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Srivari Illam, No. 61, Karthik Nagar, 10th Street, Saravanampatti, Coimbatore, Tamil Nadu 641035, India
Registered Office: 3A2 Varadarajulu Nagar, FCI Road, Ganapathy, Coimbatore, Tamil Nadu 641006, India
Ph: +91 9385339863 | www.threatenedtaxa.org
Email: sanjay@threatenedtaxa.org

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continued on the back inside cover

Cover: Tamil Lacewing *Cethosia nietneri* with colour pencils and watercolours for the background; detailing with fine liners by Elakshi Mahika Molur.

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COMMUNICATION

A study on the diversity of butterflies in selected landscapes of the Indian Institute of Technology, Guwahati campus, Assam, India

Uma Dutta [1], Sonali Dey [2] & Deepshikha Moran [3]

[1,2] Cell and Molecular Biology Laboratory, Department of Zoology, Cotton University, Guwahati, Assam 781001, India.
[3] Department of Zoology, Dibru College, Dibrugarh, Assam 786003, India.
[1] umadutta@yahoo.com (corresponding author), [2] sonalidey167@gmail.com, [3] deepshikhamoran6@gmail.com

Abstract: A study has been carried out to find out the diversity of butterflies at the Indian Institute of Technology, Guwahati campus, Assam India from September 2019 to March 2022. In the present study, a total of 82 species with a total of 1,378 individuals of butterflies belonging to six families, namely, Papilionidae, Pieridae, Lycaenidae, Nymphalidae, Hesperiidae, and Riodinidae have been recorded. During the survey, the maximum number of butterflies were observed in the old E-type site and D-type site and its adjoining areas, where there are abundant flowering, host, and nectar-collecting plants and wildflowers, and a minimum number of butterflies were listed from old and new guest house site and transit campsites. Among four study years, 2020 had the highest genera and species number followed by the year 2021. From the present study it can be concluded that despite urbanization, there is a good diversity of butterflies. Therefore, the implementation of appropriate and effective conservation methods is of utmost importance in order to protect the diversity.

Keywords: Conservation ecology, diversity, ecological indicator, flowering plants, Kamrup District, Lepidoptera, northeastern India, seasonal variation, species richness, urbanization.

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Author details: Dr. Uma Dutta—an associate professor at the Department of Zoology, Cotton University. She is the former Dean of Life Sciences and Head of the Department of Zoology, CU. Her research focuses on bio-active components in chronic disease treatment viz., cancer, diabetes cardiovascular disease as well as validation of traditional knowledge and its practices in agricultural pest control with ethnopharmacological importance. She is passionate about nature and biodiversity, especially insect, butterfly and birds. She has also published book on butterfly diversity of Cotton University campus; Sonali Dey–a UGC-JRF PhD research scholar at Department of Zoology, Cotton University; Dr. Deepshikha Moran–assistant professor, Department of Zoology, Dibru College, Dibrugarh, she has a good number of publications in journals of national and international reputes.

Author contributions: UD—contributed to the study design, conceptualisation, supervision, draft writing, review editing, data collection, spotting of the species and photography. SD—contributed to data collection, survey work, photography, draft preparation, figure and table preparation and bibliographic study. DM—contributed to table and figure preparation and some part of survey work. The first draft of the manuscript was written by Uma Dutta and edited by Sonali Dey. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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INTRODUCTION

Butterflies act as an ecological indicator of environmental variation and are highly sensitive to disturbances and changes in habitat (Nally & Fleishman 2004). In the field of conservation ecology, butterflies are considered an umbrella species (Betrus et al. 2005). It is worth mentioning that butterfly diversity indirectly indicates plant diversity because both butterfly adults and caterpillars are highly reliable on specific host plants (Padhye et al. 2006).

In India, 1,379 butterfly species, from six different families, viz., Papilionidae, Pieridae, Lycaenidae, Riodinidae, Nymphalidae, and Hesperiidae, with 74 endemic species were observed. Among these, 1,143 species (82.9%) were identified as Oriental elements, 206 species (14.9%) as Palearctic elements, and 23 species (1.7%) as Afrotropical elements. Over two-thirds of the species were documented in the northeastern states of India (Das et al. 2023). Most of the species of order Lepidoptera indicates meta population which are exclusively phytophagous in nature (Menken et al. 2010). Northeastern India comprises eight states, viz., Arunachal Pradesh, Assam, Manipur, Mizoram, Nagaland, Sikkim, and Tripura are one the richest biodiversity areas which supports a rich butterfly fauna (Bora & Meitei 2014). A huge variety of flowering plants, suitable habitats, topography and climates are ideal for butterfly distribution, diversity and abundance. Eastern Himalayan part as well as northeastern region of India comprises 58% of butterflies found in the Indian subcontinent and Myanmar (Evans 1932). Evans (1932) reported that about 962 species and subspecies of butterflies belonging to five taxonomic families are found in northeastern India alone.

Limited research has been carried out on the butterflies of Assam. A total of 70 species of butterflies belonging to 45 genera were documented from the Regional Research Laboratory Campus, Jorhat, Assam (Bhuyan et al. 2005). In various parts of Guwahati city, a number of studies were conducted to find out the number of butterfly species. A total of 72 species have been reported from Assam State Zoo-Cum-Botanical Garden, Guwahati (Ali & Basistha 2000). Saikia et al. (2015) provided an excellent documentation of about 18 species of butterflies from Jalukbari and Gauhati university campus, Guwahati. A survey in Nambor–Doigrung Wildlife Sanctuary, Assam, identified 224 butterfly species across 137 genera and five families, with Nymphalidae being the most dominant. A study surveyed butterfly diversity in Dangori Reserve Forest, Upper Assam, documenting 121 species across six families, with Nymphalidae being the most dominant. Significant findings include the recording of rare species such as *Tanaecia julii* and *Lethe chandica*, along with endemic species like *Arhopala ganesa* and *Mycalesis mineus* (Boruah & Das 2017). A study was conducted in Panbari Forest, Kaziranga, upper Assam, that presented a checklist of 137 skipper butterfly species (Hesperiidae) including species such as Purple Lancer *Salanoemia fuscicornis*, Red-vein Lancer *Pyroneura niasana burmana*, Pied Flat *Celaenorrhinus moreana*, and various species of *Choaspes*, *Potanthus*, and *Halpe* (Gogoi 2013).

Under this contemplated background, the present study was carried out to identify and estimate the butterfly diversity in IIT, Guwahati campus.

MATERIALS AND METHODS

Study Area

The present study was conducted on the IIT Guwahati campus in Assam, renowned as one of the most beautiful campuses in India. Located at 26.187 N and 91.691 E, the campus lies on the northern banks of the Brahmaputra River, connected to northern Guwahati's Amingaon town, and is approximately 20 km from the city center. Spanning 700 ac (2.8 km²), the campus features undulating terrain, hillocks, and a variety of landscapes, including evergreen, semi-evergreen, and deciduous vegetation, as well as shrubs, grasslands, and wetlands interspersed with lakes.

The campus's diverse vegetation, host plants, food plants, and nectar-rich flowers support a rich variety of reptiles, birds, mammals, insects, and, notably, many vibrant moth and butterfly species. Study sites included urban habitat areas, hilly terrains, lakes, wetlands, and specific locations such as the guest house, administrative block, and serpentile lake. The relatively undisturbed and tranquil environment of residential and non-residential areas further contributes to butterfly richness. Detailed descriptions of the selected study sites are provided in Table 1 and Image 1.

Survey Method

The study was conducted across various sites at IIT from September 2019 to March 2022 using the Pollard Walk method. Surveys were performed twice yearly at each site, between 0900 h and 1700 h on sunny days. Observers walked fixed transects, recording butterflies within 3–5 m. Unidentified butterflies were caught, identified using field methods and references,

Table 1. Types of habitats present in different study sites of IIT campus of Guwahati, Assam.

	Study site	Name of the study site	Habitats
1	Site 1	D type and its adjoining area	Flowering plants, urban habitat, children park
2	Site 2	New E type	Vegetation, different plants
3	Site 3	Old E type	Urban habitat, lots of plantation, flowering plants, children park
4	Site 4	F type and its adjoining area	Urban habitat, good management of naturally growing flowering plants
5	Site 5	Old and new guest house site	Urban habitat, flowering plants, vegetation
6	Site 6	Manas hostel site	Vegetation, small water body, flowering plants
7	Site 7	Hill top	Dense vegetation, different flowering plants and fruit trees
8	Site 8	Serpentile lake and its adjoining area	Grass beds, vegetation and plants, road side plantation
9	Site 9	Transit camp site	Wild flowering plants, vegetation
10	Site 10	Admin site and its adjoining area	Two lakes, vegetation

and released (Yasmin et al. 2023). Identification was primarily done on-site, with photographs used for challenging cases. Data on date, location, and weather were recorded. The best time for observation and photography was early mornings, especially after rain showers, when flowering plants and nectar sources attracted the highest butterfly activity.

The identifications were done with the help of Evans (1932), and Kehimkar (2008). The WPA, 1972 status of butterflies was obtained from the database available at https://vindhyabachao.org/wildlife_guidelines/schedule_species_insects.pdf

Relative abundance is calculated by the formula:

$$\text{Species relative abundance} = \frac{\text{Species abundance}}{\text{Total abundance}} \times 100$$

RESULTS

During the survey period from September 2019 to March 2022, a total of 82 species with a total of 1,378 individuals of butterfly belonging to six families and 57 different genera were recorded from different sites of IIT, Guwahati campus. Checklist of butterfly species and their abundance in different study sites are shown in Table 2. The study analyzed the composition of butterfly families over four years (2019–2022). Nymphalidae emerged as the most dominant family, with the highest species count and abundance each year, followed by Papilionidae, Lycaenidae, Pieridae, Hesperiidae, and Riodinidae. Each family displayed variations in the number of genera, species, and individuals annually, with the details summarized in Table 3 and Figure 1. Overall, Nymphalidae consistently led in diversity and population.

The majority of butterfly species were observed on the old E-type site and the D-type site with its adjoining areas, which are rich in flowering plants, host plants, and nectar-collecting wildflowers. In 2019, out of 77 species, 19 were recorded at the old E-type site, while 14 were found at the D-type site and nearby areas. In 2020, out of 83 species, both sites recorded 17 species each. Similarly, in 2021 and 2022, out of 79 and 71 species respectively, 20 and 15 species were found at the old E-type site, while 14 and 16 species were recorded at the D-type site and its surroundings (Table 4). Figure 2 illustrates butterfly abundance over four years, showing that 2020 had the highest number of genera and species, followed by 2021.

Table 5 presents the relative abundance of butterfly species, while Table 6 and Figure 3 highlight the relative abundance of different families. The study found that in 2019, *Junonia atlites* had the highest relative abundance (3%), whereas *Telicota linna* had the lowest (0.09%). In 2020, 2021, and 2022, *Papilio polytes* recorded the highest relative abundance at 2.25%, 2.72%, and 3.35%, respectively. Conversely, *Rapala tara*, *Sarangesa desahara*, and *Abisara neophron* had the lowest relative abundance (0.15%) in 2020, while *Appias galba* (0.18%) and *Orsotriaena medus* (0.12%) showed the lowest relative abundance in 2021 and 2022, respectively. Across all four years, the family Nymphalidae consistently exhibited the highest relative abundance, while Riodinidae had the lowest (Figure 2).

During this survey, 15 butterfly species with protected status under the Schedule II (Part H with serial numbers) of The Wild Life (Protection) Amendment Act, 2022, were recorded. These include *Papilio slateri, Graphium sarpedon sarpedon, Graphium eurypylus, Graphium aristeus anticrates, Cepora nadina nadina, Artipe eryx, Poritia hewitsoni, Spindasis lohita, Neptis magadha khasiana, Tanaecia lepidea, Charaxes bernardus, Melanitis zitenius, Ragadia crisilda, Parthenos sylvia gambrisius* and *Lethe insana* (Table 2).

Image 1. Different study sites of IIT Campus, Guwahati, Assam, India.

Table 2. Checklist of butterfly species and their abundance in different study areas.

	Common name	Scientific Name	Year				Site	Status	Conservation status, 2022
			2019	2020	2021	2022			
Family: Papilionidae									
1	Common Mormon	*Papilio polytes*	4+	4+	4+	3+	Site 3, site 7, site 9	Very common	
2	Great Mormon	*Papilio memnon agenor*	3+	4+	4+	3+	All sites	Common	
3	Common lime	*Papilio demoleus*	3+	3+	2+	2+	Site 1 site 2, site 5	Very common	
4	Common mime	*Papilio clytia clytia*	3+	4+	4+	3+	Site 1, site 3, site 6, site 10	Common	
5	Blue-striped Mime	*Papilio slateri*	–	3+	3+	2+	Site 2, site 7	Not rare	Schedule II (Part H; No. 250)
6	Red Helen	*Papilio helenus*	2+	3+	3+	+	Site 1, site 8	Not rare	
7	Yellow Helen	*Papilio nephelus*	4+	4+	4+	3+	Site 3, site 4, site 8,	Not rare	
8	Common Bluebottle	*Graphium sarpedon sarpedon*	+	+	2+	+	Site 6, site 10	Common	Schedule II (Part H; No. 255)
9	Fivebar Swordtail	*Graphium antiphates pompilius*	+	2+	3+	3+	Site 4, Site5	Not rare	
10	Fourbar Swordtail	*Graphium agetes aestes*	+	2+	–	–	Site 1, Site 7	Rare	
11	Common Jay	*Graphium doson*	2+	4+	3+	2+	Site 1, site 2, site 3	Not rare	
12	Great Jay	*Graphium eurypylus cheronus*	2+	3+	2+	–	Site 1, site 3	Not rare	Schedule II (Part H; No. 264)
13	Great Zebra	*Graphium xenocles xenocles*	2+	2+	1+	1+	site 2, site 6	Not rare	
14	Chain Swordtail	*Graphium aristeus anticrates*	2+	3+	2+	–	Site 5, site 6	Not rare	Schedule II (Part H; No. 252)
15	Common Rose	*Atrophaneuraaristolochiae*	+	2+	+	+	Site 3, Site 7	Rare	
16	Common Birdwing	*Troides Helena cerberus*	2+	3+	3+	2+	Site 1, site 3	Not rare	
17	White Dragontail	*Lamproptera curius curius*	3+	3+	2+	2+	Site 5, site 6	Not rare	
18	Great Windmill	*Byasa dasarada dasarada*	2+	3+	2+	2+	Site 2, site 3	Not rare	
19	Common Banded Awl	*Hasora chromus*	3+	4+	3+	2+	Site 1, site 7	Common	
20	Yellow Gorgon	*Meandrusa payeni evan*	3+	3+	2+	2+	Site 3, Site 5	Not rare	
Family: Pieridae									
1	Common grass yellow	*Eurema hacabe*	3+	4+	3+	2+	Site 3, site 7, site 10	Very common	
2	Great orangetip	*Hebomoia glaucippe*	3+	3+	2+	2+	Site 1, site 3	Common	
3	Common Emigrant	*Catopsilia Pomona*	3+	4+	3+	3+	Site 7, site 9	Very common	
4	Mottled emigrant	*Catopsilia pyranthe*	2+	3+	2+	2+	Site 3, site 7	Very common	
5	Orange Albatross	*Appias galba*	+	+	+	–	Site 4	Rare	
6	Striped Albatross	*Appias olferna*	2+	2+	+	2+	Site 4	Common	
7	Spot Puffin	*Appias lalage*	2+	+	–	+	site 3, Site 5	Not rare	
8	Lesser Gull	*Cepora nadina nadina*	2+	3+	3+	2+	Site 1, Site 3	Not rare	Schedule II (Part H; No. 286)
9	Redspot Jezebel	*Delias descombesi*	3+	4+	4+	3+	Site 1, site 5, site 7	Common	
Family: Lycaenidae									
1	Lesser grass blue	*Zizina otis*	3+	4+	3+	3+	Site 3, Site 5, site 10	Not rare	
2	Forget me not	*Catochrysops strabo*	3+	4+	3+	2+	Site 2, site 6, site 8	Common	
3	Zebra blue	*Leptotes plinius*	3+	3+	2+	2+	Site 1 site 3	Common	
4	Yamfly	*Loxura atymnus*	2+	2+	2+	+	Site 1, site 3	Not rare	
5	Assam Flash	*Rapala tara*	–	+	2+	2+	Site 5	Rare	

	Common name	Scientific Name	Year				Site	Status	Conservation status, 2022
			2019	2020	2021	2022			
6	Green Flash	*Artipe eryx*	2+	2+	+	+	Site 7, site 8	Not rare	Schedule II (Part H, No. 39)
7	Dingy Lineblue	*Petrelaea dana*	3+	2+	2+	+	Site 4, site 5	Common	
8	Common Tit	*Hypolycaena erylus himavantus*	2+	+	+	–	Site 6	Common	
9	Common Gem	*Poritia hewitsoni*	2+	3+	2+	–	Site1, site 9	Not rare	Schedule II (Part H, No. 23)
10	Common Lineblue	*Prosotas nora nora*	4+	4+	3+	2+	site 3, Site 7	common	
11	Long-banded Silverline	*Spindasis lohita*	3+	3+	2+	3+	Site 2, Site 3	Not rare	Schedule II (Part H, No. 53)
Family: Nymphalidae									
1	Leopard lacewing	*Cethosia cyane*	3+	2+	2+	+	Site 6, site 7	Not rare	
2	Peacock pansy	*Junonia almana*	+	2+	+	–	Site 1, site 3	Not rare	
3	Lemon pansy	*Junonia lemonias*	4+	3+	2+	2+	Site 5, site 8, site 10	Very common	
4	Grey pansy	*Junonia atlites*	4+	3+	3+	3+	Site 2, site 10	Very common	
5	Yellow pansy	*Junonia hiertia*	3+	4+	3+	2+	Site 7, site 5	Common	
6	Chocolate Soldier	*Junonia iphita*	2+	3+	2+	2+	Site 3, site 6	Common	
7	Great eggfly	*Hypolimnasbolina*	3+	3+	3+	2+	Site 1, site 3, site 7	Very common	
8	Plain Tiger	*Danaus chrysippus*	3+	3+	2+	2+	Site 5, site 9	Common	
9	Common four ring	*Ypthima huebneri*	3+	4+	4+	3+	Site 3, site 6	Common	
10	Common fivering	*Ypthima baldus*	2+	2+	–	+	Site 6	Common	
11	Common palmfly	*Elymnias hypermnestra*	–	+	+	–	Site 5	Rare	
12	Common Bushbrown	*Mycalesis persius*	4+	4+	3+	3+	Site 1, site 10	Very common	
13	Blue tiger	*Tirumala limniace*	3+	3+	2+	2+	Site 3, site 5	Common	
14	Dark Blue Tiger	*Tirumala septentrionis*	–	+	2+	+	Site 2, site 4	Not rare	
15	Medus Brown	*Orsotriaena medus*	2+	+	+	+	Site 1, site 7	Rare	
16	Common Indian crow	*Euploea core*	4+	3+	2+	2+	Site 5, Site 9	Common	
17	Common sailor	*Neptis hylas astola*	3+	2+	3+	2+	Site 1, site 3, Site 10	Common	
18	Spotted Sailor	*Neptis magadha khasiana*	+	2+	+	2+	Site 3, site 5	Rare	Schedule II (Part H; No. 216)
19	Grey count	*Tanaecia lepidea*	2+	4+	3+	3+	Site 1, site 4	Common	Schedule II (Part H; No. 165)
20	Plain Earl	*Tanaecia jahnu*	+	2+	+	+	Site 3, Site 6	Rare	
21	Colour sergeant female	*Athyma nefte*	3+	2+	+	2+	Site 5, site 6	Rare	
22	Tawny Rajah	*Charaxes bernardus*	2+	4+	3+	3+	Site 7, site 10	Common	Schedule II (Part H; No. 223)
23	Tawny coster	*Acraea terpsicore*	2+	4+	3+	2+	Site 3, site 5	Common	
24	Common Evening Brown	*Melanitis leda*	3+	2+	2+	+	Site 6, site 10	Common	
25	Great Evening Brown	*Melanitis zitenius*	+	2+	2+	2+	Site 1, site 3	Rare	Schedule II (Part H; No. 160)
26	Plain Tiger	*Danaus chrysippus*	3+	3+	2+	+	Site 3, Site 8	Very common	
27	Glassy Tiger	*Parantica aglea*	+	2+	4+	2+	Site 3, site 7	Common	
28	Vagrant	*Vagrans egista*	2+	+	–	2+	Site 6	Not rare	
29	Common Sergeant	*Athyma perius*	2+	3+	2+	2+	Site 8	Common	
30	Striped Ringlet	*Ragadia crisilda*	–	2+	2+	2+	Site 2, site 6	Not rare	Schedule II (Part H; No. 218)
31	Clipper	*Parthenos sylvia gambrisius*	2+	2+	+	–	Site 2, Site 5	Rare	Schedule II (Part H; No. 135)
32	Common Forester	*Lethe insana*	3+	+	+	-	Site 1, site 5, site 7	Not rare	Schedule II (Part H; No. 141)

	Common name	Scientific Name	Year				Site	Status	Conservation status, 2022
			2019	2020	2021	2022			
33	Great Nawab	*Polyura eudamippus eudamippus*	+	2 +	+	2+	site 1, Site 3	Rare	
34	Rustic	*Cupha erymanthis lotis*	2+	3+	3+	2+	Site 6	Not rare	
Family: Hesperiidae									
1	Common small flat	*Sarangesa desahara*	–	+	2+	+	Site 2, site 5	rare	
2	Common snow flat	*Tagiades japetus atticus*	4+	4+	3+	2+	Site 3, site 10	Common	
3	Paint Brush Swift	*Baoris farri*	3+	3+	2+	2+	Site 1, Site 7	common	
4	Great Swift	*Pelopidas assamensis*	+	2+	+	–	Site 3, site 4	Not rare	
5	Linna Palm Dart	*Telicota linna*	+	2+	2+	–	Site 3, site 7	Common	
Family: Riodinidae									
1	Punchinello	*Zemeros flegyas indicus*	3+	4+	3+	2+	Site 3, site 10	Common	
2	Double Banded Judy	*Abisara bifasciata*	3+	2+	2+	2+	Site 1, site 3	Not rare	
3	Tailed Judy	*Abisara neophron*	2+	+	+	-	Site 2, site 10	Not rare	

N.B. On the basis of abundance, Butterfly species were included under classes: 4+ (highly abundant, more than 25 sightings), 3+(moderately abundant, 16–25 sighting), 2+(abundant, 6–15 sighting); +(present, 1–5 sighting), -(absent).

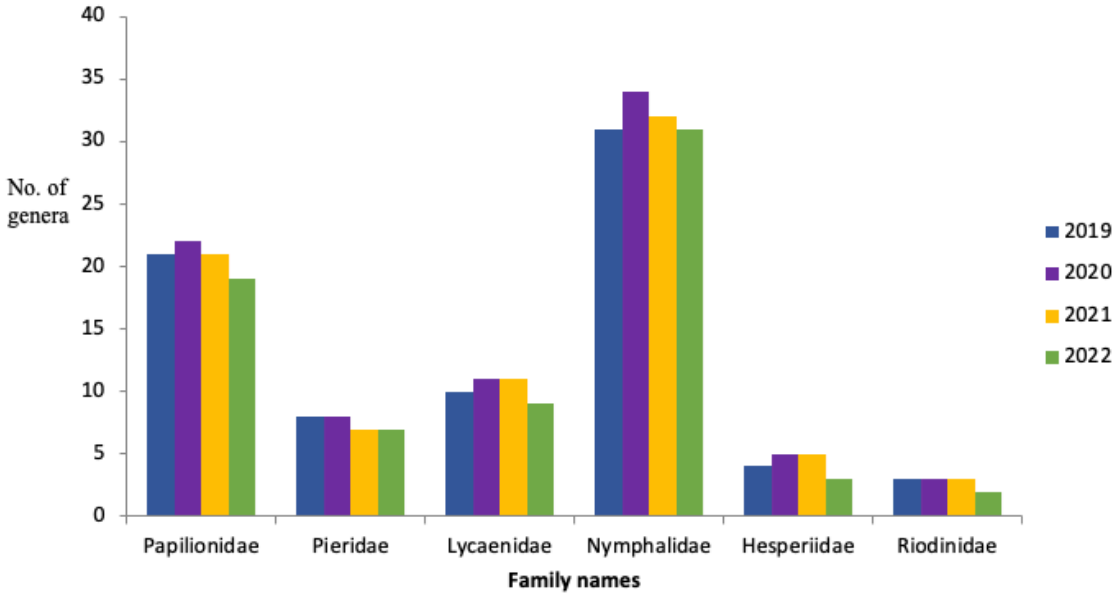


Figure 1. Bar diagram showing the number of genera of different butterfly families in four successive years.

DISCUSSION

During the survey, a total of 82 species with about 1,378 individuals of butterfly belonging to six families (Papilionidae, Pieridae, Lycaenidae, Nymphalidae, Hesperiidae and Riodinidae) and 57 different genera were recorded in the study area.

Similar studies were reported by Gogoi et al. (2023) in Soraipung Range of Dehing Patkai National Park where they recorded a total of 92 butterfly species from five families, among which 13 species were classified as protected under different schedules of the Indian Wildlife (Protection) Act, 1972 but according to Wild Life (Protection) Amendment Act, 2022, nine species among the list of 13 species are now classified as protected under Schedule I and II.

In the present investigation, a maximum number of butterflies were recorded in the year 2020 (57 genera

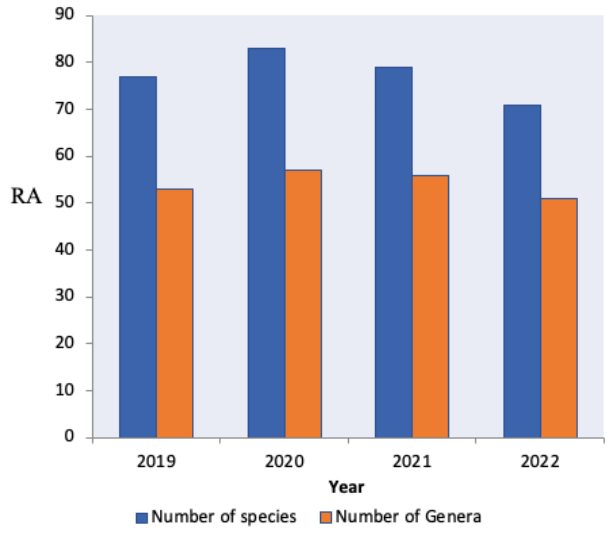


Figure 2. Bar diagram showing abundance of butterflies in four successive years across the study area.

and 63 species) and 2021 (56 genera and 79 species). This might have happened because of less human interference, disturbances and environmental pollution occurred due to COVID-19 pandemic during the year 2020 and 2021. Comparatively, a lower number of butterflies were documented in the year 2022 (51 genera and 71 species) and 2019 (53 genera and 77 species). Lower number of butterflies in 2019 may be due to restoration of day-to-day human activities in these areas.

In the present study, Nymphalidae family had the highest number and percentage of species of butterflies in all four years of study period compared with the other families. The result of the present survey is in close consortium with the findings of Ali & Basistha (2000). They documented 72 identified species of butterflies belonging to five families with the highest number of species of the Nymphalidae family from Assam State Zoo-cum-Botanical Garden, Guwahati, Assam. Furthermore, the survey of Bohra & Purkayastha (2021) of the urban landscape, of Guwahati, Assam, India, listed 249 species of butterflies belonging to six families. The Nymphalidae family was represented as dominant during the survey period. Adaptation and proper landscape management could be the reason for the high diversity of the family Nymphalidae. Another reason for the rich diversity of the family Nymphalidae might be due to their strong active flying capability and their polyphagous nature

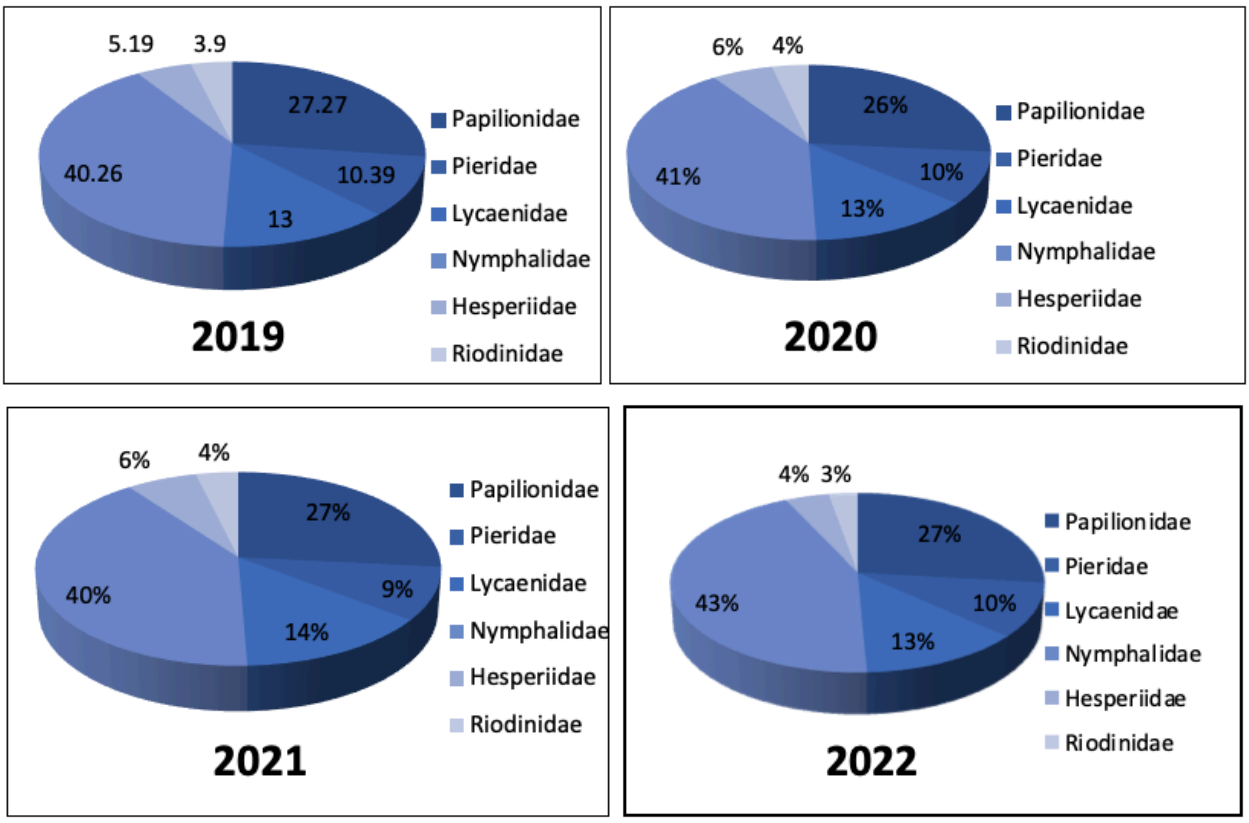


Figure 3. Pie chart showing the relative abundance of six butterfly families in different years.

Table 3. Number of genera and species of five families of butterfly.

Family	Year															
	2019				2020				2021				2022			
	No. of Genera	%	No. of Species	%	No. of Genera	%	No. of Species	%	No. of Genera	%	No. of Species	%	No. of genera	%	No. of Species	%
Papilionidae	9	16.98	21	27.27	9	15.79	22	26.51	9	16.07	21	26.58	9	17.65	19	26.76
Pieridae	6	11.32	8	10.39	6	10.53	8	9.64	6	10.71	7	8.86	6	11.76	7	9.86
Lycaenidae	10	18.87	10	12.99	11	19.30	11	13.25	11	19.64	11	13.92	9	17.64	9	12.68
Nymphalidae	22	41.51	31	40.26	24	42.11	34	40.96	23	41.07	32	40.51	22	43.14	31	43.66
Hesperiidae	4	7.55	4	5.19	5	8.77	5	6.02	5	8.93	5	6.33	3	5.88	3	4.23
Riodinidae	2 Total = 53	3.77	3 Total = 77	3.90	2 Total = 57	3.51	3 Total = 81	3.61	2 Total = 56	3.57	3 Total = 79	3.80	2 Total = 51	3.92	2 Total = 71	2.82

Table 4. Number of butterfly species in different sites of study area.

Sites	Name of the site	2019	2020	2021	2022
Site 1	D-type and its adjoining area	14	17	14	16
Site 2	New E-type	7	5	2	1
Site 3	Old E-type	19	17	20	15
Site 4	F type and its adjoining area	8	12	15	12
Site 5	Old and new guest house	1	2	3	1
Site 6	Manas hostel site	9	11	8	5
Site 7	Hill top	11	13	9	7
Site 8	Serpentile lake and its adjoining area	4	2	3	5
Site 9	Transit camp site	2	1	1	3
Site 10	Admin site and its adjoining area	2	3	4	6

which facilitates them to cover large areas and utilize a variety of host plants (Eswaran & Pramod 2005; Janz 2005; Padhye et al. 2006).

Faunal diversity is dependent upon the habitat types, food resources and food quality. The diversity and distribution of butterfly species are also influenced by sufficient larval and adult plant resources (Ramesh et al. 2010). In the present study, the highest relative abundances of different species of butterfly family were found in old E-type and hill top sites. Even though the old E-type site is an urbanized area and has human interference, the residents of this area have transformed the environment of the place in such a way that it has become an attractive and favourable place for butterflies. In agreement with the result of the present study, different earlier studies have shown that butterfly diversity in disturbed habitats is more than in undisturbed areas (Spitzer et al.1993; Hamer et al. 1997). Hill top is the least disturbed area and the occurrence of sufficient host plants make it more favourable for butterflies. *Junonia atlites* was found to have the highest relative abundance in 2019 and in the years 2020, 2021 and 2022. *Papilio polytes* showed highest relative abundance. Both *Junonia atlites* and *Papilio polytes* are common and most frequently observed butterflies and this may happen due to their adaptation power and the presence of a large number of host plants.

Adult butterflies generally prefer forest areas with medium altitude and larvae prefer ecotones with an abundance of food plants with large leaves (Piccini et al. 2022). Therefore, to conserve this beautiful creation or Nature's jewels, the suitable environment for the butterflies should be maintained as well as enhanced. Therefore, to restore growth of butterfly population, enough plantation should be carried out in and around the IIT Guwahati campus area. Prevention of human interventions and disturbances and also deforestation for the purpose of clearing land for buildings in the hilly arears and lake sides, by the management, will be a huge step towards the conservation of these amazing insects.

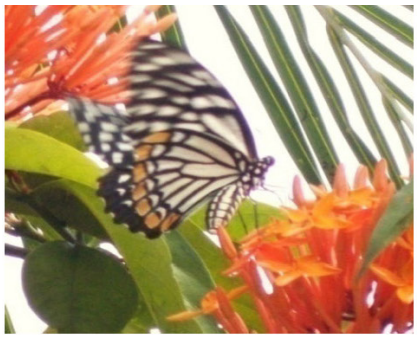
The findings of this study suggest that despite ongoing urbanization within the IIT Guwahati campus in Assam, the area still supports a thriving diversity of butterflies. During the study period, a total of 82 butterfly species, comprising 1,378 individuals from six families and 57 genera, were documented. Among these families, Nymphalidae exhibited the highest species count and percentage, followed by Papilionidae, Lycaenidae, Pieridae, Hesperiidae, and Riodinidae, in descending order of abundance (Nymphalidae > Papilionidae > Lycaenidae > Pieridae > Hesperiidae > Riodinidae).

Table 5. Numerical abundance and relative abundance (RA) of individual butterflies across the study area.

	Common name	Family	2019		2020		2021		2022	
			No.	RA (%)	No.	RA (%)	No.	RA (%)	No.	RA (%)
1	Common Mormon	Papilionidae	27	2.45	31	2.25	30	2.72	28	3.35
2	Great Mormon		24	2.18	28	2.03	26	2.36	23	2.75
3	Common lime		19	1.73	21	1.52	15	1.36	13	1.55
4	Common mime		22	2	29	2.1	27	2.45	24	2.89
5	Blue-striped Mime		-	-	18	1.31	16	1.45	13	1.55
6	Red Helen		7	0.64	16	1.16	17	1.54	5	0.6
7	Yellow Helen		27	2.45	29	2.1	28	2.54	23	2.75
8	Common Bluebottle		2	0.18	5	0.36	7	0.64	2	0.24
9	Fivebar Swordtail		5	0.45	9	0.65	16	1.45	19	2.27
10	Fourbar Swordtail		3	0.27	7	0.51	-	-	-	-
11	Common Jay		14	1.27	26	1.89	23	2.09	16	1.91
12	Great Jay		9	0.82	18	1.31	11	1	-	-
13	Great Zebra		11	1	15	1.09	12	1.09	9	1.08
14	Chain Swordtail		7	0.64	15	1.09	6	0.54	-	-
15	Common Rose		3	0.27	9	0.65	5	0.45	3	0.36
16	Common Birdwing		12	1.09	17	1.23	19	1.72	15	1.8
17	White Dragontail		17	1.55	20	1.45	14	1.27	12	1.43
18	Great Windmill		8	0.73	18	1.31	10	0.91	11	1.31
19	Common Banded Awl		21	1.91	27	1.96	24	2.18	13	1.55
20	Yellow Gorgon		21	1.91	19	1.38	13	1.18	10	1.19
21	Common grass yellow	Pieridae	21	1.91	29	2.1	26	2.36	15	1.8
22	Great orangetip		19	1.73	21	1.52	15	1.36	11	1.31
23	Common Emigrant		25	2.27	27	1.96	23	2.09	22	2.63
24	Mottled emigrant		13	1.18	18	1.31	15	1.36	14	1.67
25	Orange Albatross		8	0.73	5	0.36	2	0.18	-	-
26	Striped Albatross		12	1.09	13	0.94	11	1	14	1.67
27	Spot Puffin		6	0.55	4	0.29	-	-	2	0.24
28	Lesser Gull		11	1	16	1.16	17	1.54	12	1.43
29	Redspot Jezebel		19	1.72	26	1.89	29	2.63	21	2.51
30	Lesser grass blue	Lycaenidae	24	2.18	28	2.03	24	2.18	20	2.39
31	Forget me not		25	2.27	31	2.25	21	1.91	14	1.67
32	Zebra blue		17	1.55	22	1.6	11	1	9	1.08
33	Yamfly		5	0.45	7	0.51	4	0.36	3	0.36
34	Assam Flash		-	-	2	0.15	7	0.64	5	0.6
35	Green Flash		8	0.73	5	0.36	3	0.27	2	0.24
36	Dingy Lineblue		17	1.55	13	0.94	12	1.09	5	0.6
37	Common Tit		7	0.64	4	0.29	4	0.36	3	0.36
38	Common Gem		8	0.73	16	1.16	6	0.54	-	-
39	Common Lineblue		27	2.45	30	2.18	25	2.27	14	1.67
40	Long-banded Silverline		17	1.55	23	1.67	13	1.18	27	3.23

	Common name	Family	2019		2020		2021		2022	
			No.	RA (%)	No.	RA (%)	No.	RA (%)	No.	RA (%)
41	Leopard lacewing	Nymphalidae	21	1.91	15	1.09	10	0.91	5	0.6
42	Peacock pancy		3	0.27	8	0.58	4	0.36	-	-
43	Lemon pancy		29	2.64	22	1.6	14	1.27	9	1.08
44	Grey pancy		33	3	25	1.81	25	2.27	24	2.87
45	Yellow pansy		24	2.18	30	2.18	21	1.91	15	1.79
46	Chocolate Soldier		8	0.73	19	1.38	16	1.45	14	1.67
47	Great eggfly		16	1.45	22	1.6	19	1.72	14	1.67
48	Danaid eggfly		16	1.45	18	1.31	11	1	8	0.96
49	Common fouring		23	2.09	28	2.03	28	2.54	25	2.99
50	Common fivering		7	0.64	6	0.44	-	-	2	0.24
51	Blue striped palmfly		-	-	5	0.36	3	0.27	-	-
52	Common Bushbrown		27	2.45	31	2.25	29	2.63	23	2.75
53	Blue tiger		20	1.82	24	1.74	13	1.18	14	1.67
54	Dark Blue Tiger		-	-	3	0.22	8	0.73	5	0.6
55	Pointed Palmfly		9	0.82	7	0.51	3	0.27	1	0.12
56	Common Indian crow		27	2.45	21	1.52	13	1.18	14	1.67
57	Common sailor		20	1.82	14	1.02	19	1.72	12	1.43
58	Spotted Sailor		5	0.45	11	0.79	4	0.36	9	1.08
59	Grey count		13	1.18	27	1.96	22	2	19	2.27
60	Plain Earl		2	0.18	6	0.44	3	0.27	3	0.36
61	Perak Lascar		23	2.09	12	0.87	5	0.45	11	1.31
62	Tawny Rajah		13	1.18	28	2.03	20	1.81	14	1.67
63	Tawny coster		15	1.36	29	2.10	25	2.27	15	1.79
64	Common EveningBrown		21	1.91	9	0.65	10	0.91	4	0.48
65	Great EveningBrown		2	0.18	11	0.79	8	0.73	6	0.72
66	Plain Tiger		18	1.64	17	1.23	9	0.82	5	0.6
67	Glassy Tiger		5	0.45	14	1.02	27	2.45	13	1.55
68	Vagrant		7	0.64	3	0.22	-	-	9	1.08
69	Common Sergeant		13	1.18	24	1.74	14	1.27	12	1.43
70	Striped Ringlet		-	-	6	0.44	10	0.91	8	0.96
71	Clipper		11	1	8	0.58	4	0.36	-	-
72	Common Forester		14	1.27	23	1.67	9	0.82	4	0.48
73	Great Nawab		2	0.18	8	0.58	5	0.45	9	1.08
74	Rustic		12	1.09	21	1.52	19	1.72	13	1.55
75	Common small flat	Hesperiidae	-	-	2	0.15	7	0.64	4	0.48
76	Common snow flat		26	2.36	27	1.96	23	2.09	15	1.79
77	Paint Brush Swift		20	1.82	18	1.31	8	0.73	7	0.84
78	Great Swift		3	0.27	9	0.65	4	0.36	-	-
79	Linna Palm Dart		1	0.09	6	0.44	3	0.27	-	-
80	Punchinello	Riodinidae	21	1.91	30	2.18	22	2	19	2.27
81	Plum Judy		17	1.55	12	0.87	13	1.18	9	1.08
82	Tailed Judy		8	0.73	2	0.15	3	0.27	-	-

Papilio polytes Common Mormon



Papilio clytia clytia Common Mime

Papilio demoleus Common Lime

Eurema hacabe Common Grass Yellow

Hebomia glaucippe Great Orange Tip

Tagiades japetus atticus Common Snow Flat

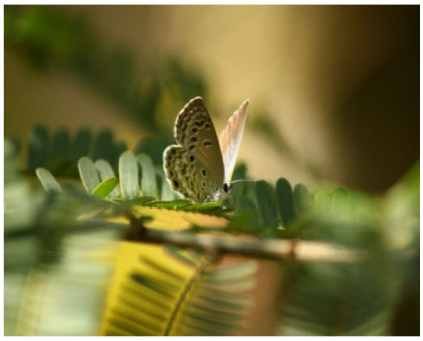
Catopsilia Pomona Common Emigrant

Catopsilia pyranthe Mottled Emigrant

Pieris canidia Indian Cabbage White

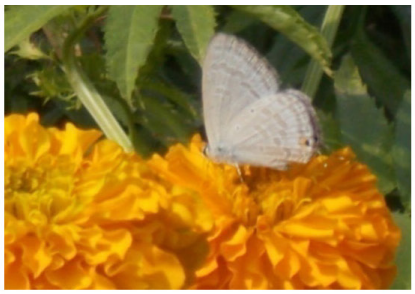
Appias olferna Striped Albatross

Zemeros flegyas indicus Punchinello



Zizina otis Lesser Glass Blue

Image 2. Photographs of some of the species of butterfly observed in the IIT Guwahati campus.

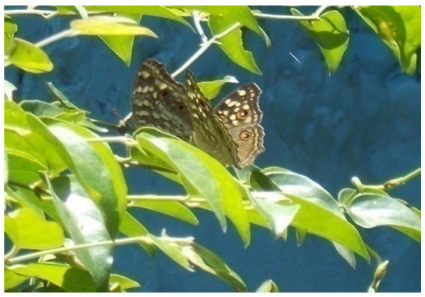


Catochrysops strabo Forget-me-not

Leptotes plinus Zebra Blue

Cethosia cyane Leopard Lacewing

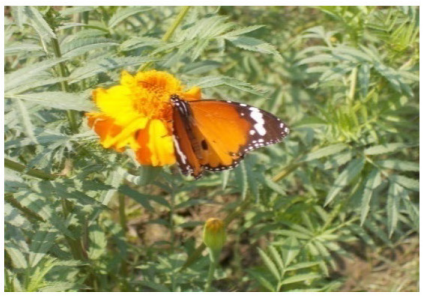
Junonia almana Peacock Pancy



Junonia lemonias Lemon Pancy

Junonia atlites Grey Pancy

Hypolimnas bolina Great Eggfly



Danaus chrysippus Plain Tiger

Ypthima huebneri Common four ring

Ypthima baldus Common Five-ring

Elymnias hypermnestra Common Palmfly

Mycalesis perseus Common Bushbrown

Appias galba Orange Albatross

Image 2 cont.. Photographs of some of the species of butterfly observed in the IIT Guwahati campus.

Tirumala limniace Blue Tiger

Euploia core Common Crow

Neptis hylas Common Sailor

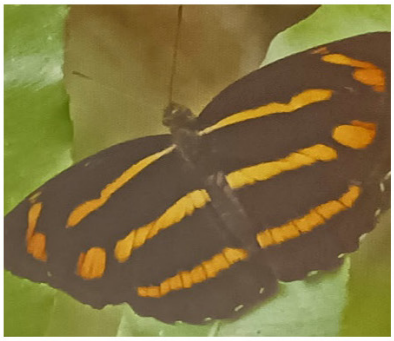
Sarangesadesahara Common Small Flat

Tanaecia lepidea Grey Count

Athyma nefte Colour Sergeant female

Acraea terpsicore Tawny Castor

Ariadne ariadne Angled Castor



Neptis ananta Yellow Sailor

Cupha erymanthislotis Rustic

Polyura eudamippus The Great Nawab

Charaxes bernardus Tawny Rajah

Image 2 cont.. Photographs of some of the species of butterfly observed in the IIT Guwahati campus.
© All the photographs are credited by Dr. Uma Dutta except *Neptis hylas* Common Sailor, *Tirumala limniace* Blue Tiger and *Junonia almana* Peacock Pancy, which are taken by Sonali Dey.

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