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Research Article

DIVERSITY AND ABUNDANCE OF BUTTERFLY (INSECTA: LEPIDOPTERA) FAUNA IN RAMPURHAT, WEST BENGAL, INDIA

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ABSTRACT

Butterfly diversity in and around Rampurhat, West Bengal, India was studied during June to November, 2017. A total of 30 butterfly species belonging to the families of Nymphalidae (47.6%), Pieridae (21.8%), Papilionidae (20.2%), Lycaenidae (6.57%) and Hesperidae (3.78%) were identified in the present investigation. Based on observation of the species concerned, 47.7% species are very common, 40.2% are common, 11.4% are not rare, 0.53% are rare and only 0.07% are very rare. In respect to diversity indices, Shannon Weiner diversity score is highest in the family Nymphalidae (H=2.14) and lowest in the family Lycaenidae (H=1.04). Evenness index (J) also shows same tendency. According to Simpson's index, Nymphalidae is also dominant family (score 1/D=0.4762). Among these five families Family Hesperiidae bears only one species, Chest nut bob. The butterflies those show high occurrence in these months are *Zizula hylax* (Lycaenidae), *Danaus chrysippus* (Nymphalidae), *Eurema hecabe* (Pieridae) and *Papilio polytes* (Paplionidae).

Present findings of various species of butterfly indicate the influence of available vegetation and other allied factors like rainfall, wind speed, temperature etc. The study suggests conservation management of butterfly species to maintain ecosystem integrity.

INTRODUCTION

Biodiversity is now recognized as an important tool to assess global and local environmental changes and sustenance of development. The functional role of biological diversity is now hampered by many anthropogenic activities and environmental degradation.

The diversity of insects plays a dominant role in both terrestrial and aquatic ecosystems. Among insects, butterflies are the most prominent group known for its great variety and beauty of their colour pattern and also an important ecological indicator of terrestrial ecosystem.

More than 1500 butterfly species, from five different families viz. Papilionidae, Pieridae, Nymphalidae, Lycaenidae, Hesperiidae have been found in India and some of the species are endemic also (Gaonkar, 1996). Among insects, butterflies play prominent role in pollination and herbivores (Kunte, 2000, Tiple *et al*., 2006) bearing a history of long term co-evolution with plants (Ehrlich and Raven, 1964). Adult butterflies are dependent on nectar and pollen as their food while the caterpillars are dependent on specific host plants for foliage (Nimbalkar *et al*., 2011). Butterflies serve as important plant pollinators in the local environment and help to pollinate more than 50 economically important plant crops (Borges *et al*., 2003). Butterflies serve the ecosystem especially by recycling nutrients essential for crops (Schmidt and Roland, 2006). Larvae of butterfly release faeces while feeding on the agrestals and provide required nutrients to the crops (Marchiori and Romanowski, 2006). Certain species pollinate various wild plants and crops on which human beings depend on for their livelihoods (Boriani *et al*., 2005). Butterflies are considered as good indicators of the health of any specified terrestrial ecosystem (New, 1991; Pollard and Yates, 1993; Kunte, 2000; Aluri and Rao, 2002; Bonebarake, 2010 and Thomas, 2005). Human disturbance and habitat feature can also be reflected by butterfly population (Kunte *et al*., 1999; Kocher and Willims, 2000; Kunte, 2000; Summerville and Crist, 2001; Koh, 2007and Blair and Launer, 1997). So butterflies have been treated as an important tool to study ecology and conservation (Watt and Boggs, 2003; Ehrlich and Hanski, 2004).

Association between habitat and butterfly diversity are well on record from different parts of India (Tiple and Khusad, 2009;

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Ramesh *et al*., 2010). Several works on butterfly are done in Kolkata or at its eastern part and in North Bengal (Deniceville, 1885; Sanders, 1944; Chowdhury and Chowdhury, 2006; Mukherjee *et al*., 2015) with a little works on other districts like Howrah (Dwari and Mondal, 2015), Murshidabad (Saha *et al*., 2015), Nadia (Day and Ghosh, 2016). But there is no report on diversity of butterfly species from Birbhum District. The present study was aimed to the estimation of butterfly diversity found in suburban areas of Rampurhat, District Birbhum, West-Bengal. India.

MATERIALS AND METHODS

Sampling site

The study was conducted in and around Rampurhat (24°18´14" N, 87°78´13" E) a sub-division town of District Birbhum, West-Bengal, India. The site is mainly sub-urban and the locality has a good number of houses, commercial buildings, roads, many gardens and denser plantings of different types.

Sampling period and time

The butterflies are observed in the sampling site from June 2017 to November 2017. Each study site was visited once in a week and transects are observed from 6 am to 5 pm, during fair weather periods i.e. without heavy rain and strong wind.

Sampling techniques

Pollard walk method (Pollard, 1977; Pollard and Yates, 1993) was followed for recording the butterflies while walking along fixed paths in the study site. Individuals were counted on either side of the path (at a distance of 3 meters).

Butterflies were primarily photographed directly in the field by using a digital camera. In critical condition, they are captured by hand-net, identified and released in the same habitat with least disturbance. Species Identity was confirmed with the help of the field guides (Evans, 1932; Kunte, 2000 and Kehimkar, 2008). Those species observed in the survey days were catagorised as,

VC= Very Common (>100 Sightings)
C=Common (50-100 Sightings)
NR = Not Rare (15-50 Sightings)
R = Rare (2-15 Sightings)
VR = Very Rare (1-2 Sightings)

Data analysis

Species diversity was calculated using Shannon diversity index [H' = $\sum . Pi \ln Pi$ and Shannon H_{max}=$Log_{10}(S)$].
Shannon evenness was calculated using the formula,

$J=H'/H_{max}$
Where, H'= Information content of sample or Shannon -diversity index,
Pi= Proportion of total sample belonging to i-th -species / families,
S= Total number of species/ family in the habitat (species richness).
Species or family Dominance Index was calculated using Dominance Index (Berger and Parker, 1970),
$D_{BP}= N_{max} / N$.
where, N_{max} = Total number or proportion of species or family
N = Number or proportion of each species or family.

Simpson's Index (Simpson, 1949),
$Pi^2=\sum_{i-1}^{s} . \frac{(Ni(n-1))}{(N(N-1))}$
Where, S =No of species or family present
N = Total no of individuals in all species
Or, C = $\sum_{i}^{s} Pi^2$
Where Pi = Ni/N_T

n = Total no of individual in each species
Ni = No of individual of i-th species
N_T = Total individuals in the sample

The Index is, D = 1/C.

The larger its value the greater the equitability (Range 1- S_T). Simpson's Index is weighed in favour of dominant species and Shannon's index in favour of rare species.

The log transformed data of butterfly species abundance were used to form a rank abundance of all the species in the study site.

RESULT

The study revealed the presence of 30 species of butterflies belonging to five families viz. Nymphalidae, Pieridae, Papilionidae, Hesperiidae, Lycaenidae in the study site. (Table I, and Fig. 1.).

Fig 1 Photographs of different butterfly species encountered in the present study. 1.*Precis iphita* 2. *Papilio polytes* 3. *Delias eucharis* 4. *Anthene emolus* 5. *Junonia lemonias* 6. *Ariadne ariadne* 7. *Papilio demoleus demoleus* 8. *Appias libythea* 9. *Catopsilia pamona* 10. *Eurema hecabe* 11. *Lambrix salsala* 12. *Danaus chrysippus* 13. *Hypolimnas bolina* 14. *Abisara echerius* 15. *Ixias pyrene* 16. *Mycalesis perseus* 17. *Ypthima daldus* 18. *Pieris raphe* 19. *Acraea violae* 20. *Junonia almana* 21. *Euploea core* 22. *Graphium doson* 23. *Euchrysops cnejus* 24. *Danaus genutia* 25. *Papilio polymnestor* 26. *Catopsilia pyranthe* 27. *Junonia atlites* 28. *Papilio demoleus* 29. *Zizula hylax* 30. *Tajuria cippus*

Species diversity is highest in the family Nymphalidae (12 species) and lowest in Hesperiidae (only one species). Species diversity and abundance is maximum in the months of October, November (25 species and 60.25%) and minimum in the months of June, July (12 species and 15.75%) and moderate in the months of August, September (20 species and 24%).

Table 1 List of butterflies observed in the study site along with their status.

Sl no	Common name	Scientific name	Family	Status
1.	Tiny grass blue	*Zizula hylax* Fabricius, 1775	Lycaenidae	C
2.	Common ciliate blue	*Anthene emolus* Godart, 1824	Lycaenidae	NR
3.	Plum judy	*Abisara echerius* Moore,1901	Lycaenidae	NR
4.	Common smoky blue	*Euchrysops cnejus* Fabricius, 1758	Lycaenidae	R
5.	Peacock royal	*Tajuria cippus* Fabricius, 1775	Lycaenidae	R
6.	Lemon pansy	*Junonia lemonias* Linnaeus, 1758	Nymphalidae	NR
7.	Chocolate pansy	*Precis iphita* Cramer, 1780	Nymphalidae	NR
8.	Common crow	*Euploea core* Cramer, 1780	Nymphalidae	NR
9.	Grey pansy	*Junonia atlites* Linnaeus, 1763	Nymphalidae	VC
10.	Plain tiger	*Danaus chrysippus* Linnaeus, 1758	Nymphalidae	VC
11.	Tawny Coster	*Acraea violae* Fabricius, 1775	Nymphalidae	C
12.	Angled castor	*Ariadne ariadne* Linnaeus, 1758	Nymphalidae	C
13.	Striped tiger/ common tiger	*Danaus genutia* Cramer, 1779	Nymphalidae	NR
14.	Great egg fly	*Hypolimnas bolina* Linnaeus, 1758	Nymphalidae	R
15.	Common bush brown	*Mycalesis perseus* Fabricius, 1775	Nymphalidae	C
16.	Common five ring	*Ypthima baldus* Fabricius, 1775	Nymphalidae	VC
17.	Peacock pansy	*Junonia almana* Linnaeus, 1758	Nymphalidae	VC
18.	Common emigrant	*Catopsilia pamona* Fabricius, 1775	Pieridae	NR
19.	Striped albatross	*Appias libythea* Fabricius, 1775	Pieridae	NR
20.	Mottled emigrant	*Catopsilia pyranthe* Linnaeus, 1758	Pieridae	C
21.	Common jezebel	*Delias eucharis* Druzy, 1773	Pieridae	NR
22.	Cabbage butterfly	*Pieris rapae* Linnaeus, 1764	Pieridae	C
23.	Common grass yellow	*Eurema hecabe* Linnaeus, 1758	Pieridae	VC
24.	Yellow orange tip	*Ixias pyrene* Linnaeus, 1764	Pieridae	R
25.	Citrus butterfly	*Papilio demoleus demoleus* Linnaeus, 1758	Papilionidae	C
26.	Common jay	*Graphium doson* C&R. Felder	Papilionidae	C
27.	Blue mormon	*Papilio polymnestor* Cramer, 1775	Papilionidae	VR
28.	Common mormon	*Papilio polytes* Linnaeus, 1758	Papilionidae	VC
29.	Lime butterfly	*Papilio demoleus* Linnaeus, 1758	Papilionidae	C
30.	Chest nut bob	*Lambrix salsala* Moore, 1865	Hesperidae	C

Based on observation of butterflies occurrence, 47.7% species are very common, 40.2% species are common, 11.4% species are not rare, 0.53% species are rare and 0.07% species are very rare (Fig. 2).

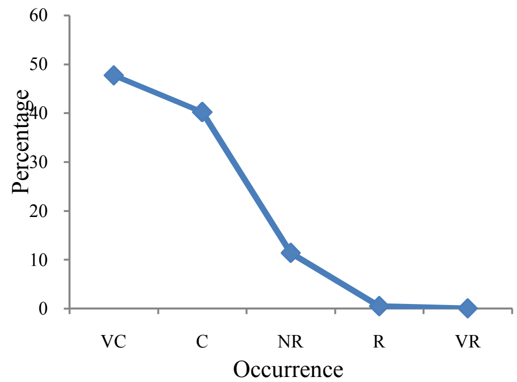

Fig 2 Occurrence of different species of butterflies in the study area

The maximum butterflies species recorded under family Nymphalidae (47.6%) followed by Pieridae (21.8%), Papilionidae (20.2%), Lycaenidae (6.57%), and Hesperiidae (3.78%) (Fig.3.).

Among these *Papilio demoleus, Eurema hecabe, Catopsilia pomona* recorded species were found in high frequencies in all the months.

Dominance Index (D_{BP}), Simpson's Index (D_S), Shannon Index (H') Shannon evenness Index (J) were calculated for each family and for all the families are presented in the Table II and Fig.4 respectively.

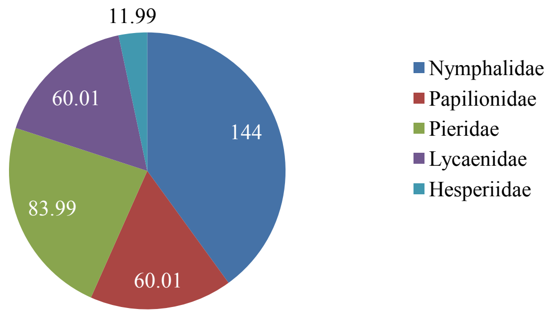

Fig 3 Species composition of five families of butterflies in the study site

Table II The values of various diversity indices of four families of butterflies.

FAMILY	H'	H_{MAX}	J	D_{BP} HIGHER	D_{BP} LOWER	D_S	D
Nymphalidae	2.1432	2.484	0.8310	0.18	0.003	0.1256	0.8744
Lycaenidae	1.0419	1.6094	0.646	0.63	0.02	0.4594	0.5406
Papilionidae	1.3021	1.6094	0.8074	0.45	0.003	0.2999	0.7000
Pieridae	1.6254	1.9459	0.84	0.35	0.006	0.2265	0.7735
Interfamily	1.3113	1.6094	0.8137	0.47	0.038	0.3209	0.6791

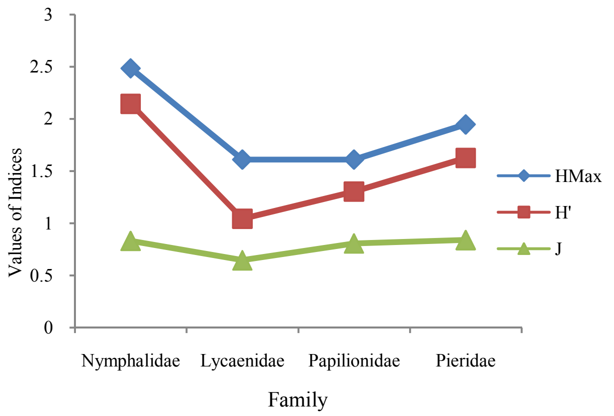

Fig 4 Values of the diversity indices in different families of butterflies in the study area.

Among four families the value of H' is more than 1.5 in Nymphalidae and Pieridae. This reflects that both the families are ideal in nature. Among other two families, family Papilionidae is more towards an ideal family (H' = 1.30).The value of J or evenness of an ideal community is 1. In the present study, maximum evenness is observed in the family Pieridae followed by Nymphalidae and Papilionidae whereas, Lycaenidae is far behind evenness (as the value is 0.646). In the study area the butterfly community (consist of five families) is towards an ideal community (the value of H' = 1.31) and in respect to evenness it is more or less even as the value tends to 1 (J= 0.81, Table II).

The dominant family in the present study is Nymphalidae (1/D = 0.4762) and the dominant species in this family is *Danaus chrysippus*. In the family Lycaenidae *Zizula hylax,Eurema hecabe* of the family Pieridae, *Papilio polytes* of the family Papilionidae are the dominant species (Table II).

Simpson's Index to explain family diversity in butterfly community in the present study reflects that it is less diverse (Ds= 0.3209 and D = 0.6791). Diversity among four families indicate that Nymphalidae is highly diverse followed by Papilionidae, Pieridae and Lycaenidae.

The rank abundance curve presented in Fig. 5 shows species diversity,

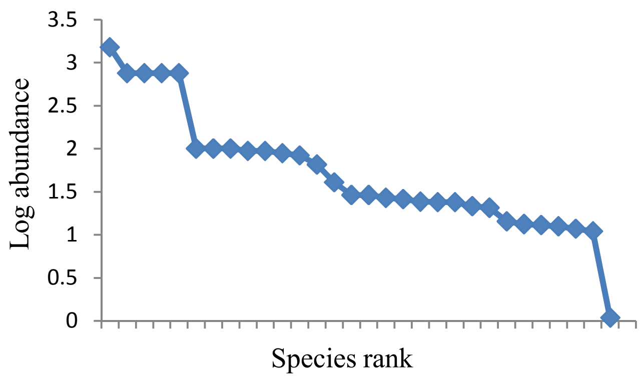

Fig 5 Rank abundance of 30 species of butterflies in the study area

DISCUSSION

The number of butterfly species observed in the present study remained similar to the observations on the species bearing similar landscape patterns in different parts of India (Dronam, 1958, 1960 ; Ray *et al*., 2012, Harsh 2014 and Saikia, 2014) and West Bengal (Mukherjee *et al*., 2015, Choudhuri and Soren, 2015, Dwari and Mondal, 2015; Saha *et al*,. 2015, Ray *et al*., 2015, Dey and Ghosh, 2016). Very low species to genus ratio (1.304) was observed in the present study which indicates strong intra-generic competition.

The present observation remains consistent with the record and views of butterflies species in different parts of world (Koh and Sodhi, 2004, Willson *et al*., 2004, Sodhi *et al*., 2010). In West Bengal, species diversity of the family Hesperiidae is very poor. Only one or two species are observed in different districts or parts of West Bengal (Ray *et al*.,2012; Dwari and Mondal, 2015; Saha *et al*., 2015 and Dey and Ghosh, 2016) except in Kolkata (Mukherjee, 2015). These findings are also true in case of present investigation (only one species).Though in Kolkata, Mukherjee *et al*.(2015) observed 18 species of the family Hesperiidae.

The preference of butterflies for particular habitat is often linked with the larval or adult food source and other climatic factors.

Nymphalidae is the dominant family in all time with highest number of species (Kunte, 1997). The dominance is related with their polyphagous nature availability of food plant found and also their strong active, flying habit assist in searching varied food resources. This is also true for the present observation.

Wynter Blyth (1957) had identified two season or peaks, March- April and October for butterfly abundance in India. Dey and Ghosh (2016) reported an increased trend in butterfly density started from post monsoon, though Mukherjee *et al*.(2015) reported species diversity and abundance were maximum in the months of March-April and minimum in the month of December-February. In present study maximum species diversity and their abundance is recorded in the months of October and November which support the study of Wynter Blyth and Dey and Ghosh but differ from the observation of Mukherjee *et al*. This may be due to climatic condition and local vegetation (as food plant of larvae).

Among different families Nymphalidae is the dominant family both in number and species composition. Similar result was observed in different parts of West Bengal (Choudhuri and Soren, 2011; Roy *et al*., 2012; Mukherjee *et al*., 2015; Dey and Ghosh, 2016) and outside West Bengal (Kunte, 1997).

The observed variation in the present study is due to the availability of the host plant and related factors like rainfall, wind speed, temperature etc. that render stability to the population and butterfly assemblages in the landscape. Increased urban development replaces or reduces the area of natural and semi-natural habitats having deleterious effect on butterfly population in local level. So the present study suggests that the conservation management is required to ensure sustenance of different ecosystem services derived from the butterflies, as butterfly abundance in a particular landscape will promote the propagation of different plant species thus help in monitoring ecosystem integrity and landscape pattern.

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