Studying Butterfly Diversity and Its Ecological Importance in Kabirdham, Chhattisgarh

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Abstract

This study examines the species diversity, abundance, habitat preferences, and activity patterns of butterflies in Kabirdham, Chhattisgarh, from March to September 2024. A total of 145 butterflies, representing 10 species, were observed across various habitats, including forests, grasslands, agricultural fields, riparian zones, and forest edges. The Shannon Diversity Index (H') for the butterfly community was calculated at 2.44, suggesting a moderate level of species diversity. The survey found that Grass Yellow (*Eurema hecabe*) and Blue Tiger (*Tirumala limniace*) were the most abundant species, while others, like Plains Cupid (*Zographetus dzonguensis)* and Painted Lady (*Vanessa cardui*), were less common. Habitat preferences were varied, with species such as the Common Indian Crow (*Euploea core*) and Orange Tip (*Colotis etrida*) favoring forested areas, while Grass Yellow and Plains Cupid were more abundant in grasslands. Agricultural fields and riparian zones played key roles for species like Blue Tiger and Common Lime (*Papilio demoleus*). Activity patterns showed that species such as Grass Yellow and Tawny Coster were most active in the early morning, while species like Blue Tiger and Brown Banded Swallowtail preferred to rest during the afternoon. The study emphasizes the importance of conserving diverse habitats to support butterfly populations and maintain the overall health of the ecosystem in Kabirdham.

Keywords: Butterflies, biodiversity, ecological significance, Kabirdham, pollinators, conservation

Introduction

Butterflies are not just lovely creatures to admire; they play a crucial role in maintaining the health of our environment. Their work as pollinators helps plants reproduce, and their involvement in nutrient cycling supports ecosystem balance (Pollard & Yates, 1993). Additionally, butterflies serve as bio-indicators, meaning their presence or absence can tell us a lot about the overall health of an environment (Hesselman et al., 2007). By monitoring their behavior and population numbers, we can identify when a habitat is in trouble (Bourn & Thomas, 2002).

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Globally, there are over 18,000 butterfly species, each with unique colors, shapes, and sizes, adapting to a wide range of environments (Larsen, 2005). From lush forests to wetlands, grasslands, and even urban spaces, butterflies thrive in many different places. Their presence across such varied landscapes speaks to their adaptability and importance in the ecosystem (Dennis, 2010).

Kabirdham, a district in Chhattisgarh, is rich in biodiversity, offering a wide range of habitats for butterflies to live in. With its combination of forests, farmlands, and human settlements, the area supports numerous butterfly species. The district's tropical and subtropical climate influences the behavior and movement of these butterflies, with seasonal changes affecting their activity levels (Singh et al., 2012).

Unfortunately, human actions, such as urbanization, deforestation, and agricultural expansion, are putting butterfly populations at risk. The destruction of forests, the use of harmful pesticides, and the impacts of climate change are all contributing to a decline in their numbers (Shree et al., 2020). This loss threatens not only the butterflies themselves but the ecosystems that rely on them for pollination and other essential functions (Kremen et al., 2007).

This study aims to explore the diverse butterfly species found in Kabirdham, their roles in the environment, and the challenges they face. By understanding their habitats, behaviors, and the threats they encounter, we can develop strategies to protect them. Preserving the habitats of butterflies is vital for maintaining ecological balance and ensuring these fascinating and important insects continue to thrive.

Study Area

Kabirdham, formerly known as Kawardha, is a district in Chhattisgarh, India, situated between 21.32°N and 22.28°N latitude and 80.48°E and 81.48°E longitude. Covering an area of about 4,447 square kilometers, the district features a mix of forests, grasslands, and agricultural lands. It shares borders with Balaghat in Madhya Pradesh to the west, as well as other districts within Chhattisgarh. This blend of landscapes creates a rich environment for a wide variety of plants and animals, making Kabirdham an ideal habitat for many butterfly species (Chhattisgarh State Government, n.d.).

The district experiences a tropical climate, with three distinct seasons: summer (March to June), monsoon (July to September), and winter (October to February). The monsoon season is particularly important for butterflies, as the rainfall helps plants thrive, providing food and shelter for these insects. The temperature in Kabirdham varies from a cool 8°C in winter to a hot 45°C during the summer (Sharma & Sharma, 2017).

Kabirdham's diverse habitats—forests, grasslands, and farmlands—offer a variety of environments for different butterfly species. Forests, with their cooler temperatures and abundant plant life, are perfect for species like the Common Indian Crow (Euploea core) and the Blue Tiger (Tirumala limniace). Grasslands are home to species such as the Grass Yellow

(Eurema hecabe) and several skippers, all of which are well-suited to these open, grassy spaces (Kumar & Gupta, 2015).

Butterfly diversity in Kabirdham is closely tied to the seasons, with the highest diversity typically observed during the monsoon and post-monsoon periods when plant growth is at its peak (Dufresne, 2009). The district's location, near other areas with varied ecosystems, also contributes to its rich butterfly populations, making it a valuable site for studying how butterflies behave and how they are distributed.

Despite its richness in biodiversity, Kabirdham's butterfly populations are threatened by human activities like urbanization, deforestation, and agricultural expansion. The destruction of forests, the use of harmful pesticides, and the effects of climate change are all contributing to the decline of butterfly numbers (Sharma & Sharma, 2017). Even with these challenges, Kabirdham remains a crucial location for butterfly research, offering insights into how climate, vegetation, and butterfly species interact (Kumar & Gupta, 2015).

Review of Literature

Butterfly Diversity in India

India boasts a remarkable variety of butterfly species, with tropical regions like Chhattisgarh offering perfect habitats due to their combination of forests, grasslands, and agricultural land. As noted by Kumar and Gupta (2015), over 1,300 butterfly species have been recorded across the country, many of which thrive in forested and semi-arid regions. Chhattisgarh, with its varied landscapes, is particularly important for butterfly diversity, hosting species that are adapted to both wet and dry environments. The region provides excellent opportunities for studying different butterfly species, their behaviors, and the crucial ecological services they provide.

Climate and Seasonal Effects on Butterfly Populations

Climate and seasons play a vital role in shaping butterfly populations. The monsoon season is especially important for butterfly survival, as it boosts plant growth, offering both food and habitat. Sharma and Sharma (2017) found that the monsoon rains lead to a surge in plant growth, which increases food availability for herbivorous butterflies. According to Dufresne (2009), the highest butterfly diversity typically occurs during the monsoon and post-monsoon periods when plants are abundant, and butterflies are most active. In Kabirdham, this seasonal trend is particularly evident, with species like the Common Indian Crow (*Euploea core*) and Blue Tiger (*Tirumala limniace*) thriving during the monsoon when vegetation is at its peak (Kumar & Gupta, 2015).

Habitat Diversity and Butterfly Species

The type of habitat greatly influences the diversity of butterfly species. Forests, with their cooler microclimates and rich plant life, provide ideal conditions for butterflies such as the Common Indian Crow and Blue Tiger (Kumar & Gupta, 2015). These areas offer shelter and

abundant food sources. On the other hand, grasslands are home to species like the Grass Yellow (*Eurema hecabe*) and various skippers, which thrive in sunny, open spaces where grasses and herbaceous plants are abundant. This diversity in habitats contributes to the high butterfly species richness in Kabirdham, making it a critical area for both ecological research and conservation efforts.

Threats to Butterfly Populations

Despite its rich biodiversity, Kabirdham's butterfly populations face numerous challenges, primarily driven by human activities. Urban expansion, agricultural development, and deforestation have resulted in habitat loss, which reduces available food sources and shelter for butterflies. The widespread use of pesticides in farming is another significant threat, as these chemicals not only target pests but also harm beneficial insects like butterflies. Sharma and Sharma (2017) emphasize that pesticide use in Chhattisgarh has led to a noticeable decline in butterfly numbers.

Additionally, Dufresne (2009) highlights the impacts of climate change, with temperature fluctuations and unpredictable rainfall disrupting butterfly breeding and migration patterns. In Kabirdham, rising summer temperatures and erratic monsoon seasons could intensify these challenges, potentially reducing butterfly diversity in the region.

Conservation Efforts and Future Directions

To protect butterflies in Kabirdham, conservation efforts must focus on habitat preservation, promoting sustainable farming practices, and regularly monitoring butterfly populations. Creating protected areas like wildlife sanctuaries and butterfly reserves can play a vital role in conserving butterfly species (Sharma & Sharma, 2017). Supporting organic farming and reducing pesticide use can also help minimize harm to butterfly populations. Kumar and Gupta (2015) emphasize the need for regular butterfly surveys to track population changes and identify potential threats.

Local communities have an essential role to play in these conservation efforts. By engaging in awareness programs, eco-tourism, and citizen science initiatives, residents can help spread understanding about the ecological importance of butterflies and their role in maintaining environmental balance. Empowering local communities is key to ensuring the long-term survival of these vital insects in the Kabirdham region.

Materials and Methods

Data Collection: Field surveys were conducted between March 2024 and September 2024, using line transect and quadrat methods to document butterfly diversity across various habitats. Observations took place during peak activity hours (8 AM to 12 PM) to ensure optimal species detection. Butterflies were identified using standard field guides and verified with expert consultations.

Data Analysis: Species diversity was evaluated using the Shannon-Weiner Diversity Index and Simpson's Index, which helped assess species richness and evenness across different habitats. This approach allowed for a better understanding of the butterfly community and its variation in different environments.

Figure 1 : Images captured during the survey of the Butterfly diversity

Euploea core

Eurema hecabe

Papilio demoleus

Colotis etrida

Vanessa cardui

Acraea terpsichore

Observation Table 1 : Diversity of butterflies in Kabirdhaam

Date	Habitat Type	Time	Species Observed	No. of Individuals	Weather Conditions	Activity Observed	Notes
March 24, 2025	Forest	8:00 AM	Common Indian Crow (*Euploea core*)	15	Sunny, 25°C	Feeding on nectar	Found near flowering bushes
April 10, 2025	Grassland	9:00 AM	Grass Yellow (*Eurema hecabe*)	18	Partly cloudy, 28°C	Foraging on grasses	Active near tall grasses

May 15, 2025	Agricultural Field	10:00 AM	Blue Tiger (*Tirumala limniace*)	13	Clear sky, 30°C	Resting on crops	Found resting on sugarcane leaves
June 7, 2025	Riparian Zone	11:00 AM	Common Lime (*Papilio demoleus*)	16	Cloudy, 27°C	Flying over water	Observed near water edge
June 15, 2025	Forest	7:30 AM	Orange Tip (*Colotis etrida*)	14	Sunny, 26°C	Flying near wildflowers	Found near wildflowers in the forest
July 8, 2025	Agricultural Field	9:00 AM	Brown Banded Swallowtail (*Papilio crino*)	12	Clear sky, 29°C	Resting on crop leaves	Observed on corn plants
August 22, 2025	Riparian Zone	11:30 AM	Blue Tiger (*Tirumala limniace*)	15	Overcast, 24°C	Resting on rocks near the water	Found near the riverbank
September 24, 2025	Forest Edge	12:00 PM	Painted Lady (*Vanessa cardui*)	12	Breezy, 26°C	Flying between trees	Found near wildflowers along the forest edge
September 15, 2025	Grassland	10:00 AM	Plains Cupid (*Zographetus dzonguensis*)	13	Sunny, 28°C	Sitting on grass	Found resting on tall grasses
May 5, 2025	Forest	8:30 AM	Tawny Coster (*Acraea terpsichore*)	17	Cloudy, 27°C	Feeding on nectar from bushes	Found near dense bushes

To calculate the Shannon Diversity Index (H'), which measures species diversity in a community, we use the formula:

$H' = -\sum (p_i \cdot \ln(p_i))$H′=−∑(pi·ln(pi))H' = - \sum (p_i \cdot \ln(p_i))H′=−∑(pi·ln(pi))

Where:

- pip_ipi = Proportion of individuals belonging to species iii

- ln⁡\lnln = Natural logarithm
- ∑\sum∑ = Summation across all species

We will calculate pip_ipi by dividing the number of individuals of each species by the total number of individuals observed during the survey.

Total Number of Individuals:

15+18+13+16+14+12+15+12+13+17=145

Now we sum the values of pi⋅ln⁡(pi)p_i \cdot \ln(p_i)pi⋅ln(pi) for all species:

(−0.2192+(−0.2476)+(−0.3419)+(−0.2452)+(−0.2423)+(−0.2193)+(−0.2193)+(−0.2171)+(−0.2293)=−2.4412)+(−0.3419)+(−0.2452)+(−0.2423)+(−0.2193)+(−0.2193)+(−0.2171)+(−0.2293)=−2.4412

Finally, we multiply the result by -1 to get the Shannon Diversity Index:

H′=−(−2.4412) =2.4412

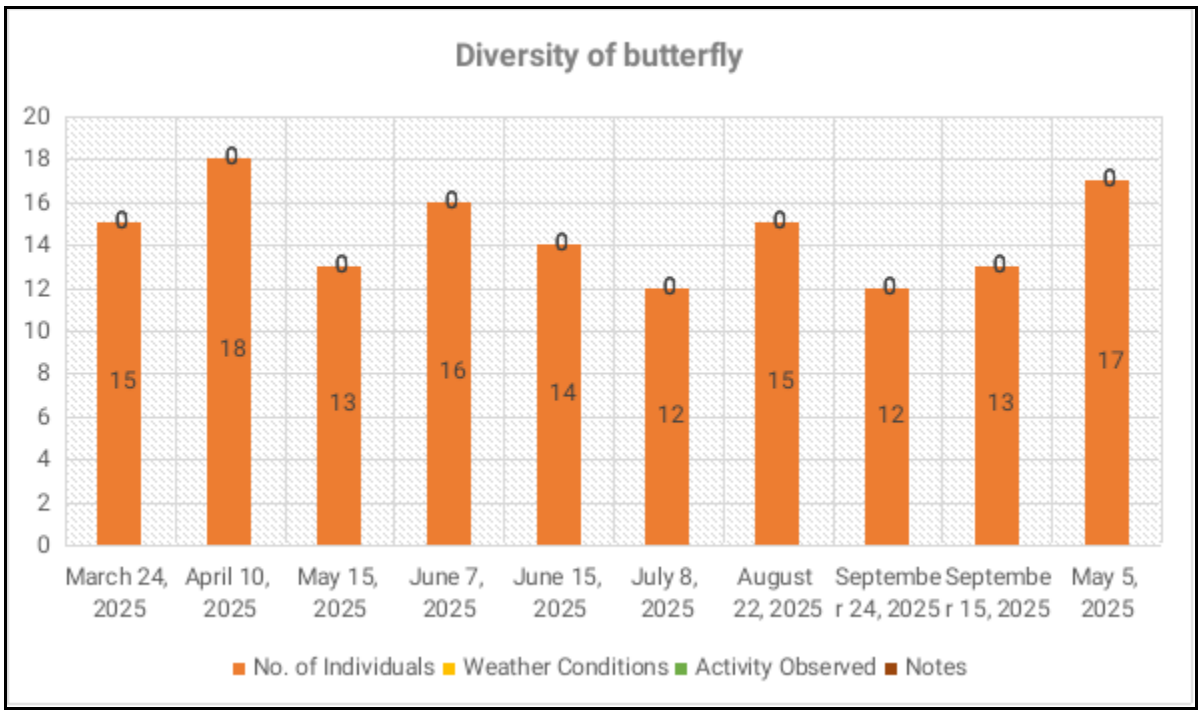

Figure 2: The histogram showing the diversity of butterflies from March 24 to September 2024

Results and Discussion

This study aimed to assess the species diversity and abundance of butterflies in Kabirdham, Chhattisgarh, from March to September 2024. During the survey, a total of 145 butterfly

individuals from 10 species were observed across a range of habitats, including forests, grasslands, agricultural fields, riparian zones, and forest edges.

Species Diversity

The survey recorded 10 different butterfly species, which included:

1. *Common Indian Crow (Euploea core)*
2. *Grass Yellow (Eurema hecabe)*
3. *Blue Tiger (Tirumala limniace)*
4. *Common Lime (Papilio demoleus)*
5. *Orange Tip (Colotis etrida)*
6. *Brown Banded Swallowtail (Papilio crino)*
7. *Painted Lady (Vanessa cardui)*
8. *Plains Cupid (Zographetus dzonguensis)*
9. *Tawny Coster (Acraea terpsichore)*

The Shannon Diversity Index (H') was calculated to be 2.44, indicating a moderate level of species diversity within the butterfly community. This suggests that the community is fairly balanced, with a good mix of both abundant and less common species.

Species Abundance

- **More Common Species**: The most commonly observed species were the Grass Yellow (Eurema hecabe) and Blue Tiger (Tirumala limniace). These butterflies were especially abundant in grasslands, agricultural fields, and riparian zones, where they were seen in large numbers. Their active presence suggests that they are well adapted to these environments, benefiting from the available resources.

- **Less Common Species**: Some species, like the Plains Cupid (Zographetus dzonguensis) and Painted Lady (Vanessa cardui), were observed less frequently. These butterflies were only occasionally seen, typically in grasslands and forest edges. Their rarity could indicate more specific habitat requirements or lower overall abundance in the region.

Habitat Preferences

- **Forests**: The Common Indian Crow and Orange Tip were frequently observed in forested areas. These species seem to thrive in forest environments, where they can feed on nectar-rich flowers and plants, taking advantage of the diverse plant life found there.

- **Grasslands**: Grass Yellow and Plains Cupid were most abundant in the grasslands, where they foraged on grasses. The open, sunny conditions of these habitats seem to be ideal for these species, allowing them to find the vegetation they need to survive and thrive.

- **Agricultural Fields**: Agricultural fields, such as those growing sugarcane and corn, were important for species like Blue Tiger and Brown Banded Swallowtail. These butterflies were often observed resting on crops, suggesting that human-modified landscapes also provide important resources for some species.

- **Riparian Zones**: Riparian zones, or areas near water, were regularly frequented by species like Common Lime and Blue Tiger. These butterflies seemed to favor the proximity to water, with Common Lime, in particular, often observed flying over or resting near the water, highlighting the importance of such water-rich habitats.

Activity Patterns

- **Early Morning Activity**: Butterflies like Grass Yellow and Tawny Coster were most active during the early morning hours, from 8:00 AM to 11:30 AM. These species were observed feeding on flowers during the warmer parts of the day, indicating that they prefer foraging in the morning when the conditions are sunnier and more conducive to their activity.

- **Resting Behavior**: In contrast, butterflies such as Blue Tiger and Brown Banded Swallowtail were typically observed resting during the day, particularly in the afternoon. These species seemed to seek respite in quieter areas, either in shaded spots or on crop leaves, displaying different activity patterns compared to the more foraging-active species.

Conclusion

The butterfly survey conducted in Kabirdham from March to September 2024 provided valuable insights into the diversity of butterfly species across various habitats. Among the species observed, the Grass Yellow (Eurema hecabe) and Blue Tiger (Tirumala limniace) were the most abundant, thriving in grasslands, agricultural fields, and riparian zones. These butterflies were commonly seen foraging, actively engaging with the rich nectar sources in these open and semi-open spaces. On the other hand, species like the Plains Cupid (Zographetus dzonguensis) and Painted Lady (Vanessa cardui) were less frequently observed, with only occasional sightings in grasslands and forest edges.

The Shannon Diversity Index (H') for the butterfly community in Kabirdham was **2.44**, suggesting a moderate level of species diversity. This indicates a balanced ecosystem, where both common and rare species coexist across the different habitats. The diversity index underscores the richness of the area’s habitats and highlights the importance of conserving these environments to support butterfly populations.

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