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A preliminary checklist of butterfly diversity in the vicinity of IIT Guwahati Campus, Guwahati, Assam, India

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Abstract
The study has been carried was out in the vicinity of IIT Guwahati campus from June 2016 to May 2017 to ascertain the number of butterfly species present. In the present study, a total number of 54 species of butterflies belonging to 6 (six) families were reported. Among various families of butterflies found, Nymphalidae family was represented by 22 species followed by 10 species of Lycaenidae, 9 species of Pieridae, 5 species of Papilionoidae, 6 species of Hesperidae and Riodinidae family was represented by 2 species. This study is a preliminary study undertaken at the proposed site which can be regarded as one of the significant taxonomical work.

Keywords: Butterfly, diversity, abundance, near IIT Guwahati Campus, Assam

1. Introduction
North east India is one of the richest biodiversity zones of our country which harbors a rich insect diversity. Like other insect species, the region supports a rich butterfly and moth fauna. It is well known fact that butterflies are important components of biodiversity, and are ecologically important due to the role they play in the food chain of a forest ecosystem [1]. It is worth mentioning that butterflies are good biological indicators of environment variation and quality and have significant conservation values [2]. A marked change in their distribution and abundance may be an early warning towards changing climatic conditions, habitat patterns and degradation of environmental qualities of that particular region or areas [3].
Diversity studies of butterflies in our country have been numerous. The number of Indian butterflies reported is one fifth of total amount of the world butterfly species [4]. The total number of butterfly species observed from the Indian region is about 1,504 [5], out of which about 962 species of butterfly belonging to five families and sub families were described from Assam region alone, of which 69 species of Papilionidae, 57 Pieridae, 269 Lycaenidae, 356 Nymphalidae and 211 species belonging to family Hesperiidae [6, 7]. A number of studies were done in various pockets of Guwahati city, Assam, to ascertain the number of butterfly species [8-11]. Diversity of tropical butterflies in urban altered forest at Gauhati university campus, Jalukbari, Guwahati, reported 140 species [10]. Jalukbari area is only 10.4 km away from IIT Guwahati campus. Recent study undertaken by Saikia *et al*. [11] reported authentication of at least 18 species of butterflies existence in Jalukbari and Gauhati university campus, which is on the opposite bank of river from the proposed study site i.e IIT Guwahati campus. However a very fragmentary work has been carried out to ascertain the butterfly Diversity in the vicinity of IIT Guwahati, Assam. Keeping all in mind, this preliminary work was carried out to prepare a checklist of butterfly diversity from the vicinity of IIT Guwahati campus, Guwahati, Assam, India.

2. Materials and methods
2.1. Study area
The survey of diversity of butterfly was carried out at in the vicinity of IIT Guwahati campus. The campus of IIT Guwahati is on the northern banks of Brahmaputra River and in the North Guwahati town of Amingaon. It is considered as the most beautiful campus in India which lies between elevation -171 feet; latitudes- $26^0$11’14’’N and longitudes $91^0$41’30^0E (Wikipedia).The campus is on a 703 acres plot of land around 20 km from the heart of the city. It has the Brahmaputra on one side and hills and vast open spaces on other.

The campus covers undulating terrain with several hillocks covered with lush green vegetation and wood interspersed by few lakes making it one of the idle habitats of butterflies.

The main study area chosen for the assessment of butterfly diversity were the campus of Kendriya Vidyalaya (Site 1) which is marked by dense grass floors and floral orchards, from main gate areas to towards the river bank (site 2) and the bank side of the river Brahmaputra (site 3).

Pic 1(a): Map showing study sites near the vicinity of IIT Guwahati Campus.

Site 1: (near KV campus)

Site 2: (fields nearby road towards river bank)

Site 3: (near water body)

Picture 1(b): Showing the view of three study sites of the study.

Field survey of butterflies was conducts from June 2016 to May 2017, following modified pollard walking methods[12].Butterflies were sampled on fixed transects in different habitats. Butterflies were sampled from 9.00 am to 5.00 pm on sunny days. Field notes, photographs and observation of butterflies were taken for the entire. Species

were noted along with the date location of capture and other important taxonomic information including the weather condition. At each location the same route of inspection was followed each time to reduce the number of variable present.

The entire study area was divided on the basis of habitats. In this method, permanent approximately 900 m long and 5 m wide line transect was set up in each habitat and marked in the field along with GPS data and land mark for repeated observations.

Butterfly species were recorded around the radius of five meters from the observer covering his either side above or front. The specimens whom were difficult to identify in the field were collected as voucher specimens using a hand net. Identifications were carried out with the help of standard keys [13-16] and web-based resources (ifoundbutterflies.org and inaturalist.org).

3. Results and Discussion

Among lepidopteron, butterflies are taxonomical well studied group of insects as they occupy a very important place in the ecosystem and their occurrence and diversity are considered as a good indicator of the environmental quality [2, 3]. Northeast India is considered very rich in butterfly diversity and researchers were always fascinated by these nature jewels and simultaneously numerous work were carried out in patches in different parts of Northeast India. Like this many pockets of Guwahati city has been accessed to find the status of butterfly fauna. One of the earliest studies regarding the urban butterfly fauna in Guwahati city was undertaken in Assam state zoo cum botanical garden reported the presence of 72 species [8]. Saikia *et al* reported 140 species in the campus of Gauhati University, Guwahati, which is just 10.4 km away from the campus of IIT Guwahati [10]. And same numbers of species were also reported from Deepar Beel area, a Ramsar site, which is about 25 km from the campus of IIT [17].

In the present study, 54 species were found from the three study sites which are shown in table 1.

Table 1: Checklist of butterflies species and their relative abundance found in the study areas**.**

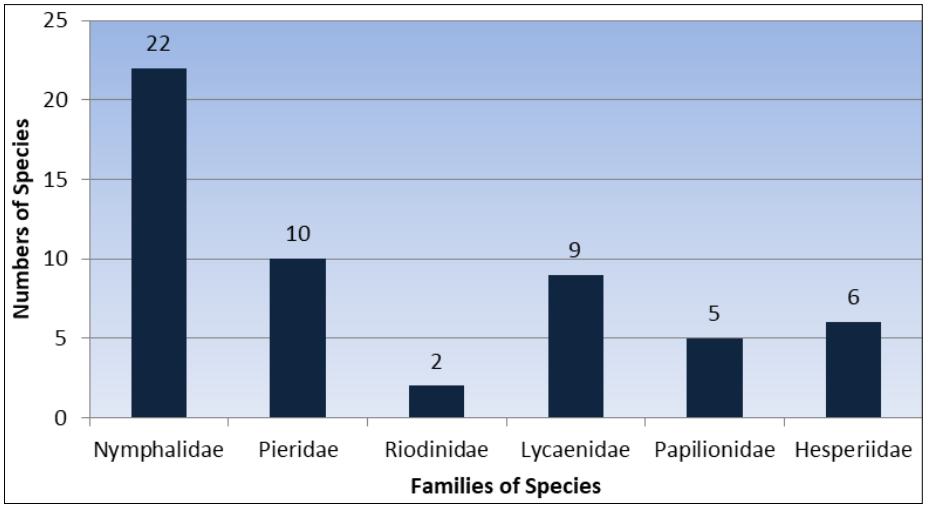
S. No	Common Name	species	Site 1	Site 2	Site 3	Relative Occurrence
1.	Grey Pansy	*Junonia atlites atlites*	+	+	+	*FC*
2.	Dusky Diadem	*Ethope himachala*	-	-	-	*UC*
3.	Common Evening brown	*Melanitis leda leda*	+	+	+	*C*
4	Perak Lascar	*Paltoporia paraka paraka*	+	-	+	*UC*
5	Common Five ring	*Ypthima baldus*	+	+	-	*C*
6	Tawny Coaster	*Acraea terpsicore*	+	+	-	*C*
7	Common Palmfly	*Elymnias hypermnestra undularis*	-	+	+	*C*
8	Common Brushbrown	*Mycalesis perseus blasius*	+	+	+	*FC*
9	Grey Count	*Tanaecia lepidea lepidae*	-	+	+	*C*
10	Common Crow	*Euploea core core*	+	+	+	*FC*
11	Large Yeoman	*Cirrochroa aoris aoris*	+	-	+	*UC*
12.	Common Red forester	*Lethe mekara*	+	+	+	*UC*
13	Lemon Pansy	*Junonia lemonias lemonias*	+	+	+	*FC*
14	Commander	*Moduza procris procris*	+	-	+	*C*
15	Striped Blue crow	*Euploea mulciber mulciber*	+	+	+	*FC*
16	Dark-branded brush brown	*Mycalesis mineus mineus*	+	+	+	*FC*
17	Spotted Palmfly	*Elymnias malelas malelas*	+	+	+	*C*
18	Chocolate Pansy	*Junonia iphita iphita*	+	+	+	*FC*
19	Common Sailor	*Neptis hylas varmona*	+	+	+	*FC*
20	Peacock Pansy	*Junonia almana almana*	-	+	-	*FC*
21	Yamfly	*Loxura atymnus atymnus*	-	-	+	*C*
22	Danaid Eggfly	*Hypolimnas misippus*	+	+	+	*FC*
23	Banded Tree brown	*Lethe verma sinitica*	+	-	+	*C*
24	Dark Himalayan oak blue	*Arhropala rama rama*	+	+	+	*C*
25	Common Acacia blue	*Surendra quercetorum quercetorum*	+	+	+	*FC*
26	Forget me-not	*Catochrysops strabo*	+	+	+	*FC*
27	Common Pierrot	*Castalius rosimon*	+	+	+	*C*
28	Common Silverline	*Spindasis vulcanus vulcanus*	+	-	+	*C*
29	Common Line blue	*Prosotas nora ardates*	+	+	+	*FC*
30	Dark Grass blue	*Zizeeria karsandra*	+	+	+	*FC*
31	Metallic Cerulean	*Jamides alecto eurysaces*	+	+	+	*FC*
32	Pale Grass blue	*Pseudozizeeria maha maha*	+	+	+	*FC*
33	Plum Judy	*Abisara echerius suffusa*	-	-	+	*C*
34	Punchinello	*Zemeros flegyas flegyas*	+	+	-	*UC*
35	Palm Bob	*Suastus gremius gremius*	+	+	+	*UC*
36	Common Straight swift	*Parnara guttatus*	+	+	+	*C*
37	Common Snow flat	*Tagiades japetus ravi*	+	+	+	*C*
38	Forest Hopper	*Artictopterus jama olivascens*	+	+	+	*UC*
39	Spotted Small flat	*Sarangesa purendra purendra*	+	+	+	*UC*
40	Common Red eye	*Matapa aria*	+	-	+	*C*
41	Common Mormon	*Papilio polytes romulus*	+	+	+	*FC*
42	Psyche	*Leptosia nina nina*	+	+	+	*C*
43	Three spot grass yellow	*Eurema blanda silhetana*	+	-	+	*C*
44	Spotless Grass yellow	*Eurema laeta laeta*	+	+	+	*FC*
45	Common Grass yellow	*Eurema hecabe hecabe*	+	+	+	*FC*
46	Tailed jay	*Graphium agamemnon agamemnon*	+	-	+	*C*

47	Great Mormon	*Papilio memnon agenor*	+	+	+	*FC*
48	Stripped Albatross	*Appias olferna*	-	-	+	*C*
49	Red spot Jezebel	*Delias descombesi descombesi*	+	+	-	*UC*
50	Chocolate Albatross	*Appias lyncida eleonora*	+	+	+	*C*
51	Indian Cabbage white	*Pieris canidia indica*	+	+	+	*FC*
52	Common Emigrant	*Catopsilia pomona*	+	+	+	*FC*
53	Lime swallow tail	*Papilo demoleus demoleus*	+	+	+	*FC*
54	Yellow Helen	*Papilio nephelus chaon*	+	-	+	*UC*

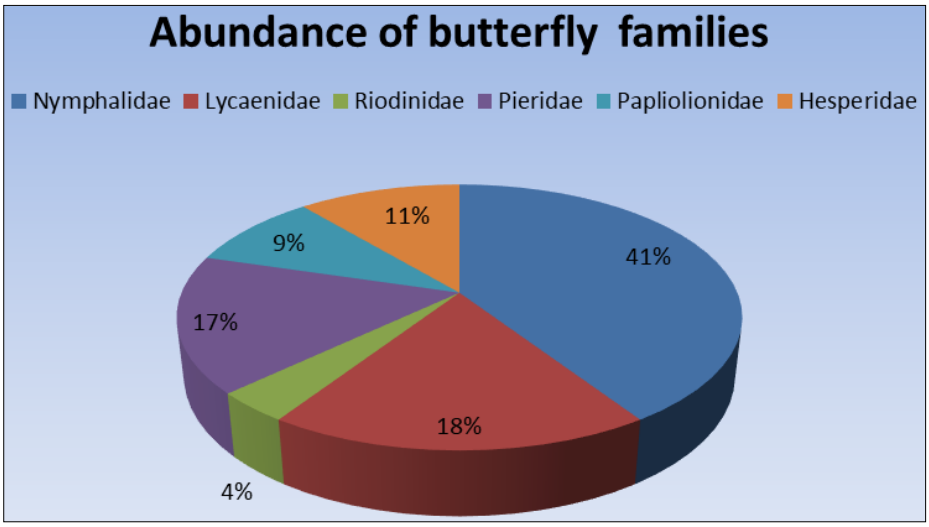
The status of abundance of butterflies were characterized into three groups based on the number of sightings in the study area namely fairly common (FC= more than 30 sightings); common (C= 15-30 sightings); uncommon (UC= less than 15 sightings), respectively.

Table 2: Family wise distribution of butterfly's species found in the study areas.

Family	Species	Number
1. Nymphalidae	1. *Junonia atlites atlites* 2. *Melanitis leda leda.* 3. *Ethope himachala* 4. *Paltoporia paraka paraka.* 5. *Ypthima baldus.* 6. *Elymnias hypermnestra undularis.* 7. *Mycalesis perseus blasius* 8. *Tanaecia lepidea lepidea.* 9. *Euploea core core* 10. *Cirrochroa aoris aoris.* 11. *Lethe mekara.* 12. *Junonia lemonias lemonias* 13. *Moduza procris procris.* 14. *Euploea mulciber mulciber* 15. *Mycalesis mineus mineus.* 16. *Junonia iphita iphita.* 17. *Neptis hylas varmona.* 18. *Junonia almana almana* 19. *Acraea terpsicore.* 20. *Lethe verma sinitica.* 21. *Hypolimnas misippus.* 22. *Elymmias malelas malelas*	22
2. Lycaenidae	1. *Castalius rosimon.* 2. *Catochrysops strabo.* 3. *Arhropala rama rama.* 4. *Surendra quercetorum quercetorum* 5. *Spindasis vulcanus vulcanus* 6. *Zizeeria karsandra* 7. *Jamides alecto eurysaces* 8. *Loxura atymnus atymnus.* 9. *Pseudozizeeria maha maha.* 10. *Prosotas nora ardates*	10
3. Riodinidae	1. *Zermeros flegyas flegyas.* 2. *Abisara echerius suffusa*	2
4. Pieridae	1. *Leptosia nina nina.* 2. *Appias olferna* 3. *Eurema hecabe hecabe* 4. *Delias descombesi descombesi.* 5. *Appias lyncidea eleonora.* 6. *Pieris canidia indica* 7. *Eurema blanda silhetana* 8. *Catopsilia pomona.* 9. *Eurema laeta laeta*	9
5 Papilionidae	1. *Papilo demoleus demoleus.* 2. *Papilio nephelus chaon.* 3. *Graphium agamemnon agamemnon.* 4. *Papilio polytes romulus.* 5. *Papilio memnon agenor*	5
6 Hesperidae	1. *Paranara guttatus* 2. *Tagiades japetus ravi.* 3. *Suastus gremius gremius* 4. *Matapa aria.* 5. *Sarangesa purendra purendra.* 6. *Artictopterus jama olivascens*	6



Graph 1: Bar diagram showing family wise butterfly species in the study areas.



Graph 2: Pie chart showing the abundance of butterfly families in the study sites.

1. Grey pansy

2. Dusky Daidem

3. Common Evening brown

4. Common Pierrot

5. Perak Lascar

6. Common Five ring

7. Punchinello

8. Common Straight Swift

9. Forgetme-not

10. Striped Albatross

11.Common Plamfly

12. Dingy Bush Brown

13. Red-spot –Jazebel

14. Grey Count

15. Common Crow

16. Large Yeoman

17. Chocolate Albatross

18. Indian Cabbage White

19. Common Snow Flat

20. Dark Himalayan Oakblue

21. Common Acacia Blue

22. Common Red Forester 23. Palm Bob 24. Common Silverline

25. Yellow Helen 26. Yamfly 27. Tawny Costar

28. Plum Judy 29. Danaid Eggfly 30. Commander

Pic 2: Few photo plates of butterflies collected from study sites.

The present study provides an array of butterfly diversity in the vicinity of IIT Guwahati campus, Guwahati, Assam. In the present study, all together 54 species of butterflies belonging to six different families were found from the three study sites. Among the families, it is found that Nymphalidae is represented by 22 species followed by Lycaenidae 10 species, Pieridae 9 species, Papilionidae 5 species, Hesperidae 6 species and Riodinidae 2 species (Graph 1). The species belonging to the six different families were listed in Table 2. The relative abundance of Nymphalidae is highest (41 %) followed by Riodinidae (4%), Pieridae (17%), Papilionidae (9%) and Hesperidae (11%) (Graph 2). Dominance of Nymphalidae family in the present finding is in conformity with study conducted in Assam state zoo cum botanical garden [8]. But the occurrence of Papilionidae from the study sites is comparatively less with the previous studies undertaken in Deepar Beel area, Jalukbari and Gauhati University campus which are nearby IIT campus [10, 11, 17]. Less occurrence of Papilionidae may be attributed to lack of host specific larval plants and fragmentation of habitat areas. Diversity of Nymphalid butterfly is more in the present study and this result is in conformity with diversity work carried out in Rani Garbangha reserve forest where 113 nymphalid butterfly species were reported [19]. It's worth mentioning that Rani Garbhanga reserve forest is one of the important forest reserve of Guwahati city and is 19.9 miles away from proposed study sites. Similarly another study reported 14 species of Papilionidae from Gauhati University campus [10], however in our study we have been able to report only 5 species of Papilionidae.

Presence of two representative of family Riodinidae namely - *Zermeros flegyas flegyas* and *Abisara echerius suffusa* is an interesting finding as till date no study on butterfly diversity in Guwahati City reported about their presence. So sighting of these two species can be said an important taxonomic finding. Amongst the different butterfly species, common Pierrot and Danaid Eggfly are the butterfly species belonging to schedule I whereas common Silverline, Metallic Cerulean and Grey Count belongs to schedule II of IUCN threat categories. Common Crow, which is placed under schedule V, is very common butterfly species. Sighting of dusky Diadem in the campus is taxonomically important as references suggest that it might be the first record from the North bank of Guwahati. Additional to that, seven species in the study area are legally protected under Schedule I, II and V of the Wildlife (Protection) Act, 1972 with the Wildlife (Protection) amendment Act 2002.

The status of abundance of butterflies were characterized into three groups based on the number of sightings in the study area namely fairly common (FC= more than 30 sightings); common (C= 15-30 sightings); uncommon (UC= less than 15 sightings), respectively and it is found that 24 species belong to FC category, 10 were relatively UC and rest are in common(C) sightings.

Observation of 54 butterfly species including sighting of rare species in an urbanized and fragmented area seems to be encouraging for conservation purposes however the number of species found is comparatively less that has been hypothesized. Non finding of butterflies of common species like one common tiger butterfly, windmills, sailors and hoppers in the present study area may be due to the increasing destruction of larval food plants, rapid urbanization and extreme climatic conditions that have been noticed in recent years. However the presence of representative of six butterfly families indicates a good richness. Reports on butterfly diversity from other habitats in the vicinity of human habitation like the Deepar beel, Jalukabari, and Gauhati University campus also indicate the presence of rich butterfly diversity [10, 11, 17]. The conservation scenario in urban areas may be improved by preserving the food plants, weeds and shrubs in habitat areas. Initiative must be taken for restoration of ecosystem in these areas so that it can boost more species presence as it is well known that are butterfly are now considered as ecological and environmental indicators[18]. Conservation of these important pollinators is essential for sustainable development so designing suitable methodology for conservation in urbanized areas involving local people is much needed. Awareness among local people may boost conservation of species and hence increase species richness in that particular area.

Although the present study is just a checklist to find the available butterfly fauna in study sites but one of the observations while doing surveys is that butterflies were found to be more abundant during monsoon and post-monsoon seasons compared to summer and winter. This may be due to extreme climatic conditions of this region in the recent times. Variable temperature from 26 degree in winter to 40 degrees in summer may makes the climate unfavorable for butterflies during summer and winter as there are very few nectaring and larval food plants available during these two seasons. Moderate monsoon favours host plant growth which supports high butterfly diversity in the monsoon and post-monsoon seasons. The least number of butterflies were collected during the winter season. But a detailed comprehensive study is required to access the availability of different species in different seasons of a year.

Though the present study is only a preliminary reporting on the butterfly diversity from mentioned sites but the study is first of its kind from the study site. This survey can be used in monitoring ecosystem health, stability and functioning together with addition in state taxonomic data base. The finding from the different study sites outside the campus of IIT encourages more elaborate research to find the exact diversity inside the campus of the esteemed institute which may which throws light into rich butterfly diversity in it and thus this study can be suggested as benchmark for further elaborate study of city's butterfly diversity and it may be considered one of the important taxonomic study.

4. Conclusion

A preliminary investigation on the diversity of butterflies in the vicinity of IIT Guwahati campus showed great richness and it depicts a great taxonomic work. In the present study altogether 54 species of butterflies were reported from the three different transect study sites. Presence of two species belonging to Riodinidae is very important finding of the survey. This study is first of its kind near the campus of IIT and it showed a good habitat place for butterflies and further elaborate studies can be carried out regarding richness in terms of subfamilies of butterflies species and conservation steps has to be initiated to maintain the diversity.

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