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A COMPARATIVE STUDY OF BUTTERFLY DIVERSITY BETWEEN RURAL AND URBAN AREAS OF RAMNAGAR BLOCK IN PURBA MEDINIPUR DISTRICT OF WEST BENGAL, INDIA

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Abstract. Butterflies exhibit high sensitivity to environmental changes. Consequently, they are widely recognized as effective bioindicator species. Assessing the diversity, richness, and community structure of species in urban and rural habitats is essential for gaining a comprehensive understanding of the environmental heterogeneity and habitat quality that influence butterfly assemblages. These comparative analyses are instrumental in understanding the impacts of anthropogenic disturbances and land-use changes on butterfly populations. The species diversity and richness along with community structure in the urban as well as rural sections of Ramnagar block in the Purba Medinipur district of West Bengal, India, were recorded, analysed, and compared in this paper. A total of 3433 individuals belonging to 64 species and 5 families were recorded during a one-year survey period. Pielou evenness index and Shannon diversity index were calculated. The species diversity and richness were higher (3.93 and 64) in rural areas compared to urban areas (3.44 and 41). The greatest number of species belonged to the Nymphalidae family (24 species), and the smallest to the Papilionidae family (8 species). *Danaus genutia* was the most dominant species, and *Pelopidas conjuncta* and *Badamia exclamatonis* were the least abundant species in rural areas, whereas *Danaus chrysippus* was the most abundant species and *Lethe europa* was the least abundant one in urban areas. Various anthropogenic activities like new constructions of lodges, hotels, buildings, widening of old roads, construction of new roads, deforestation, industrialisation, lack of natural water bodies and pollution may have caused disparities in the diversity and composition of butterfly populations in urban and rural areas.

INTRODUCTION

Butterflies are a prominent group of insects possessing significant aesthetic, cultural, economic, and ecological values (Bubová et al. 2015). Butterflies, among invertebrates, are commonly utilised as bio-indicators because they are very sensitive to environmental changes and are simple to monitor and identify (Chowdhury et al. 2023). Butterflies constitute a significant group of insects classified under the order Lepidoptera within the phylum Arthropoda. They vary greatly in size, shape and colour.

Their distribution and diversity are affected by habitat quality, climatic circumstances, and human activities, rendering them exemplary models for assessing the effects of urbanisation and land-use alterations on biodiversity (Szyszko-Podgórska et al. 2023). Butterflies are nature's jewels, found all over the world and serving many ecological responsibilities (Gogoi et al. 2023). Their diversity is directly correlated with the local vegetation (Huang et al. 2024). Butterflies require a high-quality habitat to complete their lifecycle, necessitating a substantial quantity of host plants for oviposition and developmental phases (Tiple et al. 2011). They acquire nectar from host plants as a dietary source.

Rural areas generally exhibit greater diversity due to the presence of natural vegetation, agriculture lands and less anthropogenic activities (Öckinger et al. 2009; Chiatante et al. 2021). Clark et al. (2007) suggested that urbanisation, pollution, habitat fragmentation and depletion of floral resources affect butterfly population adversely. Ramnagar block in the Purba Medinipur district of West Bengal is characterised by the presence of both urban and rural habitats. Urban regions are defined by expanding infrastructure and human settlements, whilst rural areas are defined by agricultural fields, household vegetation, and large patches of natural vegetation. Till now, very little information about butterfly population within the study region is available. The present study aims to explore the disparities in butterfly community composition, species richness, and abundance between the urban and rural parts of Ramnagar block. The findings are likely to shed light on the consequences of urbanisation for butterfly populations and assist in developing regional biodiversity conservation strategies.

MATERIALS AND METHODS

Study area

Purba Medinipur is a prominent district in the southern part of West Bengal. It harbours popular tourist destinations like Digha and Mandarmoni. Ramnagar block is situated in the Purba Medinipur district of West Bengal. Geographically, it is within the latitude of 21°40′18″ N and longitude of 87°33′01″ E (Wikipedia 2024). It encompasses both rural and urban landscapes. The urban areas are situated in the southern part along the coastline of the Bay of Bengal and contain familiar travelling spots like Mandarmoni, Tajpur, Jaldha, Sankarpur and Digha. Its northern part contains rural areas with natural vegetation, agricultural fields, homestead gardens and lots of natural water bodies. Because of its annual rainfall and varied vegetation, the area supports a great faunal, avifaunal, and floral diversity.

Study period

The study was carried out in various urban and rural parts of Ramnagar block from March 2024 to February 2025.

Study design

The sampling sites were selected on the basis of their accessibility, habitat types and representativeness of the region. A systematic survey was performed utilising transect walks and point count methodologies, which are well-established for evaluating butterfly diversity (Pollard and Yates 1993). A stratified random sampling design was employed to establish a total of 40 transects (300 m each) in urban and rural habitats (20 transects per habitat category). Between 7:00 a.m. and 10:00 a.m., butterfly surveys were conducted along these transects, predominantly in sunny conditions, during the daylight hours, when butterfly activity is typically at its peak. In order to document the species that exhibited crepuscular activity patterns or shelter preference, additional surveys were conducted on occasion during the summer months, particularly in the early morning and after 16:00 p.m. Observations were conducted by walking at a consistent pace and documenting all butterflies within a 5-meter radius. Fixed surveillance sites were set up every 100 meters throughout the transect. Each observation lasted 10 minutes. Live specimens were not collected and sweep nets were not utilised to avoid causing any harm or stress to these delicate insects. To ensure accurate identification, most species were photographed from different angles. The Google Oneplus mobile camera was used for taking photographs. Butterfly species were identified based on colour patterns, sizes, forms, and designs using literature and images (Evans 1932; Wynter-Blyth 1957; Kehimkar 2008; Kunte 2012). The photos of species that were hard to identify in the field were double-checked with the help of experts and Internet tools like the Lepidoptera database and iNaturalist.

Data analysis

MS-Word and MS-Excel software were used for the creation and estimation of various indices (Shannon diversity index, Margalef's index, Pielou's evenness index) and graphs.

Relative abundance was determined as a percentage by comparing the total counts of each species to the overall number of individuals recorded within the study region. The acquired values were categorized as presented in Table 1.

Table 1. Various categories of species based on relative abundance.

Relative abundance (RA)	Categories
> 2.0%	Very common (VC)
≤ 2.0% – > 1.0%	Common (C)
≤ 1.0% – > 0.30	Uncommon (UC)
≤ 0.30	Rare (R)

RESULTS

There were 3433 individuals recorded throughout the assessment period, belonging to five families and sixty-four species (Table 2, Figure 1). 24 species belonged to the family Nymphalidae, 13 to Lycaenidae, 10 to Pieridae, 9 to Hesperiidae, and 8 to Papilionidae. 1606 individuals belonged to the family Nymphalidae, 655 to Pieridae, 601 to Lycaenidae, 362 to Papilionidae, and 209 to Hesperiidae (Table 2). The most and least diverse families were Nymphalidae (H′ = 2.86) and Papilionidae (H′ = 1.92), respectively. The highest Pielou's evenness index value (E = 0.95) was seen in the family Hesperiidae. The calculated Margalef's index value was the highest in the family Nymphalidae (3.12), and the lowest in the Papilionidae family (1.19) (Figure 2). The Shannon diversity index values for the urban and rural areas of Ramnagar were 3.44 and 3.93, respectively. Pielou's evenness index (E) values were almost identical for urban (0.93) and rural (0.94) areas. While the rural areas harboured 64 butterfly species, only 41 species were encountered in urban areas. Total abundance was much lower in urban areas (859) as compared to rural areas (2574). *Danaus genutia* (197) and *Danaus chrysippus* (198) were the two most dominant species within

Table 2. Recorded species, their abundance, visibility period and relative abundance.

Family	Scientific name	Common name	Abundance			Seasonal occurrence	Time of observation	Relative abundance	Local status
			Urban (Mean ± SE)	Rural (Mean ± SE)	Total				
Papilionidae (8)	*Atrophaneura aristolochiae*	Common rose	13 ± 0.32	23 ± 0.71	36	S, M, A	Mr, N	1.0	C
	Chilasa clytia	Common mime	5 ± 0.45	7 ± 0.55	12	M, A	N, An	0.3	R
	Graphium agamemnon	Tailed jay	24 ± 0.45	27 ± 1.41	51	S, M, A	N	1.5	C
	Graphium sarpedon	Common blue bottle	14 ± 0.84	16 ± 1.22	30	S, M, A	Mr, N	0.9	UC
	Papilio demoleus	Lime butterfly	18 ± 1.00	53 ± 0.84	71	S, M, A, W	Mr, N, An	2.1	VC
	Papilio polytes	Common mormon	24 ± 0.71	73 ± 0.45	97	S, M, A, W	Mr, N	2.8	VC
	Papilio polymnestor	Blue mormon	9 ± 0.71	12 ± 0.55	21	M, A, W	Mr, N	0.6	UC
	Graphium doson	Common jay	8 ± 0.71	36 ± 1.14	44	S, M, A, W	N	1.3	C
Hesperiidae (9)	*Matapa aria*	Common red eye	9 ± 0.71	15 ± 0.45	24	S, M, A	Mr, N, An	0.7	UC
	Parnara guttata	Straight swift	0 ± 0.00	13 ± 0.32	13	S, M, A, W	Mr, N, An	0.4	UC
	Borbo cinnara	Rice swift	0 ± 0.00	42 ± 0.71	42	S, M, A, W	Mr, N, An	1.2	C
	Pelopidas conjuncta	Conjoined swift	3 ± 0.55	16 ± 1.22	19	S, M, A, W	Mr, N, An	0.6	UC
	Spialia galba	Indian skipper	0 ± 0.00	21 ± 0.45	21	S, M	Mr, An	0.6	UC
	Ancistroides folus	Grass demon	0 ± 0.00	15 ± 0.45	15	M, A, W	Mr, N, An	0.4	UC
	Iambrix salsala	Chestnut bob	5 ± 0.45	16 ± 1.22	21	S, M, A, W	Mr, N	0.6	UC
	Badamia exclamationis	Brown awl	3 ± 0.55	9 ± 0.71	12	M	N, An	0.3	R
	Suastus gremius	Indian palm bob	0 ± 0.00	42 ± 0.71	42	S, M, A, W	Mr, N	1.2	C
Pieridae (10)	*Pareronia hippia*	Common wanderer	27± 1.41	80 ± 1.22	107	M, A, W	N, An	3.1	VC
	Eurema hecabe	Common grass yellow	0 ± 0.00	118 ± 0.71	118	S, M, A, W	Mr, N, An	3.4	VC
	Catopsilia pomona	Common emigrant	29 ± 0.71	112 ± 1.08	141	S, M, A, W	Mr, N, An	4.1	VC
	Leptosia nina	Wandering psyche	0 ± 0.00	37 ± 1.41	37	S, M, A, W	Mr, N, An	1.1	C
	Eurema brigitta	Small grass yellow	0 ± 0.00	51 ± 1.22	51	M, A	Mr, N	1.5	C
	Delias eucharis	Common jezebel	15 ± 0.45	39 ± 1.79	54	S, M, A, W	Mr, An	1.6	C
	Catopsilia pyranthe	Mottled emigrant	28 ± 0.89	84 ± 2.06	112	S, M, A, W	Mr, An	3.3	VC
	Ixias marianne	White orange tip	0 ± 0.00	7 ± 0.55	7	A	Mr, An	0.2	R
	Ixias pyrene	Yellow orange tip	0 ± 0.00	13 ± 0.32	13	S, M, A	Mr, An	0.4	UC
	Pieris canidia	Indian cabbage white	0 ± 0.00	15 ± 0.45	15	S, M, A, W	Mr, An	0.4	UC
Nymphalidae (24)	*Junonia almana*	Peacock pansy	48 ± 0.89	72 ± 1.92	120	S, M, A, W	N, An	3.5	VC
	Junonia atlites	Grey pansy	49 ± 0.45	99 ± 2.12	148	S, M, A, W	N, An	4.3	VC
	Junonia hierta	Yellow pansy	20 ± 0.89	25 ± 1.84	45	S, M, A, W	M, An	1.3	C
	Junonia lemonias	Lemon pansy	27± 0.55	63 ± 1.14	90	S, M, A, W	N, An	2.6	VC
	Junonia iphita	Chocolate pansy	21 ± 0.45	36 ± 0.84	57	S, M, A, W	N	1.7	C
	Phalanta phalantha	Common leopard	20 ± 0.89	29 ± 0.71	49	M, A, W	N	1.4	C
	Melanitis leda	Common evening brown	32 ± 0.89	72 ± 1.92	104	S, M, A, W	Mr, An	3.0	VC
	Euploea core	Common crow	43 ± 0.71	79 ± 1.92	122	S, M, A, W	Mr, N, An	3.6	VC
	Danaus genutia	Striped tiger	83 ± 0.71	114 ± 1.22	197	S, M, A, W	Mr, N, An	5.7	VC
	Acraea terpsicore	Tawny coster	17 ± 0.63	60 ± 1.92	77	S, M, A, W	Mr, An	2.2	VC
	Danaus chrysippus	Plain tiger	69 ± 0.32	129 ± 1.41	198	S, M, A, W	Mr, N, An	5.8	VC
	Ariadne merione	Common castor	0 ± 0.00	19 ± 0.45	19	S, M, A	Mr, An	0.6	UC
	Elymnias hypermnestra	Common palmfly	0 ± 0.00	29 ± 0.71	29	S, W	N, An	0.8	UC
	Tirumala limniace	Blue tiger	0 ± 0.00	24 ± 1.41	24	S, M, A	Mr, An	0.7	UC
	Moduza procris	Commander	8 ± 0.71	13 ± 0.32	21	M, A	Mr, N	0.6	UC
	Junonia orithya	Blue pansy	12 ± 0.55	20 ± 0.89	32	S, M, A	Mr, N, An	0.9	UC
	Euthalia aconthea	Common baron	0 ± 0.00	22 ± 1.41	22	S, M, A	An	0.6	UC
	Neptis hylas	Common sailor	0 ± 0.00	10 ± 0.71	10	S, M, A, W	Mr, N	0.3	R
	Neptis jumbah	Chestnut-streaked sailor	0 ± 0.00	11 ± 1.00	11	S, M, A, W	Mr, N, An	0.3	R
	Ypthima baldus	Common five-ring	13 ± 0.32	32 ± 1.22	45	S, A	N	1.3	C
	Mycalesis perseus	Common bush brown	12 ± 0.55	40 ± 1.67	52	S, M, A, W	An	1.5	C
	Lethe europa	Bamboo tree brown	0 ± 0.00	4 ± 0.71	4	S	Mr	0.1	R
	Danaus melanippus	Black veined tiger	32 ± 0.89	48 ± 2.33	80	S, M, A, W	Mr, N, An	2.3	VC
	Euploea klugii	King crow	19 ± 0.45	31 ± 1.08	50	S, M, A, W	Mr, N, An	1.5	C
Lycaenidae (13)	*Tarucus callinara*	Spotted pierrot	8 ± 0.71	61 ± 1.67	69	S, M, A	N, An	2.0	VC
	Chilades lajus	Lime blue	23 ± 0.71	87 ± 0.71	110	S, M, A, W	Mr, N, An	3.2	VC
	Leptotes plinius	Zebra blue	0 ± 0.00	12 ± 0.55	12	S, M	Mr, An	0.3	R
	Euchrysops cnejus	Gram blue	14 ± 0.84	48 ± 1.41	62	S, M, A, W	Mr, N, An	1.8	C
	Castalius rosimon	Common pierrot	17 ± 0.63	47 ± 1.67	64	S, M, A, W	Mr, N	1.9	C
	Rapala manea	Slate flash	7 ± 0.55	15 ± 0.45	22	S, M, A, W	Mr	0.6	UC
	Acytolepis puspa	Common hedge blue	0 ± 0.00	22 ± 1.41	22	S, M, A, W	N, An	0.6	UC
	Neopithecops zalmora	Quaker	7 ± 0.55	14 ± 0.84	21	M, A, W	N, An	0.6	UC
	Spindasis vulcanus	Common silverline	9 ± 0.71	20 ± 0.89	29	M, A, W	Mr, N	0.8	UC
	Zizeeria karsandra	Dark grass blue	0 ± 0.00	46 ± 1.14	46	S, M, A, W	Mr, N, An	1.3	C
	Zizina otis	Lesser grass blue	0 ± 0.00	15 ± 0.45	15	M, A	Mr, N	0.4	UC
	Pseudozizeeria maha	Pale grass blue	0 ± 0.00	56 ± 1.14	56	S, A, W	Mr, N, An	1.6	C
	Tarucus nara	Striped pierrot	15 ± 0.45	58 ± 2.19	73	S, A, W	N, An	2.1	VC
			859	2574	3433				

S – summer, A – autumn, M – monsoon, W – winter, Mr – morning, An – afternoon, N – noon. VC – very common, C – common, UC – uncommon.

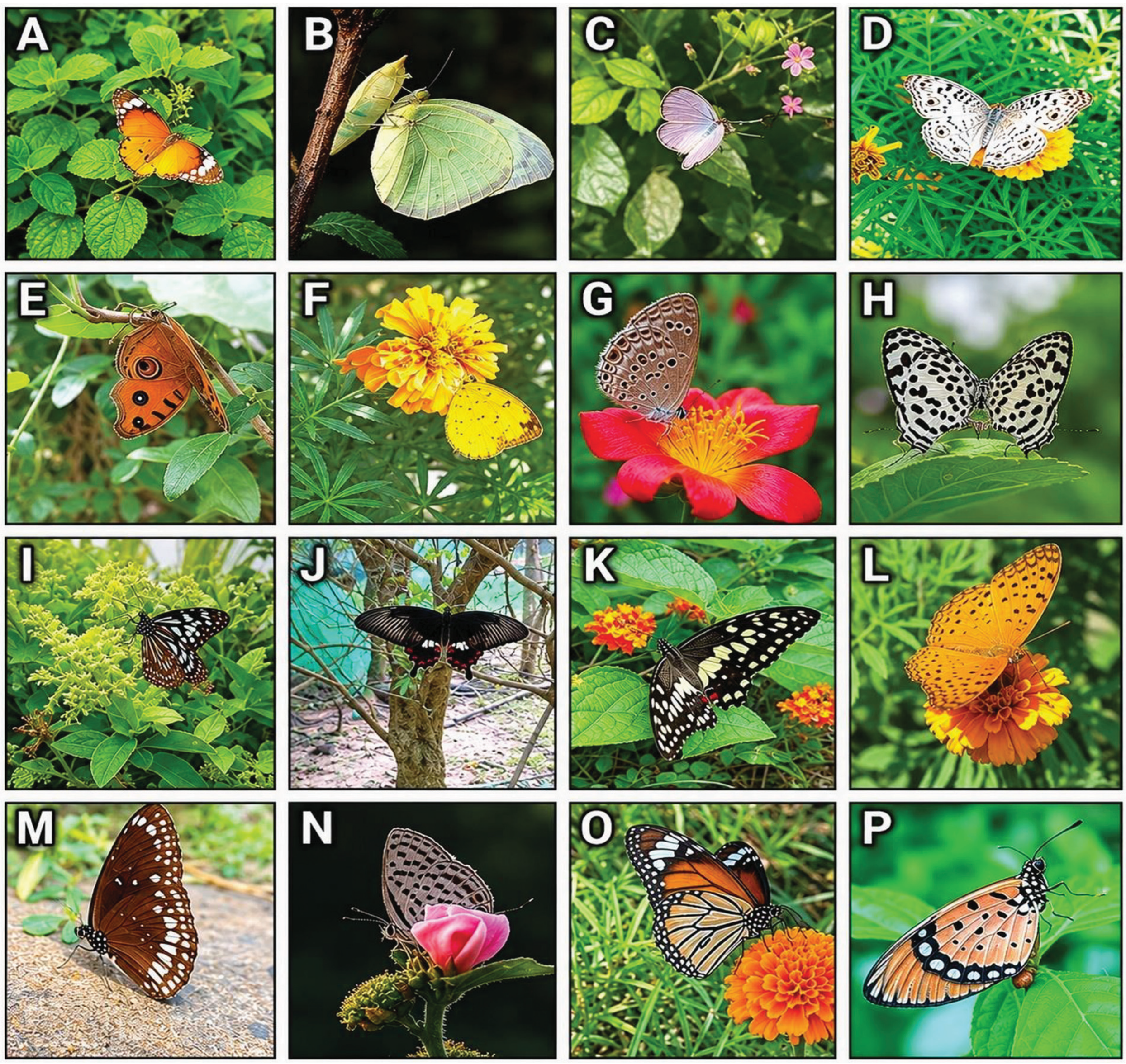

Figure 1. Some butterfly species observed during field survey: A. *Danaus chrysippus*, B. *Catopsilia pomona*, C. *Pseudozizeeria maha*, D. *Junonia atlites*, E. *Junonia almana*, F. *Eurema hecabe*, G. *Chilades lajus*, H. *Castalius rosimon*, I. *Tirumala limniace*, J. *Papilio polytes*, K. *Papilio demoleus*, L. *Phalanta phalantha*, M. *Euploea core*, N. *Tarucus nara*, O. *Danaus genutia*, P. *Acraea terpsicore*.

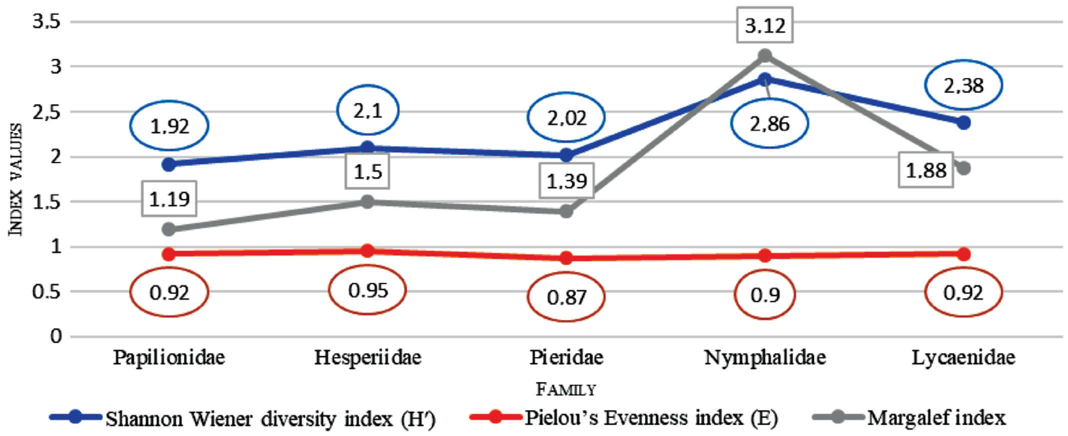

Figure 2. Disparities in diversity index values for various families.

the Ramnagar block (Table 2). A total of 18 species were recorded as very common, 18 as common, 21 as uncommon and 7 as rare in distribution in the study area (Table 2). The species like *Papilio demoleus*, *Papilio polytes*, *Pareronia hippia*, *Eurema hecabe*, *Catopsilia pomona*, *Junonia almana*, *Junonia atlites*, *Junonia lemonias*, *Acraea terpsicore*, and *Danaus melanippus* were very common (VC), whereas *Chilasa clytia*, *Badamia exclamationis*, *Ixias marianne*, *Neptis hylas*, *Neptis jumbah*, *Lethe europa*, and *Leptotes plinius* were rare (R) species of this region (Table 2).

Most of the recorded individuals (59.25%) belonged to the VC category, while the R category contained only 0.02% of the total of individuals. The maximum number of species of butterflies were visible during monsoon and post-monsoon, and the smallest number during winter season. The majority of the species were observed during morning (Mr) and afternoon (An) period (Table 2).

DISCUSSION

Butterflies are important bioindicators of environmental conditions due to their ecological sensitivity, which justifies the necessity to evaluate their diversity across temporal and spatial dimensions (Stefanescu et al. 2004). These observations indicate how species abundance and richness fluctuate with adjacent landscapes and vegetation (Öckinger et al. 2006; Mutmainnah and Santosa 2019). Accordingly, from March 2024 to February 2025, the diversity of butterflies in the rural and urban areas of Ramnagar block in the Purba Medinipur district of West Bengal was investigated. 64 species from 5 families were documented, notably the Nymphalidae family showing the greatest diversity and richness. This discovery corresponds with other researches that recognise Nymphalidae as one of the most species-diverse and ecologically influential butterfly families across multiple environments (Kunte 2000; Bonebrake et al. 2010). Local biotic interactions such as competition and predation often received limited attention in earlier butterfly studies; however, landscape-level attributes are widely recognised as key determinants of butterfly richness and abundance across geographic regions (Öckinger et al. 2006). Mukherjee et al. (2015), Chowdhury and Soren (2011), and Payra et al. (2017) found that butterfly assemblages are strongly impacted by habitat heterogeneity, vegetation complexity, and land-use patterns in the coastal and agricultural landscapes of Purba Medinipur and surrounding districts in southern West Bengal. The observed variation in butterfly diversity across spatial scales is therefore largely attributable to landscape heterogeneity (Kumar et al. 2008). In the current study, significant differences in butterfly species diversity and species richness in urban and rural areas (3.44 and 41 vs 3.93 and 64) were observed. The coastal areas of southern West Bengal have also showed similar patterns. Diverse host plants, nectar resources, and reduced anthropogenic disturbance in rural and semi-natural habitats in southern West Bengal have been observed to sustain a greater diversity of butterflies (Tiple et al. 2006; Mukherjee et al. 2015). These ecosystems provide a range of microhabitats, such as wetlands, field margins, fallow lands, and homestead vegetation, which enhance the availability of niches and species coexistence (Kehimkar 2008; Thomas 2016). The diminished diversity in urban settings is due to decreased vegetation cover, habitat fragmentation, and a restricted availability of larval host plants. Increasing urban areas and less complex vegetation patterns define the urban landscapes of southern West Bengal, which in turn limit the mobility and use of resources by butterflies (De Barros Ruas et al. 2022). Kuussaari et al. (2007) and Hogsden and Hutchinson (2004) found that as urbanisation progresses, the richness of butterfly species decreases, while species diversity increases in areas with more green space and more diverse plants. The markedly lower abundance recorded in urban areas (859 individuals) compared to rural areas (2574 individuals) further highlights the negative impacts of urbanisation, including habitat fragmentation, pollution, and reduced host plant availability (Blair and Launer 1997). Research in the coastal and peri-urban regions of West Bengal has shown that human activities have a significant impact on the butterfly community structure (Chowdhury and Soren 2011).

Consistent with research from eastern and southern India (Khyade et al. 2018; Mutmainnah and Santosa 2019), the Nymphalidae family dominated the list of recorded families in terms of diversity (H′ = 2.86) and abundance (1606 individuals). Hamm and Fordyce (2014) opined that the ecological success of this family can be attributed to the generalist grazing behaviour of many of its members, which enables them to exploit a diverse array of host plants and habitats. Bernays and Minkenberg (1997) also suggested that resources are more readily available to generalist herbivores. The strong and flexible wings of several species in this family allow them to cover great distances in their search for food (Eswaran and Pramod 2005; Padhye et al. 2006). A high Margalef's index (3.12) further supports their ecological dominance. Papilionidae, on the other hand, showed moderate abundance (362 individuals) but relatively low diversity (H′ = 1.92), suggesting more specialised habitat requirements and smaller ecological niches. This finding is consistent with what has been found in regional studies involving papilionids and their associations with particular host plants in less disturbed environments (Kehimkar 2008). A high Pielou's evenness index observed in Hesperiidae suggests a relatively uniform distribution of species within the family, possibly reflecting stable resource utilisation. According to the survey 28% species were very common (VC), 28% common (C), 33% uncommon (UC) and 11% belonged to rare (R) category locally. *Danaus genutia* and *Danaus chrysippus*, which were identified for their dominance, are widely distributed and adaptable, indicating their resistance to environmental changes. Rare species like *Neptis hylas, Chilasa clytia*, *Neptis jumbah*, *Lethe europa*, *Ixias marianne* and *Badamia exclamationis* highlights the sensitivity of specific taxa to alterations in habitat, which is also suggested by Clark et al. (2007), Tzortzakaki et al. (2018), and Habel et al. (2024). Mukherjee et al. (2015) studied the diversity of butterflies in Kolkata, West Bengal, India, and they agree that conservation efforts for uncommon species should be given priority. The fact that 59.25% of individuals were classified as very common and only 0.02% as rare suggests that resources and environmental conditions are not uniformly distributed. The findings are in line with those of Bonebrake et al. (2010), who postulated that generalist species, such as *Papilio demoleus* and *Junonia lemonias*, thrive in these types of habitats due to their high ecological tolerance, while specialist species tend to decline.

A distinct seasonal trend in species composition was observed in the present study, with the greatest species richness of butterflies appearing during the monsoon and post-monsoon seasons and the lowest species richness during winter. This finding is in line with observation of Mukherjee et al. (2015), who studied butterfly diversity in Kolkata, West Bengal, India. The increased availability of resources and improved compatibility of habitats are thought to contribute to a higher species richness during the monsoon. Increasing precipitation leads to a greater variety of flowering plants and plants that host butterflies, which in turn increases the number of butterfly species. This finding is consistent with Kunte's (2012) study, which found that butterfly species richness closely tracks vegetation dynamics, with peak richness occurring during periods of highest plant growth. According to Patra et al. (2025), species richness rises during the rainy season due to the increased availability of larval host plants, allowing more species to complete their life cycles. A high species richness is also maintained in the post-monsoon period due to the favourable environmental conditions, which include the continuous availability of floral and host plant resources and adequate moisture. In contrast, the lowest species richness recorded during winter can be attributed to reduced temperature, limited plant growth, and scarcity of resources. These conditions restrict the presence of many species, either by reducing their activity or by forcing seasonal dormancy or migration. Bonebrake et al. (2010) also noted a decline in butterfly species richness during colder periods due to unfavourable climatic conditions and reduced habitat suitability. Consistent with research from similar agroclimatic regions in eastern India, butterfly activity patterns revealed that morning and afternoon were the busiest times of the day. For flight and foraging activities, butterflies as heliothermic organisms, depend on solar radiation and optimal temperature (Altermatt 2012; Barton et al. 2014; Ashe-Jepson et al. 2023). The study by Koh (2007), which discovered that butterflies are more active during the day when the sun rises, corroborated the reported finding. As the sun rises, the number of species of butterflies increases, reaching its highest point in the afternoon, and then reducing rapidly as the sun sets. The abundance of butterflies varies substantially depending on the time of the day. The fact that these species are observed in the early afternoon hours may be due to their function as plant pollinators in the ecosystem, which necessitates sunlight to sustain their energy levels and facilitate their daily activities.

CONCLUSION

The existence of butterflies in a particular location is significant due to their function as pollinators and biological indicators. The results highlighted the disparities in butterfly species diversity (3.44 and 3.93), richness (41 and 64) and abundance (859 and 2574) between urban and rural areas of Ramnagar block. In the present study, 64 species of butterflies were recorded and Nymphalidae emerged as the highest species rich and abundant family, whereas Hesperiidae was the least abundant family. Although 18% species were very common to this region, but 11% rare species were also there. The result indicates that butterfly populations are significantly dependent on diverse habitats, intricate vegetation, and minimal human disturbance. Habitat restoration, maintaining host plant diversity, and mitigating urban pressures are key conservation measures to be taken for the butterfly species of the study area.

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