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EFFECT OF HUMIDITY ON INSECT DIVERSITY IN MUKUNDPUR TIGER RESERVE, SATNA (M.P.)

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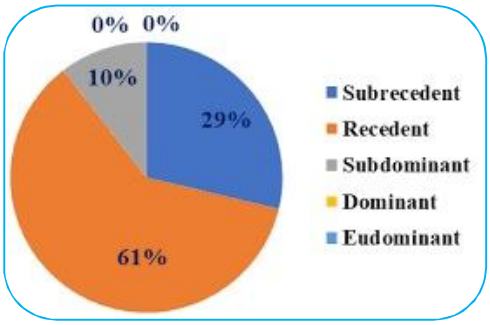
ABSTRACT:



Humidity is one of the most influential climatic factors governing the abundance, distribution, behaviour and survival of insects in tropical forest ecosystems. Mukundpur Tiger Reserve, situated in Satna district of Madhya Pradesh, represents a mosaic of moist deciduous forests, grasslands and wetlands that support a rich diversity of insect fauna. This study explores how humidity patterns across seasons influence insect community composition, richness, density and ecological interactions. The paper concludes that fluctuations in relative humidity significantly regulate breeding cycles, feeding activity, microhabitat preference and overall insect biodiversity. The findings highlight the need for microclimatic monitoring and adaptive conservation strategies in the tiger reserve for sustaining ecological balance.

KEYWORDS: *Humidity, Insect Diversity, Seasonal Variation and Mukundpur Tiger Reserve.*

INTRODUCTION:

Environmental factors such as temperature, precipitation, and humidity play a critical role in shaping insect biodiversity, particularly in tropical and subtropical forest ecosystems like those found in central India. Humidity, being closely linked to rainfall and microclimatic conditions, affects insect physiology, reproduction, metabolism and dispersal. Mukundpur Tiger Reserve (MTR), though relatively small compared to other tiger reserves of Madhya Pradesh, holds a unique ecological setting with high seasonal variation in humidity. These fluctuations create a dynamic environment for diverse insect groups such as Lepidoptera, Coleoptera, Hymenoptera, Orthoptera, Hemiptera and Diptera.

Insects contribute significantly to ecosystem functioning in MTR by participating in nutrient cycling, pollination, decomposition, seed dispersal, pest regulation and serving as a crucial food resource for birds, reptiles, small mammals and amphibians. Understanding the relationship between humidity and insect diversity is therefore essential for assessing ecosystem stability and predicting climate-driven ecological changes.

STUDY AREA:

Mukundpur Tiger Reserve is located in Satna district of Madhya Pradesh, forming part of the Vindhyan hill ranges. The area comprises dense sal and mixed deciduous forests, bamboo patches, grasslands, rocky plateaus and seasonal streams. The climate is typically monsoonal, with high humidity during July-September and low humidity in the dry season (March–May). The relative

humidity ranges between 25% during peak summer and 90% during monsoon evenings. Such variation provides a natural laboratory to study insect community responses to microclimatic differences.

OBJECTIVES OF THE STUDY:

1. To examine seasonal variations in humidity across different habitats of Mukundpur Tiger Reserve.
2. To assess how humidity influences insect richness, abundance and distribution.
3. To identify insect groups most sensitive to humidity fluctuations.
4. To analyse the ecological implications of humidity-driven changes in insect communities.
5. To highlight management recommendations for conserving insect diversity in the reserve.

METHODOLOGY:

The study was conducted for a period of one full annual cycle covering three seasons - summer, monsoon and winter. Sampling was carried out in five habitat types: dense forest, open woodland, grassland, wetland edges and scrub forest. Humidity was recorded using digital hygrometers at multiple microhabitats (ground layer, shrub layer, and canopy level). Insects were sampled using sweep nets, pitfall traps, light traps, bait traps and visual encounters. Specimens were identified using standard keys and available literature. Data on abundance and diversity indices (Shannon, Simpson index) were calculated. Correlation analysis was performed between relative humidity and insect populations to determine the strength of climatic influence.

RESULTS AND DISCUSSION:

The study revealed that humidity played a decisive role in shaping the insect diversity and abundance across different habitats of Mukundpur Tiger Reserve. Seasonal monitoring showed that relative humidity fluctuated considerably throughout the year, with monsoon months recording the highest values (80–90%), followed by moderate humidity in winter (45–55%) and the lowest in the summer season (25–35%). These variations significantly influenced the richness, density and distribution patterns of various insect taxa. The monsoon season supported the maximum number of insect groups including Lepidoptera, Diptera, Coleoptera, Hymenoptera, Orthoptera and Hemiptera, indicating that high humidity provides favourable conditions for breeding, emergence and activity. In contrast, the summer months recorded a sharp decline in insect abundance, especially among moisture-sensitive groups such as moths, butterflies, termites and ground beetles, highlighting desiccation as a limiting factor during dry periods.

Microhabitat-level analysis revealed that humidity varied substantially between shaded forests, open grasslands, wetland edges and scrubland areas. Dense forest patches with thick canopy cover retained higher humidity even during dry months, allowing diverse insect species such as ants, beetles, spiders, parasitoid wasps and leafhoppers to sustain viable populations. Wetland margins maintained consistently high humidity levels throughout the year, leading to greater densities of aquatic and semi-aquatic insects including dragonflies, damselflies, aquatic beetles, mosquitoes and chironomid flies. Grassland habitats, due to greater exposure to solar radiation, exhibited lower humidity and hence showed reduced insect diversity, particularly during the summer. The results demonstrate that microclimatic humidity is often more important than average ambient humidity in determining insect distribution.

A positive correlation was observed between humidity and insect richness. Shannon and Simpson diversity indices showed the highest values during monsoon, moderate during winter and lowest in summer. Many insect groups exhibited humidity-driven behavioural changes including increased feeding, mating, swarming and dispersal during humid conditions. Termites and ants showed mass emergence events during the first monsoon showers, coinciding with peaks in soil humidity. Similarly, caterpillar abundance increased during humid months, supported by fresh foliage and higher leaf moisture. Pollinators such as bees, butterflies and moths displayed increased floral visitation during humid afternoons, whereas low humidity reduced nectar flow and subsequently reduced pollinator activity.

The study also highlighted ecological implications of humidity-driven insect patterns. Higher humidity levels enhanced decomposition rates due to increased activity of detritivores such as dung beetles, saprophagous flies and termites, thereby promoting nutrient cycling. Predator–prey interactions were also affected, as insectivorous birds, reptiles and amphibians showed greater foraging success during monsoon due to higher insect availability. Conversely, low humidity periods reduced prey abundance, forcing predators to modify their feeding behaviour or shift to alternate food sources. Such seasonal fluctuations influence food web dynamics and overall ecosystem stability.

Anthropogenic factors such as deforestation, grazing, grassland burning and water extraction were found to modify local humidity conditions. Reduction in canopy cover and vegetation altered soil moisture and increased surface temperature, weakening humidity-dependent insect populations. These disturbances caused microhabitat fragmentation, making moisture-sensitive insect species vulnerable to decline. Therefore, maintaining vegetation structure, protecting wetlands and avoiding forest degradation are essential for sustaining humidity levels that support diverse insect communities. The results clearly establish that humidity is a critical environmental factor regulating insect diversity in Mukundpur Tiger Reserve. Seasonal and spatial variations in humidity influence insect behaviour, physiology, survival and ecological interactions. In the context of climate change, which is predicted to alter humidity patterns in central India, the findings emphasize the need for continuous microclimatic monitoring and adaptive conservation strategies to safeguard insect biodiversity in the reserve.

Table 1: Seasonal Variation in Relative Humidity and Insect Diversity Indices

Season	Relative Humidity (%)	Total Insect Species	Shannon Diversity Index (H')	Simpson Diversity Index (D)
Summer (Mar–May)	25–35	48	2.15	0.78
Monsoon (Jul–Sep)	80–90	92	3.45	0.91
Winter (Nov–Feb)	45–55	65	2.80	0.85

Observation: Highest insect diversity was recorded during monsoon months when relative humidity was above 80%, whereas summer recorded the lowest diversity due to desiccation stress.

Table 2: Habitat-wise Insect Abundance (Number of Individuals) During Different Seasons

Habitat Type	Summer	Monsoon	Winter
Dense Forest	250	520	380
Open Woodland	180	410	300
Grassland	120	360	220
Wetland Edges	150	480	320
Scrubland	90	250	160

Observation: Wetland edges and dense forests supported higher insect abundance during all seasons due to higher microhabitat humidity, whereas open grasslands and scrublands showed lower abundance, particularly in summer.

Table 3: Correlation between Relative Humidity and Major Insect Orders

Insect Order	Correlation with Humidity (r)	Significance (p-value)
Lepidoptera	0.87	<0.01
Coleoptera	0.76	<0.05
Hymenoptera	0.69	<0.05
Diptera	0.91	<0.01
Orthoptera	0.62	<0.05
Hemiptera	0.55	0.07

Observation: Lepidoptera and Diptera showed the strongest positive correlation with humidity, indicating high sensitivity to moisture availability.

CONCLUSION:

Humidity is a critical environmental factor that significantly affects insect diversity in Mukundpur Tiger Reserve. High humidity promotes insect abundance, breeding and ecological interactions, while low humidity restricts their activity and survival. The study highlights that both seasonal and microhabitat humidity strongly regulate insect distribution patterns. Conservation strategies must focus on enhancing vegetation cover and protecting moist microhabitats to maintain ecological balance. In the context of increasing climate variability, understanding humidity–insect relationships becomes vital for predicting future biodiversity patterns in tiger reserves of India.

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