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## Study on the butterfly diversity in Chittaranjan town, Bardhaman district, West Bengal

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### Abstract

Butterflies are the most charismatic insects. They are always a centre of attraction because of unique pattern and colorization of their wings. Present study portrays the diversity and abundance of butterfly species at Chittaranjan, a locomotive area of district Paschim Bardhaman. This survey was conducted during August, 2021 to March, 2022. A total of 47 species of butterflies belongs to 38 genera and 5 families were recorded from six different area. The relative abundance, Species diversity index, Species Dominance and Species Evenness of different butterflies were also studied in the present study. The family Nymphalidae was seen as the most dominant among five families.

**Keywords:** Butterfly, diversity, Paschim Bardhaman, West Bengal, India

### Introduction

Insect biodiversity represents a large proportion of all biodiversity on the Earth and constitute about 75% of all described animal species. Among them butterflies are the most charismatic insects on the Earth and have a vital role in ecosystem. They have been praised for centuries for their aesthetic values as well as behavioral display. Butterflies have been studied systematically since the early 18<sup>th</sup> century worldwide and about 19,238 species are documented throughout the world so far (Heppner, 1998) <sup>[1]</sup>. But a recent estimate shows that a total of 18,732 species of butterflies are found in the world excluding Hedyliidae family (Nieuwerkerken *et al.*, 2011) <sup>[2]</sup>. As a mega-diverse country India is prosperous with both flora and fauna. India is home to about 1501 species of butterflies (Ackery, 1984; Gaonkar, 1996 & Kehimar, 2008) <sup>[3]</sup> <sup>[4, 5]</sup> which constitute 65% of total Indian fauna. 6 families of butterflies are found in India. Among 1501 species of butterflies, 521 are Nymphalids (brush footed butterflies), 422 Lycaenids (blues), 109 Pierids (whites & yellows), 107 Papilionids (swallowtails) and 321 are Hesperides (skippers) (Gay *et al.*, 1992) <sup>[6]</sup>. The factors like climate, topography of the region, pollution, over exploitation may cause the change of diversity of species.

Butterfly is a gateway to nature. They are part of our natural heritage (Kasambe, 2016) <sup>[7]</sup>. Not only aesthetic value they also have ecological and economical value. Butterflies are one of the well-researched groups in the world because of their beauty and ecological importance (Hedge *et al.*, 2020) <sup>[8]</sup>.

Butterflies are the most colorful insects. They are seen in open sunny grasslands, shrubs, but some prefer tree canopy. Their occurrence is seasonal (Kunte, 1997) <sup>[9]</sup>. Some morphological differences are seen during wet-season form (WSF) and dry-season form (DSF). Butterflies are extremely sensitive to environmental changes. Butterflies are very active within temperature range between 80°-100°F. When temperature drops too low, they can't contract their muscle to fly. They naturally prefer to eat nectar, pollen. Some of them show a conspicuous behavior called "mud puddling" which helps them to obtain essential minerals, amino acids, salts which play an important role in their lifecycle (Sculley & Boggs, 1996; Molleman *et al.*, 2005, Boggs & Jackson, 2008) <sup>[10, 11]</sup>. Interaction of butterfly species with plants need help in pollination and at the same time, butterflies need food in the form of nectar and pollen. Butterflies play an important role in ecosystem. These insects represent healthier ecosystem (Ghazanfar, 2016) <sup>[12]</sup>. They act as environmental bio-indicators in the ecosystem. They are very specific to host plants and sometimes few plants are shared as food by a number of butterflies. We can get information on ecology of an area by doing faunistic survey of butterflies, their occurrence and behavioral study. They are important pollinators to most agricultural crops (Sreekumar, 2001) <sup>[13]</sup>. In addition to their ecological niche, butterflies are also a food source to predators like birds, spiders, lizards and other animals (Kasambe, 2018) <sup>[14]</sup>.

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There are not significant works done on butterfly diversity from Chittaranjan, Paschim Bardhaman. The present work helps to assess the diversity of butterflies in Chittaranjan for the purpose of conservation of butterfly species. Moreover, the present paper also gives an idea about the Species Diversity Index(Shannon diversity index, Simpson’s diversity index), Evenness, Relative Abundance, based on the observations made at Sundarpahadi, Simjuri jungle, Amladahi, Hill top area, Karnel Singh Park, Fatehpur during August, 2021 to March, 2022.

**Materials and Methods**

**Study area and Sampling sites**

Chittaranjan is a locomotive town belongs to undulating latterite in Asansol sub-division of Paschim Bardhaman district in the state of West Bengal, India. This town is located at 23.87°N 86.87°E with an area of 18.34 km<sup>2</sup>. It has an average elevation of 155 m. (508 ft). This area lays between two mighty rivers- the Ajay and the Damodar. Chittaranjan is known for its greenery and atmosphere.



**Fig 1:** Satellite overview map of Chittaranjan

Six sampling sites were selected in the study area, which are as follows:

- A. Sundarpahadi
- B. Simjuri Jungle

- C. Amladahi
- D. Hill Top Area
- E. Karnel Singh Park
- F. Fatehpur



**Fig 2:** Types of habitats in the study range: (1) Wetland area; (2) Fragmented forest; (3) Open scrub; (4) Urban forest; (5) Garden habitat

**Survey Method and Identification of the butterfly species**

The study areas were surveyed once in each month for the period of 8 months from August, 2021 to March, 2022. Monthly observations were carried out during morning hours (8.00 am to 10.00 am) and butterflies were recorded based on direct observation. Photographs of butterfly species in natural habitats were also taken for future references. Later the butterflies were identified from photographs by using standard literature (Smetacek, 2017; Kehimkar, 2008; Kasambe, 2016) [15, 5, 7]. Butterflies were broadly grouped into five categories; very common, common, not rare, rare and very rare based on their sighting records and relative abundance (Tiple *et al.*, 2007) [16].

**Statistical Analysis of Data**

For Statistical Analysis of data, the following different formulas were used during the present study:

- 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 index of diversity mathematical formula is giving as follows:

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

Where,  $\Sigma$  = 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 mathematical formula is giving as follows:

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

Where,  $\Sigma$  = sum of (Total)

$n_i$  = the number of individuals of each different species

$N$  = the total number of individuals of all the species

- The Evenness of diversity mathematical formula is giving

as follows:

$$(E) = H' / \ln(S)$$

Where,  $H'$  = Shannon's diversity index

$\ln(S)$  = Natural logarithm of species richness

**Results**

During the survey, a total of 47 butterfly species belonging to 5 families (Papilionidae, Nymphalidae, Lycaenidae, Pieridae & Hesperidae) have been recorded as documented in the checklist (Table 1). Out of 47 species, 22 species are recorded from Sundarpahadi, 19 species are from Simjuri Jungle, 22 species are from Amladahi, 35 species are from Hill Top Area, 21 species are from Karnel Singh Park and 13 species are from Fatehpur (Figure 3). Family Nymphalidae has showed dominance (38.29%) with 18 species over family Lycaenidae (25.53%, 12 Sp.), Pieridae (14.89%, 7 sp.), Papilionidae (12.76%, 6 sp.) and Hesperidae (8.51%, 4 sp.) (Figure 6).

According to visibility, 5 species are very common (VC), 5 species are common (C), 11 species are not rare (NR), 24 species are rare (R) and 2 species are very rare (VR) (Tiple *et al.*, 2007) [16]. The species diversity and evenness of the six localities have been estimated by values of Shannon diversity index, Simpson's diversity index.

*Eurema hecabe* has been seen as most abundant species (11.731%) while *Rathinda amor* (0.063%) and *Danaus genutia* (0.063%) has been found as very rare species and these two species are not found in every study area.

It is shown that Fatehpur has the least species evenness (0.8459) while Amladahi has the greatest evenness (0.9219). As Fatehpur is a market area and full of noise of vehicles & pollutions, the numbers of species are less and a lower index of evenness and Shannon diversity (2.1697) is estimated. Whereas Hill Top area is undisturbed and full of greenery. That's why this area is shown high index of Shannon diversity (3.2047) (Table 3; Figure). The overall diversity index of the study area is 3.1747, which measures at "high level" (Fernando *et al.* 1998) [17].

**Table 1:** Checklist of butterfly species observed in the study area

Family	Scientific name	Common name	Locality	No. of individuals	Status
Papilionidae	<i>Graphium doson</i> (C. & R. Felder, 1864)	Common jay	C, D	23	NR
	<i>Graphium Agamemnon</i> (Linnaeus, 1758)	Tailed jay	A, C, D	35	NR
	<i>Papilio polytes</i> (Linnaeus, 1758)	Common mormon	A, B, C, D, E, F	101	VC
	<i>Papilio demoleus</i> (Linnaeus, 1758)	Lime butterfly	A, B, C, D, E, F	98	C
	<i>Papilio polymnestor</i> (Cramer, 1775)	Blue mormon	B, E	8	R
	<i>Atrophaneura aristolochiae</i> (Fabricius, 1775)	Common rose	A, D	12	R
Nymphalidae	<i>Tirumala limniace</i> (Cramer, 1775)	Blue tiger	C, D, E	28	NR
	<i>Danaus chrysippus</i> (Linnaeus, 1758)	Plain tiger	A, B, D, E	82	C
	<i>Danaus genutia</i> (Cramer, 1779)	Stripped tiger	D	1	VR
	<i>Euploea core</i> (Cramer, 1780)	Common crow	A, B, C, D	88	C
	<i>Meantis leda</i> (Linnaeus, 1758)	Common evening brown	A, C, D	39	NR
	<i>Elymnias hypermenstra</i> (Linnaeus, 1763)	Common palmfly	A, B, D, F	32	NR
	<i>Acraea violae</i> (Fabricius, 1793)	Tawny coster	A, D, E, F	79	C
	<i>Phalanta phalantha</i> (Drury, 1773)	Common leopard	D, E	9	R
	<i>Neptis hylas</i> (Linnaeus, 1758)	Common sailor	A, D	8	R
	<i>Euthalia aconthea</i> (Cramer, 1777)	Common baron	A, C	5	R
	<i>Junonia atlites</i> (Linnaeus, 1763)	Grey pansy	A, B, C, D, E, F	146	VC
	<i>Junonia iphita</i> (Linnaeus, 1758)	Chocolate pansy	B, C, D, E	15	R
	<i>Junonia almana</i> (Cramer, 1779)	Peacock pansy	D, E	10	R
	<i>Junonia lemonia</i> (Linnaeus, 1758)	Lemon pansy	B, D	8	R
	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	Great eggfly	B, C, D, E	22	NR
	<i>Mycalesis perseus</i> (Fabricius, 1775)	Common bush brown	A, D, E	25	NR

	<i>Moduza procris</i> (Cramer,1777)	Commander	A,C	2	R
	<i>Ariadne ariadne</i> (Linnaeus, 1763)	Angled castor	C,D,F	17	NR
Lycaenidae	<i>Curetis thetis</i> (Drury,1773)	Indian sunbeam	B,D	9	R
	<i>Castalius rosimon</i> (Fabricius,1775)	Common pierrot	B,D,E	22	NR
	<i>Tarcus nara</i> (Kollar,1848)	Rounded pierrot	B,E	12	R
	<i>Catochrysops starbo</i> (Fabricius,1793)	Forget-me-not	C,D,E,F	12	R
	<i>Pseudozizeeria maha</i> (Kollar,1844)	Pale grass blue	A,B,C,D,E,F	109	VC
	<i>Euchrysops cnejus</i> (Fabricius,1798)	Gram blue	D,E,F	7	R
	<i>Iraota timoleon</i> (Stoll,1790)	Silverstreak blue	A	2	R
	<i>Luthrades pandava</i> (Horsfield,1829)	Plains cupid	B,E	11	R
	<i>Zizina otis</i> (Fabricius,1787)	Lesser grass blue	E	2	R
	<i>Jamides celeno</i> (Cramer,1775)	Common cerulean	D	3	R
	<i>Chilades lajus</i> (Stoll,1780)	Lime blue	A,D	6	R
	<i>Rathinda amor</i> (Fabricius,1775)	Monkey puzzle	D	1	VR
Pieridae	<i>Eurema hecabe</i> (Linnaeus, 1758)	Common grass yellow	A,B,C,D,E,F	185	VC
	<i>Eurema bigitta</i> (Stoll,1780)	Small grass yellow	E	2	R
	<i>Catopsilia pyranthae</i> (Linnaeus, 1758)	Mottled emigrant	B,C,D,F	154	VC
	<i>Catopsilia pomona</i> (Fabricius,1775)	Common emigrant	B,C,D	57	C
	<i>Leptosia nina</i> (Fabricius,1793)	Psyche	A,C,D,F	38	NR
	<i>Appias olferna</i> (Swinhoe, 1890)	Eastern stripped albatross	A,C	11	R
Hesperidae	<i>Pareronia valeria</i> (Cramer,1776)	Common wanderer	F	2	R
	<i>Borbo cinnara</i> (Wallace,1866)	Rice swift	A,B,D	17	NR
	<i>Ampittia discorides</i> (Fabricius,1793)	Bush hopper	D	5	R
	<i>Udaspes folus</i> (Cramer,1775)	Grass demon	A	5	R
	<i>Suastus gremius</i> (Fabricius,1798)	Indian palm bob	D	12	R

A-Sundarpahadi; B-Simjuri jungle; C-Amladahi; D-Hill top area; E- Karnel Singh Park; F-Fatehpur  
 VC-very common; C-common; R-rare; NR-not rare; VR-very rare

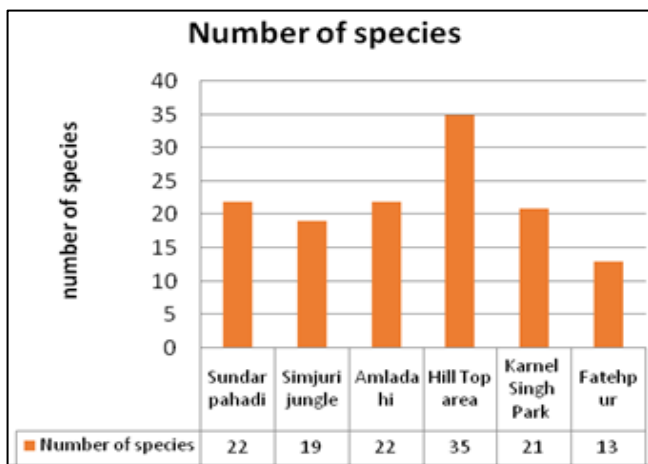
**Table 2:** Relative abundance of Butterflies at six different study sites of Chittaranjan during August, 2021 to March, 2022

Family	Scientific name	No. of individuals	Relative Abundance (%)
Papilionidae	<i>Graphium doson</i> (C. & R. Felder, 1864)	23	1.4585
	<i>Graphium Agamemnon</i> (Linnaeus, 1758)	35	2.2194
	<i>Papilio polytes</i> (Linnaeus, 1758)	101	6.4046
	<i>Papilio demoleus</i> (Linnaeus, 1758)	98	6.2143
	<i>Papilio polymnestor</i> (Cramer,1775)	8	0.5073
	<i>Atrophaneura aristolochiae</i> (Fabricius,1775)	12	0.7609
Nymphalidae	<i>Tirumala limniace</i> (Cramer,1775)	28	1.7755
	<i>Danaus chrysippus</i> (Linnaeus, 1758)	82	5.1997
	<i>Danaus genutia</i> (Cramer,1779)	1	0.0634
	<i>Euploea core</i> (Cramer,1780)	88	5.5802
	<i>Meantis leda</i> (Linnaeus, 1758)	39	2.4731
	<i>Elymnias hypermenstra</i> (Linnaeus, 1763)	32	2.0292
	<i>Acraea violae</i> (Fabricius, 1793)	79	5.0095
	<i>Phalanta phalantha</i> (Drury, 1773)	9	0.5707
	<i>Neptis hylas</i> (Linnaeus, 1758)	8	0.5073
	<i>Euthalia aconthea</i> (Cramer,1777)	5	0.3171
	<i>Junonia atltes</i> (Linnaeus, 1763)	146	9.2581
	<i>Junonia iphita</i> (Linnaeus, 1758)	15	0.9512
	<i>Junonia almana</i> (Cramer,1779)	10	0.6341
	<i>Junonia lemonia</i> (Linnaeus, 1758)	8	0.5073
	<i>Hypolimnas bolina</i> (Linnaeus, 1758)	22	1.3951
	<i>Mycalasis perseus</i> (Fabricius,1775)	25	1.5853
	<i>Moduza procris</i> (Cramer,1777)	2	0.1268
	<i>Ariadne ariadne</i> (Linnaeus, 1763)	17	1.0779
	Lycaenidae	<i>Curetis thetis</i> (Drury,1773)	9
<i>Castalius rosimon</i> (Fabricius,1775)		22	1.3951
<i>Tarcus nara</i> (Kollar,1848)		12	0.7609
<i>Catochrysops starbo</i> (Fabricius,1793)		12	0.7609
<i>Pseudozizeeria maha</i> (Kollar,1844)		109	6.9119
<i>Euchrysops cnejus</i> (Fabricius,1798)		7	0.4439
<i>Iraota timoleon</i> (Stoll,1790)		2	0.1268
<i>Luthrades pandava</i> (Horsfield,1829)		11	0.6975
<i>Zizina otis</i> (Fabricius,1787)		2	0.1268
<i>Jamides celeno</i> (Cramer,1775)		3	0.1902
<i>Chilades lajus</i> (Stoll,1780)		6	0.3805
<i>Rathinda amor</i> (Fabricius,1775)		1	0.0634
Pieridae	<i>Eurema hecabe</i> (Linnaeus, 1758)	185	11.731
	<i>Eurema bigitta</i> (Stoll,1780)	2	0.1268

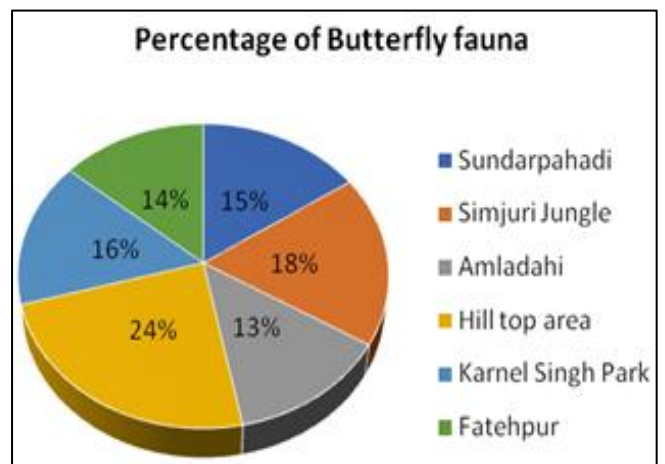
	<i>Catopsilia pyranthae</i> (Linnaeus, 1758)	154	9.7654
	<i>Catopsilia pomona</i> (Fabricius, 1775)	57	3.6145
	<i>Leptosia nina</i> (Fabricius, 1793)	38	2.4096
	<i>Appias olferna</i> (Swinhoe, 1890)	11	0.6975
	<i>Pareronia valeria</i> (Cramer, 1776)	2	0.1268
Hesperiidae	<i>Borbo cinnara</i> (Wallace, 1866)	17	1.0779
	<i>Ampittia discorides</i> (Fabricius, 1793)	5	0.3171
	<i>Udaspes folus</i> (Cramer, 1775)	5	0.3171
	<i>Suastus gremius</i> (Fabricius, 1798)	12	0.7609
Total		1577	100

**Table 3:** Diversity Indices of Six Different Study Area of Chittaranjan

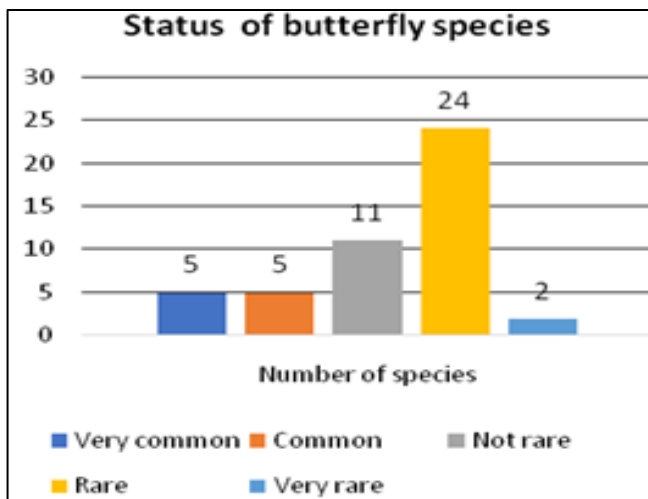
Locality	Shannon Diversity Index	Simpson's Diversity Index	Pielou's Evenness Index
Sundarpahadi	2.8289	0.9355	0.9152
Simjuri jungle	2.5718	0.9118	0.8734
Amladahi	2.8496	0.9389	0.9219
Hill Top Area	3.2047	0.9475	0.9014
Karnel Singh Park	2.6628	0.919	0.8746
Fatehpur	2.1697	0.8563	0.8459



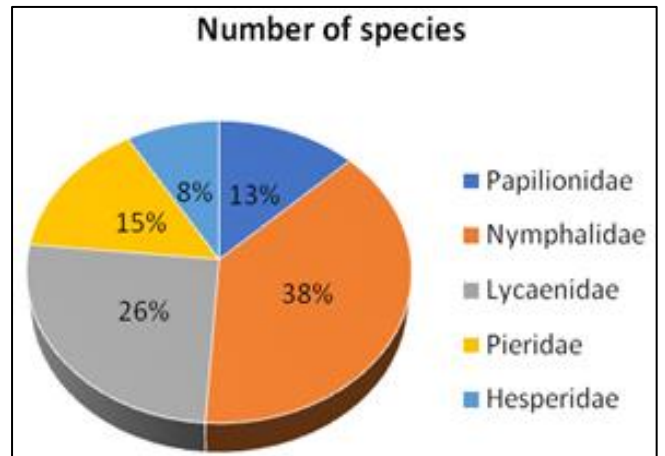
**Fig 3:** Number of Butterfly species collected from six sites of Chittaranjan during study period (August, 2021 to March, 2022).



**Fig 5:** Percentage of Butterfly fauna in all six studied sites in saline wetlands during study period (August, 2021 to March, 2022).



**Fig 4:** Status of butterfly species at Chittaranjan



**Fig 6:** Family wise percentage of species recorded from all the six different studied sites of Chittaranjan during the present study (August, 2021 to March, 2022)

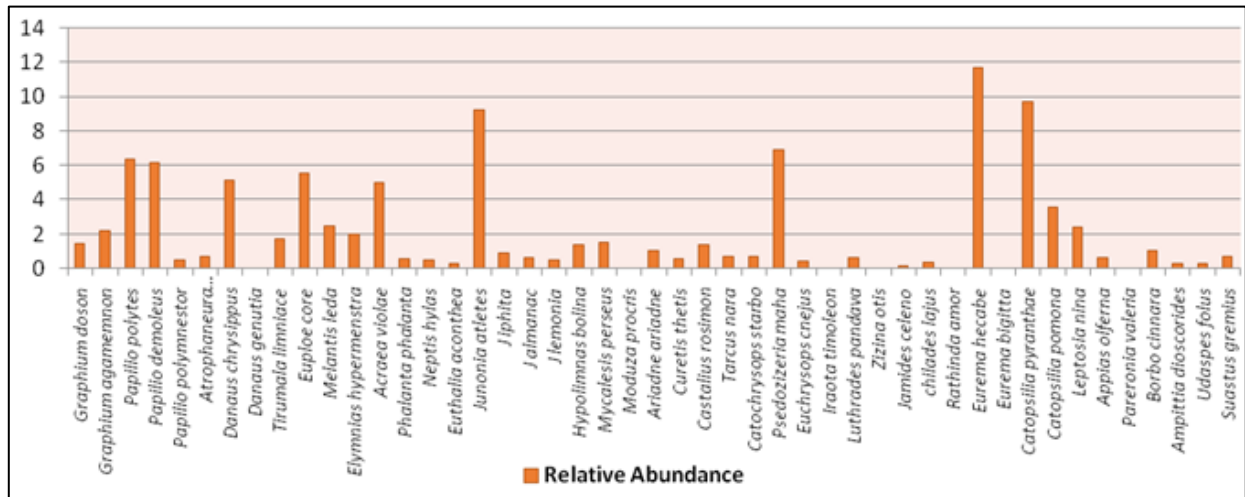


Fig 7: Relative abundance of Butterfly species at Chittaranjan during August, 2021 to March, 2022

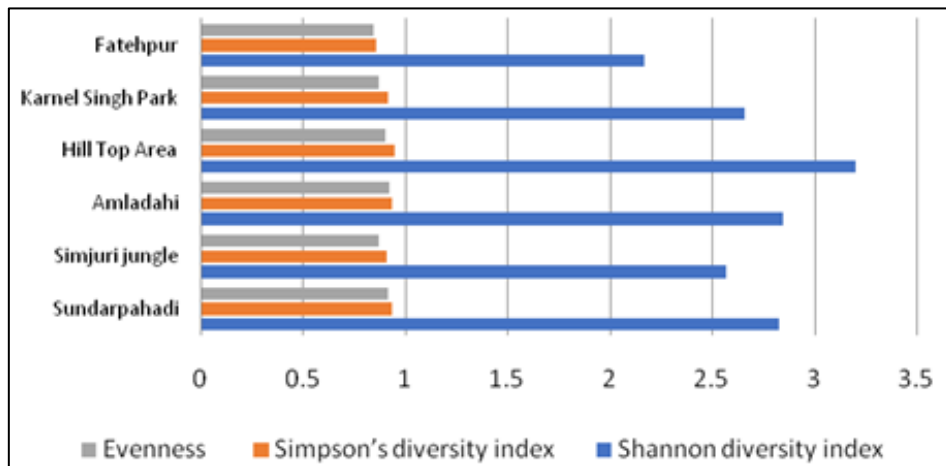
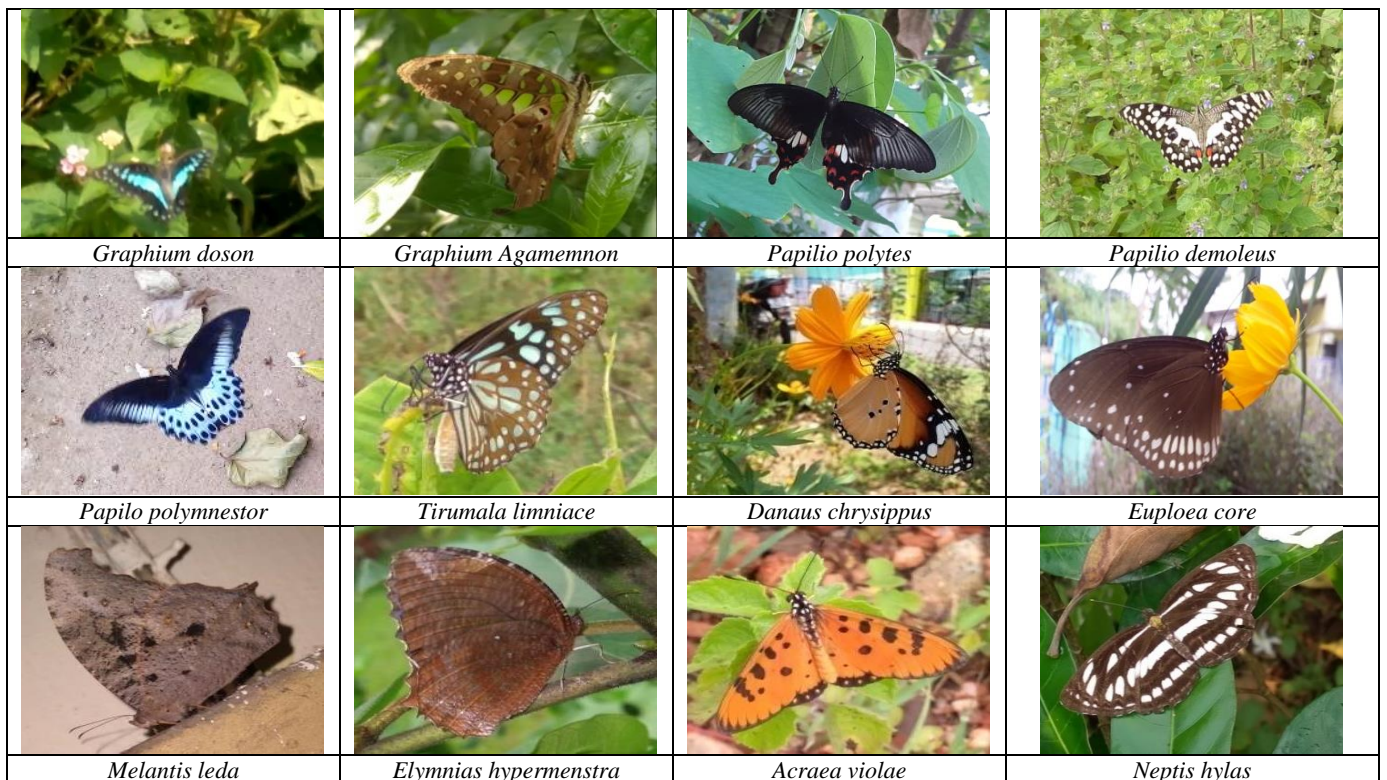

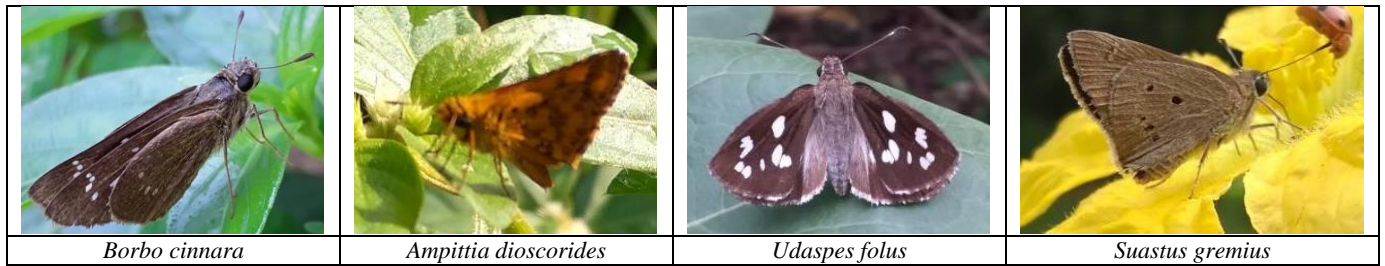


Fig 8: Shannon diversity index, Simpson's diversity index and evenness for Butterfly species between different sites of Chittaranjan



			
<i>Phalanta phalantha</i>	<i>Euthalia aconthea</i>	<i>Hypolimnas bolina</i>	<i>Mycalesis perseus</i>
			
<i>Junonia athletes</i>	<i>Junonia iphita</i>	<i>Junonia lemonia</i>	<i>Junonia almanac</i>
			
<i>Moduza procris</i>	<i>Ariadne ariadne</i>	<i>Curetis thetis</i>	<i>Castalius rosimon</i>
			
<i>Tarcus nara</i>	<i>Catochrysops starbo</i>	<i>Pseudozizeria maha</i>	<i>Euchrysops cnejus</i>
			
<i>Luthrades pandava</i>	<i>Jamides celeno</i>	<i>Zizina otis</i>	<i>Chilades lajus</i>
			
<i>Iraota timoleon</i>	<i>Rathinda amor</i>	<i>Eurema hecabe</i>	<i>Eurema bigitta</i>
			
<i>Leptosia nina</i>	<i>Catopsilia pyranthae</i>	<i>Catopsilia pomona</i>	<i>Appias olferna</i>



**Fig 9:** Photographs of butterfly species recorded from different study sites of Chittaranjan

### Discussion

A total of 47 butterfly species with a total of 1577 individuals were listed over the period of 8 months. The Shannon diversity index of overall studied area with a value of 3.1746 indicates the more diverse the species are in the habitat. From statistical analysis we get the value of Simpson's diversity index (0.9422). This Simpson's diversity index value shows that the community has greater diversity with several species. Pielou's Evenness Index value of six different sites lies between 0.8459 and 0.9219. This higher value of index shows the diversity along with species richness and implies that the community has equal appointment of species individuals and less dominance (Pielou, 1966) [18]. This study has highlighted the importance of locomotive area as a preferred habitat for butterflies. Among insects, butterflies occupy a vital position in the ecosystem and their occurrence and diversity are considered as bioindicator of the health of any terrestrial ecosystem.

Although Chittaranjan is an industrial belt area but plenty of greenery are seen in and around the area. There are lots of trees, herbs, shrubs found in every locality of Chittaranjan. This is the big reason of the abundance of butterfly species. These vegetations can provide them food (nectar) as well as shelter. The present study will also act as a baseline for future research works in understanding the nature of interaction between butterflies and flowering plants of this area, in order to conserve these butterflies for the continuity of ecosystem services.

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