IMPACT OF SEASONAL VARIATION ON SPECIES RICHNESS, DIVERSITY AND RELATIVE ABUNDANCE OF BUTTERFLIES IN BHILWARA DISTRICT, RAJASTHAN, INDIA

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ABSTRACT
A study was conducted in Bhilwara district to assess seasonal variations in butterfly species richness, diversity and relative abundance from July 2022 to June 2025. A primary survey was conducted from July 2022 to June 2023 to identify sampling sites and transects, followed by monthly surveys from July 2023 to June 2025 to monitor seasonal changes in butterfly communities. A total of 49 species belonging to 37 genera, 13 subfamilies and five families of butterflies were observed in Bhilwara district. In terms of seasonal variation in butterfly communities, the highest number of butterfly species and individuals was noted during the rainy season (rainy 2025= 46 species; 1245 individuals and rainy 2024= 42 species; 1012 individuals) followed by winter season (winter 2023–24 = 39 species; 958 individuals and winter 2024–25 = 41 species; 886 individuals), and lowest number of butterfly species and individuals was noted during summer season (summer 2025= 36 species and 659 individuals and summer 2024= 37 species; 846 individuals).
Values of different diversity indices, such as the Simpson diversity index (0.9646–0.9749), Shannon diversity index (3.476–3.751), and Menhinick index (1.254–1.402) also varied with seasonal fluctuations. Species richness, diversity, population, and relative abundance of butterflies fluctuated due to variations in climatic conditions. Extremely high temperatures in summer season, as well as low temperatures during winter season and availability of adequate resources in these seasons, caused a decline in species richness and population, affecting adult and pupa survival. In contrast, the rainy season provided favorable host plant availability, offering higher species richness, diversity and abundance of butterflies. Furthermore, species vary in their tolerance to climatic changes, allowing some species to thrive in adverse environmental conditions. Occurrence of butterfly species also varies according to the season; some species appear throughout pyears, whereas others, such as *Colotis vestalis*, *Hebomoia glaucippe* and *Suastus gremius*, appear during specific seasons, such as the rainy season in the study area.

Key Words: Butterfly, Bhilwara, Seasonal variation, Diversity, Rainy season

INTRODUCTION
Butterflies are important bio-indicators of ecosystems because of their heightened sensitivity to environmental changes, rendering them indispensable subjects for ecological studies (Oostermeijer & Van Swaay, 1998; Bonebrake *et al.,* 2010; Ghazanfar *et al.,* 2016). Their distribution, species richness, diversity, and population structures are influenced by various environmental factors, including temperature, humidity, rainfall, vegetation composition and structure, and anthropogenic disturbances (Kunte, 2008; Aguirre-Gutierrez *et al.,* 2017;Checa *et al.,* 2019;Gupta *et al.,* 2019; Choudhary *et al.,* 2020; Choudhary & Chishty, 2020; Chishty *et al.,* 2020; Pires *et al.,* 2020). These factors affect resource availability and habitat suitability, ultimately determining species composition within diverse ecosystems (Stefanescu *et al.,* 2003; Menendez *et al.,* 2007; Forister *et al.,* 2010; Robinson *et al.,* 2012; Ombugadu *et al.,* 2024).
Furthermore, climatic conditions during specific seasons influence and determine the community structure of butterflies. For instance, temperature and precipitation markedly influence species richness and abundance. Warmer climatic conditions usually promote higher species diversity in tropical regions, whereas extreme or adverse climatic conditions lead to shifts in species distribution and richness patterns (Forister *et al.,* 2010). In temperate ecosystems, butterfly populations exhibit seasonal variations influenced by changes in temperature and photoperiod length (Roy *et al.,* 2001). Similar observations of seasonal variation in butterfly communities have also been noted in subtropical regions (Sengupta *et al.,* 2014; Miya *et al.,* 2025).
Moreover, microclimatic conditions, such as canopy cover and solar radiation, play a crucial role in the thermoregulation and activity patterns of butterflies (Srygley, 2004; Checa*et al.,* 2014; Mahata *et al.,* 2023). Understanding these ecological

interactions is vital for developing effective conservation strategies, particularly in the context of climatic changes and habitat degradation (Hannah *et al.,* 2002 a&b; Bonebrake *et al.,* 2010; Forister *et al.,* 2010; Manzoor *et al.,* 2013). Butterflies play a crucial role in ecosystems, serving as both pollinators and herbivores in their interactions with plants (Tiple *et al.,* 2006). The Indian subcontinent is home to approximately 1504 butterfly species (Tiple, 2011).

Several studies have been conducted on species richness, diversity, and distribution patterns in various eco-regions of Rajasthan (Trigunayat & Singh, 1998; Kazmi *et al.,* 2003; Sharma, 2014; Kulshreshtha & Jain, 2016; Meena, 2020; Choudhary*et al.,* 2020; Choudhary & Chishty, 2020; Pahadiya, 2020; Rani &Ahmed, 2021; Sharma *et al.,* 2023; Prajapat *et al.,* 2023; Meena, 2023; Gocher & Dang, 2025; Kumar & Sharma, 2025; Koli *et al.,* 2025). However, to date, no studies on butterfly species richness and diversity in relation to seasonal variations have been conducted in Bhilwara district, Rajasthan. Therefore, the present study aimed to investigate the impact of seasonal variations on the species richness, diversity and abundance of butterflies in Bhilwara district, Rajasthan.

Study area:

Bhilwara district, with a total area of 10, 455 square kilometers, is located between 25 °10 ' to 25 °58 ' N latitudes and 74 °10 ' to 75 °28′ E longitudes (Figure 1). It has a strategic location among the surrounding districts, each contributing to its unique geographical characteristics. In north, it shares a border with Ajmer, while Rajsamand district is positioned in north-west, west and south-west. Southern and south-eastern borders are shared with Chittaurgarh district, and eastern and north-eastern parts are adjacent to Bundi and Tonk districts. Geographical and ecological features of district are characterized by a diverse terrain with varying climatic conditions, as well as variations in forest distribution and habitat heterogeneity. Eastern and southeastern regions of the district receive more rainfall and host most forest areas, especially in tehsils of Jahazpur, Mandalgarh, and Bijoliya. District comprises several predominant tree species, such as dhokra (*Anogeissus pendula*), babool (*Vachellia nilotica*) and khair (*Senegalia catechu*), indicative of the regions' arid and semi-arid environmental conditions. District comprises 12 tehsils and is characterized by a high plateau with a cluster of hills in the southeastern part.

Aravalli range passes through several places in the district, which contributes to its varied topographic features. District also comprises lentic and lotic ecosystems due to the presence of numerous water bodies and rivers. Presence of water bodies and rivers also contributes to variations in habitat characteristics features of the district. District experiences exhibit notable variations in seasons throughout the year owing to significant fluctuations in temperature. Winter season, occurring between October and February, is characterized by low temperatures. After winter season, the area experiences hot and dry weather from March to June, known as summer season. Summer season is characterized by extreme temperatures and warm days. After summer season, the district receives rainfall due to arrival of the southwest monsoon, which typically begins in late June and lasts until mid-September.

MATERIAL AND METHODS

A study was conducted to assess the seasonal variations in species richness and diversity patterns and relative abundance of butterflies in Bhilwara district from July 2022 to September 2025. An initial or primary field survey was conducted from July 2022 to June 2023 to determine sampling sites and transects. Subsequently, monthly field surveys were conducted from July 2023 to September 2025 to examine seasonal variations in butterfly species richness and diversity patterns. Surveys were conducted after sunrise from 8:00 to 11:00 am and in afternoon from 1:00 to 4:00 pm, while walking along transect at a constant speed. Surveys were conducted along different transects selected in various microhabitats, such as grasslands, agricultural land, abandoned fields, rural areas, urban areas, roadside areas, eco-parks, gardens, riverbank areas, surrounding water bodies and urban areas of Bhilwara district. During each 1 km transect walk of 40 min, butterflies on both sides of the transect within a distance of 5 m and up to 2 m in front of the observer were recorded.

Butterflies were collected using standard entomological sampling techniques. Aerial nets, made of lightweight and fine mesh material, were used to capture both flying and resting butterflies. Beating or sweeping nets, constructed with heavy cloth such as canvas and attached to sturdy handles, were employed to sweep through vegetation for collecting insects. A killing jar was prepared using glass or plastic containers lined with a 1 cm layer of plaster of Paris or absorbent material such as cotton or paper, infused with ethyl acetate or acetone as a killing agent. Butterfly specimens that died due to road accidents were also collected and identified using standard literature, field guides, and online databases.

Collected specimens were preserved following standard entomological procedures including killing, relaxation, pinning, spreading, labelling, and mounting. Specimens were initially euthanized in killing jars using volatile chemicals such as ethyl acetate or chloroform. To prevent damage to delicate body parts, particularly wings, specimens were relaxed in a humid chamber containing an absorbent layer moistened with water and a small amount of ethyl acetate to inhibit fungal growth, typically for 24 hours. Subsequently, specimens were pinned by inserting a pin through the thoracic region and mounted on spreading boards, where wings were carefully spread at an angle of approximately 90° using fine pins. After spreading, specimens were dried in an oven at 37°C for 24 hours. Each specimen was labelled with essential information including collection site, date, habitat, and collector's name using permanent ink. Finally, the preserved specimens were mounted and stored in insect cabinets with naphthalene balls to protect against pests, following standard preservation techniques.

Butterflies falling under the provisions of the Wildlife Protection Act, 1972 were neither collected nor harmed during the study.

At the time of data collection, the name of species and number of individuals of butterflies were counted and noted in field data sheets. Nomenclature of butterfly species was followed as per the guidelines provided by " Indian National Commission on Butterfly Names" (Kunte and Sondhi, 2025), and standard field guides, including "A naturalist's guide to the Butterflies of India, Pakistan, Nepal, Bhutan, Bangladesh, and Sri Lanka (Smetacek, 2018) were used to find out their common name, scientific name and families.

Photographs of study area and butterfly species were taken using a Nikon P1000 camera and a smartphone with a zoom lens. Photographs of butterflies were used for species identification. Species identification was carried out based on color patterns, size and shapes and designs, considering the available literature and standard field guides and information provided by Singh, A.P. (2010), Kehimkar, (2016) and Peter Smetacek, (2018) as well as online data base "butterflies of India" (Kunte *et al.,* 2024). Species richness and seasonal diversity of butterflies were calculated using various diversity indices in MS Excel and Past software (version 4.03).

Shannon diversity index (H′) is a quantitative measure of species diversity within a community or specific area (Shannon & Weaver, 1949). This index considers both the number of species and their distribution within a particular community, habitat, or area.

$$\mathbf{H'} = -\sum_{i=1}^{R} pi \ln pi$$

Where H' =Shannon's diversity index; S= Total number of species in the community. ; pi= relative abundance of species ith species.; In – natural log to base 2.

Simpson's diversity index (D) is a quantitative measure of diversity that accounts for both the number of species and their relative abundance in a particular area. The index indicates that diversity increases with higher species richness and evenness (Simpson, 1949).

$$\mathbf{D = 1 - \left(\frac{\Sigma n\ (n-1)}{N(N-1)}\right)}$$

Where D=Dominance; N- Total number of individuals of all species; n = Total number of individuals of a particular species.

Menhinick's Richness Index: The ratio of the number of taxa/species to the square-root of sample size.

$$\mathbf{D_{mn} = \frac{S}{\sqrt{N}}}$$

Where N = Total number of individuals in sample size; S = Number of species in sample

Relative abundance: Relative abundance of each species in particular season was determined using the following formula:

$$\textbf{Relative abudance}\ (\%) = \frac{\mathbf{ISi}}{\mathbf{\Sigma Nsi}} \mathbf{X\ 100}$$

Where, Isi= Total number of individuals of particular species or given species. ΣNsi =Total number of individuals of all species in seasons.

RESULT AND DISCUSSION

Study was conducted in various areas and microhabitats, including agricultural landscapes, mountainous regions, uncultivated areas, abandoned fields, gardens, eco-parks, grasslands, and areas surrounding wetlands and river basins in the Bhilwara district. During study, a total 49 butterfly species belonging to 37 genera, 13 subfamilies, and five families of order Lepidoptera were recorded from Bhilwara district of Rajasthan (Table 1). Family Lycaenidae was most diverse, represented by 14 genera with 15 species. Subsequently, nine genera and 13 species of butterflies were recorded from family Nymphalidae. Third most diverse family was Pieridae, with 13 species across eight genera. Hesperiidae family represented by 4 species belonging to 4 genera (Table 1). Remaining four species across two genera were recorded from family Papilionidae. Seasonal changes play an important role in shaping species richness, diversity and abundance patterns in butterflies in a particular habitat or environment, due to the availability of host plants. To evaluate the effect of these seasonal changes on butterfly communities in the Bhilwara district, data collected throughout the year were categorized into three distinct seasons: rainy or monsoon (July–September), winter (October–February), and summer (March–June).

Maximum number of butterfly species and individuals was recorded during rainy season (Rainy 2025= 46 species; 1245 individuals and Rainy 2024= 42 species; 1012 individuals) followed by winter season (Winter 2023–24 = 39 species; 958 individuals and Winter 2024–25 = 41 species; 886 individuals) and lowest number of butterfly species and individuals was noted during summer season (Summer 2025= 36 species and 659 individuals and Summer 2024= 37 species; 846 individuals) (Table 1 & 2).Species numbers and populations of butterflies showed notable changes with seasonal variations. It is largely dependent on and driven by variations in climatic conditions across different seasons or throughout the year.

In summer, high temperatures and limited water availability create challenging survival conditions for butterflies, leading to a significant decline in both species number and population. Similarly, in winter season, which is characterized by extremely low temperatures, there was also a reduction in species richness and butterfly populations in particular areas. These adverse climatic conditions, particularly affecting survival of adult butterflies and pupae, lead to a struggle to withstand adverse climatic conditions and limited resource availability in these seasons.

In contrast, the rainy and post-monsoon seasons offer favorable conditions, including increased humidity and availability of host plants, resulting in a significant increase in butterfly species richness, diversity and population. These seasonal fluctuations highlight importance of environmental factors and resource availability in butterfly survival. Additionally, the higher availability of host plants during the rainy season favors the reproduction of various butterfly species, contributing to their increased number during this time.However, several species of butterflies exhibit varying levels of tolerance to climatic changes, thereby enabling some to survive despite challenging conditions.Subsequently several butterflies species such as *Papilio demoleus, Papilio polytes, Graphium doson, Graphium agammemnon, Catopsilia Pomona, Anaphaeis aurota, Danaus chrysippus, Junonia orithya, Junonia lemonias, Junonia almana, Junonia atlites, Hypolimnas bolina, Cynthia cardui, Phalanta phalantha, Acraea terpsicore*, *Ypthima asterope, Biblia ilithyia, Ariadne merione, Lepotes plinius, Freyeria trochylus, Catochrysops strabo, Zizula hylax, Zizeeria karsandra, Zizina otis* occurrence was noted throughout the year. Species such as *Colotis vestalis*, *Hebomoia glaucippe*, and *Suastus gremius* appeared during the rainy season. These species are intolerant to harsh climatic conditions and skip the summer and winter seasons in the pupal stage. This has been shown to be the case during extreme conditions such as low temperatures and drought summers, when insects go into the diapause stage to avoid harsh and adverse climatic conditions.

Seasonal variations also influence the diversity and abundance patterns of butterfly communities in the study area. These were observed using diversity indices such as Simpson's diversity, Shannon's diversity index, and Menhinick's diversity index. Highest value of Simpson diversity index was observed during rainy season 2024 (0.9749) followed by rainy 2023 (0.9701), winter 2024-25 (0.9698), summer 2024 (0.9694), summer 2025 (0.9683) and lowest value of Simpson diversity was observed during winter 2023-24 (0.9646) (Table 2). Subsequently, highest value of Shannon diversity index was observed during rainy season 2024 (3.751) followed by rainy 2023 (3.602), winter 2024-25 (3.582), summer 2024 (3.536), summer 2025 (3.507) and lowest value of Shannon diversity index was observed during winter 2023-24 (3.476) (Table 2). In this sequence value of Menhinick was observed higher during the summer 2025 (1.402) followed by winter 2024-25 (1.377), rainy 2023 (1.32), rainy 2024 (1.304), summer 2024 (1.272) and lowest value of Menhinick index was observed during the winter 2023-24 (1.254) (Table 2).The relative abundance of each butterfly species also varied according to the seasonal changes in the study area. Table 1 presents the relative abundance of each species along with the different seasons in the study area.

Several studies have examined the impact of seasonal variations across different parts or habitats of the world, including India (Kunte, 1997; Tiple & Khurad, 2009;Grotan *et al.,* 2012; Sengupta *et al.,* 2014; Gohel & Raval, 2019; Gupta *et al.,* 2019; Naik *et al.,* 2022; Kc & Sapkota, 2024; Miya *et al.,* 2025; Ravathy & Sukanya, 2025). Similar to present study, Tiple & Khurad (2009) observed higher species richness and diversity during monsoon season compared to winter and summer seasons. Studies have concluded that the variation across the Indian subcontinent suggests different habitat complexity and environmental factors largely influence the diversity and distribution patterns of butterflies, along with geographical reasons, as well as variation occurring due to different seasons (Miya *et al.,* 2025). Kunte (1997) concluded that monsoon precipitation improves habitat conditions, leading to higher butterfly diversity and abundance. Increasing vegetation and greenery during monsoon season provides abundant food resources for both larvae and adult stages. Similar to this conclusion, present study also observed comparable observations and found highest species richness, diversity, and abundance during monsoon season compared to winter and summer seasons (Table 2).

In rainy season, a warm and humid climate creates suitable conditions for butterfly reproduction and development of larval stages (Bonebrake *et al.,* 2010; Forister *et al.,* 2010). Adequate humidity facilitates butterfly emergence, activity and reproduction, whereas low or insufficient humidity can lead to desiccation stress and reduced survival (Fartmann& Hermann, 2006; Habel *et al.,* 2022; Gupta *et al.,* 2019; Mahata *et al.,* 2023). Conversely, extreme heat and temperatures during summer season can adversely affect butterfly species richness, diversity and abundance due to a decrease in food sources (Kharouba *et al.,* 2014). Additionally, extreme temperatures and heat are responsible for butterfly mortality (Kharouba *et al.,* 2014; Essen s*et al.,* 2017). Additionally, diversity and abundance of butterflies are also influenced by the combined effects of unfavorable habitat conditions as well as limited resource availability, which is responsible for low counts of butterfly diversity and abundance in summer and winter seasons; in contrast, monsoon season offers high resource availability and favorable habitat conditions, resulting in high diversity and abundance of butterflies (Kunte, 2000; Kehimkar, 2008; Chowdhury *et al.,* 2021).

Human-modified or altered habitats, such as urban and agricultural regions, typically exhibit reduced butterfly species richness and diversity compared to natural habitats, although they may support distinct species assemblages (Kunte *et al.* 1999; Choudhary *et al.*, 2020). Semi-natural habitats within urban environments can maintain butterfly diversity (Mahata *et al.*, 2019); however, ongoing urban expansion and habitat fragmentation pose significant threats to their survival by diminishing open spaces and natural habitats on a global scale (Choudhary & Chishty, 2020).During monsoon season, growth of young and tender leaves provides high-quality food for larvae, resulting in peak butterfly abundance during monsoon season (Kunte, 1997; Sengupta *et al.,* 2014). Similar to these studies, present study also found higher butterfly abundance during monsoon season than during the winter and summer seasons in Bhilwara district, Rajasthan (Table 1&2). Furthermore, winter season showed moderate similarity with monsoon and post-monsoon assemblages, indicating a gradual shift in species composition due to lower temperatures and a decline in resources. During winter, several species of butterflies enter diapause or exhibit reduced activity, which also contributes to low diversity in the winter season compared with the monsoon period (Pollard & Yates, 1993).

Furthermore, Kachhawa *et al.* (2021) studied the temporal dynamics of butterfly composition in the Aravalli region of Jaipur district and observed a total of 25 species belonging to four families. They observed that the Simpson diversity index ranged from 0.067004 to 0.932996. In current study, values of different diversity indices, such as the Simpson diversity index (0.9646 to 0.9749), Shannon diversity index (3.476 to 3.751), and Menhinick index (1.254 to 1.402), also varied with seasonal fluctuations (Table 2). Prajapat *et al.* (2023) conducted an observational study on butterfly diversity in the Jhalana Reserve Forest and Galta Forest areas of the Jaipur district and recorded a total of 2,138 butterfly individuals belonging to 35 species across 23 genera and five families. Highest butterfly abundance was observed during monsoon season, with a decrease in the pre-monsoon period and lowest abundance in the post-monsoon season.Singh, A.P. (2010) analyzed butterfly diversity in Ankua Reserve Forest, Koina Rand, Saranda Division of West Singhbhum district Jharkhand and observed 71 species across five families and 56 genera. Among these, the minimum number of species was observed in February (38), whereas the maximum number of species was found in September (56). This study also indicated that the monsoon month of September recorded higher butterfly species richness than the winter month of February. Subsequently, during the current study, similar species richness was observed in the Bhilwara district (Table 1&2).

Table 1: Family, sub-family, scientific, and common names of butterflies and their relative abundance observed in different seasons from the Bhilwara district (R= Rainy season; W= Winter season, S= Summer season).

S. no.	Family	Sub-Family	Scientific Name	Common Name	Relative abundance of species in particular seasons					
					2023-24			2024-25		
					R	W	S	R	W	S
1	Papilionidae	Papilioninae	*Papiliodemoleus* Linnaeus, 1758	Lime Swallowtail	4.25	4.13	3.19	3.78	4.18	3.03
2			*Papiliopolytes* Linnaeus, 1758	Common Mormon	4.15	3.20	3.55	3.29	3.16	4.10
3			*Graphiumdoson* Felder & Felder, 1864	Common Jay	2.08	1.96	1.77	2.49	2.26	1.82
4			*Graphiumagammemnon* Linnaeus, 1758	Tailed Jay	0.69	0.62	0.71	0.96	0.56	0.61
5	Pieridae	Coliadinae	*Catopsiliapyranthe* Linnaeus, 1758	Oriental Mottled Emigrant	0.59	0.41	0.35	1.53	0.34	0.00
6			*Catopsiliapomona* Fabricius, 1775	Common Emigrant	3.16	2.79	1.54	3.37	2.37	1.82
7			*Euremahecabe* Linnaeus, 1758	Common Grass Yellow	1.68	1.65	1.65	1.29	1.69	0.00
8			*Euremalaeta* Boisduval, 1836	Spotless Grass Yellow	1.09	0.00	2.48	1.37	3.50	3.49
9		Pierinae	*Anaphaeisaurota* Fabricius, 1793	Pioneer	4.05	3.41	3.43	3.61	2.37	3.19
10			*Delias eucharis* Drury, 1773	Indian Jezebel	0.30	0.31	0.00	1.69	0.23	0.00
11			*Colotisamata* Fabricius, 1775	Small Salmon Arab	0.40	0.21	0.00	0.56	0.34	0.00
12			*Colotisvestalis* Butler, 1876	White Arab	0.59	0.00	0.00	0.88	2.82	0.00
13			*Colotisetrida* Boisduval, 1836	Little Orange Tip	0.00	0.00	3.31	2.41	2.37	3.49
14			*Ixias pyrene* Linnaeus, 1764	Yellow Orange Tip	0.00	0.00	2.48	1.61	0.00	3.19
15			*Ixias marianne*	White Orange Tip	0.89	0.62	0.00	0.64	0.68	0.00

			Cramer, 1779							
16			*Hebomoiaglaucippe* Linnaeus, 1758	Great Orange Tip	1.98	0.00	0.00	1.45	0.00	0.00
17			*Ceporanerissa* Fabricius, 1775	Common Gull	0.00	4.24	3.07	0.00	3.50	3.19
18	Nymphalidae	Danainae	*Danauschrysippus* Linnaeus, 1758	Plain Tiger	3.06	2.17	2.36	1.77	2.82	2.88
19		Nymphalinae	*Junoniaorithya* Linnaeus, 1758	Blue Pansy	2.27	2.07	2.13	2.01	2.60	1.97
20			*Junonialemonias* Linnaeus, 1758	Lemon Pansy	1.98	1.76	1.89	1.69	1.47	1.67
21			*Junoniaalmana* Linnaeus, 1758	Peacock Pansy	1.58	1.14	1.06	1.69	1.47	3.19
22			*Junoniaatlites* Linnaeus, 1763	Grey Pansy	2.17	2.07	2.48	1.85	2.37	3.03
23			*Hypolimnasbolina* Linnaeus, 1758	Great Eggfly	2.08	2.17	3.31	1.69	1.69	3.95
24			*Hypolimnasmisippus* Linnaeus, 1764	DanaidEggfly	2.77	2.69	0.00	2.33	2.37	0.00
25			*Cynthia cardui* Linnaeus, 1758	Painted Lady	2.87	2.79	3.31	2.57	2.82	4.70
26		Heliconiinae	*Phalantaphalantha* Drury, 1773	Common Leopard	6.13	5.89	4.49	4.50	3.95	3.49
27			*Acraeaterpsicore* Linnaeus, 1758	Tawny Coster	1.48	1.34	2.25	1.69	1.35	3.03
28		Satyrinae	*Ypthimaasterope* Klug, 1832	Common Three Ring	1.68	1.55	2.48	1.77	1.47	3.03
29		Biblidinae	*Bibliailithyia* Drury, 1773	Joker	3.16	2.79	1.42	3.13	2.37	4.70
30			*Ariadne merione* Cramer, 1777	Common Castor	3.66	3.20	2.84	1.69	1.35	3.79
31	Lycaenidae	Polyommatinae	*Discolampaethion* Westwood, 1851	Banded Blue Pierrot	2.08	2.17	0.00	3.05	2.14	0.00
32			*Lepotesplinius* Fabricius, 1793	Zebra Blue	2.67	2.27	4.37	2.97	3.16	4.25

33			*Freyeriatrochylus* Freyer, 1845	Orange-spotted Grass Jewel	1.19	1.14	2.36	1.37	1.92	3.19
34			*Tarucusnara* Kollar, 1848	Striped Pierrot	1.68	2.38	0.00	1.61	3.39	0.00
35			*Taracuscallinara* Butler, 1886	Spotted Pierrot	2.08	2.07	0.00	2.41	2.60	0.00
36			*Niphandacymbia* Niceville, 1884	Pointed Pierrot	3.06	3.10	0.00	2.09	3.50	0.00
37			*Catochrysopsstrabo*Fabricius, 1793	Forget-me-not	2.67	2.07	3.66	2.17	2.60	3.19
38			*Zizulahylax* Fabricius, 1775	Tiny Grass Blue	3.16	1.24	2.13	2.25	2.03	3.34
39			*Euchrysopscnejus* Fabricius, 1798	Gram Blue	3.75	0.00	2.48	2.41	0.00	3.03
40			*Chiladespandava* Horsfield, 1829	Plains Cupid	2.57	0.00	3.43	2.25	0.00	1.82
41			*Psuedozizeeriamaha* Kollar, 1848	Pale Grass Blue	3.16	0.00	4.49	3.61	0.00	1.97
42			*Zizeeriakarsandra* Moore, 1865	Dark Grass Blue	3.16	2.79	3.55	2.97	3.27	3.19
43			*Zizinaotis* Fabricius, 1787	Lesser Grass Blue	3.75	3.93	3.66	2.01	3.50	0.76
44			*Lampidesboeticus* Linnaeus, 1767	Pea Blue	2.87	0.00	2.60	1.93	0.00	1.52
45		Aphnaeini	*Aphnaeusictis* Hewitson, 1865	Common Shot Silverline	0.00	6.30	0.00	2.89	5.08	1.21
46	Hesperiidae	Coliadinae	*Hasorachromus* Cramer, 1780	Common Banded Awl	0.00	6.82	2.60	0.00	5.76	1.82
47		Hesperiinae	*Suastusgremius* Fabricius, 1798	Oriental Palm Bob	1.38	0.00	0.00	1.77	0.00	0.00
48			*Potanthusnesta* Evans, 1934	Indian Dart	0.00	5.89	3.43	0.00	2.60	1.97
49		Pyrginae	*Spialiagalba* Fabricius, 1793	Asian Grizzled Skipper	0.00	2.69	3.66	2.97	0.00	1.37

Table 2: Species, individuals, and values of different diversity indices in different seasons (R= Rainy season; W= Winter season; S= Summer season)

Diversity indices	2023-24			2024-25		
	R	W	S	R	W	S
Species richness	42	39	37	46	41	36
Individuals	1012	968	846	1245	886	659
Simpson_1-D	0.9701	0.9646	0.9694	0.9749	0.9698	0.9683
Shannon_H	3.602	3.476	3.536	3.751	3.582	3.507
Menhinick	1.32	1.254	1.272	1.304	1.377	1.402

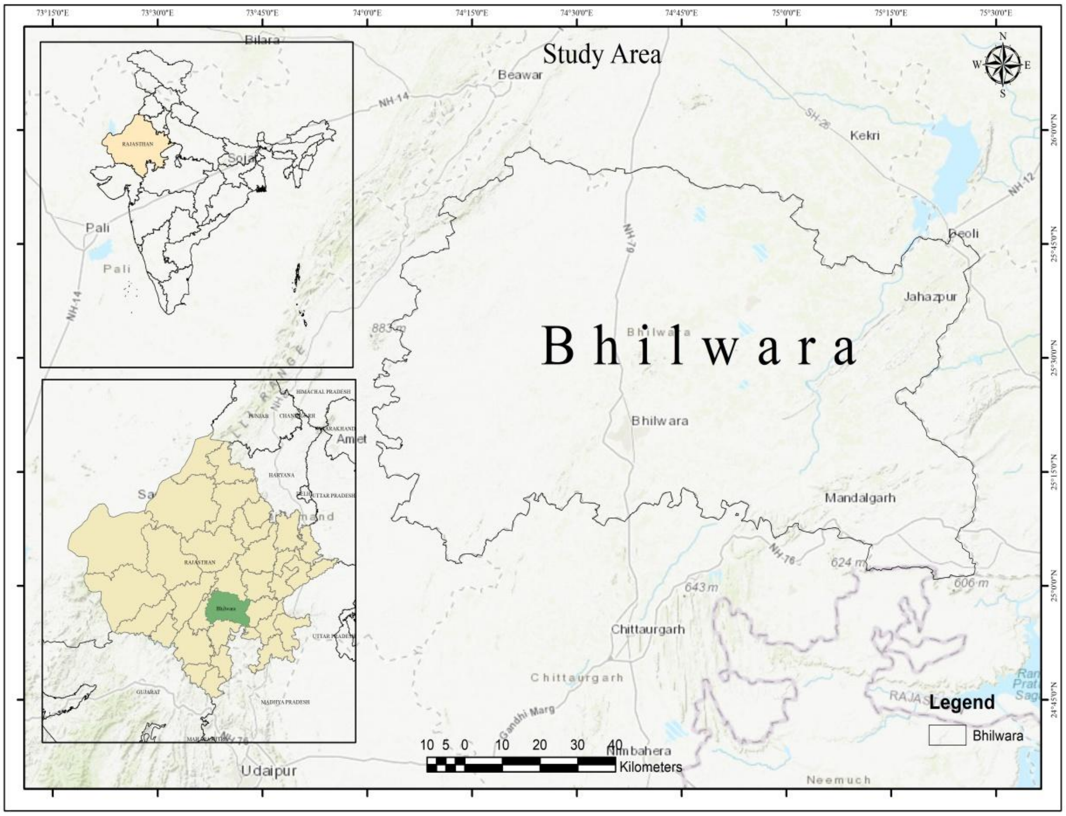
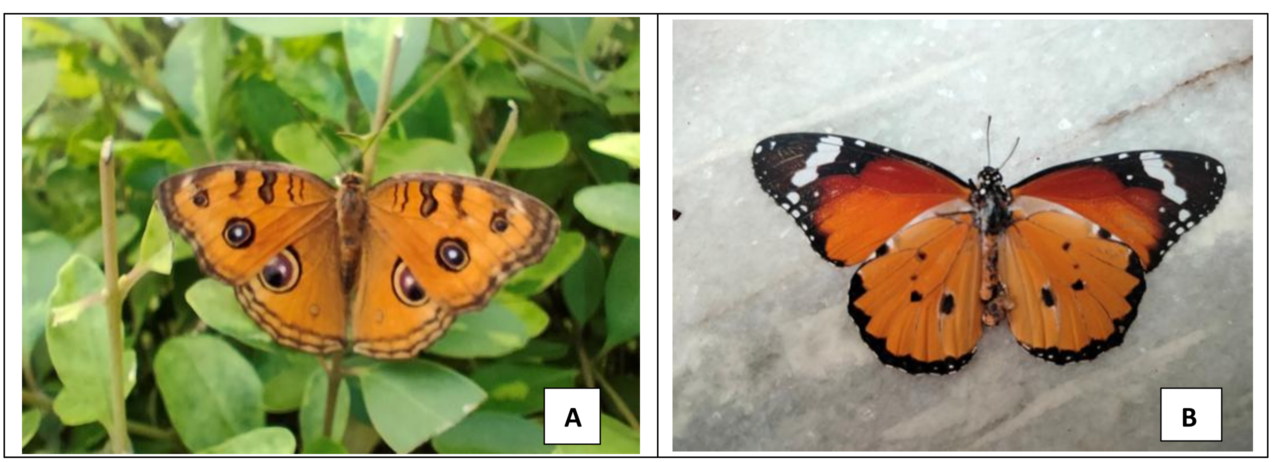


Figure 1: Map of study area: Bhilwara district, Rajasthan



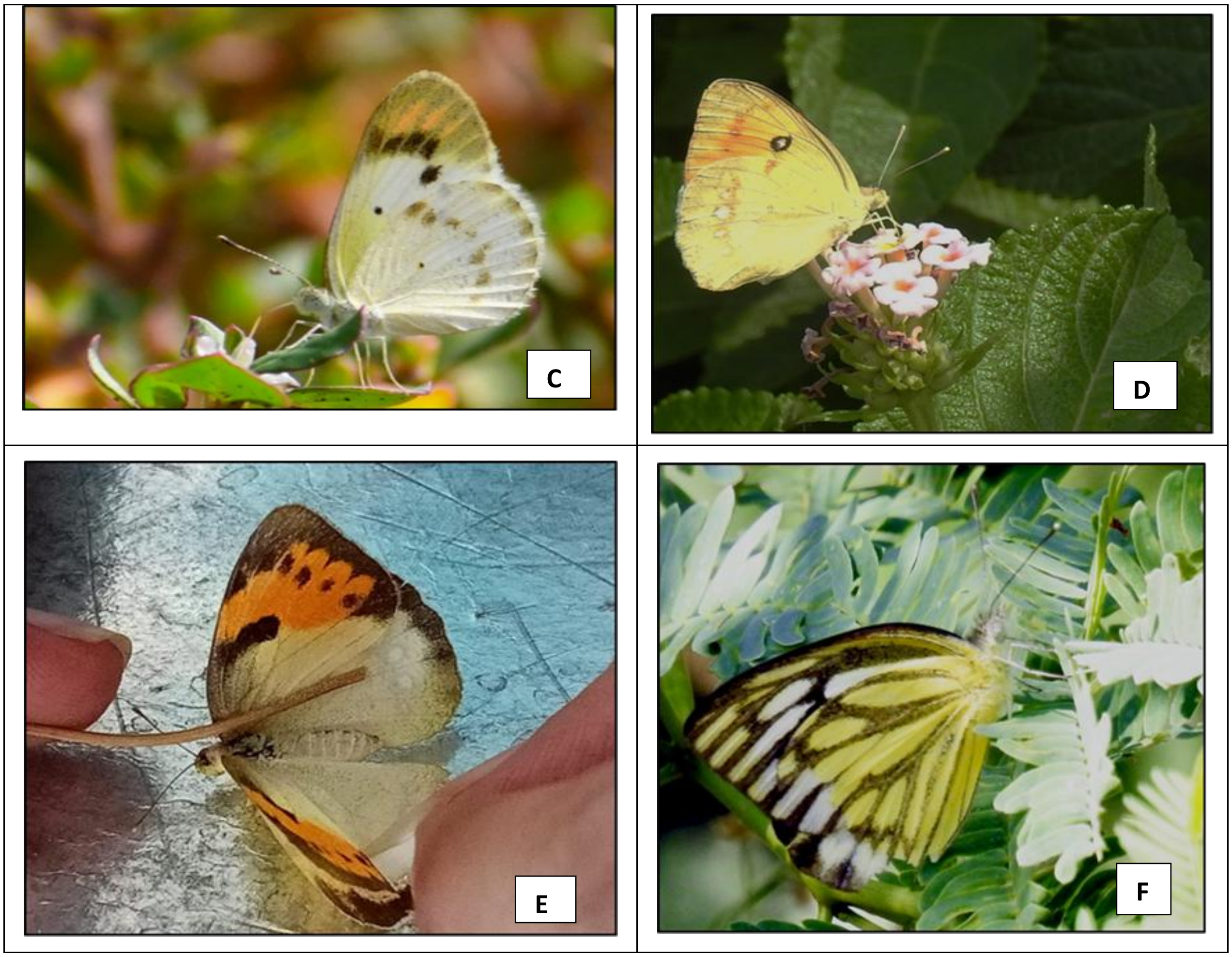


Figure 2: Some photographs of butterflies taken from Bhilwara district. A- Peacock Pansy. B- Plain Tiger. C- Little Orange Tip. D- Yellow Orange Tip. E- White Orange Tip. F- Common Gull.

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