	8	53.33	23	69.70
2	Coleoptera	2	13.33	3	9.09
3	Blattodea	2	13.33	3	9.09
4	Hemiptera	2	13.33	2	6.06
5	Orthoptera	1	6.67	2	6.06
	Total	15	100.00	33	100.00

Table 3: Summary of insects based on host plant category, type of damage, and associated host plant species

S. No.	Host plant category	Type of damage	Insect species	Host plant species (Botanical name)
1	Forest trees	Leaf feeding, leaf damage, heavy defoliation	<i>Junonia lemonias</i> , <i>Euploea core</i> , <i>Catopsilia pomona</i> , <i>Arhopala centaurus</i> , <i>Idea leuconoe</i> , <i>Attacus atlas</i> , <i>Lyssa zampa</i> , <i>Papilio polytes</i> , <i>Papilio demoleus</i>	<i>Tectona grandis</i> , <i>Ficus religiosa</i> , <i>Cassia fistula</i> , <i>Terminalia arjuna</i> , <i>Wrightia tinctoria</i> , <i>Michelia champaca</i> , <i>Ficus racemosa</i> , <i>Citrus aurantium</i> , <i>Citrus limon</i>
2	Forest shrubs	Leaf feeding	<i>Danaus chrysippus</i> , <i>Tirumala limniace</i> , <i>Parthenos sylvia</i>	<i>Calotropis gigantea</i> , <i>Calotropis procera</i> , <i>Clerodendrum infortunatum</i>
3	Fruit trees	Leaf feeding, wood borer, sap sucking	<i>Graphium agamemnon</i> , <i>Batocera rufomaculata</i> , <i>Aspidiotus destructor</i>	<i>Annona squamosa</i> , <i>Mangifera indica</i>
4	Agricultural crops	Leaf feeding, sap sucking, fruit/pod borer	<i>Leptocoris tagalicus</i> , <i>Spodoptera litura</i> , <i>Helicoverpa armigera</i> , <i>Pieris brassicae</i>	<i>Gossypium herbaceum</i> , <i>Ricinus communis</i> , <i>Cicer arietinum</i> , <i>Brassica oleracea</i>
5	Plantation/ horticultural crops	Leaf feeding, defoliation, crown & stem borer	<i>Papilio polytes</i> , <i>Papilio demoleus</i> , <i>Oryctes rhinoceros</i> , <i>Bombyx mori</i>	<i>Citrus aurantium</i> , <i>Citrus limon</i> , <i>Cocos nucifera</i> , <i>Morus alba</i>
6	Grassland	Leaf feeding	<i>Oxya japonica</i> , <i>Acrida exaltata</i>	<i>Cynodon dactylon</i> , <i>Saccharum spontaneum</i>
7	Weeds	Leaf feeding	<i>Zizina otis</i> , <i>Eurema hecabe</i> , <i>Hypolimnas misippus</i> , <i>Acraea violae</i> , <i>Pyrisitia nise</i>	<i>Desmodium triflorum</i> , <i>Cassia tora</i> , <i>Portulaca oleracea</i> , <i>Passiflora foetida</i> , <i>Mimosa pudica</i>
8	Bamboo	Leaf feeding	<i>Lethe europa</i>	<i>Bambusa arundinacea</i>
9	Dead wood	Wood borer, wood destruction	<i>Xylotrupes gideon</i> , <i>Odontotermes obesus</i> , <i>Coptotermes heimi</i>	Dead/rotten wood
10	Soil / roots	Root and wood damage	<i>Microtermes obesi</i>	Soil and roots

Table 4: Order-and family-wise classification of insects with their nature of feeding

Order	Family	Insects Included	Nature of feeding
Lepidoptera	Nymphalidae	<i>Danaus chrysippus</i> , <i>Junonia lemonias</i> , <i>Euploea core</i> , <i>Tirumala limniace</i> , <i>Parthenos sylvia</i> , <i>Hypolimnas misippus</i> , <i>Acraea violae</i> , <i>Lethe europa</i> , <i>Idea leuconoe</i>	Leaf feeder/defoliator/borer
	Pieridae	<i>Catopsilia pomona</i> , <i>Pieris brassicae</i> , <i>Eurema hecabe</i> , <i>Pyrisitia nise</i>	
	Papilionidae	<i>Papilio polytes</i> , <i>Papilio demoleus</i> , <i>Graphium agamemnon</i>	
	Bombycidae	<i>Bombyx mori</i>	
	Noctuidae	<i>Spodoptera litura</i> , <i>Helicoverpa armigera</i>	
	Lycaenidae	<i>Zizina otis</i> , <i>Arhopala centaurus</i>	
	Saturniidae	<i>Attacus atlas</i>	
	Uraniidae	<i>Lyssa zampa</i>	
Coleoptera	Cerambycidae	<i>Batocera rufomaculata</i>	Wood borer, Crown & stem borer, Wood feeder
	Scarabaeidae	<i>Oryctes rhinoceros</i> , <i>Xylotrupes gideon</i>	
Blattodea	Termitidae	<i>Odontotermes obesus</i> , <i>Microtermes obesi</i>	Root & wood feeder
	Rhinotermitidae	<i>Coptotermes heimi</i>	
Hemiptera	Rhopalidae	<i>Leptocoris tagalicus</i>	Sap sucker
	Diaspididae	<i>Aspidiotus destructor</i>	
Orthoptera	Acrididae	<i>Oxya japonica</i> , <i>Acrida exaltata</i>	Leaf feeder

**Fig 1:** Study site (Sitanadi wildlife sanctuary)



Fig 2: Study site (Sitanadi wildlife sanctuary)

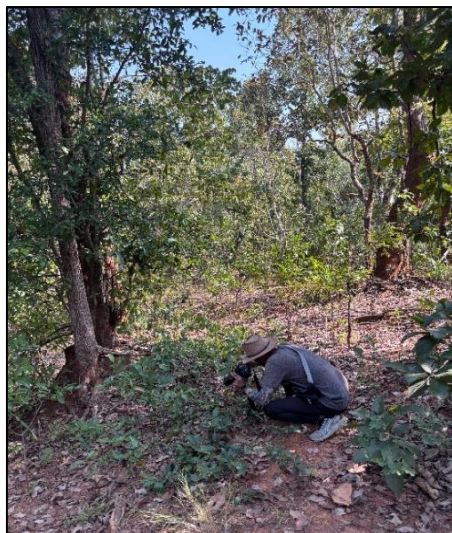


Fig 3: Study site (Sitanadi wildlife sanctuary)

Fig 4: *Batocera rufomaculata*Fig 5: *Parthenos sylvia*Fig 6: *Danaus chrysippus*

Conclusion

The study documents the diversity and host plant associations of phytophagous insects in the Udanti-Sitanadi Wildlife Sanctuary, recording 33 species across five insect orders. Lepidoptera emerged as the dominant group, reflecting the strong influence of host plant diversity and forest habitat complexity on insect assemblages. Forest trees supported the highest insect diversity, with leaf feeding and defoliation as the most common forms of herbivory, while distinct feeding guilds were observed across agricultural, plantation, grassland, and weed habitats. These findings highlight the ecological importance of phytophagous insects in regulating vegetation dynamics and emphasize the need for continued monitoring to support biodiversity conservation and forest management in protected ecosystems.

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