Preliminary survey of Diversity and Urbanization affecting the abundance of Lepidoptera

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Abstract

Butterflies are insects from the order of lepidoptera of Phylum Arthropoda. The present investigation comprises preliminary survey of biodiversity of Butterflies in Pimpri Chinchwad Municipal Corporation, Maharashtra was undertaken. In the present study thirty butterflies offive different families were observed. Out of thirty butterflies found, two of them falls in Schedule-I and other two falls under schedule-II of Wildlife Protection Act 1972. The prevalence of butterflies and moths signifies the importance and changes in the surrounding environmental conditions. It affects the population of butterflies from different habitat was done. It was observed that abundance of butterflies was lesser in urban habitat compare to rural and sub-urban habitats. Conservation strategies are needed to be made in urban areas to maintain the diversity of Lepidoptera.

Urbanization is a process that leads to the growth of cities due to industrialization and economic development, and that leads to urban-specific changes. Extensive urbanization may lead to environmental degradation and can cause many serious problems¹⁵. Sustainable urban development, that meets the needs of the present without compromising the ability of the future generations to meet their own needs. It can be achieved by emphasizing improvement, progress and positive change, including both environmental and social aspects².

The butterflies are the insects from order lepidopteran of phylum Arthropoda³. They are beautifully colored, diverse and functionally important group. They are herbivores, pollinators and indicators of environmental change⁵. They play important role maintaining ecological balance in ecosystem as they are integral part of pray-predator system¹².

About 1,80,000 species of Lepidoptera are described till now. More than 8000 butterfly species³ with about 1504 species of butterfly species found in India.¹

Urbanization is one of the main reasons for loss of biodiversity. Urbanization and human recreational activities cause loss of habitat, run-off from roads, litter deposition and weeds are the factors which affects the butterfly population¹. If vegetation of green spaces is established in an urban area, there will be improvement in microclimatic condition and it will lead to healthier urban ecosystem. Population of butterflies and other associated species will be increased¹⁴ Knowledge of other wildlife group and other socio-economic variable will lead us to more sustainable, live able and biodiverse cities⁷.

Aim of study is the effect of urbanization on the abundance butterflies in Pimpri Chinchwad area, Maharashtra. Here, we provide an essential baseline for the butterfly diversity in Pimpri Chinchwad area, it is the rapidly growing urban area.Present study examines the diversity and distribution of butterfly species across three different habitats namely, Rural, Sub-urban and Urban habitat. We investigated that, Abundance of butterflies was higher in rural and sub-urban area. This may be due to the presence of nectar plants and undisturbed habitats of butterflies. The abundance of butterflies was found less in urban area, this may be due to urbanization. In this paper we discussed, Impact of urbanization on butterfly species and need of conservation in an urban area.

Study area :

The Pimpri Chinchwad area, Maharashtra was selected to study the diversity of lepidoptera. The area is situated between the North altitude 18⁰,62'N, and the longitude 73°,80° E. the area of PCMC is 177sq. the climate of PCMC is hot during summer (March to May) with the temperature ranges between 25°C to 41°C and the humidity is between 70-80%. Pimpri Chinchwad area is situated in the north-west part of Pune, Maharashtra state. Three major types of habitats were selected for study of butterfly, such as 1. Rural habitat, 2. Sub-urban habitat, and 3. Urban area.

Survey method for Butterflies :

The field survey of butterfly was carried out in different locations of Pimpri Chinchwad area. Pollard walk method was used for the survey¹¹. The butterflies were observed and recorded up to 5 meter while walking slow. The photographs were taken for the identification purpose. During the present study, the butterflies were neither killed nor collected.

Identification of Butterfles :

The identification of the Lepidoptera, was done with the help of photographs and on field observation. The size, shapes, color patterns and designs were considered for the identification. With the help of relevant available literature⁷ and expert entomologist the species were identified.

Data Analysis :

(A) Shanon Index H: - Species diversity was calculated using the Shanon Index. (1)

$$H=\Sigma[(pi)\times\ln(pi)]$$

Here, pi is the proportion of the i^{th} species in the total sample. The number of species (species richness) in the community and their evenness in abundance (or equitability) are the two parameters that define H.

(B) Pielou's Evenness Index J: -

The species evenness is the proportion of individuals among the species. Evenness of species indicates their relative abundance on site¹¹.

$$J = \frac{H}{\ln S}$$

Here, S is the number of species present in the site.

(C) Simpson's Diversity Index D': -

Species dominance across habitats is estimated by Simpson's dominance index¹⁶. This index is used to determine the proportion of species in an area, by using following formula.

$$D=\frac{\Sigma n (n-1)}{N (N-1)}$$

n= The total number of organisms of a particular species.

N= The total number of organisms of all species.

The Value of D ranges between 0 & 1.

Figure 1: The representative butterfly species of Butterfly encountered in the present study.



Figure 1. The representative butterfly species encountered in the present study: A, Talicada nyseus; B, Zizeeria karsandra; C, Castalius rosimon; D, Catochrysops strabo; E, Jamides celeno; F, Pseudozizeeria maha; G, Luthrodes pandava; H, Acytolepis puspa; I, Hypolimnas misippus; J, Ypthima huebneri; K, Tirumala limniace; L, Acraea terpsicore; M, Elymnas hypermnestra; N, Mycalesis mineus; O, Pyrisitia nise; P, Graphium agamemnon

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Figure1 Continued: The representative butterfly species of Butterfly encountered in the present study



Figure 1 cotinued. The representative butterfly species encountered in the present study: A, *Catopsilia pomona;* B, *Papilio demoleus;* C, *Papilio polytes;* D, *Hasora vitta;* E, *Kricogonia lyside;* F, *Junonia lemonias;* G, *Junonia atlites;* H, *Moduza procris;* I, *Cepora nerissa;* J, *Eurema hecabe;* K, *Danaus genutia;* L, *Danaus chrysippus;* M, *Ariadne merione;* N, *Appias drusilla;*

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Sr/N	Family	Scientific Name	Common Name	Abundance
1	Lycaenidae	Talicada nyseus	Red Pierrot	21
2		Zizeeria karsandra	Dark Grass Blue	3
3		Castalius rosimon	Common Pierrot	3
4		Catochrysops strabo	Forget me not	6
5		Jamides celeno	Common cerulean	5
6		Pseudozizeeria maha	Pseudozizeeria maha Pale Grass Blue	
7		Luthrodes pandava	Cycad Blue	7
8		Acytolepis puspa	Common Hedge Blue	1
9	Nymphalidae	Hypolimnas misippus	Great Eggfly	2
10		Ypthima huebneri	Common Four-ring	13
11		Tirumala limninace	Blue Tiger	3
12		Acraea terpsicore	Acraea terpsicore Towny Coster	
13		Junonia atlites	a atlites Grey Pancy	
14		Moduza procris	The commander	2
15		Danaus chrysippus Plain tiger		1
16		Junonia lemonias Lemon pancy		9
17		Danaus genutia Common tiger		4
18		Ariadne merione Common castor		3
19	Elymnas hypermnes		Common Palmfly	19
20		Mycalesis mineus	Dark Brand Bush Brown	3
21	Pieridae	Pyrisitia nise	Mimosa Yellow	13
22		Cepora nerissa	Common gull	1
23		Appias drusilla	Tropical white	4
24		Kricogonia lyside	Lysidesulphur	8
25		Eurema hecabe	Common grass yellow	23
26		Catopsilia pomona	Common Emmigrant	8
27	Papillionidae	Papilio demoleus	Lime Butterfly	3
28		Papilio polytes	Common Mormon	4
29		Graphium agamemnon	Tailed Jay	3
30	Hesperiidae	Hasora vitta	Plain Banded awl	4

Table-1. The butterfly species encountered in the present study.

Table-2. Schedule species of butterfly found under Indian Wildlife (PROTECTION) ACT, 1972:

Sr/N	Family	Scientific Name	Common Name	WPA(1972)
1	Lycaenidae	Castalius rosimon	Common Pierrot	Sch I (Part IV)
2	Lycaenidae	Acytolepis puspa	CommonHedge Blue	Sch I (Part IV)
3	Nymphalidae	Hypolimnas missipus	Great Eggfly	Sch II (Part II)
4	Pieridae	Cepora nerissa	Common gull	Sch II (Part II)

(2	1	9)
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Figure 2. Abundance of butterfly species in different habitats.

A total of 30 butterfly species with a total of 197 individuals belonging to 5 families were recorded (with photographic record) during the study. The butterfly list along with them abundance in different habitats is given in Table-1. The three most abundant species are *Eurema hecabe* (with 26 individuals) followed by *Elyminas hypermnestra* (with 19 individuals) and *Pyresitia nise* (With15 individuals). The greatest number of all these three species occurred in rural habitat. A total of 197 individuals were recorded from the PCMC area with highest abundance in rural habitat (n = 89) followed by sub-urban habitat (n = 61) and urban habitat (n = 47).

Table-3. Butterfly abundance according to different habitats

	Rural	Sub-	Urban
		Urban	
Common	41	25	23
Uncommon	26	25	10
Rare	23	17	7

Out of the five families of butterflies, Nymphalidae were themost commonly recorded, accounting for 40% (n = 66) oftotal species recorded followed by Lycaenidae 26% (n = 60), Pieridae20% (n = 57), and Papilionidae 10% (n=10) of total species and minimum were recorded for Hesperiidae 4% (n = 4).

Figure 2 shows that proportion of rare species tends to decrease from rural to suburban to urban habitat. The proportion of uncommon species is similar inrural habitat and sub-urban habitat environment while it tends todecrease in urban habitat. Theproportion of commonspecies, on the other hand, indicates a decreasing trend from rural to sub-urban to urban habitat.

Table-4. Results of different ecological indices for different habitats.

Ecological	Rural	Sub-	Urban	
Indices		urban		
Evenness (J)	0.104	0.116	0.114	
Species richness (S)	29	22	18	
Total Abundance	89	61	41	
Shannon-Wiener	0.35	0.36	0.33	
Index (H)				
Simpson's Diversity	0.20	0.09	0.05	
Index (D)				

The diversity of butterfly species in three different habitattypes in PCMC area is represented in Table-4. The rural habitat has the greatest species number with 29 species and sub-urban has 22 species, while urbanhabitat ranks lowest with 18 species. The same order follows for abundance and diversity index with highest diversityindex for rural habitat and least for urban habitat and greatest individual numbers for ruraland least for urban environment. The greatest species number of rural habitats leads to the high diversity index although ithas a lower evenness index than sub-urban habitat. Theevenness index is almost similar in the entire three habitats with the index being highest in sub-urban habitat wherethere is not any dominating species with high individual number.

Thirty species of were documented during the survey. Rural habitat found to have highest species abundance and richness followed by sub-urban habitat and lowest in urban habitat. One important aspect of the study is statistics of common species between different habitats, which indicates the diversity of butterflies found in them. The rural and suburban habitats show high abundance of butterfly as these habitats are relatively richer in nectar plants. Plants are essential source of nourishment for butterflies and moths. Some specific plants provide tropical resource for caterpillars, while other provide nectar for adults⁹. Butterflies can be found in both urban and rural areas. The diversity and richness of butterflies are much lower in urban area than rural area¹³. Native flora and fauna of the urban area is disappearing due to unplanned urbanization and anthropo-genic Activities. It led to habitat loss. To restore habitats conservation strategies are needed to be made⁴.

Government should take initiative for the conservation of lepidoptera. To achieve sustainable development and conservation of butterfly species proper conservation and management planning is needed⁴.

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