# ABUNDANCE AND SOME BEHAVIOURAL ASPECTS OF LYCAENID BUTTERFLIES IN THE BUTTERFLY RESEARCH PARK AT THE BHAWAL NATIONAL PARK, GAZIPUR

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## Abstract

A field survey was conducted to assess the abundance of lycaenid butterflies in the Butterfly Research Park at the Bhawal National Park, Gazipur from January 2010 to October 2011. The survey was carried out along with four transects (viz. TR-I, TR-II, TR-III and TR-IV) in four seasons (viz. winter, summer, monsoon and post-monsoon) of the year. 22 species of lycaenid butterflies was recorded from a total of 1,321 collected individual specimens. Out of 22 species, 10 species belonged to the subfamily Polyommatinae (viz. *Castalius rosimon*, *Discolampa ethion*, *Caleta decidia*, *Tarucus callinara*, *Chilades lajus*, *Euchrysops cnejus*, *Catochrysops strabo*, *Lampides boeticus*, *Pseudozizeeria maha* and *Zizina otis*) and 12 species belonged to the subfamily Theclinae (viz. *Arhopala pseudocentaurus*, *Arhopala amantes*, *Loxura atymnus*, *Rapala manea*, *Rapala pheretima*, *Rapala iarbus*, *Deudorix epijarbas*, *Remelana jangala*, *Hypolycaena erylus*, *Spindasis nipalicus*, *Spindasis lohita* and *Tajuria cippus*). The dominant lycaenid butterfly was represented by two species of *Arhopala* (viz. *A. pseudocentaurus*, 35.73% and *A. amantes*, 23.47%). The lycaenid butterflies showed the highest abundance (34.82%) in winter and lowest (13.24%) in summer. The maximum number (38.30%) of the butterflies were recorded from Transect-IV followed by the Transect-I (25.36%), Transect-II (24.53%) and Transect-III (11.81%). It was found that lycaenid butterfly was more synchronized with the flowers of ground vegetation, herbs and shrubs than that of canopy trees in the experiment site. The lycaenid abundance increased with the decrease of temperature ($r = -0.66$; $p = 0.13$) and with the increase of relative humidity ($r = 0.41$; $p = 0.19$). This study reveals that the availability of lycaenid butterflies is related to plant-phenological changes in the study area.

***Key words*****:** Abundance, lycaenid butterflies, temperature, relative humidity.

## INTRODUCTION

Butterflies are common, almost everywhere, attractive and easy to observe. Lycaenidae is the second largest family of butterflies under the order Lepidoptera, comprising about 6,000 species in worldwide distribution, the greatest diversity in the tropics (Ackery and Vane-Wright 1984, Bashar 2014). They are rather small in size, brilliantly coloured showing marked sexual dimorphism that always occurs as a difference on the upper wing surface. But ventrally both are usually similar (Roberts 2001). Butterflies and their caterpillars are dependent on specific host plants for foliage, nectar and pollen as their food. The abundance of butterflies is more related to the availability of food plants (Gutierrez and Mendez 1995). Adult lycaenids commonly seek nectar from flowers and clearly have very restricted ranges of food plants (New 1993). Seasonal availability of food plants has a marked correspondent in abundance of lycaenid butterflies. Such seasonal availability may be an important feature facilitating the use of lycaenids as indicators of habitat quality (Robbins and Aiello 1982, Bashar 2015). Thus, butterfly diversity indirectly reflects overall plant diversity, especially that of herbs and shrubs, in a given area (Nimbalkar *et al.* 2011). The interaction between the butterfly's activities and the phenological functioning of the plants stands as key tool in nature for speciation both in flora and fauna in the wild state (Bashar 2010, 2015).

The composition of butterfly community varies highly among seasons than among habitats. Biotic and environmental factors are considered to govern significant size of lycaenid populations (Hussain *et al.* 2011, Cushman and Murphy 1993). The diversity and distribution of butterfly population may vary depending on using suitable habitat pattern (Padhye *et al.* 2006). The relationship between two biotic factors (plant-animal) is vital to maximize the assemblage of both factors in an ecosystem (Bashar *et al.* 2006). Therefore, the present investigation was to envisage the role of interrelationship between population abundance of lycaenid butterflies and related plants. This relationship plays a significant role in biodiversity conservation.

## MATERIAL AND METHODS

A field survey of lycaenid butterflies was carried out from January 2010 to October 2011 in the Butterfly Research Park (BRP) of the Bhawal National Park, Gazipur. It is situated in between longitude 90˚24′06″E and latitude 24˚05′06″N. This research park is a semi-natural forest that covers 100×42sq m areas. The abundance of lycaenid butterflies was examined using the transect (TR) method followed by Pollard and Yates (1993) and Rao and Richard (2006). Four transects (viz. TR-I, TR-II, TR-III and TR-IV) were selected in this survey. The area of TR-I and TR-III is 43×15 square metres and of TR-II and TR-IV is 67×17 square metres each. The TR-I is situated in the east side of the Butterfly Research Park and covered with fully planted vegetation. The TR-II is situated in the south side that is covered with both natural and planted vegetation. The TR-III and TR-IV are situated in the west and the north side of the park, covering with both natural and planted vegetation.

The butterfly species were identified directly in the field and from the photograph taken during survey period. The lycaenids and related plant species were identified following Bingham (1907), Eliot (1973), Pinratana (1981), Bashar *et al.* (2006a), Ek-Amnuay (2006), Akand (2012) and Bashar (2014, 2015), and Ahmed *et al.* (2009), respectively. Observations were made twice in a month during the time between 9.30 a.m. and 4.30 p.m. through a “constant walk” for 10-15 minutes along each transect, and recorded the number of individuals of lycaenid species. The information recorded including mating, egg-laying, foraging, basking, resting, puddling and flying active condition. The daily readings of physical factors (Temperature and relative humidity) were used for the calculation of monthly mean temperature and relative humidity. The collected data have been categorized into four seasons, viz. winter (November-January), summer (February-April), monsoon (May-July) and post-monsoon (August-October).

## RESULTS AND DISCUSSION

The increase of relative species abundance is related to the increase of relative resource abundance (Tuomisto *et al.* 2003). The butterfly species abundance in an ecological area is governed mainly by the availability of plant resources (Yamamoto *et al.* 2007). Keeping this fact in front, lycaenid butterfly was selected to measure how the relative resources influence the species abundance. A total of 1,321 individuals was counted representing 22 species of lycaenid butterflies (Table 1). The butterfly species comprised under two subfamilies, Polyommatinae and Theclinae of the family Lycaenidae.

A B C D

Fig. 1. Some recorded lycaenid butterflies while in different active conditions with related plants. A. Foraging *Tajuria cippus* on *Asclepias curassavica* flower; B. Egg laying *Castalius rosimon* on its host plant *Ziziphus mauritiana;* C. Basking condition of *Hypolycaena erylus* on leaves of *Chromolaena odorata;* D. Resting *Arhopala pseudocentaurus* is under the leaf of *Citrus aurantifolia*.

**Table 1. List of recorded lycaenid species.**

| Sub family | Scientific name | Common name |
|---|---|---|
| Polyommatinae | *Castalius rosimon* (Fabricius, 1775) | Common Pierrot |
| | *Discolampa ethion* (Westwood, 1851) | Banded Blue Pierrot |
| | *Caleta decidia* (Hewitson, 1876) | Angled Pierrot |
| | *Tarucus callinara* Butler, 1886 | Spotted Pierrot |
| | *Chilades lajus* (Stoll, 1780) | Lime Blue |
| | *Euchrysops cnejus* (Fabricius, 1798) | Gram Blue |
| | *Catochrysops strabo* (Fabricius, 1793) | Forget-me-not |
| | *Lampides boeticus* (Linnaeus, 1767) | Pea Blue |
| | *Pseudozizeeria maha* (Kollar, 1848) | Pale Grass Blue |
| | *Zizina otis* (Fabricius, 1787) | Lesser Grass Blue |
| Theclinae | *Arhopala amantes* Hewitson, 1862 | Large Oakblue |
| | *Arhopala pseudocentaurus* (Doubleday, 1847) | Common Oakblue |
| | *Loxura atymnus* (Stoll, 1780) | Yam fly |
| | *Rapala manea* (Hewitson, 1863) | Slate Flash |
| | *Rapala pheretima* (Hewitson, 1863) | Copper Flash |
| | *Rapala iarbus* (Fabricius, 1787) | Common Red Flash |
| | *Deudorix epijarbas* (Moore, 1858) | Common Cornelian |
| | *Remelana jangala* (Horsfield, 1829) | Chocolate Royal |
| | *Hypolycaena erylus* (Godart, 1824) | Common Tit |
| | *Spindasis lohita* (Horsfield, 1829) | Long-banded Silverline |
| | *Spindasis nipalicus* (de Niceville, 1889) | Silver-red Silverline |
| | *Tajuria cippus* (Fabricius, 1978) | Peacock Royal |

The relative abundance of a species was compared to other species in the study area. Among the recorded species, *Arhopala pseudocentaurus* (35.73%) and *A. amantes* (23.47%) of subfamily Theclinae were the dominant lycaenid butterfly species (Fig. 2).

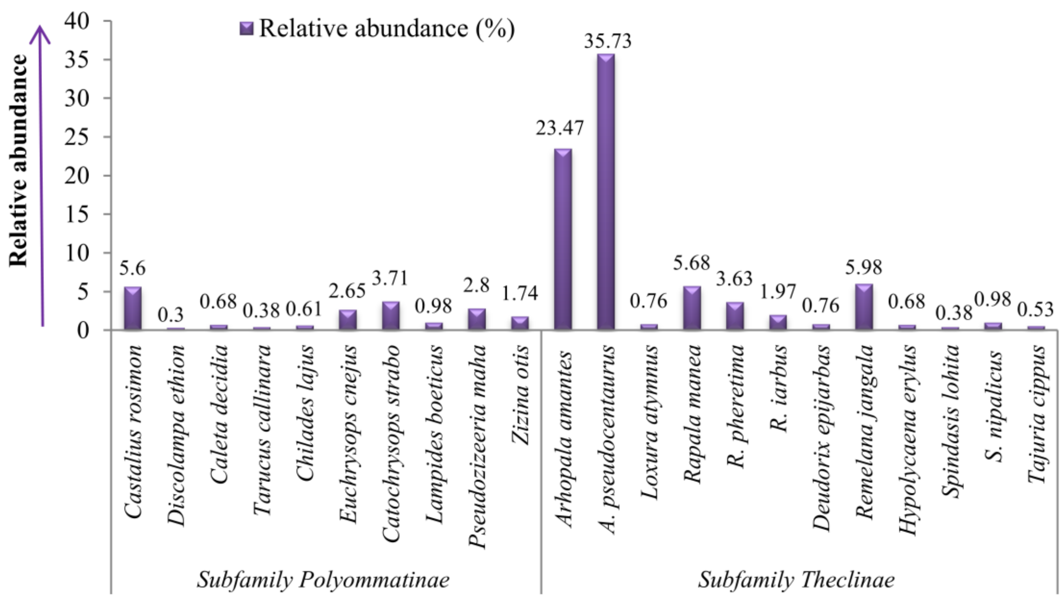


Fig. 2. Relative abundance of lycaenid butterfly species (Figures above the bars indicating percentage value).

Butterflies are associated with plants for food and shelter. The lycaenid butterflies were found more active in collecting nectar on flowering plants. They were used to spend less time on other plants (not at flowering stage) for different activities like mating, egg-laying, basking and resting condition (Fig. 1). Twenty four dominant plant species of four transects under 16 families were counted. Among them 11 species were recorded in TR-I and TR-IV each. Ten and seven species were counted in TR-II and TR-III, respectively. The recorded plant species with types is listed in Table 2. The type of the listed plants species was herbs (2), shrubs (13) and trees (9).

**Table 2. List of lycaenid related plants in four transects from January 2010 to October 2011 in the experimental site. Plants are marked as present (+) and absent (-).**

| Plant's Family | Scientific name of plant | Plant type | Transects | | | |
|---|---|---|---|---|---|---|
| | | | TR-I | TR-II | TR-III | TR-IV |
| Annonaceae | *Polyalthia longifolia* (Sonn.) Thw. | Tree | + | - | - | - |
| Arecaceae | *Calamus guruba* Buch.-Ham. | Shrub | + | - | - | - |
| | *Chrysalidocarpus lutescens* (Bory) H. | Small tree | - | + | + | - |
| Asclepiadaceae | *Asclepias curassavica* L. | Shrub | + | - | + | - |
| Asteraceae | *Cosmos bipinnatus* Cav. | Shrub | + | - | - | - |
| | *Chromolaena odorata* (L.) | Shrub | - | - | - | + |
| | *Mikania cordata* Robinson | Herb | - | - | - | + |
| Caesalpiniaceae | *Cassia fistula* L. | Tree | - | + | - | - |
| Dipterocarpaceae | *Shorea robusta* C. F. Gaertn. | Tree | - | + | + | + |
| Fabaceae | *Sesbania bispinosa* (Jacq.) Wight. | Shrub | + | - | - | - |
| | *Samanea saman* (Jacq.) Merr. | Tree | - | - | - | + |
| Malvaceae | *Hibiscus rosa-sinensis* L. | Shrub | + | - | - | - |
| Melastomataceae | *Melastoma malabathricum* L. | Shrub | - | + | - | - |
| Myrtaceae | *Syzygium fruticosum* DC. | Small tree | - | -- | + | - |
| | *Callistemon citrinus* (Curtis) Skeels. | Small tree | - | + | + | + |
| Poaceae | *Panica indica* | Herb | - | + | - | + |
| Rhamnaceae | *Ziziphus mauritiana* Lamk. | Small tree | - | + | + | + |
| Rubiaceae | *Ixora coccinea* L. | Shrub | + | - | - | + |
| Rutaceae | *Citrus aurantifolia* Swingle. | Shrub | + | + | - | + |
| Sapotaceae | *Madhuca indica* Gmel. | Tree | - | - | + | - |
| Verbenaceae | *Clerodendrum viscosum* Vent. | Shrub | - | + | - | - |
| | *Lantana camara* L. | Shrub | + | - | - | - |
| | *Duranta plumieri* L. | Shrub | + | - | - | + |
| | *Duranta repens* L. | Shrub | + | + | - | + |

In determining the pattern of butterfly community, relative abundance of butterfly and plant resources is an important aspect that characterizes a butterfly community (Yamamoto *et al.* 2007, Bashar 2014). The abundance of lycaenid species varied among the four transects in the experimental sites (Fig. 3). This fluctuation might depend on biotic factors (viz. plant availability and flowering period of plants).

The transect-wise data on the butterfly abundance show a similar pattern of seasonal fluctuation in all the four transects. Invariably in all transects, winter was the most preferred season followed by post-monsoon, monsoon and summer. The total individual abundance and species richness exhibited considerable variability during the year.

A potentially interesting phenomenon concerning seasonality of abundance was observed in lycaenid butterflies at the experimental site. Most of the observed species was associated with herbs and shrubs (Bashar 2015). These plants are in flowering stage during the winter. The lycaenids started appearing in late post-monsoon season continuously in very early summer and reached their peak in winter, synchronizing with the presence of their adult food plants (Akand 2012). This pattern might be a result of resource-based interspecific competition for nectar-sources in adult butterflies. Butterflies of other family was less abundant and not herb feeder equally in this period. Much larger pierids, nymphalids and tiny lycaenids, all compete for the same flowers at the ground layer vegetation (Kunte 1997). In general, when a butterfly finds a good-source already occupied by another butterfly, it flutters and hovers over the feeder and drives it away. Small lycaenids are ill-adapted for this type of competition.

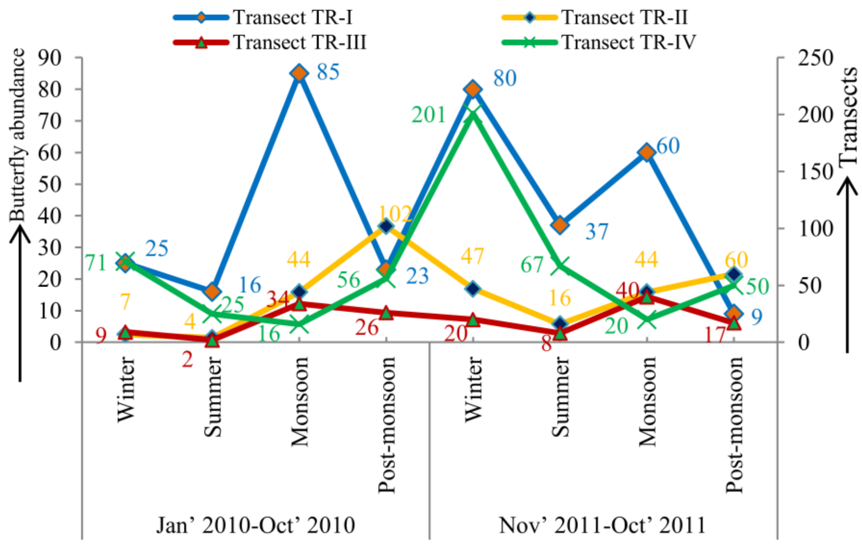


Fig. 3. Pattern of fluctuation in lycaenid butterfly availability on four transects.

Regarding abundance, the lycaenid butterflies displayed the highest abundance (34.82%) in winter and lowest (13.24%) in summer; on the other hand, more or less the same abundance was found in monsoon (25.97%) and post-monsoon (25.97%) during the study period (Table 3).

**Table 3. Seasonal pattern of availability of the lycaenid butterflies in different transects.**

| Year | Season | Transect | | | | Total |
|---|---|---|---|---|---|---|
| | | TR-I | TR-II | TR-III | TR-IV | |
| January'2010 – October'2011 | Winter | 105 (31.35%) | 54 (16.67%) | 29 (18.59%) | 272 (53.75%) | 460 (34.82%) |
| | Summer | 53 (15.82%) | 20 (6.17%) | 10 (6.41%) | 92 (18.18%) | 175 (13.24%) |
| | Monsoon | 145 (43.28%) | 88 (27.16%) | 74 (47.44%) | 36 (7.12%) | 343 (25.97%) |
| | Post-monsoon | 32 (9.55%) | 162 (50%) | 43 (27.56%) | 106 (20.95%) | 343 (25.97%) |
| | Total | 335 (25.36%) | 324 (24.53%) | 156 (11.81%) | 506 (38.30%) | 1321 (100%) |

The peak abundance of the most species and their overall abundance concentrated in winter, while many of them were absent in post-monsoon. *Arhopala amantes* and *A. pseudocentaurus* were common and found all the year round, whereas *Loxura atymnus*, *Spindasis lohita*, and *Discolampa ethion* were rare, found in a single season (winter). Their abundance varied over seasons and transects; variation between seasons in a particular transect was more prominent compared to that of other transects in a particular season.

The relative abundance of butterflies showed seasonal fluctuation during the study period in all transects. The maximum amount of lycaenid individuals was assessed (Table 3) in Transect-IV with a covariance of 38.30% followed by Transect-I (25.36%), Transect-II (24.53%) and Transect-III (11.81%). It was found that species richness was highest in the Transect-IV (20) followed by Transect-I (16), Transect-II (16) and Transect-III (9). Differences of butterfly species richness indicate the differences in plant diversity among transects. The least amount of variation in the butterfly abundance in Transect-III may be because of the relatively less vegetation diversity associated with lycaenid butterflies.

Two-way ANOVA was used to assess differences of lycaenids availability with various seasons and different transects. There was no statistically significant difference (**F = 0.78, *p*>0.05**) among all seasons though highest number of lycaenid butterflies observed during winter. A similar test on abundance among different transect shows no significant difference (**F = 1.14, *p*>0.05**) though highest butterfly individuals was observed in Transect-IV.

The seasonal abundance might be controlled by the complex interactions with various biotic and abiotic factors. Plant phenology and climate are the key factors that affect butterfly population dynamics (Murphy *et al.* 1990, Spitzer *et al.* 1993, Barlow *et al.* 2007). Lycaenids prefer suitable abiotic factors and their entire life directly depend on temperature, relative humidity and other abiotic factors. An attempt was made to assess the relationship between selected abiotic factors (temperature and relative humidity) and the lycaenid abundance. The highest temperature recorded 33.1°C during summer 2010 and lowest temperature was 25°C during winter 2011. The highest relative humidity was 79% during monsoon, 2010 and 2011 as well as the lowest was 58% during winter 2010 and summer 2011. Butterfly abundance was peaked during winter when temperature declined and butterflies continually disappeared when temperature raised (Fig. 4).

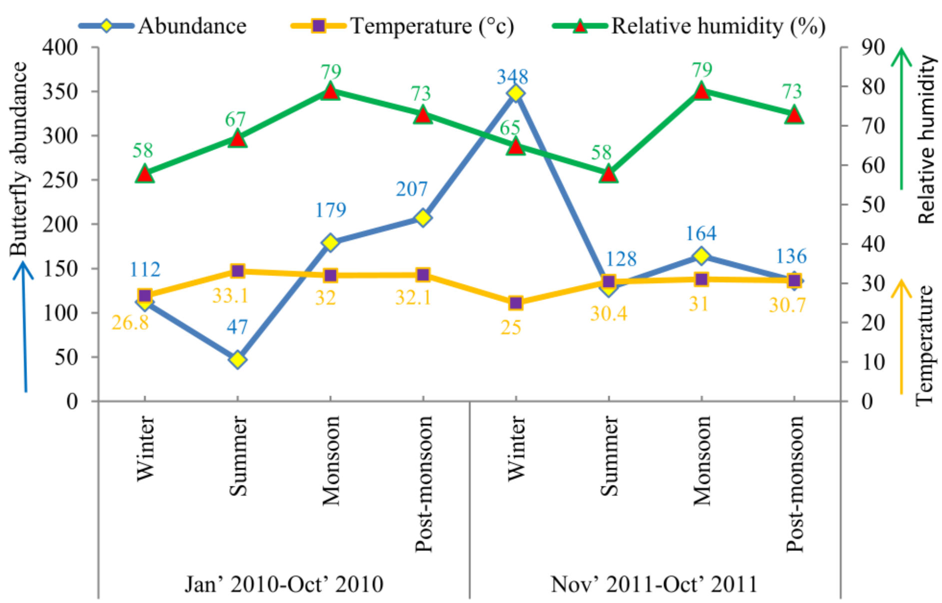


Fig. 4. Average temperature and relative humidity in different seasons and years.

The correlation between abiotic factors (temperature and relative humidity) and butterfly abundance (the number of individuals) was calculated through the Spearman's rank correlation coefficient. The significant negative correlation found in between lycaenid abundance and temperature (**r = − 0.66; *p* = 0.13**) while a positive correlation assessed in between lycaenid abundance and relative humidity (**r = 0.41; *p* = 0.19**). The butterfly abundance increased with decreasing temperature and increasing relative humidity. Abundance of lycaenid butterflies significantly differed among the seasons. The comparison of seasonal fluctuations in abundance among different transects revealed that the seasonality of the lycaenid population might be controlled by the common microclimatic factors. The overall abundance of lycaenid butterflies was highest during winter and lowest in summer and the flower abundance was the major factor affecting the seasonal abundance of butterflies. The abundance of the species varies according to its own ecological requirements.

It was observed that lycaenid butterflies were more abundant in transect-IV where natural vegetation occupied maximum portion. This investigation gives an overall picture about the availability and seasonality of lycaenid butterflies in the Butterfly Research Park, a part of deciduous forest Bhawal National Park, Gazipur. This study shows the interaction between the two biotic aspects (plants and animals), a key factor for sustaining ecological balance in an ecosystem that causes nature conservation in its own way.

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