

## **Spatial and temporal dimensions of butterfly species diversity in Jahangirnagar University campus and its suburbs, Bangladesh**

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### **Abstract**

Survey was conducted in four different areas viz. Jahangirnagar University Campus, Gerua, Nabinagar and Chandra of Bangladesh from October 2012 to September 2013. A total of 100 species of butterflies under 9 families were identified. The maximum number of butterflies (31 species) was recorded under the family Lycaenidae followed by Nymphalidae (17 species), Pieridae (16 species), Hesperidae (15 species), Satyridae (7 species), Papilionidae (7 species), Danaidae (5 species) and 1 species to each family of Acraeidae and Amathusiidae. Species diversity was higher from summer to early monsoon and declined in late winter. Out of four areas, the highest number of butterfly was recorded at Jahangirnagar University campus followed by Gerua, Nabinagar and the lowest at Chandra. Out of 100 species, 7 were very common, 12 were common, 17 were rare, 64 were very rare. Dusky Part Wing (*Psolos fuligo* Mabille, 1876) under the family Hesperidae was recorded for the first time in Bangladesh.

**Key words:** Spatial and temporal dimensions, butterflies, JU campus, suburbs

### **INTRODUCTION**

Butterfly is one of the most wonderful and fascinating smaller creatures on earth. It has been increasingly recognized that butterflies are important for ecological and conservation monitoring because of its strong sensitivity to any changes of climatic conditions as well as seasonal and ecological changes (Kunte 1997; Houlahan *et al.*, 2000; Mac Nally *et al.*, 2004; Stuart *et al.*, 2004). Adult butterflies function as vital plant pollinators in the environment causing pollination to more than 50 economically important plant crops (Borges *et al.*, 2003, Rajagopal *et al.*, 2011). However, it is a matter of regret that they are not taken into account under conservation efforts at broad way.

It is estimated that approximately 28,000 species of butterflies are found to inhabit in the world (Robbins & Opler, 1997) while it is assumed that there are about 400 species of butterflies exists in Bangladesh (Larsan, 2004; Chowdhury & Hossain, 2013). Of which, 325 species have been identified in Bangladesh (Ameen & Chowdhury, 1968; Baksha & Choudhury, 1983; Baksha & Choudhury, 1985; Alam & Ullah, 1995; Chowdhury & Mohiuddin, 2003; Hossain *et al.*, 2003; Larsan, 2004; Bashar *et al.*, 2006; Razzak *et al.*, 2007; Ahmad *et al.*, 2009; Shefa & Hossain, 2010; Islam *et al.*, 2011; Habib *et al.*, 2012; Habib *et al.*, 2013; Chowdhury & Hossain, 2013; Islam *et al.*, 2013; Khandokar *et al.*, 2013; Neogi *et al.*, 2014; Bashar, 2014; Hossain, 2014; Hossain, 2014a, Hossain, 2014b). On the other hand, about 110 species of butterflies were recorded in Jahangirnagar University campus and many more remain to be identified in this area (Hossain *et al.*,

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2003; Razzak *et al.*, 2007; Shefa & Hossain, 2010; Chowdhury & Hossain, 2013). Thus, present study was started to evaluate the species diversity, dynamics, ecological status of within and around Jahangirnagar University campus.

## MATERIALS AND METHOD

**Study sites:** The study areas are geographically situated in central part of Bangladesh under Dhaka and Gazipur district. The study sites were selected depending on their vegetation characteristics and human interferences. The temperature was highest in April (36.3° C) and lowest in January (7.7° C). The total rainfall during the study period was 1217 mm and the mean monthly humidity was 82.07 %. Description of the study sites are given below:

**Jahangirnagar University campus (J):** The campus of Jahangirnagar University is an undeclared sanctuary. Geographically the campus is at 23°5243.89' N latitude and 90°1617.10' E longitude, 32 km north-west from Dhaka City which includes about 280 hectors of area and it is about 6 meter high from mean sea level (Fig. 1). There are many woodlands, grasslands, garden, vegetable garden, rice field and bushes which are the habitat of many insects and wildlife including butterflies. All of these plants are very important for butterfly as larval host plant and nectar plants.

**Gerua (G):** It (23°5202.61' N latitude and 90°1247.70' E longitude) is adjacent to Jahangirnagar University campus (Fig: 1). It is also enriched with reddish and yellowish soil with large amount of iron, aluminum and calcium. From the month of June to August, east side of gerua bazaar (crop field site) covered with rainwater. Gerua consists of some cultivated lands, homestead vegetation and bushes.

**Nabinagar (National Martyr's Monument and Kurgao area) (N):** Geographically it (23°5443.87' N latitude and 90°1513.05' E longitude) is closed to Jahangirnagar University campus (Fig. 1). It is enriched with red soil. Nabinagar is most human produced disturbed area. This area is bounded by Savar Cantonment Golf course on south and Jahangirnagar University campus on south east, Chandra–Nabinagr road on north- east , Ganakbari on north, Gono Shastha and Bangshi river on west.

**Chandra (Sal Forest Area) (C):** Chandra, the moist deciduous Sal (*Shorea robusta*) forest is distributed at the Kaliakur Upazila in Gazipur district. Geographically it (24°0300.66' N latitude and 90°1414.93' E longitude) is closed to Nabinagar area (Fig.1). It is characterized by high, undulated land surface with red soil. Sal plants were more common in this area, but at present these natural trees are replaced by exotic plant species (*Acacia* sp.). Chandra area is divided into eastern and western part by Nabinagar – Chandra road. BKSP (Bangladesh Krira Shikkha Proothistan), Nandan Park and EPZ (export processing zone) situated on south of this area.

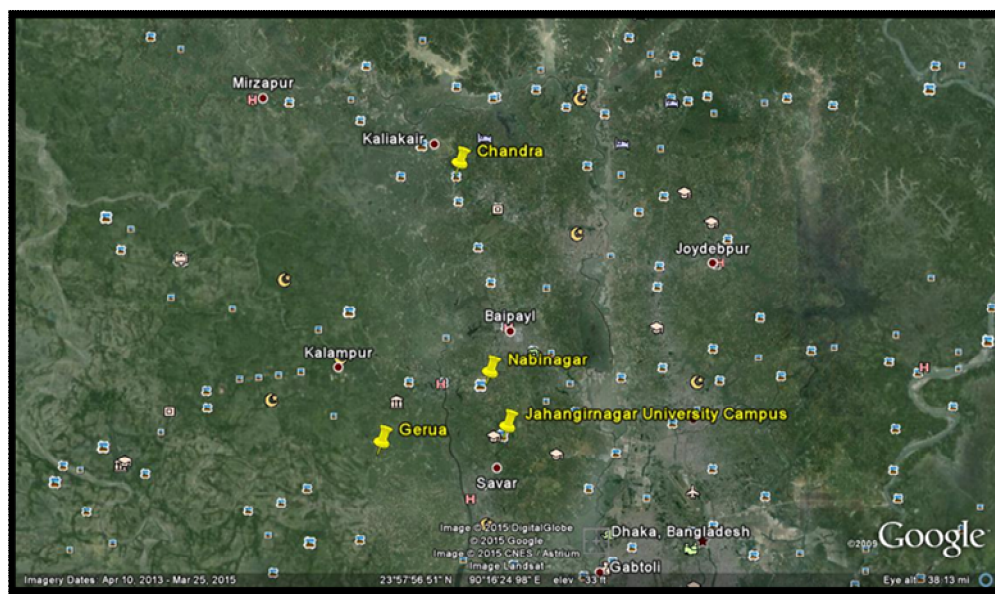
**Sampling methods:** Butterflies were collected from morning 8:30 am to evening 5:00 pm during October 2012 to September 2013. However, counting days were changed during unfavorable weather condition. Similar transect-line was set up at each site.

**Collection:** Butterflies were collected using a hand-held sweeping net and placed in killing jar. Chloroform was used as killing agent. After killing, they were taken into triangular paper envelope to give a perfect using shape. At last, specimens were taken in laboratory at Department of Zoology, Jahangirnagar University for further confirmation of identification and preservation.

**Identification:** The identification of butterflies was conducted by using the keys of Bingham (1905), Bingham (1907), Evans (1932), Wynter-Blyth (1957) and Talbot (1978 a, b).

For convenience of data collection and interpretation, the year was divided into six seasons as, (a) early winter (October and November), (b) late winter (December and January), (c) spring (February and March), (d) summer (April and May), (e) early monsoon (June and July) and (f) late monsoon (August and September). The occurrence of butterfly indicated by 1-12 number (in Table 1) depending on the different study period (month) that comprises by October (10), November (11), December (12), January (1), February (2), March (3), April (4), May (5), June (6), July (7), August (8) and September (9).

For assessing butterfly status, the observed butterflies species were grouped into four categories to indicate the status of assessment namely : Very common (VC) : presence of 35 to 50 butterfly per month , Common (C) : presence of 20 to 35 butterfly per month , Rare (R) : presence of 10 to 20 butterfly per month and Very Rare (VR) : presence of 1 to 10 butterfly per month.



**Fig. 1. Map of four different study areas (Yellow marks)**

## RESULTS AND DISCUSSION

During the period of study, a total of 100 species of butterflies under 9 families were recorded. Among them, 17 species belonged to the family Nymphalidae, 16 species to Pieridae, 31 Species to Lycaenidae, 7 species to Satyridae, 7 species to Papilionidae, 5 species to Danaidae, 15 species to Hesperidae and 1 species to each family of Acraeidae and Amathusidae in JU campus, Gerua, Nabinagar and Chandra (Table 1, Fig. 2). Out of 100 identified species, 1 species, Dusky Part Wing (*Psolos fuligo* Mabille, 1876) under the family Hesperidae was newly recorded species in Bangladesh (Plate 1). This species found at bushes and preferred shady areas. Besides Bangladesh, this species is also found in India, Laos, Malaysia, Philippines, Singapore, Thailand and Vietnam (Choudhury & Hossain, 2013).

In JU campus a total of 98 species (except *Rapala iarbus* and *Arhopala amantes*) under 9 families were recorded (Table 1). On the other hand, 71 species of butterflies under 8 families, 69 species under 8 families and 68 species under 8 families were recorded from Gerua, Nabinagar and Chandra respectively, (Table 1 and 2).

In this investigation, out of 100 species, 7 species were very common (*Junonia atlites*, *Junonia almana*, *Eurema hecabe*, *Zizina otis sangara*, *Melanitis leda*, *Mycaeleus perseus blasius*, *Parnara guttata*), 12 species were common (*Phalanta phalantha*, *Neptis hylas*, *Junonia lemonias*, *Leptosia nina*, *Catopsilia Pomona*, *Castalius rosimon rosimon*, *Prosotas dubiosa*, *Rapala manea schitacea*, *Neopithecops zalmora*, *Elymnias hypermnestra*, *Papilio polytes*, *Iambrix salsala*), 17 species were rare and 64 species were very rare (Table 1).

Out of 100 species, 27 were found throughout the year in all study areas and the species were *Junonia atlites*, *Junonia almana*, *Phalanta phalantha*, *Cethosia cyane*, *Neptis hylas*, *Leptosia nina*, *Eurema hecabe*, *Delias eucharis*, *Castalius rosimon rosimon*, *Prosotas dubiosa*, *Rapala manea*, *Chilades laius laius*, *Zizula hylax*, *Remelana jangala*, *Zizina otis sangara*, *Zizzeria maha*, *Melanitis leda*, *Mycaeleus perseus blasius*, *Mycaeleus perseus*, *Elymnias hypermnestra*, *Mycaeleus mineus*, *Graphium agamemnon*, *Papilio polytes*, *Graphium doson*, *Papilio demolius*, *Parnara guttata*, *Telicota ancilla bambusae* and the rest of the other species were season specific (Table 1). Butterflies did not occur evenly throughout the year and species abundance was gradually increased in the month of November, 2012. On the other hand the highest species diversity documented during March to April, 2013 whereas the lowest species diversity in January, 2013 (Table 3).

**Table 1. Status, abundance, occurrence and distribution of butterfly in JU campus and its suburbs**

Sl. no	Common name	Scientific name	Status	Abundance (average)	Occurrence (months*)	Distributio
Nymphalidae						
1	Yellow Pansy	<i>Junonia hierta</i> Fab.	VR	7.9	2-5	J,G,N
2	Grey Pansy	<i>Junonia atlites</i> Linn.	VC	38.8	10-9	J,G,N,C

3	Peacock Pansy	<i>Junonia almana</i> Linn.	VC	39.4	10-9	J,G,N,C
4	Common Leopard	<i>Phalanta phalantha</i> Drury	C	23.6	10-9	J,G,N,C
5	The Commander	<i>Moduza procris</i> Cramer	VR	1	11-12, 5, 8	J,G
6	Leopard Lacewing	<i>Cethosia cyane</i> Drury	R	11.6	10-9	J,G,N,C
7	Common Castor	<i>Ariadne merione</i> Moore	VR	6	10, 2-9	J,G,N,C
8	Angled Castor	<i>Ariadne ariadne</i> Linn.	VR	5.3	10, 2-5, 7-9	J,G,N,C
9	Common Sailor	<i>Neptis hylas</i> Linn.	C	21	10-9	J,G,N,C
10	Chestnut Streaked Sailor	<i>Neptis jumbah</i> Moore	VR	2.7	11-12, 2-7	J
11	Common Sergeant	<i>Athyma opalina</i> Linn.	VR	3.5	10-12, 2-5, 7	J,G,N,C
12	Lemon Pansy	<i>Junonia lemonias</i> Linn.	C	20.5	10, 2-9	J,G,N,C
13	Great Eggfly	<i>Hypolimnas bolina</i> Linn.	VR	6.8	10-12, 2-9	J,G,N,C
14	Common Baron	<i>Euthalia aconthea</i> Moore	VR	4.9	10-11, 2-9	J,G,N,C
15	Powdered Baron	<i>Euthalia monina</i> Moore	VR	0.1	4	J
16	Gaudy Baron	<i>Euthalia lubentina</i> Fruhstorfer	VR	0.1	4	J
17	Blue Pansy	<i>Junonia orithya</i> Linn.	VR	0.2	3, 5	J
Pieridae						
18	Psyche	<i>Leptosia nina</i> Fab.	C	28.8	10-9	J,G,N,C
19	Striped Albatross	<i>Appias libythea</i> Swinhoe	R	15.8	10-12, 2-9	J,G,N,C
20	Common Emigrant	<i>Catopsilia pomona</i> Fab.	C	25.6	10-12, 2-9	J,G,N,C
21	Mottled Emigrant	<i>Catopsilia pyranthe</i> Linn.	VR	9.9	10-12, 2-9	J,G,N,C
22	Common Gull	<i>Cepora nerissa nerissa</i> Fab.	R	15.7	10-11, 2-9	J,G,N,C
23	Common Grass Yellow	<i>Eurema hecabe</i> Linn.	VC	49.1	10-9	J,G,N,C
24	Common Jezebel	<i>Delias eucharis</i> Drury	R	12.6	10-9	J,G,N,C
25	Red Spot Jezebel	<i>Delias descombesi</i> Boisduval	VR	0.5	3-4	J
26	Common Wanderer	<i>Pareronia valeria</i> Cramer	VR	6.1	11-12, 2-6, 8	J,G,N,C
27	Pale Wanderer	<i>Pareronia anais</i> Lesson	VR	8.1	10-12, 2-7	J,G,N,C
28	Chocolate Albatross	<i>Appias lyncida</i> Cramer	VR	3.6	2-6, 9	J,G,N,C
29	Painted Jezebel	<i>Delias hyparete</i> Linn	VR	1.8	2-4	J,G,N,C
30	Great Orange Tip	<i>Hebomoia glaucippe</i> Linn.	VR	0.8	11-12, 2-4	J
31	Indian Cabbage White	<i>Arlogeia canidia</i> Evans	VR	1.3	12-1	G
32	Lemon Emigrant	<i>Catopsilia crocale</i> Cramer	VR	5.4	3-5, 9	J

33	Three Spot Grass Yellow	<i>Eurema blanda</i> Wallace	VR	2	3-4	J
Lycaenidae						
34	Common Pierrot	<i>Castalius rosimon</i> Fab.	C	33.9	10-9	J,G,N,C
35	Stripped Pierrot	<i>Tarucus nara</i> Kollar	VR	5.5	10-12, 2-9	J,G,N,C
36	Spotted Pierrot	<i>Tarucus callinara</i> Butler	VR	2.3	10-12, 2-7	J,G,N
37	Angled Pierrot	<i>Caleta caleta</i> Hewitson	R	11	10, 2-9	J,G,N,C
38	Common Line Blue	<i>Prosotas nora ardates</i> Moore	VR	8.4	10-12, 2-9	J,G,N,C
39	Tailless Line Blue	<i>Prosotas dubiosa</i> Evans	C	21.2	10-9	J,G,N,C
40	Dark Grass Blue	<i>Zizeria karsandra</i> Moore	VR	6.2	2-9	J,G,N,C
41	Slate Flash	<i>Rapala manea</i> Moore	C	25.9	10-9	J,G,N,C
42	Pea Blue	<i>Lampides boeticus</i> Linn.	VR	2.1	10, 2-6	J,G
43	Lime Blue	<i>Chilades laius laius</i> Cramer	VR	9.1	10-9	J,G,N,C
44	The Quaker	<i>Neopithecopis zalmora</i> Butler	C	20.7	10, 12-9	J,G,N,C
45	Forget me not	<i>Catochrysops strabo</i> Fab.	VR	1.8	10-11, 2-5	J,G
46	Tiny Grass Blue	<i>Zizula hylax</i> Fab.	R	15.4	10-9	J,G,N,C
47	Common Silverline	<i>Spindasis vulcanus</i> Fab.	VR	4	10-11, 2, 4-9	J,G,N
48	Shot Silverline	<i>Spindasis ictis</i> Hewitson	VR	2.7	10, 2-6	J,N,C
49	Long Banded Silverline	<i>Spindasis lohita</i> Horsefield	VR	0.2	10-11	J
50	Indian Cupid	<i>Everes lacturnus</i> Godart	VR	5.5	10, 3-8	J,G,N,C
51	Common Cerulean	<i>Jamides celeno</i> Cramer	VR	1.9	11, 2, 4, 6-7	J,N,C
52	Yamfly	<i>Loxura atymnus</i> Fruhstorfer	VR	1.3	12, 2, 6-9	J,G
53	Chocolate Royal	<i>Remelana jangala</i> Moore	VR	5.2	10-9	J,G,N,C
54	Monkey Puzzle	<i>Rathinda amor</i> Fab.	VR	2.1	11, 2-3, 6-9	J
55	Lesser Grass Blue	<i>Zizina otis sangara</i> Moore	VC	40.3	10-9	J,G,N,C
56	Pale Grass Blue	<i>Zizeria maha</i> Kollar	R	16.8	10-9	J,G,N,C
57	Centaur Oakblue	<i>Arhopala centaurus</i> Moore	VR	0.2	5	J
58	Large Oakblue	<i>Arhopala amantes</i> Hewitson	VR	0.1	12	C
59	Ape fly	<i>Spalgis epius epius</i> Westwood	VR	0.5	5-6, 9	J
60	Common Red Flash	<i>Rapala iarbus</i> Fab.	VR	0.1	11	C

61	Common Acacia Blue	<i>Surendra quercetorum</i> Moore	VR	0.7	2-3, 9	J
62	Pointed Ciliate Blue	<i>Anthene lycaenina</i> Felder	VR	1	11-12	J
63	Metallic Cerulean	<i>Jamides alecto</i> Felder	VR	0.3	10, 6	J
64	Gram Blue	<i>Euchrysops cnejus</i> Fab.	VR	0.2	7	C
Satyridae						
65	Common Evening Brown	<i>Melanitis leda</i> Linn.	VC	52.5	10-9	J,G,N,C
66	Common Bushbrown	<i>Mycaeleus perseus blasius</i> Fab.	VC	37.3	10-9	J,G,N,C
67	Dingy Bushbrown	<i>Mycaeleus perseus</i> Linn.	R	19.8	10-9	J,G,N,C
68	Common Palmfly	<i>Elymnias hypermnestra</i> Linn.	C	20.8	10-9	J,G,N,C
69	Dark Brand Bushbrown	<i>Mycaeleus mineus</i> Linn.	VR	7.1	10-9	J,G,N,C
70	Lepcha Bushbrown	<i>Mycaeleus lepcha</i> Moore	VR	8.1	11-12, 2-3, 5-9	J,G,N,C
71	Bamboo Treebrown	<i>Lethe europa</i> Fruhstorfer	VR	6.6	10-6	J,G,N,C
Papilionidae						
72	Tailed Jay	<i>Graphium agamemnon</i> Linn.	VR	9.8	10-9	J,G,N,C
73	Common Mormon	<i>Papilio polytes</i> Linn.	C	22.7	10-9	J,G,N,C
74	Common Rose	<i>Pachliopta aristolochiae</i> Fab.	VR	5.7	10-12, 2-6	J,G,N,C
75	Blue Mormon	<i>Papilio polymnestor</i> Cramer	R	10.7	11-12, 3-9	J,G,N,C
76	Common Jay	<i>Graphium doson</i> Felder	R	14.3	10-9	J,G,N,C
77	Common Mime	<i>Chilasa clytia</i> Linn.	VR	9.4	10-12, 2-9	J,G,N,C
78	Lime Swallow tail	<i>Papilio demolius</i> Linn.	R	19.8	10-9	J,G,N,C
Danaiidae						
79	Blue Tiger	<i>Tirumala limniace</i> Cramer	VR	8.3	10-12, 2-9	J,G,N,C
80	Plain Tiger	<i>Danaus chrysippus</i> Linn.	R	11.9	11-1, 3-9	J,G,N,C
81	Striped Tiger	<i>Danaus genutia</i> Cramer	VR	7.9	10-12, 2-9	J,G,N,C
82	Common Crow	<i>Euploea core</i> Cramer	R	12.3	10-12, 3-8	J,G,N,C
83	Glassy Tiger	<i>Danaus genutia aglia</i> Cramer	VR	3.5	11-12, 3-7	J,C
Hesperiidae						
84	Common Snow Flat	<i>Tagiades japedus</i> Moore	VR	8.4	10-12, 2-9	J,G,N,C
85	Straight Swift	<i>Parnara guttata</i> Snellen	VC	41.8	10-9	J,G,N,C

86	Chestnut Bob	<i>Iambrix salsala</i> Moore	C	26.9	10-12, 2-8	J,G,N,C
87	Grass Demon	<i>Udaspes folus</i> Cramer	VR	0.5	2-3, 6	J,N
88	Chestnut Angle	<i>Odontoptilum angulata</i> ,Felder	VR	0.2	2-3	J
89	Brown Awl	<i>Badamia exclamationis</i> Fab.	R	16.3	2-8	J,G,N
90	Common Red Eye	<i>Matapa aria</i> Moore	VR	3.5	11, 2-4, 6-9	J,G,N,C
91	Contiguous Swift	<i>Polytremis lubricans</i> Herrich-Schaffer	R	10.2	10-12, 2-9	J,G,N,C
92	Tree Flitter	<i>Hyarotis adarastus</i> Moore	VR	3.4	11, 2, 4-9	J,G,N
93	Dark Palm Dart	<i>Telicota ancilla</i> Moore	R	16.9	10-9	J,G,N,C
94	Indian Palm Bob	<i>Sauastrus gremius</i> Fab.	VR	4.4	10-11, 5-9	J,N,C
95	Giant Red Eye	<i>Gangara thyrsis</i> Fab.	VR	0.1	8	J
96	Smaller Dartlet	<i>Oriens goloides</i> Moore	VR	0.5	7-8	J
97	Dusky Part Wing	<i>Psolos fuligo</i> Mabille	VR	0.5	10, 7-8	J
98	Obscure Branded Swift	<i>Pelopidas agna</i> Moore	VR	0.5	7	J
Acraeidae						
99	Tawny Coster	<i>Acraia viole</i> Fab.	R	11.8	4-5	J,G,N,C
Amathusidae						
100	Common Duffer	<i>Discophora sonaica zal</i> Westwood	VR	0.1	11	J

VC= Very common, C= Common, R=Rare, VR=Very rare; J=JU Campus, G=Gerua, N=Nabinagar, C=Chandra; \* detailed in methods and materials

**Table 2. Familywise diversity of butterfly species observed in four study areas**

Family	JU campus	Gerua	Nabinagar	Chandra
Nymphalidae	17	13	12	11
Pieridae	16	12	10	11
Lycaenidae	29	19	18	19
Satyridae	7	7	7	7
Papilionidae	7	7	7	7
Danaidae	5	4	4	5
Hesperiidae	15	8	10	7
Acraeidae	1	1	1	1
Amathusidae	1	0	0	0
Total	98	71	69	68



**Table 3. Seasonal diversity of butterflies during 2012- 2013**

Butterfly Family	Year and months											
	2012			2013								
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
	Early winter		Late winter		Spring		Summer		Early monsoon		Late monsoon	
Nymphalidae	10	9	8	5	14	14	15	15	10	11	12	9
Pieridae	8	10	10	4	12	15	15	11	10	8	8	9
Lycaenidae	20	19	18	10	22	20	20	21	23	19	20	18
Satyridae	6	7	7	7	7	7	6	7	7	6	6	6
Papilionidae	6	7	7	4	6	7	7	7	7	6	6	6
Danaidae	3	4	4	1	2	4	4	4	4	4	4	3
Hesperiidae	7	8	5	1	10	9	8	8	10	12	12	7
Acraeidae	0	0	0	0	0	0	1	1	0	0	0	0
Amathusidae	0	1	0	0	0	0	0	0	0	0	0	0
Total	60	65	59	32	73	76	76	74	71	66	68	58

Previously, an investigation from JU campus reported 51 species, where 21 species were identified as new records from Bangladesh (Hossain *et al.*, 2003). Among 51 species, 39 were similar compared with the present study. Besides, Razzak *et al.* (2004) reported 80 species of butterfly belonging to 10 families from JU Campus of which 36 species were new records from Bangladesh. Among 80 species reported by Razzak, 64 species were similar to the present finding. Shefa & Hossain (2010) reported 4 more new species from Bangladesh in a survey from JU Campus of which *Taracus nara*, *Junonia orithya* and *Zizula hylax* were similar to the present finding (Table 1). On the other hand, a total of 89 species under 10 families were recorded from JU Campus by Asaduzzaman (2011) of which 70 species were similar to the present findings (Table 1).

Islam *et al.* (2011) conducted an investigation in four different areas of Savar as, Krishnopur, AERE (Atomic Energy Research Establishment), Horters (part of JU Campus) and Rajalak Farm those were not overlapped with the selected areas of present investigation. They identified 158 species of butterfly under 10 families. Out of 158 species, 74 species were similar to the present findings (Table 1). They showed *Delias hyparete*, *Mycaeleus mineus*, *Acraia viole* and *Neptis jumbah* as very common (VC) species where these species were very rare (VR) compared to present findings (Table: 1). On the other hand, Islam *et al.* (2011) showed *Neopithecops zalmora*, *Catopsilia pomona*, *Mycaeleus perseus* as rare (R), but in present finding these species were common (C) (Table 1). Present record of 100 butterfly species in JU campus and its suburbs indicates that the diversity of butterfly has been increasing to greater extent. The JU campus is rich of its own diversity of vegetation types (Hossain *et al.*, 1995). This diverse ecological habitat includes woodlands, climbers, vines, grasses, shrubs and herbs. The reason for increase of butterfly diversity in JU Campus might be due to its vegetation type (larval host plants and other vegetations for nectar and shelter of butterflies), soil condition, lake and favorable climate conditions (Hossain *et al.*, 2003; Bashar *et al.*, 2003; Razzak, *et al.*, 2007; Tiple, 2009; Shefa & Hossain, 2010; Chowdhury & Hossain, 2013). In this present

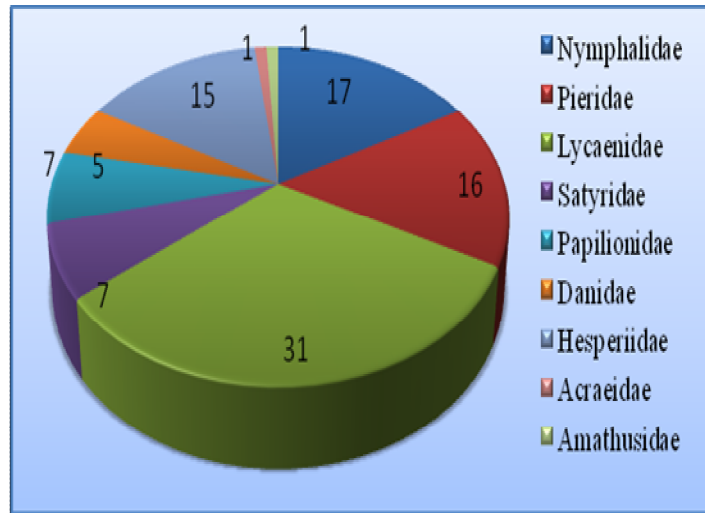
study, lowest number of butterfly species was recorded at Chandra (68 species) and highest number was recorded at JU Campus (98 species) (Table 2). Nabinagar and Chandra were more vulnerable to butterflies, because of the introduction of exotic plant species and monocultures (Nagy *et al.*, 1998; Kocher, 2000; Marini-Filho *et al.*, 2010; Majumder *et al.*, 2013), contamination of soil, air and water quality by disposal of industrial waste and chemicals (Rima, 2014), human interference (Kocher & Williams, 2000).

Natural habitat selection of butterflies is directly related to the availability of preferred food plants for larvae and adults (Grossmueller & Lederhouse, 1987; Thomas, 1995). But it was observed in the present study that the natural plant habitat being converted with exotic plant species (*Acacia* sp) in Chandra (Sal forest) and monocultures that may be responsible for the poor species richness and diversity of butterfly (Nagy *et al.*, 1998; Kocher, 2000; Marini-Filho *et al.*, 2010; Majumder *et al.*, 2013). *Acacia* sp. was the most dominant plants at Chandra (Sal Forest) and this exotic species was also observed at minimum level in JU Campus. *Acacia* sp. is threatening to native habitats by competing with indigenous vegetation and it is also responsible for the alteration of microbial soil functionalities and the early development of a native tree species (Boudiaf *et al.*, 2013). Although *Acacia* plant has many more bad effects to environment but in the present investigation it was observed that *Acacia auriculiformis* (Akashmoni) also act as larval host plant of a butterfly, Common Acacia blue (Family: Lycaenidae) (Monwar Hossain - personal communication).

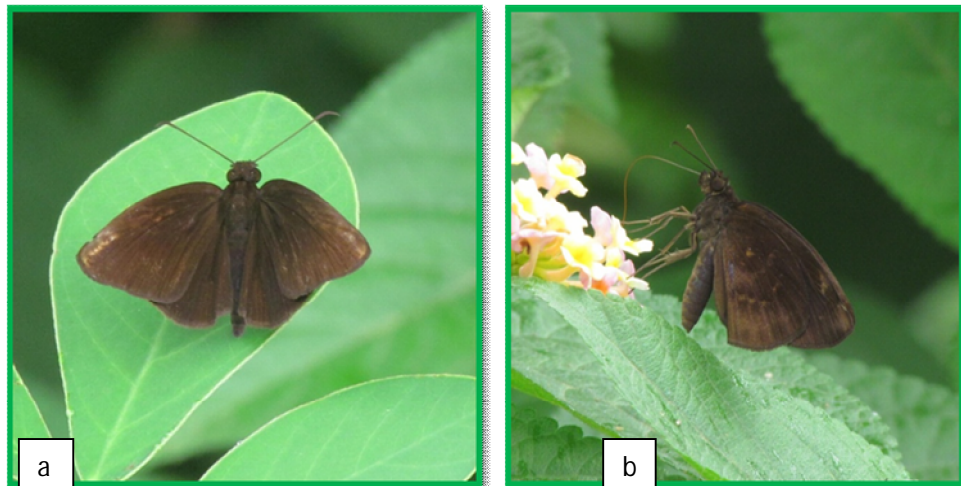
The changes in the diversity of butterflies occur due to various causes. Short-term changes may occur due to variation in weather, whereas long term changes due to modification of habitat quality and availability of larval host plants (Kocher *et al.*, 2000). Butterflies are highly season specific. During the adverse condition of weather, in late winter (December, 2012-January, 2013) low population of butterfly was maintained due to scarcity of water, drying of grasses and other nectar feeding plants, continuing cold weather and low moisture (Table 3). The optimum time for butterfly species richness was from March, 2013 to June, 2013 (Table 3). The reason for increase of diversity might be the availability of nectarine plants such as *Ixora chinensis*, *Lantana camara*, *Curcuma* sp., *Ageratum conyzoides*, *Mykania* sp and so on. Those are good food sources of adult butterflies in early winter and the availability of larval host plants like *Citrus* sp, *Madhuca indica*, *Mimusops elengi*, *Neolamarckia cadamba*, *Polyalthia longifolia*, *Mangifera indica*, *Artocarpus heterophyllus* etc. in spring and summer as well as favorable weather conditions (Farjana Akter - personal observation). The availability of adult and larval food plants is the main biotic factor to retain butterfly diversity (Ruszczyk, 1986b).

The rich diversity of butterfly species indicates the good and healthy environment since butterfly acts as biotic indicators to any environmental change and habitat structure changes (Brown & Chippendale, 1974; Thomas, 2005; Gross *et al.*, 2007). The presence of more herbaceous plants makes opportunity and support for most of the butterfly. Due to existing of various economic and ecological importance (good indicator of climatic change and pollinator), butterfly conservation is necessary. Therefore to save our flying

beauty and to enrich the population of butterfly, awareness buildup among mass people is necessary along with concern authorities should take necessary measures at greater extent to maintain the sustainability of our ecosystem.



**Fig. 2. Incidence (number) of butterflies among different families**



**Plate 1. Dusky Part Wing (*Psulos fuligo*), (a) Dorsal side and (b) Ventral side**

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