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Abundance and species diversity of butterflies during rainy season in north 24Pgs and north Kolkata, WB, India

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Abstract: *Butterflies are important bio-indicators of ecosystem health, and their activity often increases during the rainy season due to abundant vegetation, flowering plants and higher precipitation bringing down the pollution level. The present work aims to survey the variety of butterfly species, its abundance found during the rainy season in North 24 Parganas and North Kolkata, to understand the habitat preferences and to identify host plants and nectar sources associated with butterflies in the local environment. In the selected study area the abiotic components and its relationship was assessed to check the proper well being of the butterfly species thriving there in, its presence and its diversity. The study also showed that the area advocates a variety of butterfly species, considering its biological diversity and obtainability of suitable habitats and host plants.*

Key words: *Butterflies, species diversity, abundance, host plants, abiotic components.*

1. INTRODUCTION:

Often referred to as the "flying jewels of nature," the Butterflies belong to the order Lepidoptera, which also includes moths which correctly signifies ‘Scaly wings” in Greek. One of the most admired insects for its alluring bright colors, delicate wings, and graceful flight. However, a much deeper ecological significance lies beyond their beauty. Extremely sensitive to environmental changes, they play a crucial role in pollination, serve as outstanding bio- indicators of ecosystem health, and are important members of terrestrial food chains, feeding both predators and parasitoids. (5,6,7). These insects exhibit complete metamorphosis and the adult flying stage are the butterflies.. Each of these stages has unique ecological requirements, making butterflies highly sensitive to environmental changes such as climate, pollution, urbanization, and habitat destruction. This sensitivity makes butterflies ideal bioindicators — their presence or absence can reflect the quality of an ecosystem (1,5,9). India is home to approximately 1100 species of butterflies, making it a butterfly-rich country in the world (7,8, 11,12). West Bengal alone hosts over 400 recorded species, thanks to its varied landscapes that include forests, wetlands, gardens, and urban parks (2,3,4). North Kolkata, though urbanized, still retains several green areas such as local parks, roadside trees, waterbodies, and open grounds that serve as microhabitats for a variety of butterfly species(10). The rainy season (monsoon), typically spanning from June to September, brings a surge in plant growth due to increased humidity and rainfall. This leads to the blooming of many nectar plants and the sprouting of new leaves on host plants, providing optimal conditions for butterfly activity(5,6). During this time, butterflies are not only more abundant but also more diverse in terms of species observed.

2. MATERIALS AND METHODS:

A butterfly survey involves observing, identifying, and recording butterfly species in a given area. To do this accurately, certain materials and tools are essential for fieldwork, identification, and data collection (5,8). The current study deals with the diversity and abundance in mainly North 24 Parganas and some parts of North Kolkata,WB, India, which include a mix of urban gardens, water bodies, parks, residential greenery, and semi-natural habitats. These places offer suitable environments for butterflies during the monsoon season due to the abundance of host plants, nectar sources, and moist conditions (2,4,10). These locations were selected due to their floral diversity, tree cover, and accessibility for regular observations (4,10). Survey Locations were Belgharia, Agarpara, Sodepur, Titagarh, Barrackpore, Eco Park,Newtown, Sithir More, North Kolkata (Shyambazar,Sobhabazar and Baghbazar), WB, India.

The study was carried out during the rainy season for 8 weeks, specifically between: 10th June to 4th August 2025. This period coincides with the monsoon season in West Bengal, which supports lush vegetation, ideal for butterfly breeding and foraging(1,5,6). Rainy conditions lead to more host plants for caterpillars(5,6), plenty of flowering plants for nectar (5,7) and high butterfly activity and visibility(1,2,10). Essential Materials used for Butterfly Survey are: Field Notebook or Data Sheets for recording, for Weather conditions: used digital apps or tablets for faster data logging (6,7). Used Camera / Smartphone: for photographing butterflies for identification or documentation Macro lens helpful for close-up shots and useful when species are difficult to identify on the spot (6,7). Binoculars (Close-focus) were used for observing butterflies from a distance without disturbing them and essential in areas where butterflies perch high or are skittish (8). The study took the assistance of GPS Device / Smartphone with GPS App, Weather Monitoring Tools, Thermometer, hygrometer for Weather impacts on activity of butterflies(5,7,8), Mobile Apps / Digital Tools: iNaturalist, Butterflies of India when online data was available. Butterfly surveys are conducted using systematic methods to assess butterfly diversity, abundance, and distribution in a particular area. The study was conducted following 10 transect methods (2,5, 36) as is simple, repeatable, and allows for statistical analysis. Opportunistic and random sampling were also conducted wherever possible. The study was conducted between 8:00 AM and 11AM, when butterfly activity is highest and is accessible.

3. RESULTS:

3. a. **Total Species Observed (Table -1)**

The total species observed is 36. Total Individuals Counted (X) = 232 butterflies observed across all 8 localities.

3. b. **Most Abundant Species (Highest Total Count)**: Common Four Ring – 32 individuals Common Five Ring –31 individuals, Pale Grass Blue –23 individuals and Common Grass Yellow – 22 individuals. These species are dominant in our study area.

3. c. **Species with Highest Frequency (Present in Most Locations):** Common Four Ring – Found in 5 localities (62.5%), Common Five Ring – Found in 6 localities (75%), Pale Grass Blue – Found in 4 localities (50%), Grey Pansy – Found in 5 localities (62.5%). These species are widely distributed.

3.d. Species with Highest Dominance: Common Four Ring and Common Five Ring. These two species contribute 27.15% of the total dominance.

3. e. Species Least Observed (Rare or Localized): Species with only 1 individual and low frequency: Common Gull, Three Spot Grass Yellow, Striped Pierrot,
Summer Azure, Tawny Coster, Commander, Common Rose, Common Mime, Lime Blue, Dark Grass Blue.

3.f. Species with Zero SD and SE (No variation): These species were recorded only once or in one place or all the values in every location are same, hence: Commander, Common Crow, Common Jezebel, Common Mime, Dark Blue Tiger, Mottled Emigrant, Common Gull, Three Spot Grass Yellow, Striped Pierrot, Gram Blue, Tawny Coster, Common Rose, Summer Azure, Lime Blue, Dark Grass Blue, Cabbage white, Lime blue, Dark Branded Bushbrown.

3. g. Species with High SD and SE (High variation): Common Five Ring SD: 7.39, SE: 2.62; Common Four Ring: SD: 8.29, SE: 2.93; Pale Grass Blue SD: 4.48, SE: 1.58; Common Grass Yellow SD: 4.96, SE: 1.75.

3.h. Moderate SD and SE (Moderate spread): Grey Pansy – SD: 2.75, SE: 0.97 , Plains Cupid – SD: 1.87, SE: 0.66, Common Palmfly– SD: 1.85, SE: 0.65, Psyche – SD: 0.53, SE: 0.18, Peacock Pansy – SD: 1.11, SE: 0.39.

3. i. t-Test Significance: At df=35 and level of significance=0.05 [df=n-1 here n=36 (36 species)]. Critical t value= 2.030. Calculated t value =4.66; 4.66>2.030 that means Calculated t value> Critical t value. Null Hypothesis is rejected. t test value is marked as Significant.

Results: On Abiotic factors:

3. j. Solar Radiation Intensity (W/m^2): The mean solar radiation intensity across all sampling days is 354.543 W/m². This value falls within the moderate to high sunlight intensity range, ideal for butterfly activity. Solar radiation values showed daily variability, with peaks on clear days and dips during rain or overcast skies.

3. k. Temperature (°C): The temperature values mostly range between 28°C to 33°C, with a calculated mean of 31.04°C. Minimum observed value: 24.83°C Maximum observed value: 32.5°C. Mean: 31.04°C, which falls within the ideal temperature range for butterfly activity.

3.l. Rainfall (mm): The rainfall values in my table vary, with several days showing no rainfall (0 mm) and a few days showing values as high as 9 mm and 7 mm. The mean rainfall recorded is 1.23 mm. Minimum rainfall: 0 mm (many days) Maximum rainfall: 9.25 mm. Mean rainfall: 1.23 mm (Light rainfall category).

3. m. Humidity (%): The data shows that humidity ranged between 75% to 95% on most days. The mean relative

humidity value listed is 80.74%. Minimum humidity: 67.5%. Maximum humidity: 94.16%. Mean humidity: 80.74%. This range falls under high humidity, which is expected during the rainy season in tropical regions like North Kolkata and North 24 Parganas.

3. n. Atmospheric Pressure (hPa): The atmospheric pressure values mostly range from 990.0 hPa to 1000.0+ hPa. The mean atmospheric pressure is 969.650 hPa. This is within the normal pressure range for lowland tropical areas

3. o. Wind Speed (mph): Wind speed values from the data mostly range between 4mph and 9 mph. The mean wind speed is approximately 6.44 mph. This indicates light to moderate breeze conditions throughout the survey period.

Figure 1. Most abundant butterfly species/ Species with highest frequency/ Species with High SD and SE (High variation)
(alongwith the observed locations) with their host plants from the study area

A. i. Common Four Ring ii. Location of spotting iii. Host plant: Three leaved wild vine
(Species with highest dominance as well)

B.i. Common Five Ring ii. Location of spotting iii. Host plant: Egyptian Starflower
(Species with highest dominance as well)

C. i. Common Grass Yellow ii. Location of spotting iii. Host plant: Water Hyssop

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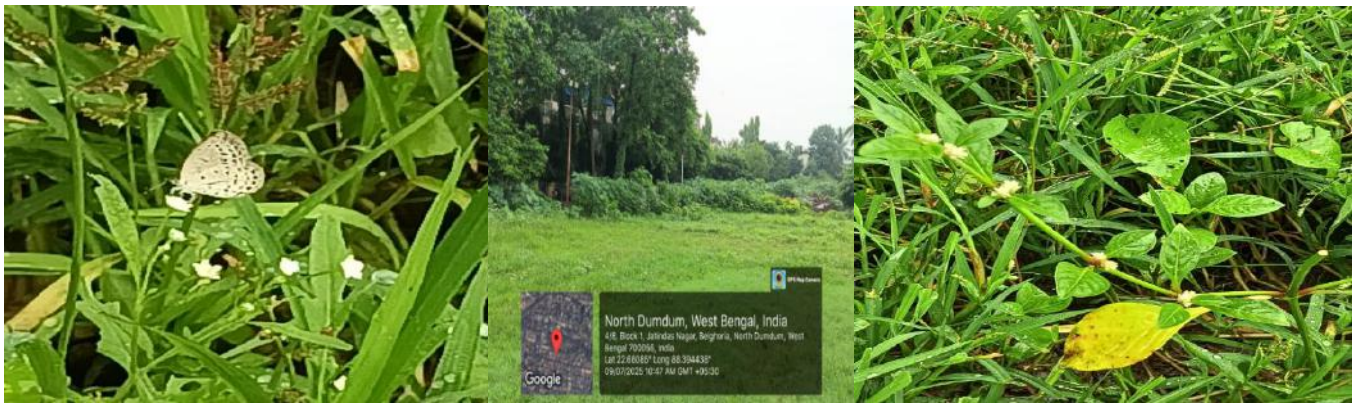

D.i. Pale Grass Blue ii. . Location of spotting iii. Host Plant: Sessile Joyweed

Figure 2. Butterfly species moderately spead (alongwith the observed locations) with their host plants from the study area

A. i. Grey Pansy ii. Location of spotting iii. Host plant: Mexican Fireplant

B. i. Psyche ii.. Location of spotting iii. Host plant: Sweet Basil

Table 1. Abundance of Butterflies in various localities of our study area

		Abundance of Butterflies in various localities of our study area															
		Localities of our study area															
	Butterfly species	A	B	C	D	E	F	G	H	n no. of localities	Total No.of species	Average	Frequency %	Dominance Index	SD ±	SE ±	t-value
1	Common Crow	1	0	0	0	0	0	0	1	2	2	1	25	27.15	0	0	4.66

2	**Commander**	1	0	0	0	0	0	0	0	1	1	1	12.5		0	0	(Significant)
3	**Common Jezebel**	4	0	0	0	0	0	0	0	1	4	1	12.5		0	0	
4	**Blue Tiger**	3	1	0	0	0	0	0	0	2	4	2	25		0.52	0.18	
5	**Common Castor**	4	0	0	0	0	0	2	0	2	6	3	25		0.52	0.18	
6	**Common Palmfly**	7	1	0	0	1	0	0	0	3	9	3	37.5		1.85	0.65	
7	**Green Pansy**	10	2	0	1	3	0	0	2	5	18	3.6	62.5		2.75	0.97	
8	**Lemon Pansy**	5	0	0	0	0	0	0	0	1	5	5	12.5		0	0	
9	**Plain Tiger**	4	0	1	0	0	0	0	0	2	5	2.5	25		0.80	0.28	
10	**Lime Butterfly**	2	0	0	0	1	0	0	0	2	3	1.5	2.5		0.26	0.09	
11	**Striped Albatross**	1	1	0	0	0	0	2	0	3	4	1.33	37.5		0.30	0.10	
12	**Common Grass Yellow**	18	1	0	0	3	0	0	0	3	22	7.33	37.5		4.96	1.75	
13	**Common Mime**	1	0	0	0	0	0	0	0	1	1	1	12.5		0	0	
14	**Dark Blue Tiger**	2	0	0	0	0	0	0	0	1	2	2	12.5		0	0	
15	**Mottled Emigrant**	0	0	0	0	0	2	0	0	1	2	2	12.5		0	0	
16	**Peacock Pansy**	5	0	0	1	2	0	0	0	3	8	2.66	37.5		1.11	0.39	
17	**Common Gull**	0	0	0	0	0	0	0	1	1	1	1	12.5		0	0	
18	**Three spot Glass Yellow**	1	0	0	0	0	0	0	0	1	1	1	12.5		0	0	
19	**Stripped Pierrot**	1	0	0	0	0	0	0	0	1	1	1	12.5		0	0	
20	**Common Five Ring**	23	1	1	0	2	0	2	2	6	31	5.16	75		7.39	2.62	
21	**Common Four Ring**	26	2	1	2	0	1	0	0	5	32	6.4	62.5		8.29	2.93	
22	**Dark Branded Bushbrown**	1	0	0	0	0	0	0	0	1	1	1	12.5		0	0	
23	**Plains Cupid**	10	0	0	0	0	3	0	0	2	13	6.5	25		1.87	0.66	
24	**Gram Blue**	4	0	0	0	0	0	0	0	1	4	4	12.5		0	0	
25	**Pea Blue**	2	1	0	0	0	0	0	0	2	3	1.5	25		0.26	0.09	
26	**Common Rose**	0	1	0	0	0	0	0	0	1	1	1	12.5		0	0	
27	**Pale Grass Blue**	16	0	3	0	0	0	2	2	4	23	5.75	50		4.48	1.58	
28	**Common Hedge Blue**	2	0	1	0	0	0	0	0	2	3	1.5	25		0.26	0.09	
29	**Summer Azure**	0	0	0	0	0	1	0	0	1	1	1	12.5		0	0	
30	**Tawny Coster**	1	0	0	0	0	0	0	0	1	1	1	12.5		0	0	
31	**Common Bush brown**	2	0	1	0	0	0	0	0	2	3	1.5	25		0.26	0.09	
32	**Common Pierrot**	1	2	1	0	0	1	0	0	4	5	1.25	50		0.32	0.11	
33	**Psyche**	3	0	0	1	0	0	0	0	2	4	2	25		0.53	0.18	

34	**Cabbage White**	2	0	0	0	0	0	0	0	1	2	2	12.5		0	0
35	**Dark Glass Blue**	3	0	0	0	0	0	0	0	1	3	3	12.5		0	0
36	**Lime Blue**	3	0	0	0	0	0	0	0	1	3	3	12.5		0	0
Total		169	13	9	5	12	8	8	8	73	232					

Calculated t value	**Critical t Value**	**Degrees of freedom(df) [n-1][n=36]**	**Significance Level(α)**	**Comparison Result**	**Conclusion**
4.66	2.030	35	0.05	4.66>2.030	Null Hypothesis is Rejected (Significant)

Localities: A. Belgharia; B.: Agarpara; C.: Sodepur; D.:Titagarh;

E.: Barrackpore F.:Ecopark; G: Sinthi more; H.: North Kolkata

Solar Radiation Intensity(W/m^2)	Temperature(Degree Celsius)	Rainfall(mm)	Humidity(%)	ATM Pressure(hPa)	Wind Speed(mph)
354.543	31.04	1.23	80.74	969.650	6.44

Table: 2 Assessment of Abiotic factors during the study period in the study area (Mean Values)

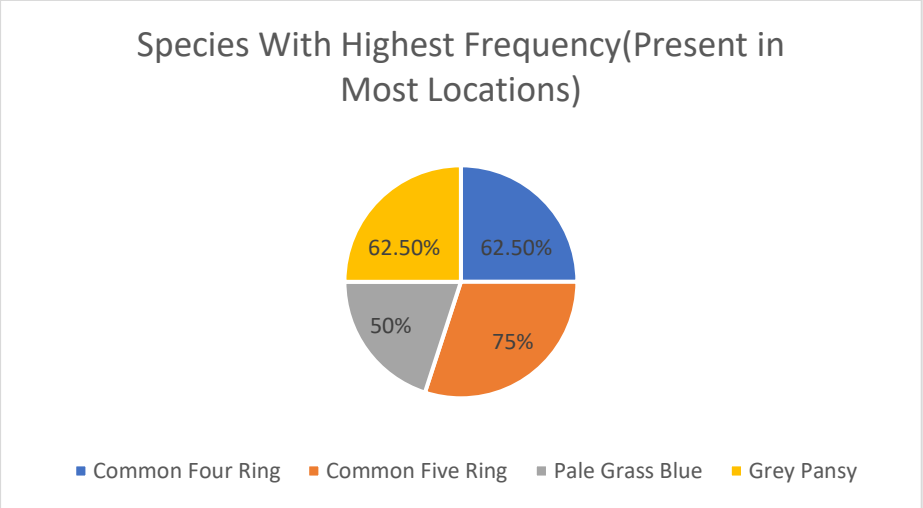

CHART 1.: Butterfly Species with highest frequency in the study areas

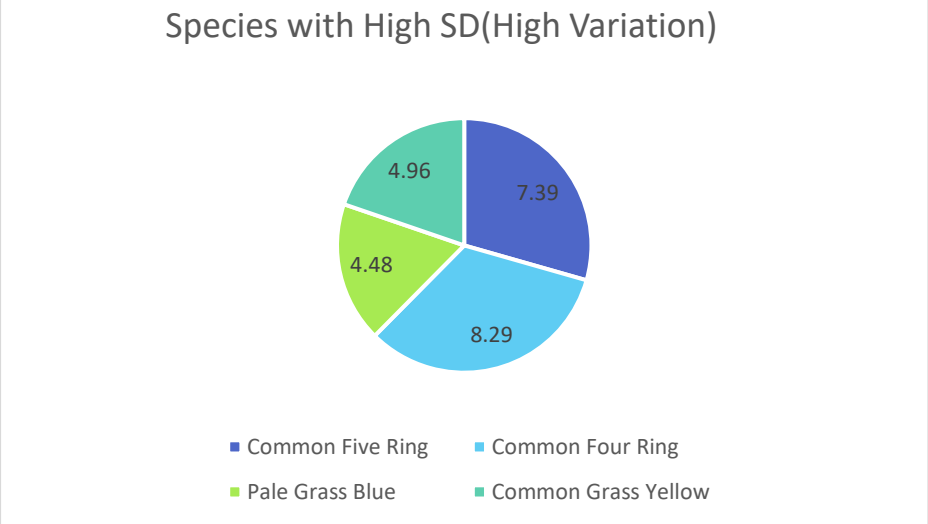

Chart2: Butterfly Species with High SD(High Variations present in most locations)

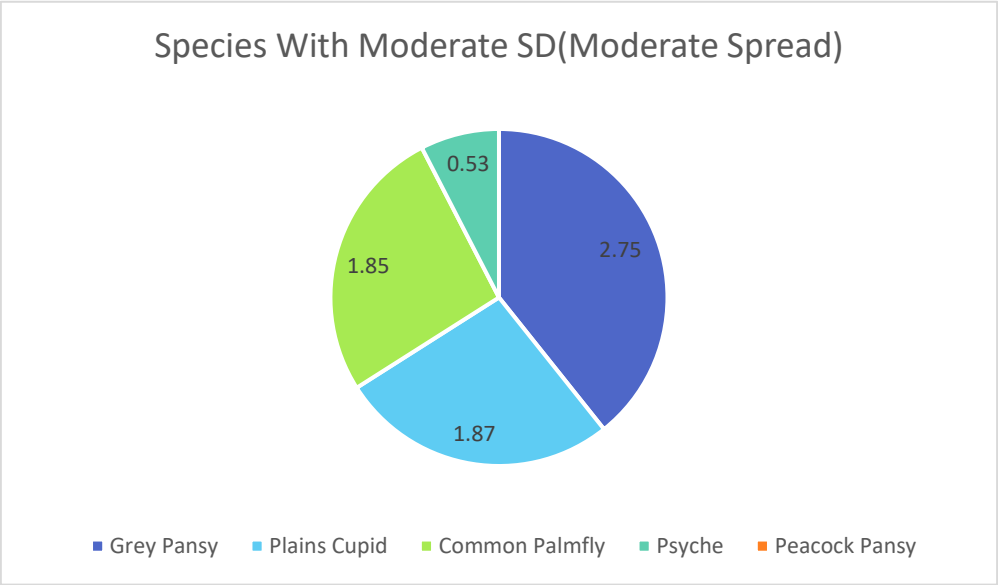

Chart 3.: Butterfly Species with Moderate SD(Moderate Variations present in most locations)

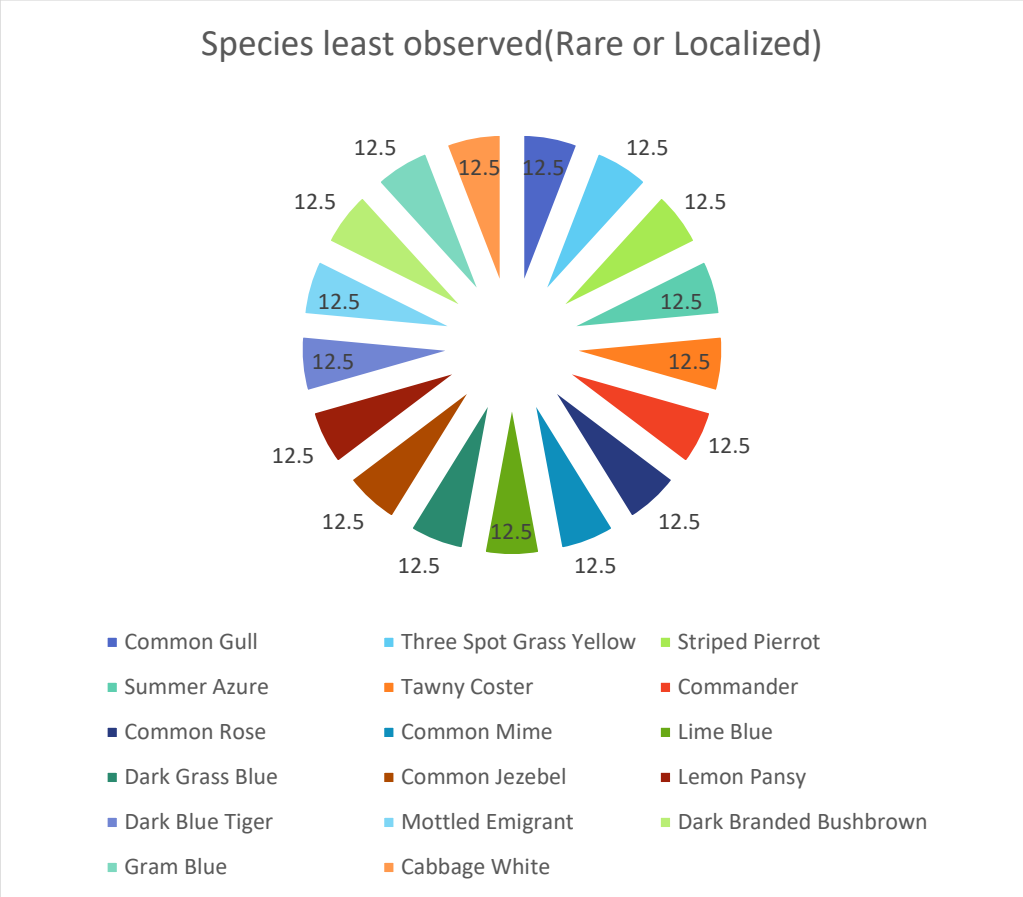

Chart 4.: Butterfly Species with least observed SD(Rare or localized Variations present in most locations)

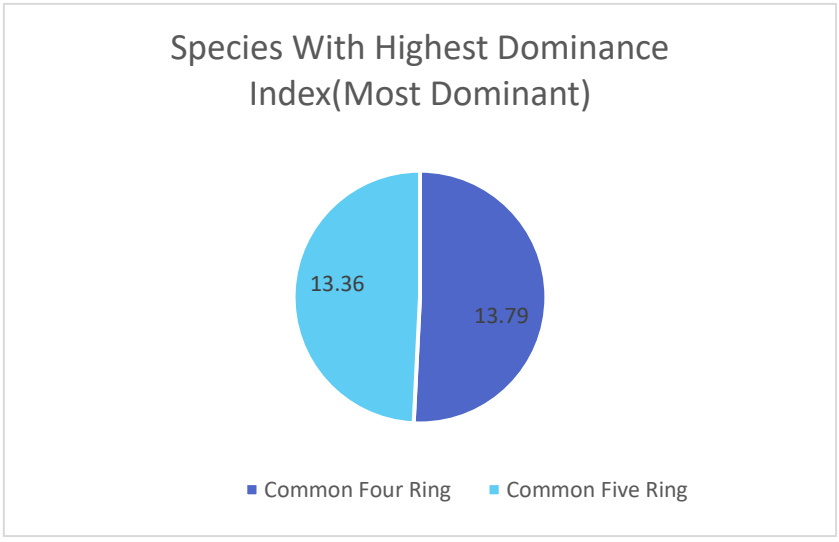

Chart 5.: Butterfly Species with Highest Dominance index (present in most locations)

4. DISCUSSIONS:

Butterflies are among the most beautiful and ecologically important insects that play a crucial role in pollination and act as bio-indicators, reflecting the health of ecosystems (2,5,13). In recent times, habitat loss and climate change have threatened butterfly populations(14-17). Observing butterflies helps us to understand local biodiversity and the impact of environmental changes (4,9,18,19). Butterflies are easy to observe and identify in the field, making them ideal subjects for ecological study (1,5, 23, 24). This also allows us to connect with nature directly, promoting awareness about conservation (3,7). It provides an opportunity to learn scientific methods such as field data collection, species identification, and systematic recording (6,10, 22). From the present study, we observed a total of 36 butterfly species along with their host plants (Figure 1) and 232 individuals were observed across 8 localities surveyed under 24PGS North and north Kolkata, WB, India, indicating moderate to high butterfly richness in the area (3.a., Table 1, Chart 1,Chart 2, Chart 3).

Among these the most abundant species (Highest Total Count) was Common Four Ring (32 individuals), Common Five Ring (31 individuals), Common Grass Yellow (22 individuals) and Pale Grass Blue (23 individuals) also showed notable abundance(3. b., Table 1, Chart 1). Their abundance may be due to adaptability to habitat, availability of host Plants, high reproductive rate and tolerance to human and environmental disturbance (2,6, 20). Species with Highest Frequency (Present in Most Locations): Common Four Ring, found in 5 localities (62.5%), Common Five Ring, found in 6 localities (75%), Pale Grass Blue , found in 4 localities (50%) and Grey Pansy, found in 5 localities (62.5%) (3.c.,, Chart 1). Our data reveals that these species are widely distributed, widely spread and not restricted to specific areas. Reasons behind their high frequency may be due to their broad ecological tolerance, they can survive in various Microhabitats (widespread habitat preference), wide availability of nectar and host plants, and may be due to their habitat preferences.(5,7, 20, 21). Species with Highest Dominance were observed as Common Four Ring and Common Five Ring (3. d., Chart 5). From the observed data it is observed that these two species contribute 27.15% of the total dominance. The observed data shows that species with High SD and SE (High variation) in Common Five Ring (SD±: 7.39, SE±: 2.62), Common Four Ring (SD±: 8.29, SE±: 2.93), Pale Grass Blue (SD±: 4.48, SE±: 1.58) and in Common Grass Yellow (SD±: 4.96, SE±: 1.75) (3.g., Chart 2). These species are numerically dominant, suggesting that they are well-adapted to the habitat conditions in North 24 Parganas and North Kolkata during the rainy season. This high dominance shows that these species out compete others, potentially due to favorable breeding, feeding, or climatic conditions during the study period. These species also show high fluctuation across different localities, meaning they are not uniformly distributed, but when present, they occur in large numbers. Moderate SD and SE (Moderate spread) was observed in Grey Pansy (SD±: 2.75, SE±: 0.97), Plains Cupid (SD±: 1.87, SE±: 0.66), Common Palmfly (SD±: 1.85, SE±: 0.65), Psyche (SD±: 0.53, SE±: 0.18) and in Peacock Pansy (SD±: 1.11, SE±: 0.3) (3. h., Chart 3). From our study it was evident that these species have a balanced presence, not too rare or dominant, and may be important indicators of stable habitat conditions.

Rare and Localized Species observed were Common Gull, Striped Pierrot, Summer Azure, Tawny Coster, Commander etc., as observed only once or in one location. These species were found rare, migratory, seasonal, or dependent on specific host plants or microhabitats (7, 31, 32) that are not commonly found in the surveyed locations. From the calculated Standard Deviation (SD) and Standard Error (SE) values obtained as 0 SD± and SE± for species such as Commander, Common Crow, Jezebel), had no variation in their count (3. f., Chart 4). These were observed only once or had uniform numbers across all sites, indicating either low presence or consistent but sparse distribution. From the t test (3.i.,Table 1,) we observed at df=35 and level of significance=0.05 [df=n-1 here n=36 (36 species)]. Critical t value= 2.030. The result showed Calculated t value =4.66 as 4.66>2.030 that means Calculated t value> Critical t value so Null Hypothesis is rejected. Thus, the difference in abundance is statistically significant. Thus, there is a significant variation in butterfly abundance across species so that not all species are equally distributed or abundant. From our data reinforces the presence of dominant species and rare/localized (8, 25, 26, 30).

From our observation on abiotic factors, the result shows (Table 2) the mean solar radiation intensity across all sampling days was 354.543 W/m²(3.j., Table 2,). This value falls within the moderate to high sunlight intensity range, ideal for butterfly activity. Solar radiation values showed daily variability, with peaks on clear days and dips during rain or overcast skies. A mean of ~354 W/m² indicates favorable light conditions for basking, flight, feeding on nectar, mating and territorial behavior (33, 35). On days with radiation intensity above 300 W/m², butterfly activity is generally higher and more diverse. Days with lower intensity (below ~200 W/m²) may have limited activity. Butterflies, being ectothermic, depend on external sunlight for thermoregulation (6,7, 27-29, 33).

From the temperature (°C) data it was noted that the temperature values mostly range between 28°C to 33°C, with a maximum observed value was 32.5°C and minimum observed value was noted as 24.83°C. Mean calculated as 31.04°C (Table 2, 3.k.), which falls within the ideal temperature range for butterfly activity and highly favorable for butterfly visibility and activity during most of the survey days. Neither too cold nor too hot, thus thermal stress was not likely experienced by the butterflies (33).

The rainfall (mm) values obtained vary, with several days showing no rainfall (0 mm) and a few days showing values as high as 9 mm and 7 mm. The mean rainfall recorded is 1.23 mm. Minimum rainfall was 0 mm (for many days) and Maximum rainfall was 9.25 mm. Mean rainfall was calculated (3. l.,Table 2) as 1.23 mm (Light rainfall category). Butterflies are highly sensitive to rainfall. They avoid flight during rain and take shelter under leaves or in shrubs (7). Rainfall was generally low to moderate. There were intermittent light showers rather than continuous heavy rainfall. Butterfly activity tends to drop on rainy days due to reduced solar radiation and wet vegetation making nectar access difficult. However, light or post-rain conditions (after showers stop) may increase nectar availability and mud-puddling behavior (6,8, 33).

The data on Humidity (%) showed that humidity ranged 75% to 95% during most days. The mean relative humidity value listed was 80.74% (3. m., Table 2) . Minimum humidity was 67.5%, Maximum humidity was 94.16%. This range falls under high humidity, which is expected during the rainy season in tropical regions like North Kolkata and North 24 Parganas. High humidity, especially above 80%, creates a favorable environment for butterfly survival, especially for maintaining body hydration, supporting plant growth, which increases nectar and host plant availability enhancing mud-puddling behavior (seen in males for mineral uptake) (6, 34). However, excessive humidity combined with low sunlight or rain may reduce flying time and visibility of butterflies(7). Many butterfly species, particularly Pieridae and Nymphalidae, are active in high humidity, especially after rain when sunlight reappears. (7,8).

Data on atmospheric pressure values mostly range from 990.0 hPa to 1000.0+ hPa. The mean atmospheric pressure was noted as 969.650 hPa (3.n., Table 2). This is within the normal pressure range for lowland tropical areas during monsoon. High atmospheric pressure (above 1010 hPa) usually indicates clear and dry weather, favorable for butterfly activity. Low to moderate pressure (990–1000 hPa), as observed from the study, often correlates with cloudy, humid, or rainy conditions. Butterflies tend to reduce their activity just before or during low-pressure dips because it often precedes rain (5,6). However, many species resume activity when pressure stabilizes, especially when sunlight returns (5,6).

Regarding data on Wind speed values mostly range between 4mph and 9mph. The mean wind speed was noted as approximately 6.44 mph (3.o., Table 2). This indicates light to moderate breeze conditions throughout the survey period. Butterflies are sensitive to wind. Strong winds can hinder their flight and feeding behavior (5,7). Average wind speed was recorded as 6.44 mph is in the range that allows normal butterfly activity. This might cause slight disturbance to smaller or weaker flyers. On calmer days (wind speed below 3 mph), butterfly sightings tend to be higher. Higher speeds (above 7–8 mph) may result in reduced visibility of butterflies as they take shelter.

5. CONCLUSIONS:

This study documented the presence, diversity, and behavior of butterfly species in the selected study area. From the observations it indicates that the area supports a high range of diversity among butterfly species, reflecting its ecological richness and availability of suitable habitats and host plants(4,8,9, 34). Overall, the study was a meaningful step toward understanding and appreciating the role of butterflies in maintaining the balance of nature and understanding their presence and behavior is important for future conservation planning (4,8,9, 35).

The study reflects not only ecological knowledge but also encourages a sense of responsibility toward protecting biodiversity(6,10).

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