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Butterfly (Lepidoptera- Rhophalocera) Diversity in the Developing Urban Area of Gelephu, Bhutan

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Abstract

Urban development has led to substantial fragmentation of natural habitats of wildlife, depletion of water resources, and increase in air and soil pollution resulting in significant impact on biodiversity and ecological processes. Butterflies are good biological indicators of anthropogenic disturbance of environment. Considering the impact of habitat fragmentation and change in environment and climate variables, this study was undertaken to study butterfly diversity in and around the expanding Gelephu town in southern Bhutan. The survey was carried out from January to December, 2015 with an objective to generate baseline information on the presence and status of butterflies in the urban area of Gelephu. A total of 56 species of butterflies belonging to 5 different families were recorded. Family Nymphalidae had the highest number of species (46%, n = 26) and the lowest was represented by family Papilionidae (5%, n = 3). Establishment of Green Park in the urban area could create good habitat for increasing butterfly biodiversity in urban area of Gelephu.

Keywords: Butterfly, conservation, diversity, urban area

Introduction

Biodiversity decline is attributed mainly to increase in global human population (Stoate *et al.*, 2001; Benton *et al*., 2002; 2003). Urban development in particular has led to substantial fragmentation of natural habitats of wildlife, depletion of water resources, and increase in air and soil pollution resulting in significant decrease of biodiversity (Robinson and Qunin, 1988) causing species endangerment (Schultz, 2001) and disruption in ecological processes (Christie and Hochuli, 2005). Butterflies are the best studied pollinators around the globe (Ghazoul, 2002), but some of them are endangered and require conservation plan (Wilcove and Chen, 1998). In Bhutan, urbanisation might have affected butterfly diversity, which is difficult to substantiate in absence of any baseline information.

Recently, butterfly studies have generated some scientific information and interest among young people in Bhutan. Singh and Chib (2015) published a checklist and Wangdi and Sherub (2015) published a pictorial guide along with a checklist of butterflies of Bhutan. There are additional publications on butterfly diversity by Singh and Chid (2014) and Nidup *et al.* (2015). However, there are no studies on butterfly diversity found in the urban areas of Bhutan. Therefore, this study was undertaken to explore butterfly diversities and their status in the rapidly growing town of Gelephu in southern Bhutan.

Materials and Method

Study area

Gelephu town is located in central-southern foothills of Bhutan. It shares international boundary with Assam state of India and is one of the hubs for business for Bhutanese people. It spreads over an area of 8 km^2 and is surrounded by rural agriculture fields, rivers, and forest. The town has people from different ethnicity and background, and has nearly 1,700 people. Several schools, government and private offices

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are located within the town area. Town is on the developing phase and currently a lot of infrastructures are being planned and developed.

This foothill is located in a strategic location, at the confluence of the Indo-Gangetic and Indo-Malayan bio-geographical realms. It forms a part of ten global biodiversity hotspots constituting a unique ecosystem of international significance (RMNP, 2015). Therefore, this area has scientific significance in terms of wildlife presence.

Owing to its strategic location different types of habitats are found such as sub-tropical forest patches, open shrub land, and agriculture fringes in the study area. This southern foothills complex represents the last refuge and best remaining habitat for the endemic and globally threatened species like the Golden langur, Hispid hare, Bengal tiger, Asian elephant, and Asiatic water buffalo.

Sampling procedure

The study area was divided into three compartments and within each compartment five transect lines were laid. Each transect line was of 400–500 m length depending upon locations. Compartments were categorised as; i) Compartment 1 – main town area with high settlements, traffic, and buildings, ii) Compartment 2 – intermediate settlements with few buildings, vegetable garden around the buildings, and less traffic, and iii) Compartment 3 – low settlements and area adjacent to agriculture fields, river or forest.

All transects were visited once within three months during the study period from January – December, 2015. All butterflies observed were recorded within the 5 m radius of the recorder (Pollard, 1977). To maximize detection, the survey followed the procedure applied by Royer *et al.* (1998), focusing mostly on bright sunny days at 0900–1200 hours and 1300–1500 hours in October and January, 0830–1100 hours in April and 1400–1700 hours in July. To avoid researcher's bias, 30-40 minutes effort was given for each transect line, avoiding double counting of butterfly as much as possible.

Butterfly identification

Butterflies were identified in the field through visual observations and the ones which were difficult to identify from a distance were caught carefully with the help of sweep-net for detailed observation. Further, photographs of butterflies are taken using Cannon 60D camera (18–270 mm lens) and the photographs were used for

Table 1. Checklist and presence of butterflies in different compartments of Gelephu town

Sl.	Common name	Scientific name	Compartments		
			One	Two	Three
	Family: Hesperidae				
1	Chestnut Angle	*Odontoptilium angulata* C. & R. Felder, 1862			x
2	Himalayan Dart	*Potanthus dara* Kollar, 1844			x
3	Common Spotted Flat	*Celaenorrhinus leucocera*, Moore, 1865			x
4	Small Branded Swift	*Pelopidas mathias* Evans, 1949		x	x
5	Fulvous Pied Flat	*Pseudocoladenia dan* Evans, 1949		x	x
6	Water Snow Flat	*Tagiades litigiosa* Hubner, 1819			x
	Family: Lycaenidae				
7	Bright Sunbeam	*Curetis bulis* Westwood, 1882			x
8	Purple Sapphire	*Heliophorus epicles* Godrat, 1824	x	x	x
9	Common Pierrot	*Castalius rosimon* Fabricius, 1775		x	x
10	Indian Cupid	*Everes lacturnus* Godrat, 1824		x	
11	Large Hedge Blue	*Celastrina Huegelii* Moore, 1883		x	x
12	Malayan	*Megisba malayan* Moore, 1879			x
13	Lesser Grass Blue	*Zizina otis* Fabricius, 1787		x	x
14	Pale Grass Blue	*Pseudozizeeria maha* Koller, 1848			x
15	Punchinello	*Zemeros flegyas* Fabricius, 1897		x	x
16	Common Emperial	*Cheritra freja* Fabricius, 1793		x	
17	Slate Flash	*Rapala manea* Moore, 1879			x
	Family: Nymphalidae				
18	Black Prince	*Rohana parisatis* Moore, 1857			x

Table 1. Checklist and presence … cont...

Sl.	Common name	Scientific name	Compartments		
			One	Two	Three
19	Circe	*Hestina nama* Doubleday, 1845	x	x	x
20	Common Castor	*Ariadne merione* Cramer, 1777		x	x
21	Tawny Rajah	*Charaxes bernardus* Felder, 1857			x
22	Tabby	*Pseudergolis wedah* Kollar, 1844	x	x	x
23	Blue Tiger	*Turimala limniace* Moore 1880,			x
24	Chestnut Tiger	*Parantica sita* Kollar, 1844		x	
25	Common Crow	*Euploea core* Cramer, 1790	x	x	x
26	Dark Blue Tiger	*Turimala septentrionis* Butler, 1874			x
27	Glassy Tiger	*Parantica aglea* Moore, 1883		x	x
28	Striped Blue Crow	*Euploea mulciber* Cramer, 1777		x	x
29	Striped Tiger	*Danaus genutia* Cramer, 1779	x	x	x
30	Leopard Lacewing	*Cethosia cyane* Drury, 1770	x	x	x
31	Red Lacewing	*Cethosia biblis* Fabricius, 1770	x	x	x
32	Grey Count	*Taneacia lepidea* Butler, 1868	x	x	x
33	Streaked Baron	*Euthalia alpheda jama* Fedler, 1866			x
34	Blue Pansy	*Junonio orithiye* Hubener, 1816	x	x	x
35	Chocolate Pansy	*Junonia iphita* Cramer, 1779	x	x	x
36	Common Jester	*Symbrenthia hippoclus Moore*, 1874		x	x
37	Great Eggfly	*Hypolimnas bolina* Linnaeus, 1758	x	x	x
38	Grey Pansy	*Junonia atlites* Johanssen, 1764	x	x	x
39	Lemon Pansy	*Junonia lemonias* Linnaeus, 1758	x	x	x
40	Peacock Pansy	*Junonia almanac* Linnaeus, 1758	x	x	x
41	Yellow Pansy	*Junonia hierta* Evans, 1923	x	x	x
42	Common Fivering	*Ypthima baldus* Fabricius, 1775	x	x	x
43	Nigger	*Orsotrioena medus* Fabricius, 1775	x	x	x
	Family: Papilionadae				
44	Common Mormon	*Papilio polytes* Linnaeus, 1758	x	x	x
45	Great Mormon	*Papilio memnon* Linnaeus, 1758	x	x	x
46	Paris Peacock	*Papilio paris* Linnaeus, 1758		x	
	Family: Pieridae				
47	Common Grass Yellow	*Eurema hecabe* Moore, 1886		x	
48	Mottled Emigrant	*Catopsilia pyranthe* Linneaus, 1758			x
49	Chocolate Albatross	*Appias lyncida* Boisduval, 1836		x	x
50	Common Gull	*Cepora nerissa* Fabricuis, 1775		x	x
51	Great Orange Tip	*Hebomoia glaucippe* Linneaus, 1758		x	x
52	Indian Cabbage White	*Pieris canidia* Evans, 1926	x	x	x
53	Large Cabbage White	*Pieris brassicae* Grey,1846	x	x	x
54	Psyche	*Leptosia nina* Fabricius, 1793	x	x	x
55	Red Base Jezebel	*Delias pasithoe* Linnaeus, 1758			x
56	Yellow Orange Tip	*Ixias pyrene* Butler, 1896	x	x	x

Note: "x" indicates the presence of butterfly species in different compartment during field survey

further confirmation in the camp. Species identification was done using available literature of Kehimkar (2008); Wangdi and Sherub (2012a; 2012b; 2014; 2015); Singh and Chib (2014); and Nidup *et al.* (2015).

Results and Discussion

Bright and warm season is found to be the best time for butterfly survey (Singh, 2012; Nidup *et al.*, 2015) since availability of food plants depends on temperature and season (Tiple and Khurad, 2009; Nidup *et al*., 2015). A total of 56 butterfly species (Table 1) were recorded belonging to 5 different families in the 3 compartments. Among the 5 families, Nymphalidae was the most common (46%, n = 26) followed by Lycaenidae (20%, n = 11), Pieridae (18%, n = 10), Hesperiidae (11%, n = 6), and Papilionidae (5%, n = 3). The observed difference could be due to difference in family size, Nymphalidae being the largest family – about 6,000 species of Nymphalidae are found worldwide (Kehimkar, 2008). Similar studies carried out in and around Nagpur city, central India by Tiple *et al.* (2009) and in Tropical Forest Research Institute, Jabalpur, Madhya Pradesh, Central India by Tiple (2012) recorded highest species in Nymphalidae and lowest in Papilionidae. Ramesh *et al.* (2010) also recorded Nymphalidae as the most abundant family but heterogeneous landscapes had more Hesperiidae members in Kalpakkam, South India.

Highest number of individuals and species diversity was encountered in compartment three (38%, n = 161) and (45%, n = 52) followed by in compartment two (37%, n = 157) and (35%, n = 41) and compartment one (25%, n = 105) and (20%, n = 23). Compartment three was adjacent to forest edge which is suitable habitat for specialist as well as for generalist fauna (Nidup *et al*., 2015), so this could be the underlying reason for the record of maximum species and individuals of butterflies in this compartment. Similar study conducted by Tiple and Khurad (2009) also recorded differences in species number between disturbed and undisturbed study sites in Nagpur city. Owing to presence of high diversity of butterflies in compartment three, maximum number of predation on butterflies were also seen during the study period. Since habitat fragmentation and modification of natural habitat adversely affect availability of food and nectar plants for larvae and adult butterflies (Tiple and Khurad 2009; Chowdhury, 2014), presence of such conditions in the compartment one could have attributed to the low species diversity and individual counts.

Currently, expansion of road and other infrastructure construction have further added to habitat fragmentation and loss of food and nectar plants in compartment two and three. In Nagpur city (Tiple and Khurad, 2009), habitat modification and fragmentation has shifted the presence of butterfly diversity composition as the plant community changed. It is likely that such phenomenon could be observed in Gelephu town in nearer future as the habitats are being fragmented and modified very fast. However, all the butterflies observed in Gelephu were 'common' and 'generalist' and none of the species were threatened globally as per the IUCN Red List. Among 56 species observed, 23 species were abundant and were found in all the compartments indicating these species are generalists and can tolerate some level of disturbance.

Conclusion

In this study, 56 species of butterflies were recorded most of which were generalists. Edge habitat had greater diversity and higher species counts. The study could not be conducted throughout the year, yet some variation in species composition could be observed in different months. It is also uncertain as to how the diversity will be affected by the growing urban area. Therefore, more studies on butterfly diversity in the study area are required to monitor the response of butterflies to urban growth for the development of a long term conservation strategy and ecosystem management. As noted by Raut and Pendharkar (2010) careful habitat restoration by creating green parks and green urban spaces in the town could assist in bringing nature and wildlife in the urban areas.

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