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BUTTERFLY ABUNDANCE IN RELATION TO ABIOTIC-BIOTIC FACTORS OF FOREST ECOSYSTEM OF THE BUTTERFLY RESEARCH PARK, GAZIPUR, BANGLADESH

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Abstract: The pattern of butterfly abundance, their diversity with abiotic (temperature, humidity, rainfall, photoperiod) and biotic (plants) factors were studied in the Butterfly Research Park (BRP) at Bhawal National Park, Gazipur, Bangladesh. Total 2393 individuals per day comprising 44 species under 32 genera belonging to the families Danaidae, Nymphalidae, Pieridae, Papilionidae, Lycaenidae, Hesperiidae and Satyridae were recorded from January to December, 2012. The butterflies were more abundant in the months of May, November, December; and least abundant in August and September respectively. Danaidae showed a highest abundance over the other families. Hesperiidae and Pieridae were very common; Nymphalidae and Papilionidae were common; and Lycaenidae and Satyridae were few in number respectively. Papilionids, Pierids and Nymphalids were found highest in May and June. Danaids, Satyrids and Hesperiids were peak in November and Lycaenids in April. Danaids and Papilionids were lowest in August; Hesperiids and Satyrids in March; Nymphalids, Pierids and Lycaenids were in September, October and December respectively.

Key words: Butterfly, species richness, abiotic and biotic factors.

INTRODUCTION

Butterfly stands as an ideal subject for ecological study in landscapes (Thomas and Malorie 1985). Butterflies play important roles in pollination and in the studies of community ecology (Pollard 1991). Butterfly acts as abiotic indicator for environmental assessment (Sakuratani and Fujiyama 1991, Kremen 1992, Schmitt 2003) and is used for forecasting climate change impact. The butterflies are very sensitive with changes of microclimate and habitat (Erhardt 1985). Butterfly belonging to the families viz., Papilionidae, Pieridae, Nymphalidae, Danaidae, Satyridae, Lycaenidae and Hesperiidae are commonly found in Bangladesh (Bashar *et al.* 2005). Butterfly abundance is a part of ecological assessment that refers the quantity of species to a particular ecosystem. Assessment of species abundance is a fundamental requirement in ecology and biodiversity conservation (Yoccoz *et al.* 2001). Seasonal fluctuations of butterflies covering a particular area are influenced by environmental factors viz., temperature, photoperiod, rainfall, humidity and availability of food resources, types of vegetations viz., herbs, shrubs and trees (Anu *et al.* 2009, Shanthi *et al.* 2009 and Tiple *et al.* 2007).

The present investigation was undertaken to determine the abundance of butterfly species and their diversity with abiotic factors viz., temperature, relative humidity, rainfall, sunlight intensity and biotic factors viz., flowering period of associated plants.

MATERIAL AND METHODS

Study area: Butterfly Research Park (BRP) (24°5′44.98″N and90°24′14.4″E) is situated at the Bhawal National Park (BNP) in Gazipur, 40 kilometers north of Dhaka City, Bangladesh. It is aesthetically blended with introduced vegetations.

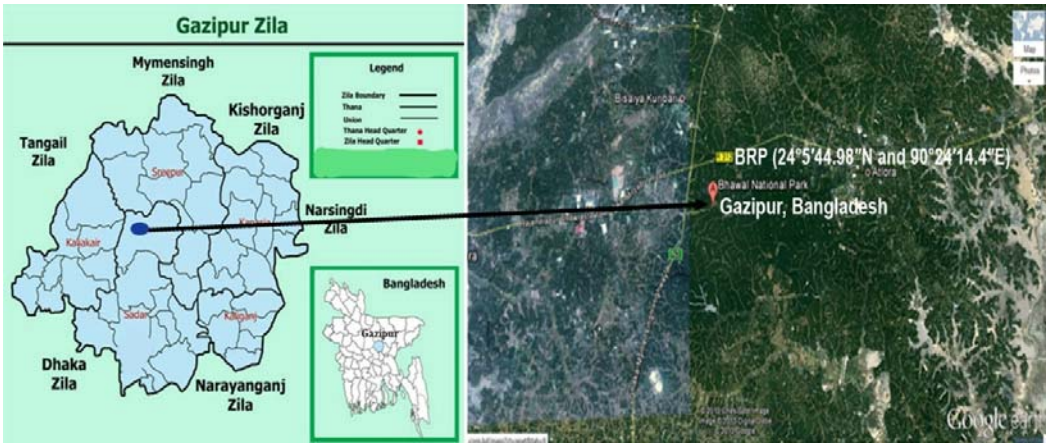

Fig. 1.Map of Bangladesh showing the location of Gazipur District highlighting the Butterfly Research Park, Bhawal National Park, Gazipur

Methodology: Sampling was made once a week during the study period. The total area was divided into four transects (73.15, 45.72, 68.58 and 44.20 meter respectively). Butterfly abundance was measured in four different sessions: First session (9.00am-9.30am), second session (11.00am-11.30am), third session (1.00pm-1.30pm) and fourth session (3.00-3.30) respectively. In each session, four transects were observed according to Hussain *et al.* (2008) and Robert (2001).

The collected butterflies of different families were identified following Bashar *et al.* (2005), Kunte (2000), Gunathilagaraj *et al.* (1998), Smith (1993), Fres(1989), Roberts (2001) and Marsh and Geer (1992). The host plants, nectar plants and shelter plants of butterflies were identified following to Ahmed *et al.* (2009).

Throughout the study period the abundance of the butterflies of different families was recorded according to the methods adopted by Bashar *et al.* (2005), Roberts (2001) and Marsh and Geer (1992).

Abiotic factors viz., temperature and relative humidity were measured on the site with a Thermo-Hygrometer. The data on rainfall and photoperiod were taken from the Bangladesh Metrological Department and www.sunrise-and-suset.com, respectively.

RESULTS AND DISCUSSION

The temperature, relative humidity, rainfall and photoperiod of the Butterfly Research Park during the study period are given in Table 1. All the parameters were quite high during March - October compared to other months.

Table 1. Abiotic factors of the Butterfly Research Park during January-December, 2012

Months	Temperature (◦c)			Relative Humidity, RH(%)			Rainfall (mm)	Photoperiod (h)
	Min	Max	Mean±SD	Min	Max	Mean ± SD		Mean ±SD
January	20.6	31.0	25.8±7.35	45	69	57±16.97	7.7	10.85±0.21
February	20.1	37.5	28.8±12.30	21	73	47±36.77	28.9	11.37±0.18
March	23.0	36.0	29.5±9.19	43	73	58±21.21	65.8	12.03±0.21
April	30.1	32.9	31.5±1.97	81	85	83±2.82	156.3	12.72±0.19
May	33.4	40.4	36.9±4.95	46	74	60±19.78	339.4	13.28±0.14
June	28.5	37.5	33.0±6.36	58	78	68±14.14	340.4	13.57±0.02
July	32.2	35.0	33.6±1.98	69	85	77±11.31	373.1	13.42±0.10
August	26.2	40.9	33.5±10.39	49	89	57±28.28	316.5	12.92±0.18
September	26.0	39.0	32.5±9.19	64	82	73±12.72	300.4	12.26±0.20
October	29.8	35.1	32.4±3.75	52	74	63±15.56	172.3	11.57±0.20
November	26.8	30.8	28.8±2.83	49	73	61±16.97	34.4	10.98±0.18
December	17.0	23.0	20.0±4.24	64	86	75±15.56	12.8	10.69±0.03

Min=Minimum; Max=Maximum; h= hour.

The total 2393 individuals per day belonging to 44 species and 32 genera under the 7 families were recorded from the BRP, Bhawal National Park, Gazipur, Bangladesh (Table 2).

The butterflies were more abundant in the months of May (414±136.47), November (415±181.54) and December (301±204.71) and least abundant in August and September 69±34.88 and 68±50.96 respectively (Fig. 2). Assamlata, Gadha, Kesaraj in May; Hatisur, Bangadha, Cosmos, Bankarpas, Gadha, Jaba in November and December were flowering stages. Anu *et al.* (2009) stated that the abundance of butterfly was influenced by environmental factors viz., temperature, photoperiod, rainfall, humidity, availability of food resources and vegetations type. According to Kabir (2009) highest abundance of butterflies was found in the month of March and April.

Table 2. Total number of genera, species of different butterfly families and family-wise abundance during January-December, 2012

Family	Name of Species	No. of genera (% of corresponding no.)	No. of species (% of corresponding no.)	No. of total individuals/day (Avg. no. ± SD) (% of Avg. no.)
Danaidae	*Danaus chrysippus* (Linnaeus, 1758) *Danaus genutia* (Cramer, 1779) *Danaus affinis* Fabricius, 1775 *Tirumala limniace* Cramer, 1775 *Euploea core* (Cramer, 1780)	3 (9.37)	5 (11.36)	978±368.89 (40.87%)
Nymphalidae	*Ariadne merione* (Cramer, 1777) *Athyma opalina* (Kollar, 1844) *Hypolimnas bolina* (Linnaeus, 1758) *Junonia almana* (Linnaeus, 1758) *Junonia atlites* (Linnaeus, 1763) *Junonia orithya* (Linnaeus, 1758) *Neptis soma*Linnaeus, 1758 *Phalantha phalantha* (Drury, 1773)	6 (18.75)	8 (18.18)	320±173.13 (13.37%)
Pieridae	*Appias lyncida* Cramer, 1777 *Catopsilia crocale* Fabricius, 1775 *Catopsilia pomona* Fabricius, 1775 *Catopsilia pyranthe* (Linnaeus, 1758) *Delias descombesi* Boisduval, 1836 *Delias eucharis* (Drury, 1773) *Eurema hecabe* (Linnaeus, 1758) *Pieris canidia* (Sparrman, 1768)	5 (15.62)	8 (18.18)	388±214.44 (16.22%)
Papilionidae	*Graphium agamemnon* (Linnaeus, 1758) *Graphium doson* C&R Felder, 1864 *Papilio clytia* Linnaeus, 1758 *Papilio demoleus* Linnaeus, 1758 *Pachliopta aristolochiae* (Fabricius, 1775) *Papilio polytes* Linnaeus, 1758 *Papilio polymnestor* Cramer, 1775 *Troides helena* (Linnaeus, 1758)	5(15.62)	8 (18.18)	186 ± 88.5 (7.77%)
Lycaenidae	*Arhopala amantes* (Hewitson, 1862) *Castalius rosimon* (Fabricius, 1775) *Catochrysops strabo* Fabricius 1793 *Euchrysops cnejus* (Fabricius 1798) *Pseudozizeeria maha* (Kollar 1848) *Tajuria cippus* (Fabricius, 1798)	6 (18.75)	6 (13.64)	69 ± 31.56 (2.88%)
Hesperiidae	*Iambrix salsala* (Moore, 1865) *Parnara guttata* Bremer & Grey, 1852 *Pelopidas conjuncta* (Herrich-Schäffer, 1869) *Tagiades japetus* (Stoll, 1782) *Udaspes folus* (Cramer, 1775)	4 (12.5)	5 (11.36)	404 ± 194.42 (16.89%)
Satyridae	*Elymnias hypermnestra* (Linnaeus, 1763) *Melanitis leda* (Linnaeus, 1758) *Melanitis phedima* (Cramer, 1780) *Mycalesis perseus* (Fabricius, 1775)	3 (9.37)	4 (9.09)	48 ± 21.2 (2.01%)
Total		32	44	2393

The Danaidae family showed a remarkable abundance over the other families followed by Hesperiidae, Pieridae, Nymphalidae, Papilionidae, Lycaenidae and Satyridae respectively. This family represented 978 individuals per day and about 40.87% of total butterflies. Under this family three genera and five species were recorded. The very common species was *Euploea core*. *Danaus crysippus* and *Tirumala limniace* were common. *Danaus affinis* was few in number (Table 2).

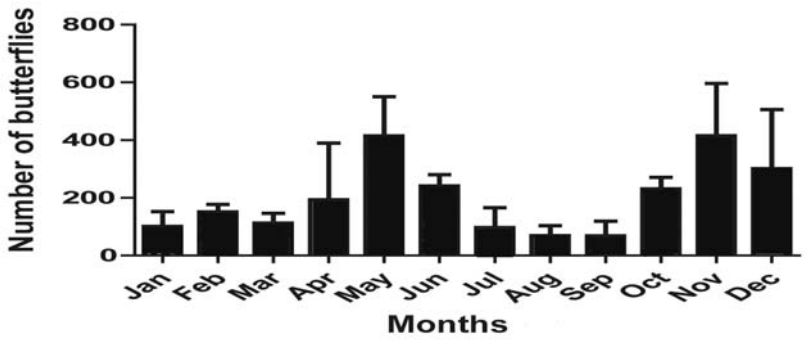

Fig. 2.Month wise abundance of butterfly during the year 2012

The Danaid population was highest (180 individuals/day) in the month of November at 28.8°C, 61% RH, 34.4 mm rainfall and lowest in August (17 individuals/day) at 33.5°C, 57%RH, 316.5 mm rainfall. The number of danaids of different species was average number in rest of the month (Table 1 and Fig. 3). In November Hatisur and Bangadha were at flowering stages. Tiple *et al.* (2007) observed that seasonal fluctuations influenced by environmental factors. Bashar *et al.* (2006a) reported that Danaidae was at the peak of their populations in the months March-June in some forests of Bangladesh.

Nymphalidae family represented by 320 individuals per day and 13.37% of total butterfly including eight species under six genera. *Junonia almana* was very common; *Athyma opalina* and *Ariadne merione* were few in number. *Junonia atlities* and *Neptis soma* were common in the study area (Table 2). The Nymphalid population was highest (62 individuals/day) in the month of June at 33°C, 68% RH, 340.4 mm rainfall and lowest number in September (8 individuals/day) at 32.5°C, 73% RH, 300.4 mm rainfall respectively (Table 1 and Fig 3). In June the nectar plants Bankarpas and Lantana were their flowering stages. According to Murphy and Wilcox (1986) butterflies are dependent on environmental conditions for growth, development and survival. Bashar *et al.* (2006a) examined that peak of their populations in the months of March-June.

The family Pieridae was represented by 388 individuals per day and 16.22% of total butterflies. It included eight species under five genera. *Eurema hecabe* was very common and *Pieris canadia* was few in number. *Catopsilia pyranthe, C. pomona*, *C. crocale* and *Delias eucharis* were also common (Table 2).

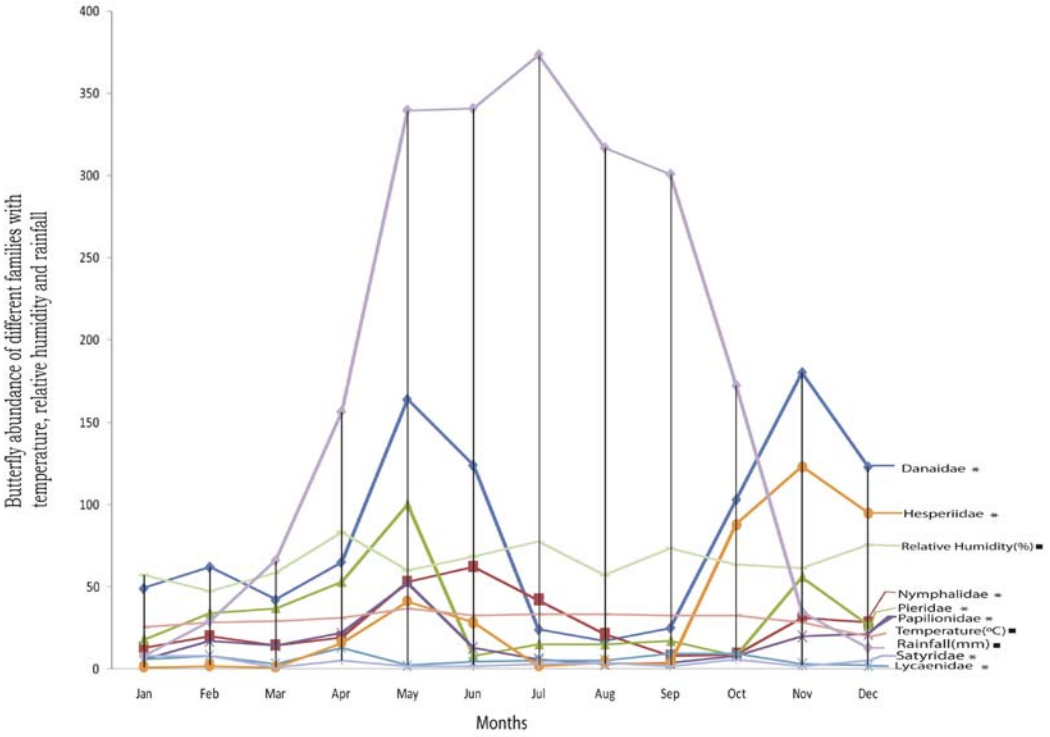

Fig. 3.Butterfly abundance and abiotic factors during the year 2012

The Pierid population was highest (100 individuals/day) in the month of May at 36.9ºC, 60% RH, 339.4 mm rainfall and lowest (8 individuals/day) in October at 32.4 ºC, 63%RH, 172.3 mm rainfall respectively (Table 1 and Fig. 3). In May maximum abundance observed with high temperature and good humidity condition and most plants (Assamlata, Gadha, Kesaraj) were at flowering stages. Bashar *et al.* (2006a) investigated that Pierids were maximum in the months March-June.

Papilionidae family was represented total 186 individuals per day and 7.7% of total butterflies. It included eight species under five genera. The *Pachliopta aristolochiae* was very common. *Troides helena* and *Papilio polymnestor* were few in number. *Papilio demoleus* and *P. polytes* were common (Table 2). The Papilionid population were highest (52 individuals/day) during May at 36.9 ºC,

60%RH, 339.4 mm rainfall and lowest abundance (3 individuals/day) in August at 33.5ºC, 57%RH, 316.5mm rainfall respectively (Table 1 and Fig. 3). In May most nectar plants (Assamlata, Gadha, Kesaraj) were their flowering stages. According to Bashar *et al.* (2006a) papilionids were at the peak abundance in the months March-June.

Family Lycaenidae was represented by 69 individuals under six species per day and 2.88% of total butterflies. *Arhopala amantes* observed maximum in number. *Pseudozizeeria maha* was few. *Euchrysops cnejus* was in common (Table 2). The Lycaenid population were highest (13 individuals/day) in April at 31.5ºC, 83%RH, 156.3mm rainfall along with nectar plants (Panica, Motkila, Nayantara and Nilopetunia) were their flowering stages and lowest (2 individuals/day) in December at 20ºC, 75%RH, 12.8mm rainfall with foggy weather and shortage of nectar plants (Fig. 3). According to Spitzer *et al.* (1993) plant phenology and climate are key environmental variables that affect abundance of butterfly.

Hesperiidae family was represented by 404 individuals and 16.89% of total butterflies. The *Parnara guttata* and *Iambrix salsala* were very common and few respectively. *Parnara apostate* was common in number (Table 2). Maximum abundance (123 individuals/day) of Hesperiid population was in November at 28.8ºC, 61% RH, 34.4 mm rainfall and lowest in January (1 individuals/day) at 25.8ºC, 45% RH, 7.7mm rainfall respectively (Table 1 and Fig. 3). In November the nectar plants Bangadha and Kesaraj had their flowering stages with high juvenile. Blair and Launer (1997) reported that month-wise variations are influenced by availability of food resources.

Family Satyridae was represented by 48 individuals per day and 2.01% of total butterflies. *Mycalesis perseus* and *Elymnias hypermnestra* were very common and few respectively. *Melanitis leda* and *Melanitis phedima* were common (Table 2). Highest abundance of Satyrids population was recorded in January (8 individuals/day) at 25.8ºC, 45% RH, 7.7 mm rainfall and lowest in March (1 individuals/day) at 29.5ºC, 58% RH, 65.8mm rainfall (Table 1 and Fig. 3). Assamlata, Lantana were their flowering stages in January. Jackson and Baines (1999) investigated that butterflies living in a forest are vary depending on weather and vegetations conditions of the forests.

It was observed that the diversity of different butterfly families has relation with abiotic factors and associated plants. Temperature ranging between 27ºC-38ºC, relative humidity 60%-80%, optimum sunlight and flowering period of plants as well as presence of host and shelter plants influence the abundance of butterflies. Despite the presence of flowering period of nectar plants, host plants and shelter plants; low temperature, humidity, light intensity, photoperiod,

cloudy and foggy weather create negative impact on butterfly abundance in BRP. The result will help to assess forest ecosystem, diversity and most importantly the possibility in establishing butterfly research park. The present endeavor may fulfill the demand of ecotourism industry development.

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