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Study on Lepidopteran Diversity of Pursurah, Hooghly, West Bengal

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The current study was conducted from different areas of Damodar and Mundeswari river basin, Pursurah block of Hooghly district of West Bengal during June 2021 to May 2022. The insect faunal diversity of this area seems not to have been investigated earlier. The study recorded 48 Lepidopteran species (41 Genera) belonging to 12 families, A total of 33 butterfly species belonging to the families of Nymphalidae (27%), Pieridae (10%), Papilionidae (15%), Lycaenidae (11%) and Hesperidae (6%) and 15 moth species belonging to Erebidae (15%), Sphingidae (4%), Geometridae (2%), Noctuidae (4%), Lasiocampidae (2%), Scythrididae (2%), Zygaenidae (2%) were identified in the present study. Based on specimens observed during the study, 19% species

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are very common, 42% are common, 20% are not rare, 19% are rare. During the study, we observed Blue Mormon, the region's largest butterfly and the second-largest butterfly species in India.

Keywords: Lepidoptera; Rhopalocera; Heterocera; diversity indices; relative abundance.

1. INTRODUCTION

Research on insect diversity is crucial due to insects' dominance in terrestrial and aquatic ecosystems, as well as their vital roles in providing ecosystem services like pollination, pest control, decomposition, and ecological balance [1]. Butterflies, belonging to the order Lepidoptera-Rhopalocera, are a vital group of colourful insects. They exhibit preferences for specific habitats and their diversity varies across seasons. Due to their sensitivity to environmental changes, they are regarded as excellent bioindicators of ecosystem health. Apart from being bioindicators [2] of metal contamination, butterflies serve as important pollinators for host plants, and their abundance often signifies a more robust ecosystem. Additionally, their coevolutionary relationships with plants further underscore their ecological significance. Butterflies and moths are widely recognized as among the most thoroughly studied groups of insects from a taxonomic perspective. Globally, there are over 180,000 species of butterflies, moths, and skippers, with approximately 80 percent inhabiting tropical regions [3]. The Indian subcontinent, characterized by diverse terrain, climate, and vegetation, is home to approximately 1,504 species of butterflies and other Lepidopterans [4].

Detailed surveys of butterflies, including their occurrence and behavioural patterns, provide valuable insights into the ecology of an area. Additionally, butterflies serve as an important food source for predators such as birds, spiders, lizards, and other animals, contributing to their role in the biological food chain both as larvae and adults. Several moths produce silk of economic value. The caterpillar of lepidopteran insects is known as major pests of many agricultural crops and has economic importance. Thus, taxonomic and ecological studies of butterflies and moth help to devise effective control strategies in crop pest management. The assessment of lepidopteran diversity in protected areas have been effectively done but it seems that such studies in a local or regional scale is very rare.

In recent years, butterfly populations have faced near extinction events due to various threats. Their co-evolutionary relationships with plants underscore their importance; they facilitate plant reproduction and contribute to biodiversity. Thus, protecting butterflies is vital for maintaining the intricate web of life in which they and plants are deeply interconnected [5].

The present study focusses on the butterfly fauna assessment of Damodar and Mundeswari river basin, Pursurah block (Latitude: 22.770860 to 22.957573 and Longitude: 87.891230 to 87.982534) of Hooghly district, West Bengal. This area seems to have no report on lepidopteran diversity. Therefore, the current study aimed to compile a checklist of butterflies and moths found in the Damodar and Mundeswari river basin within Hooghly district, located in southern West Bengal, India.

2. MATERIALS AND METHODS

Study Area: A field survey was carried out in and around different villages of Pursurah block. The butterflies were observed in 10 different sites in the study area. The sites are selected mainly based on the vegetation and environments. All the sites are rural and the locality has a smaller number of houses and mainly agricultural fields (Paddy, Ground Nut, Jute, Potato) and undisturbed bushes (Passionflower, Lantanas) and moderate number of trees (Oleander, Mango tree, and Guava). The study area (Pursurah Block) is bounded by the Damodar River in the East and Mundeswari river in the west. The selected sites and their corresponding coordinates are - Soaluk, Bhangamora, Baikunthapur, Deulpara, Ranbagpur, Rasulpur, Jangalpara, Pursurah, Saidpur and Takipur.

Fig. 1. Pursurah Block area (marked in Red), Hooghly, West Bengal, India [6]

Survey method: The specimens were observed for a period of one year from June 2021 to May 2022. The butterflies were observed and recorded weekly twice in the morning (8:00 am to 10:30 am) and afternoon (03:00 pm to 5:30 pm). As many of the moths are nocturnal, they were mainly observed and recorded in evening. The butterflies were observed using line transect method [7]. The counts were made by walking in a straight line up to 100 meters. Each transect was divided into two segments of 100 meters. Butterflies were observed within 2 meters on both sides of the transect, then spotted and recorded. The butterflies and moths were recorded based on direct sighting. The butterflies are not captured and preserved, only photographs were taken using mobile phone (Lenovo K8 and Realme 7). The observed butterflies and the moths were identified following relevant literatures [8-17]. The Butterflies and the moths were broadly categorized into four groups namely – Very common (VC) (more than 100 sightings), common (C) (50 to 100 sightings), uncommon (UC) (less than 50 but more than 15 sightings) and rare (R) (less than 15 sightings) based on their sighting records [18].

Analysis of Biodiversity indices: The following formulas were used during the present study [19]:

- **Relative Abundance** = the total number of species in an area / The total sum of the populations of all species in the area × 100

- **The Simpson dominance index**-

$$(D)= 1 - [\Sigma n_i(n_i-1) / N(N-1)]$$

Where,

Σ = sum of (Total)
n_i = the number of individuals of each different species
N = the total number of individuals of all the species

- **The Shannon index of diversity** -

$$(H') = - [\Sigma(n_i/N) \times \ln(n_i/N)]$$

Where,

Σ = sum of (Total)
n_i = the number of individuals of each different species
N = the total number of individuals of all the species

Differences in butterfly and moth diversity between different sites and seasons were tested using Kruskal– Kruskal–Wallis H test where sites and seasons were treated as independent variables and butterfly/moth frequency as a dependent variable [20].

3. RESULTS AND DISCUSSION

A total number of 33 species under 27 genera of butterflies belonging to five families and 15 species under 14 genera of moths belonging to six families were recorded from the study area. Among the five families of butterflies, Nymphalidae (13 Species, 10 Genera) represents the most dominant family followed by Papilionidae (7 Species, 4 Genera), Lycaenidae (5 Species, 5 Genera), Pieridae (5 Species, 5 Genera), Hesperidae (3 Species, 3 Genera) [Table 1]. Among the 6 families of moths, Erebidae (7 Species, 6 Genera) represents the most dominant family followed by Sphingidae (2 Species, 2 Genera), Noctuidae (2 Species, 2 Genera), Geometridae (1 Species, 1 Genus), Lasiocampidae (1 Species, 1 Genus), Scythrididae (1 Species, 1 Genus), Zygaenidae (1 Species, 1 Genus) [Table 2]. Figs. 6a and 6b represents some of the images of butterflies and moths. During the study, some of the Very Common (VC) species sampled included Pale Grass Blue Butterfly (*Pseudozizeeria maha)* and Common Mormon Butterfly (*Papilio polytes)* and some rare species were Common Jay Butterfly (*Graphium doson*) and Tailed Jay Butterfly (*Graphium agamemnon*).

Table 1. List of butterflies (*Rhopalocera*) observed in the study area

	Common Name	Scientific Name	Family	Status	Individuals Observed
1.	Common Pierrot	*Castalius rosimon* (Fabricius, 1775)	Lycaenidae	UC	35
2.	Common Cerulean	*Jamides celeno* (Cramer, 1775)	Lycaenidae	C	65
3.	Pale Grass Blue	*Pseudozizeeria maha* (Kollar, 1844)	Lycaenidae	VC	100
4.	Indian Sunbeam	*Curetis thetis* (Drury, 1773)	Lycaenidae	C	58
5.	Slate Flash	*Rapala manea* (Hewitson, 1863)	Lycaenidae	VC	88
6.	Great Eggfly	*Hypolimnas bolina* (Linnaeus, 1758)	Nymphalidae	UC	23
7.	Common Five Ring	*Ypthima baldus* (Fabricius, 1775)	Nymphalidae	R	16
8.	Stripped Tiger	*Danaus genutia* (Cramer, 1779)	Nymphalidae	R	14
9.	Blue Tiger	*Tirumala limniace* (Cramer, 1775)	Nymphalidae	R	17
10.	Grey Pansy	*Junonia atlites* (Linnaeus, 1763)	Nymphalidae	C	67
11.	Common Baron	*Euthalian aconthea* (Cramer, 1777)	Nymphalidae	C	73
12.	Plain Tiger	*Danaus chrysippus* (Linnaeus, 1758)	Nymphalidae	C	71
13.	Common Palmfly	*Elymnias hypermenstra* (Linnaeus, 1763)	Nymphalidae	UC	27
14.	Lemon Pansy	*Junonia lemonias* (Linnaeus, 1758)	Nymphalidae	C	68
15.	Evening Brown	*Melanitis leda* (Linnaeus, 1758)	Nymphalidae	VC	89
16.	Common Crow	*Euploea core* Cramer, 1780	Nymphalidae	C	54
17.	Tawny Coster	*Acraea terpsicore* (Linnaeus, 1758)	Nymphalidae	VC	100
18.	Peacock Pansy	*Junonia almana* (Linnaeus, 1758)	Nymphalidae	C	56
19.	Psyche	*Leptosia nina* (Fabricius, 1793)	Pieridae	C	62
20.	Yellow Grass	*Eurema hecabe* (Linnaeus, 1758)	Pieridae	C	71
21.	Common Jezebel	*Delias eucharis* (Drury, 1773)	Pieridae	UC	32
22.	Common Gull	*Cerpora nerissa* Fabricius, 1775	Pieridae	UC	26
23.	Mottled Emigrant	*Catopsilla pyranthe* (Linnaeus, 1758)	Pieridae	C	54
24.	Common Jay	*Graphium doson* Felder, 1864	Papilionidae	R	3
25.	Tailed Jay	*Graphium agamemnon* (Linnaeus, 1758)	Papilionidae	R	2
26.	Common Mime	*Papilio clytia* Linnaeus, 1758	Papilionidae	UC	23
27.	Common Mormon	*Papilio polytes* Linnaeus, 1758	Papilionidae	VC	100
28.	Lime Swallowtail	*Papilio demoleus* Linnaeus, 1758	Papilionidae	UC	35
29.	Common Rose	*Pachliopta aristolochiae* (Fabricius,1775)	Papilionidae	R	15
30.	Blue Mormon	*Papilio polymnestor* Cramer, 1775	Papilionidae	UC	29
31.	Lesser Dart	*Potanthus omaha* (H. Edwards, 1863)	Hesperiidae	VC	100
32.	Grass Demon	*Udaspes folus* (Cramer, 1775)	Hesperiidae	C	72
33.	Common Redeye	*Matapa aria* (Moore, 1865)	Hesperiidae	C	65
				Total	**1710**

Table 2. List of moths (*Heterocera*) observed in the study area

	Scientific Name	Family	Status	Individuals Observed
1.	*Amata phegea* (Linnaeus, 1758)	Erebidae	VC	100
2.	*Amata passalis* (Fabricius, 1781)	Erebidae	C	76
3.	*Collita griseola* (Hübner, 1803)	Erebidae	C	73
4.	*Olepa ricini* (Fabricius, 1775)	Erebidae	VC	100
5.	*Asota caricae* (Fabricius, 1775)	Erebidae	C	68
6.	*Spirama helicina* (Hübner, 1824)	Erebidae	R	1
7.	*Euproctis fraterna* Moore, 1883	Erebidae	C	57
8.	*Theretra nessus* (Drury, 1773)	Sphingidae	R	2
9.	*Daphnis nerii* (Linnaeus, 1758)	Sphingidae	UC	13
10.	*Leucania comma* (Linnaeus, 1761)	Noctuidae	C	58
11.	*Spodoptera litura* (Fabricius, 1775)	Noctuidae	C	78
12.	*Hemithea aestivaria* (Hübner, 1799)	Geometridae	C	78
13.	*Gastropacha pardale* Walker, 1855	Lasiocampidae	UC	23
14.	*Eretmocera impactella* (Walker, 1864)	Scythrididae	VC	100
15.	*Trypanophora semihyalina* Kollar, 1844	Zygaenidae	R	12
			Total	**839**

Table 3a. Number of butterflies observed in different seasons and different habitats

	Butterfly Species	Seasonal Variation			Different Habitat	
		Pre - Monsoon	Monsoon	Post - Monsoon	Undisturbed	Disturbed
1.	*Castalius rosimon*	6	21	8	21	14
2.	*Jamides celeno*	11	45	9	39	26
3.	*Pseudozizeeria maha*	26	62	12	68	32
4.	*Curetis thetis*	13	36	9	46	12
5.	*Rapala manea*	17	58	13	64	24
6.	*Hypolimnas bolina*	8	13	2	16	7
7.	*Ypthima baldus*	2	11	3	10	6
8.	*Danaus genutia*	3	10	1	11	3
9.	*Tirumala limniace*	4	11	2	12	5
10.	*Junonia atlites*	16	43	8	43	24
11.	*Euthalian aconthea*	18	49	6	51	22
12.	*Danaus chrysippus*	16	47	8	37	34
13.	*Elymnias hypermenstra*	8	14	5	19	8
14.	*Junonia lemonias*	12	47	9	46	22
15.	*Melanitis leda*	18	60	11	62	27
16.	*Euploea core*	12	39	3	33	21
17.	*Acraea terpsicore*	12	63	25	71	29
18.	*Junonia almana*	10	38	8	38	18
19.	*Leptosia nina*	11	39	12	39	23
20.	*Eurema hecabe*	18	42	11	46	25
21.	*Delias eucharis*	6	23	3	26	6
22.	*Cerpora nerissa*	4	19	3	14	12
23.	*Catopsilla pyranthe*	12	32	10	32	22
24.	*Graphium doson*	1	2	0	3	0
25.	*Graphium agamemnon*	0	2	0	2	0
26.	*Papilio clytia*	5	16	2	17	6
27.	*Papilio polytes*	20	66	14	56	44
28.	*Papilio demoleus*	9	19	7	22	13
29.	*Pachliopta aristolochiae*	4	10	1	8	7
30.	*Papilio polymnestor*	6	19	4	17	12
31.	*Potanthus omaha*	27	54	19	69	31
32.	*Udaspes folus*	19	41	12	46	26
33.	*Matapa aria*	16	38	11	42	23

Table 3b. Number of moths observed in different seasons and different habitats

	Moth Species	Seasonal Variation			Different Habitat	
		Pre - Monsoon	Monsoon	Post - Monsoon	Undisturbed	Disturbed
1.	*Amata phegea*	21	67	12	67	33
2.	*Amata passalis*	19	44	13	47	29
3.	*Collita griseola*	18	43	12	51	22
4.	*Olepa ricini*	23	62	15	64	36
5.	*Asota caricae*	16	46	6	42	26
6.	*Spirama helicina*	0	1	0	1	0
7.	*Euproctis fraterna*	13	35	9	36	21
8.	*Theretra nessus*	0	2	0	2	0
9.	*Daphnis nerii*	2	10	1	9	4
10.	*Leucania comma*	14	35	9	39	19
11.	*Spodoptera litura*	21	42	15	47	31
12.	*Hemithea aestivaria*	19	47	12	56	22
13.	*Gastropacha pardale*	7	12	4	14	9
14.	*Eretmocera impactella*	21	62	17	69	31
15.	*Trypanophora semihyalina*	3	8	1	8	4

Table 4a. Kruskal–Wallis H test for butterfly and moth abundance across different seasons [p value is less than 0.05, hence, proving the alternate hypothesis of dissimilar diversity across seasons]

	Butterfly	Moth
Chi Square	33.37092	11.108
Degrees of freedom	2	2
Significance (p value = 0.05)	0.0001	0.00387

Table 4b. Kruskal–Wallis H test for butterfly and moth abundance across study sites [p value is less than 0.05, hence, proving the alternate hypothesis of dissimilar diversity across sites]

	Butterfly	Moth
Chi Square	10.61	5.11
Degrees of freedom	1	1
Significance (p value = 0.05)	0.001	0.023

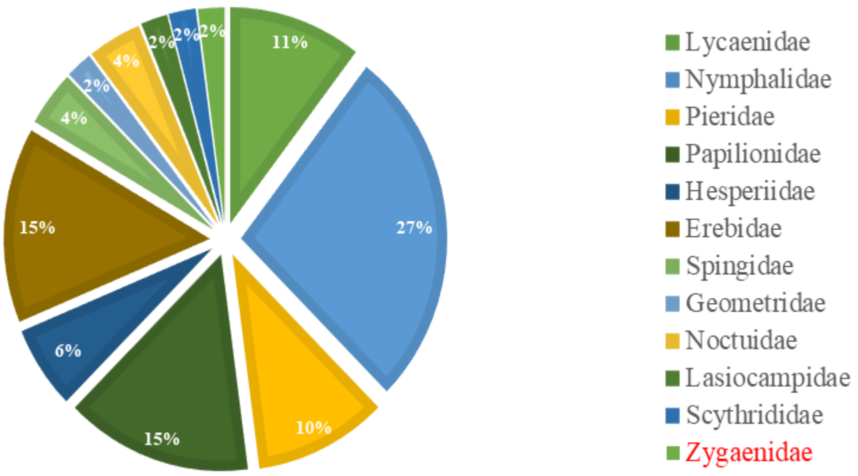

Fig. 2a. Species composition of the observed families of *Lepidoptera* in the study area

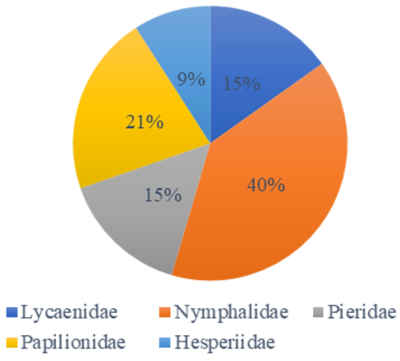

Fig. 2b. Species composition of the observed families of Butterflies in the study area

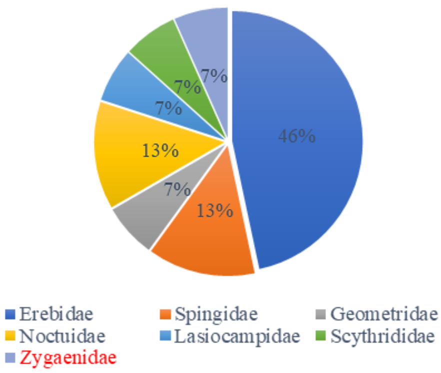

Fig. 2c. Species composition of the observed families of Moths in the study area

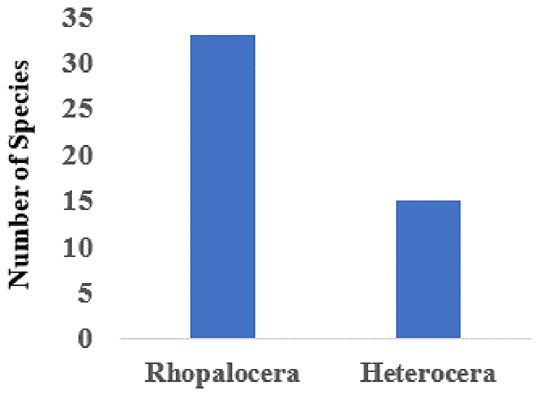

Fig. 3. Representation of Lepidopteran Suborders in the study area

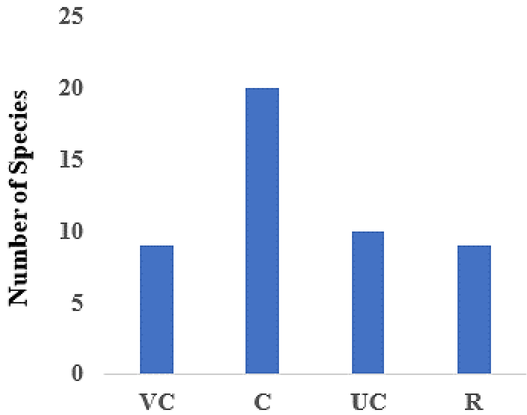

Fig. 4a. Sighting wise representation of Lepidopteran Species in the study area

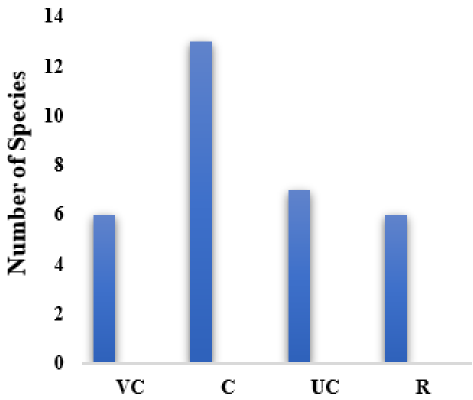

Fig. 4b. Sighting wise representation of Butterfly Species in the study area

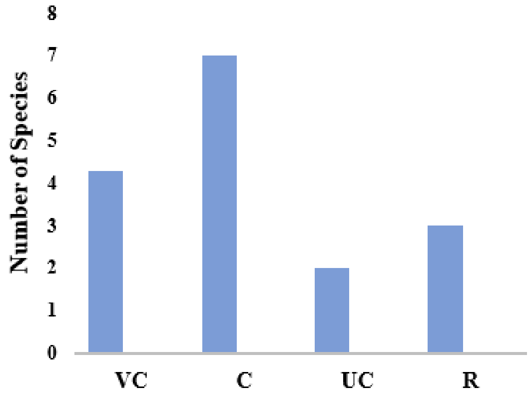

Fig. 4c. Sighting wise representation of Moth Species in the study area

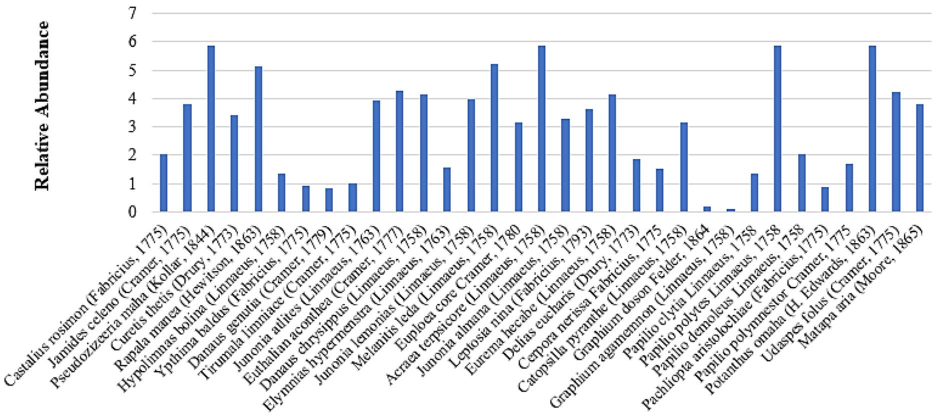

Fig. 5a. Relative abundance of butterfly species

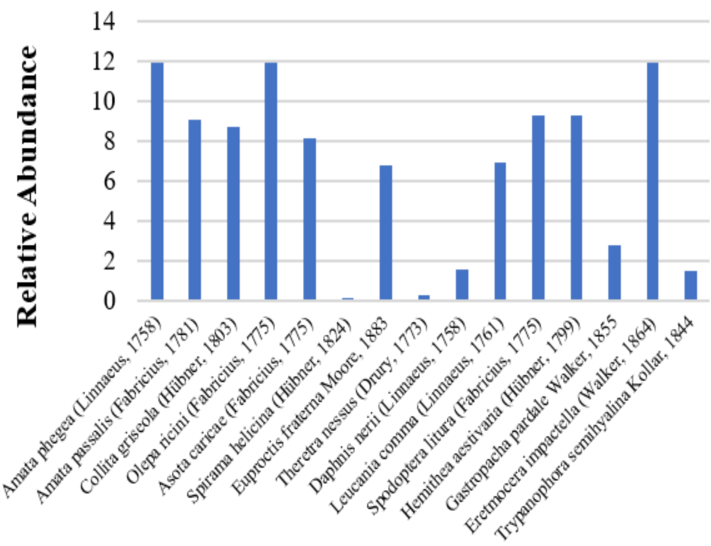

Fig. 5b. Relative abundance of moth species

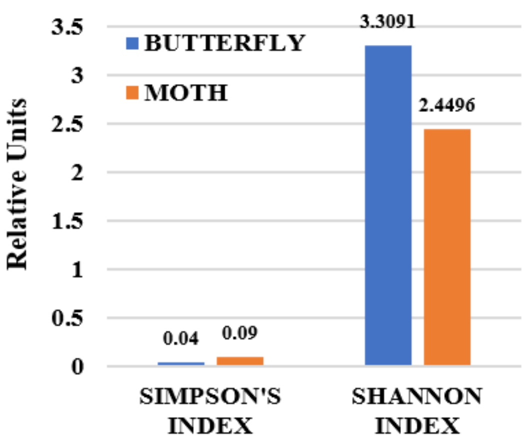

Fig. 5c. Biodiversity indices for butterflies and moths

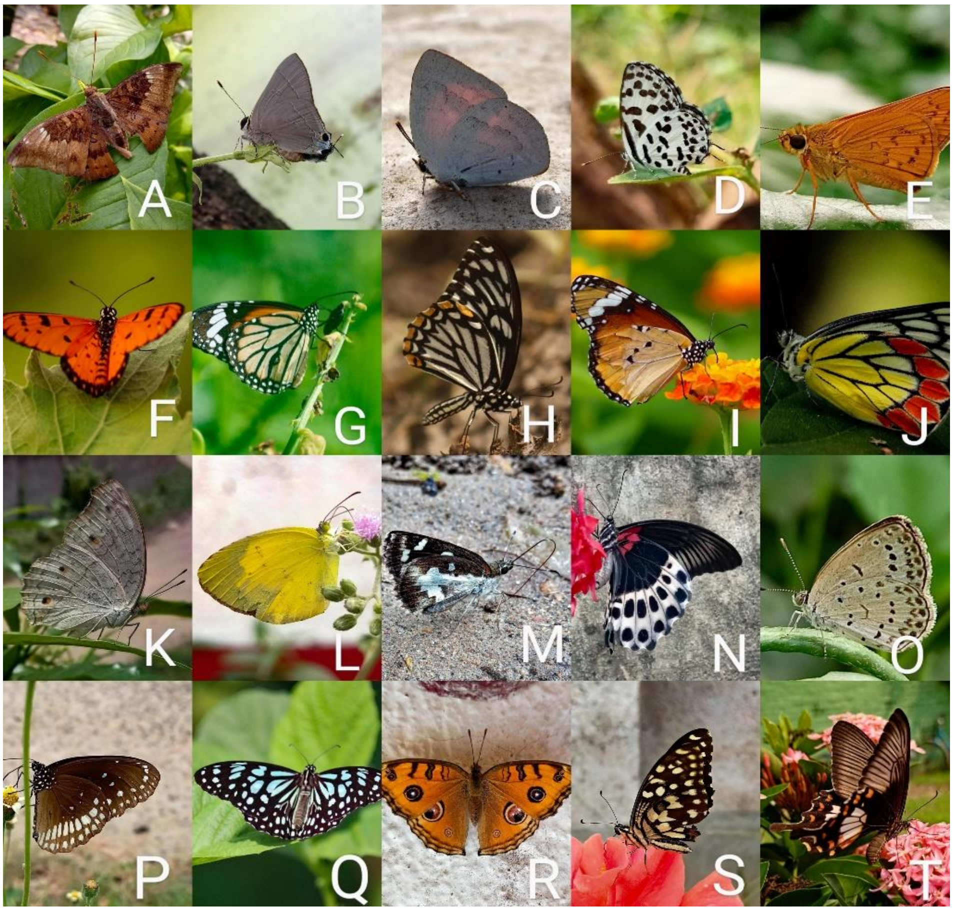

Fig. 6a. Some of the Butterflies (Rhopalocera) observed in the study area. A. *Euthalian aconthea*, B. *Rapala manea,* C.*Curetis thetis,* D.*Castalius rosimon,* E. *Potanthus omaha,* F.*Acraea terpsicore,* G.*Danaus genutia,* H.*Papilio clytia,* I.*Danaus chrysippus,* J.*Delias eucharis,* K.*Junonia atlites,* L.*Eurema hecabe,* M.*Udaspes folus,* N.*Papilio polymnestor,* O.*Pseudozizeeria maha,* P.*Euploea core,* Q.*Tirumala limniace,* R.*Junonia almana,* S.*Papilio demoleus,* T. *Papilio polytes*

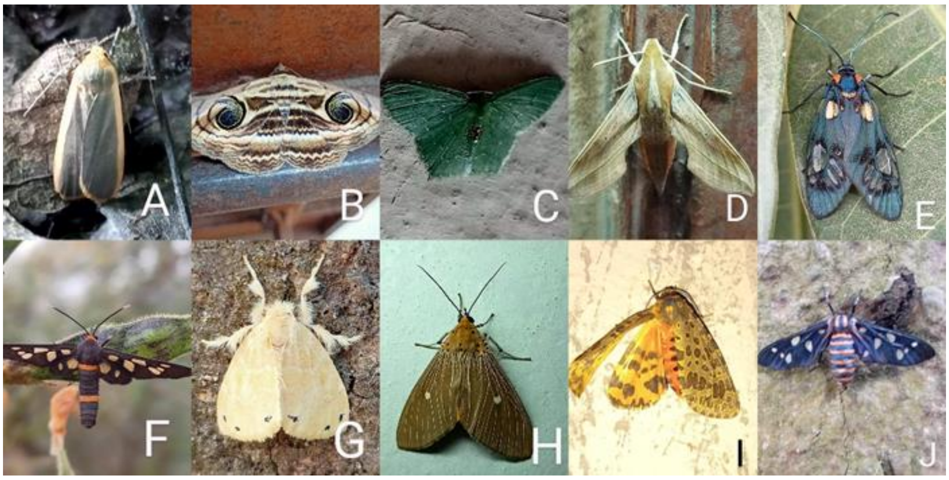

Fig. 6b. Some Moths (Heterocera) observed in the study area. A. *Collita griseola* B.*Spirama helicina* C.*Hemithea aestivaria* D.*Theretra Nessus E.Trypanophora semihyalina* F.*Amata phegea* G.*Euproctis fraterna* H.*Asota caricae* I.*Olepa ricini* J.*Amata passalis*

The present study, aims at evaluating butterflies in the Damodar and Mundeswari river basin area, Pursurah block, Hooghly, West Bengal, India. The accumulated results thus far clearly demonstrate that the overall diversity of butterflies in this district is robust. The diversity of butterfly and moth species is closely correlated with the presence of their host plants and adult nectar sources. The study suggests that areas with abundant butterfly and moth diversity tend to have rich populations of both larval host and nectar plants. The biodiversity of butterfly fauna in Pursurah, Hooghly, West Bengal, is primarily attributed to the area's lush vegetation. Vegetation plays a pivotal role in supporting insect communities by providing essential food sources and resources. Urbanization, agriculture, and deforestation cause habitat loss for the butterfly species and the butterflies face challenges for foraging and breeding grounds.

Fig. 2a represents the family wise and Fig. 3 represents suborder wise graphical representation of the Lepidopteran species. During the study 33 genera of suborder Rhopalocera (Butterfly) (Fig. 3) and 15 genera of suborder Heterocera (Moth) (Fig. 3) were observed. Fig. 2b illustrates the family-wise distribution of butterfly species, while Fig. 2c depicts the family-wise distribution of moth species. Some of the genera is very common in the study area and some of the genera is rare in the study area. The status wise graphical representation of the different lepidopteran species is represented in Fig. 4a. The status of the butterfly species and the moth species have been depicted separately in Figs. 4b and 4c respectively. Out of total 48 observed genera, 9 genera were very common (More than 100 sightings), 20 genera were common (50 to 100 sightings), 10 genera were uncommon or not common (Less than 50 but more than 15 sightings) and 9 genera were rare (Less than 10 sightings) in the study area. The common Jay butterfly was observed only 3 times, and the Blue Jay Butterfly was observed only 2 times during the observation period. The most abundant butterfly species was Common Mormon Butterfly (more than 200 sightings). In case of moths the Sphinx moth and *Spirama* moth were very rare species in the study area, during the observation period they were observed only one time. The relative abundance of the different butterfly species and moth species has been depicted in Figs. 5a and 5b respectively. Simpson's index includes species richness as well as evenness in a single number. Higher the value of D, lower the diversity [19]. Simpson's index for butterfly species was calculated to be 0.04 and that of moth species was calculated to be 0.09 showing that the distribution of butterflies is more even and they are richer in the study area. In case of Shannon Diversity index increase in value indicates increase in biodiversity and the values for real communities' range between 1.5 to 3.5. The Shannon-Wiener value for butterfly community was calculated to be 3.31 showing it to be highly diverse as compared to moth community which was calculated to be 2.45 and hence moderately diverse [19].

The diversity of the Lepidopteran species is not similar in all the sites of the study area. More species were observed in the sites near the river and mostly undisturbed. And a smaller number of species was observed in the agricultural field areas that are quite disturbed due to agricultural activities. From Deulpara (22.892958, 87.951395) and Ranbagpur (22.901447, 87.924565) most species of butterflies and moths were observed. The diversity of the lepidopteran species also varied with seasonal variation. In Monsoon season (July to October) most of the butterfly was observed and, in the Post-monsoon, (November to Feb) season a smaller number of butterfly and moths were observed. In Pre-monsoon (March to June) season moderate number of butterfly and moths were observed.

Tables 3a and 3b represent the Seasonal variation and variation in Disturbed and Undisturbed sites in-between the study area of Butterfly and Moth species Respectively. Kruskal–Wallis H test showed that there was a statistically significant difference in butterfly diversity between the three seasons and two sites (Tables 4a and 4b). At $\alpha = 0.05$ (95% of confidence level) of significance, this rejected the null hypothesis of similar diversity of butterflies across the three seasons and two sites thereby confirming the alternate hypothesis of considerable variation of butterfly and moth diversity at the sites and across seasons. The observed differences in butterfly and moth populations between undisturbed and disturbed habitats reveal the critical influence of habitat condition on these insects' diversity and abundance [21]. The higher numbers of butterflies and moths in undisturbed areas, such as bushes and riverbanks, suggest that these environments provide essential resources and conditions favourable for their survival. These habitats likely offer abundant nectar sources, suitable host plants for larvae, supporting robust populations. In contrast, the lower numbers recorded in disturbed areas, such as agricultural fields reflect the adverse effects of habitat modification. Agricultural practices and urbanization often lead to habitat fragmentation, reduced floral diversity, and increased pesticide use, all of which can negatively impact the availability of resources and suitable conditions for butterflies and moths [21]. The variations in butterfly and moth populations across the Pre-Monsoon, Monsoon, and Post-Monsoon seasons underscore the significant impact of seasonal changes on these insects' populations [22]. The peak in numbers during the Monsoon can be attributed to increased rainfall, which enhances the availability of nectar-rich flowering plants and creates favourable microclimate conditions, supporting higher populations and successful reproduction. In contrast, the moderate numbers during the Pre-Monsoon season reflect transitional conditions where resource availability is not as abundant as during the Monsoon, affecting the population size. The decline in butterfly and moth counts in the Post-Monsoon period is linked to reduced rainfall and the subsequent decrease in plant growth and nectar sources, making the environment less supportive for these insects. These findings highlight the crucial role of seasonal dynamics in shaping the life cycles and populations of butterflies and moths, and the importance of preserving and restoring natural habitats emphasizing the need for conservation strategies throughout the year.

The preference of butterflies for specific habitats is often associated with the availability of larval or adult food sources, as well as other climatic factors. The caterpillar of some observed butterfly (Common Mormon butterfly, Citrus plants) and moth acts as pest of crop and deals huge damage to that crop, although the adult form (both butterfly and moth) acts as pollinator of that particular plant. Figs. 6a and 6b depict the representative photographs of butterflies and moths recorded from the area.

During the current study on the diversity of butterflies and moths, several research papers on this topic were reviewed. Choudhury [23], Kannan and Chandrasekaran [24], and Paunikar and Sharma [25] describe the butterfly diversity in the Sathyamangalam Tiger Reserve in Tamil Nadu, the Guma Reserve Forest in Western Assam, and the protected forest areas of the North-West Himalayas in India, respectively. In the papers mentioned above, 239, 168 and 102 butterfly species were described and identified. However, none of the studies included diversity indices such as the Simpson and Shannon-Weiner indices. The relative abundance of butterflies was reported based on observational data. Rai and Chaudhary [26] describe the diversity of butterfly species in Hastinapur Wildlife Sanctuary, Uttar Pradesh, India. In their research, only the Simpson index was used for statistical analysis of butterfly diversity. Arya et al. [27] describe the diversity of butterflies (Lepidoptera: Papilionoidea) in the temperate forest ecosystem of Binsar Wildlife Sanctuary in the Indian Himalayan Region. This article utilized various diversity indices, including the Similarity Index, Simpson index, Shannon-Weiner index, and Evenness. However, none of the above-mentioned articles discussed statistical analyses for seasonal variation or for undisturbed versus disturbed habitats. This article presents an analysis of butterfly and moth diversity using indices such as the Simpson Dominance Index, Shannon-Weiner Index, and Relative Abundance. To assess seasonal variation and differences between disturbed and undisturbed habitats, the Kruskal-Wallis H test was employed. Thus, the article incorporates a range of diversity indices and statistical analyses to describe both the diversity and the variations across seasons and habitats.

4. CONCLUSION

This study establishes baseline data for the butterflies of the Damodar and Mundeswari river basin area within the Pursurah block of Hooghly. This data will serve as a foundation for future researchers to focus on exploring the distribution, diversity, and abundance of butterflies in the region, as well as identifying potential threats to their populations. From the study, it can be concluded that areas of the district contiguous to the banks of the Damodar and Mundeswari river exhibit a rich diversity of butterfly species. This richness is attributed to the presence of bushy areas and agricultural fields, coupled with lower levels of disturbance in these regions. The diverse habitats in this area provide benefits not only to insects but also to birds. However, habitat destruction resulting from tree cutting and urban expansion poses a potential threat to the faunal diversity of the region. Butterfly diversity notably varies across different habitats and landscapes. The abundant diversity of butterflies, particularly within the Nymphalidae and Lycaenidae families in the study area, suggests a varied assemblage of floral species.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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