

ORIGINAL ARTICLE

Impact of Landuse Change and Habitat Degradation on Butterfly Diversity in Rajarhat Newtown, West Bengal, India

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ABSTRACT

Butterflies are attractive species and great bio indicators. Even slight anthropogenic changes in their native habitat can cause migration or local population extinction. Rajarhat Newtown is one of Kolkata's areas where the land use pattern is quickly changing due to urbanisation. Within last 20 years, the land use pattern of Rajarhat Newtown has dramatically changed. Between 2000 and 2021, vegetation cover fell by 63.33 percent, agricultural land fell by 87.05 percent, and water bodies fell by 34.15 percent. During same time frame habitation increased 3.29 times. In 2017-18, a total of 47 species of butterflies from 38 genera and five families were discovered in the research area. The Nymphalidae family dominated the five families with 15 species (31.9%) belonging to 12 genera (31.6%), followed by Lycaenidae with 10 species (21.2%) from 10 genera (26.3%), Hesperidae with 8 species (17%) belonging to 8 genera (21.1%), Papilionidae and Pieridae with 7 species (14.8%) each from 2 genera (5.26%) and 6 genera (15.8%) respectively. The survey showed 18 species out of 49 species (38.30%) were common, 21 species (44.68%) were uncommon and 8 species (17.02%) were rare. We found the same number of species in 2020-21, but their occurrence differs from 2017-18. Ten species out of 47 were common (21.28 percent), 20 species were uncommon (42.55 percent), and 17 species were rare (36.17 percent). The current research contributes to our understanding of how land use change affects the variety of butterfly fauna in Rajarhat Newtown.

Keywords: butterfly, bio indicator, land use, Rajarhat Newtown, urbanization

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INTRODUCTION

Butterflies are both attractive and important indicator insects. They are well-known pollinators who are highly sensitive to climatic conditions such as temperature, humidity, rainfall, air temperature, wind speed, and, most importantly, the availability of larval host plants [1]. Since of their short generation time, rapid mobility, and habitat preference, butterflies are good bio indicators because they can be easily inspected and react quickly to environmental changes [2]. Butterflies are the most well-known insects in the world, both taxonomically and ecologically [3]. Because most butterfly larvae require host plants and adults have a strong link with nectar plants, vegetation changes have a significant impact on butterflies [4]. They are extremely vulnerable to urbanization's consequences [5]. Abundance butterflies are regarded suitable indicator taxa of habitat degradation due to their extreme sensitivity to environmental changes [6]. It has been discovered that even slight anthropogenic changes in their native habitat can cause migration or local population extinction [7]. Land usage and change are two of the most pressing topics in modern geography. Land use changes at a quick rate in different regions as a result of increasing urbanization [8]. Rajarhat Newtown is one of the areas in Kolkata where the land use pattern is quickly changing as a result of urbanisation. Butterfly species richness, diversity, and abundance are reduced as a result of urban elements such as concrete structures, highways, and population increase [9 - 10]. Because

they are effective indicators of climate change, this habitat destruction must have a significant impact on such a sensitive species [11]. In this study, we attempted to analyse the impact of habitat degradation and land-use pattern change on the diversity of butterfly fauna in Rajarhat Newtown through time, as well as the impact of habitat degradation and land-use pattern change on the diversity of butterfly fauna in Rajarhat Newtown.

MATERIAL AND METHODS

Study area:

Rajarhat New Town is a satellite city in Bidhannagar Municipal Corporation of North 24 Parganas in the Indian state of west Bengal (Figure 1). It is close to Kolkata and is part of the Kolkata Metropolitan Development Authority's jurisdiction (KMDA). The real estate market in Rajarhat has exploded. A green corridor has already been established along this tract of land. Rajarhat New town is located between 22°30'32" N to 22°38'03" N and 88°26'29" E to 88°32'57" E. This township is located in the Barasat Sadar Division of North 24 Parganas, West Bengal, India and encompasses an area of 6158.32 hectares, The climate of Rajarhat New Town is tropical. The average annual maximum temperature is 38.5°C, with a minimum temperature of 17.4°C. The research area receives 1029 mm of rainfall per year [12-13].

Field data collection:

Between September 2017 and January 2018, and September 2020 and January 2021, the survey was conducted. Each survey entails going along a transect and recording and identifying any butterflies within 10 metres. Most species could be identified on the wing, but other species required netting (Lycaenidae and Hesperidae). The majority of the observations were made in the morning (8 a.m.–10 a.m.), with some surveys taking place in the afternoon (4 p.m.–6 p.m.) for shade-loving butterflies. Random observations as well as opportunistic sampling while walking through the road and agricultural field were used to investigate every possible habitat in Rajarhat New Town. The specimens were photographed with a Canon 700D camera. With the help of available literature, specimens were identified [14-18]. Butterflies were categorised into three categories based on the frequency of sightings: a. Common, b. Uncommon, and c. Rare. Any species that was counted more than 50 times was placed in the Common group, 20-50 in the Uncommon category, and less than 20 in the Rare category.

RESULT AND DISCUSSION

Within the last 20 years, the land use pattern of Rajarhat Newtown has dramatically changed (Figure 2 and 3). Between 2000 and 2021, vegetation cover declined from 896.45 square kilometres to 328.74 square kilometres, agricultural land decreased from 2373.87 square kilometres to 307.85 square kilometres, and water bodies decreased from 908.74 square kilometres to 598.44 square kilometres. However, the habitation area grows from 1178.01 square kilometres to 3878.14 square kilometres, while open land grows from 801.25 square kilometres to 1045.15 square kilometers (Table 1). Between 2000 and 2021, vegetation cover fell by 63.33 percent, agricultural land fell by 87.05 percent, and water bodies fell by 34.15 percent. During the same time period, habitation increased by 3.29 times (Figure 4). In Rajarhat Newtown, land use has changed dramatically over the last 20 years, resulting of the loss of flora and a rapid development in concrete buildings (Figure 5). In 2017-18, a total of 47 species of butterflies from 38 genera and five families were recorded in the research area (Table 2). The Nymphalidae family dominated the five families, with 15 species (31.9%) belonging to 12 genera (31.6%), followed by the Lycaenidae family, which had 10 species (21.2%) from 10 genera (26.3 percent), Hesperidae with 8 species (17%) belonging to 8 genera (21.1%), Papilionidae and Pieridae with 7 species (14.8%) each from 2 genera (5.26%) and 6 genera (15.8%) respectively. Nymphalidae and Lycaenidae were the most frequently sighted groups during the survey. All species were classified based on direct sightings during the survey. 18 species (38.30%) were found to be common, 21 species (44.68%) were recorded as uncommon, and 8 species (17.02%) were rare (Table 4). Two species are protected in Schedule II (part II) and two species are included in Schedule IV of the Wildlife (Protection) Act of 1972. We found all 47 species of 38 genera in 2020-21. Ten species (21.28 percent) were found to be common, 20 species (42.55 percent) were found to be uncommon, and 17 species (36.17 percent) were found to be rare in the survey (Table 4). Nymphalidae was the dominant family still. In comparison to 2017-18, the analysis shows a 50 percent rise in the occurrence of common species in the papilionidae, 33.35 percent in Nymphalidae, 66.7 percent in Pieridae, and 50 percent in Lycaenidae in 2020-21 (Figure 6). Rare species were found twice more often in the Papilionidae and Nymphalidae families, and three times as often in the Pieridae and Hesperidae families. In comparison to the uncommon category identified in 2017-18, the occurrence of common species has fallen by 44% over time, while the rare category has climbed by 2.25 times (Table 4). A total of 47 species were identified in both surveys. As a result, there is no evidence

of local extinction or migration. Between 2017-18 and 2020-21, the occurrence of common species decreased dramatically, while the rarity of species increased by more than double. This may be correlated with the destruction of host plants due to habitat degradation [19]. Although we know that climate change is having an influence on butterflies, the impact on individual species is difficult to anticipate because the responses will be based on a complex interplay between plants and animals as well as the climatic conditions that create their habitat [20]. According to the findings, rapid urbanisation is developing in Rajarhat Newtown, resulting in habitat degradation and a decline in diversity among butterfly species in the area.

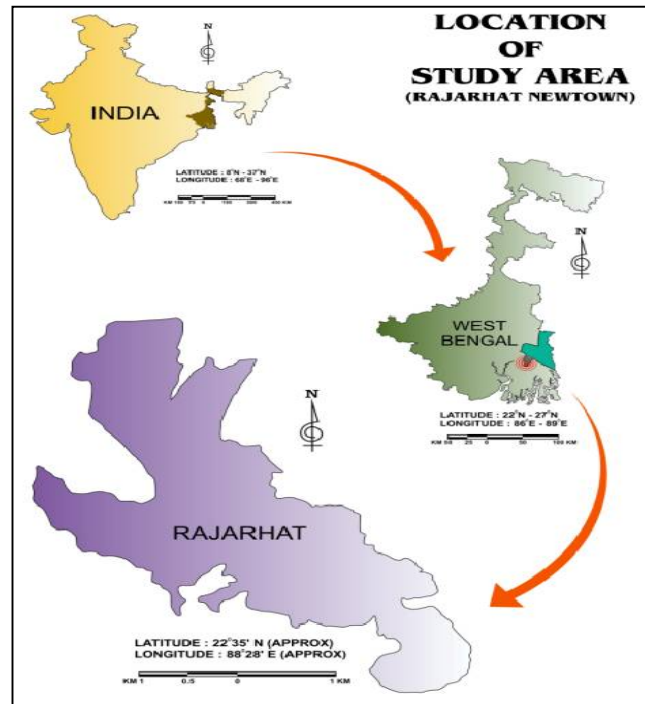


Figure 1. Location Map Source: Orient Longman School and WBHDCO

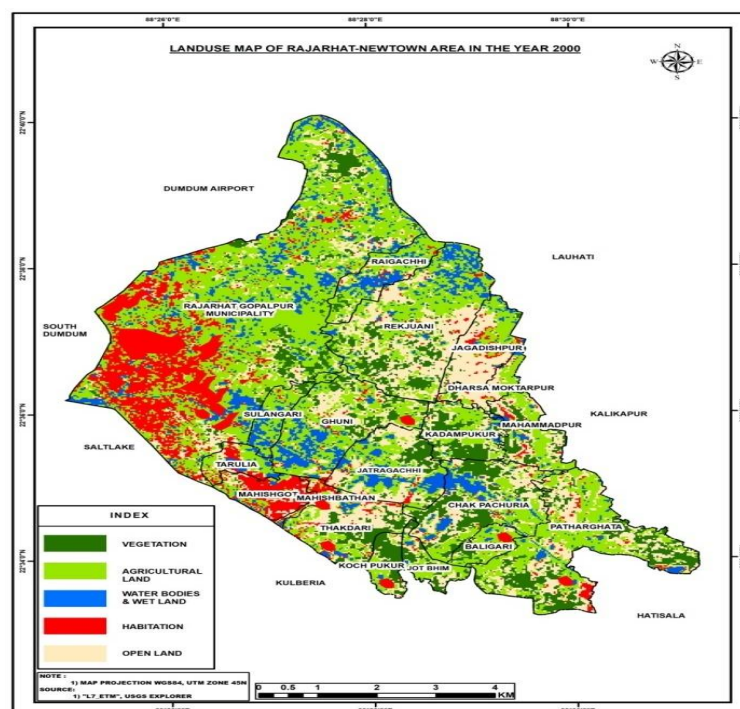


Figure 2. Land use and land cover map of Rajarhat Newtown, 2000. Source: "L7_ETM", USGS EXPLORER.

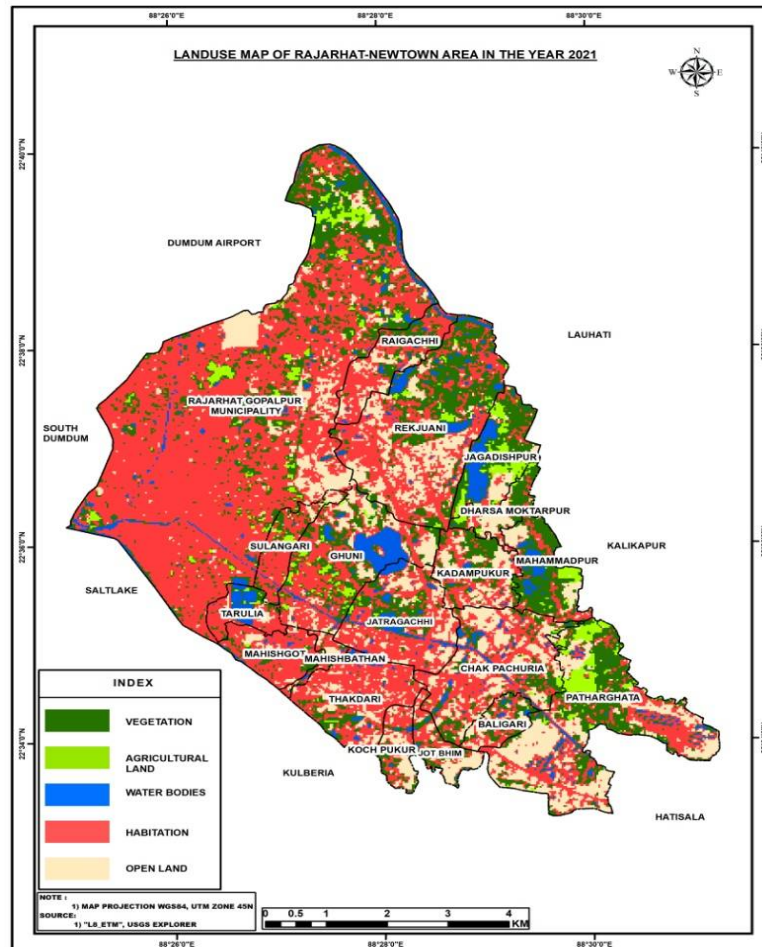


Figure 3. Land use and land cover map of Rajarhat Newtown, 2021. Source: "L7_ETM", USGS EXPLORER.

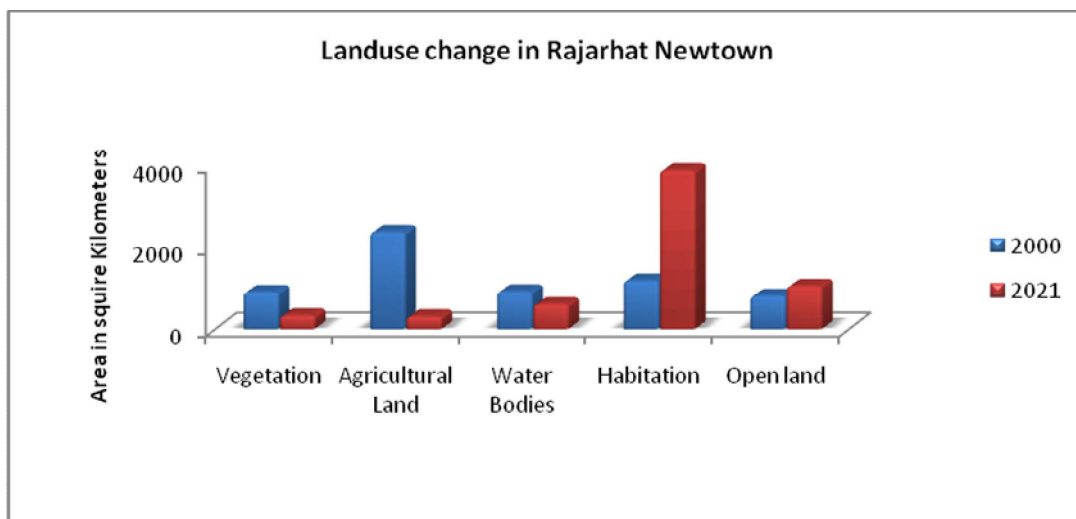


Figure 4: Graph showing land use change in Rajarhat Newtown from year 2000 to year 2021



Figure 5. Land use change and habitat degradation (a) Study area in 2017-18, (b) Study area in 2020-21.

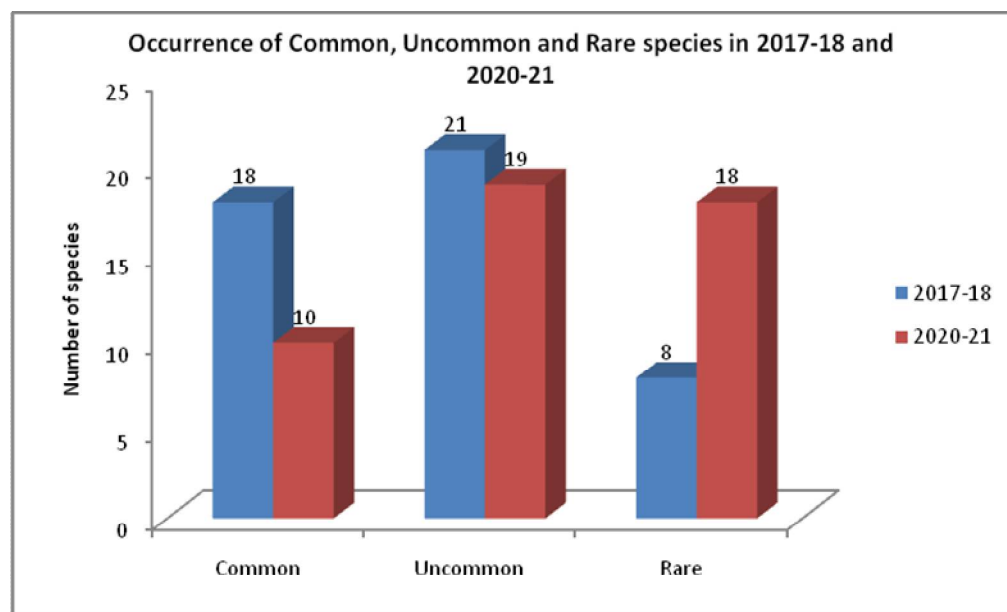


Figure. 6: Graph showing occurrence of Common, Uncommon and Rare butterfly species in 2017-18 and 2020-21

Table. 1: land use in year 2000 and 2021

Land pattern	Year 2000	Year 2021
Vegetation	896.45 Sq. KM	328.74 Sq. KM
Agricultural Land	2373.87 Sq. KM	307.85 Sq. KM
Water Bodies	908.74 Sq. KM	598.44 Sq. KM
Habitation	1178.01 Sq. KM	3878.14 Sq. KM
Open land	801.25 Sq. KM	1045.15 Sq. KM

Table. 2: Checklist of butterflies recorded in the study area

Sl. No.	Common name	Scientific name	Status 2017-18	Status 2020-21	WPA 1972 status
Family: Papilionidae (Swallowtails)					
1	Tailed Jay	<i>Graphium agamemnon</i>	C	U	
2	Common Bluebottle	<i>Graphium sarpedon</i>	R	R	
3	Common Mime	<i>Papilio clytia</i>	U	U	
4	Common Mormon	<i>Papilio polytes</i>	C	C	
5	Lime Butterfly	<i>Papilio demoleus</i>	C	U	
6	Blue Mormon	<i>Papilio polymnestor</i>	U	R	
7	Common Jay	<i>Graphium doson</i>	C	C	
Family: Nymphalidae (Brush footed butterfly)					
8	Tawny Coster	<i>Acraea violae</i>	C	U	
9	Chocolate pansy	<i>Precis atlites</i>	U	U	
10	Grey pansy	<i>Junonia atlites</i>	C	C	
11	Common Sailor	<i>Neptis hylus</i>	U	R	
12	Commander	<i>Moduza procris</i>	U	R	
13	Common Tiger	<i>Danaus genutia</i>	C	U	
14	Plain Tiger	<i>Danaus chrysippus</i>	C	C	
15	Blue Tiger	<i>Tirumala limniace</i>	R	R	
16	Common Crow	<i>Euploea core</i>	U	U	Sch IV
17	Common Evening Brown	<i>Melanitis leda</i>	U	U	
18	Common Palmfly	<i>Elymnias hypermnestra</i>	U	R	
19	Lemon pansy	<i>Junonina lemonias</i>	C	C	
20	Peacock pansey	<i>Junonina atlites</i>	C	C	
21	Danaid eggfly	<i>Hypolimnias misippus</i>	R	R	Sch II
22	Great eggfly	<i>Hypolimnias bolina</i>	R	R	
Family: Pieridae					
23	Common Jezebel	<i>Delias eucharis</i>	U	U	
24	Psyche	<i>Leptosia nina</i>	C	C	
25	Common Wanderer	<i>Pareronia hippa</i>	U	U	
26	Common Emigrant	<i>Captopsilla pomona</i>	C	U	
27	Mottled Emigrant	<i>Captopsilla pyranthe</i>	U	U	
28	Common Grass Yellow	<i>Eurema hecabe</i>	C	U	
29	Striped albatross	<i>Appias libythea</i>	R	R	Sch IV
Family: Lycaenidae (Blues)					
30	Apefly	<i>Spalgis epeus</i>	U	R	
31	Common Pierrot	<i>Castalius thetis</i>	C	U	
32	Quaker	<i>Euchrysops zalmora</i>	C	C	
33	Indian Sunbeam	<i>Curetis thetis</i>	R	R	
34	Forget me not	<i>Catochrysops strabo</i>	U	R	
35	Dark grass blue	<i>Zizeeria karsandra</i>	C	U	
36	Pea blue	<i>Lampides plinius</i>	R	R	Sch II
37	Pale grass blue	<i>Ziznia otis</i>	C	C	
38	Common silverline	<i>Spindasis vulcanas</i>	U	R	
39	Common cerulean	<i>Jamides celeno</i>	U	R	
Family: Hesperidae (Skipper)					
40	Chestnut Bob	<i>Iambrix salsala</i>	C	C	
41	Indian Skipper	<i>Spialia galba</i>	U	U	
42	Indian Palm Bob	<i>Suastus germius</i>	U	U	
43	Rice Swift	<i>Pelopides guttata</i>	U	U	
44	Common Red Eye	<i>Matapa aria</i>	U	R	
45	Forest hopper	<i>Astictopterus jama</i>	R	R	
46	Grass demon	<i>Udaspes folus</i>	U	U	
47	Tree filter	<i>Hyarotis adrastus</i>	U	R	

Table: 3: Family wise occurrence of Common, Uncommon and Rare butterfly species in 2017-18 and 2020-21

Family	Category	2017-18	2020-21
Papilionidae	C	4	3
	U	2	2
	R	1	2
Nymphalidae	C	6	4
	U	6	5
	R	3	6
Pieridae	C	3	1
	U	3	5
	R	1	1
Lycaenidae	C	4	2
	U	4	2
	R	2	6
Hesperiidae	C	1	1
	U	6	4
	R	1	3

Table: 4: Occurrence of Common, Uncommon and Rare butterfly species in 2017-18 and 200-21

Total	2017-18	2020-21
Common	18	10
Uncommon	21	19
Rare	08	18

CONCLUSION

Within the last 20 years, the land use pattern of Rajarhat Newtown has dramatically changed. Vegetation cover, agricultural land and water bodies decreased significantly. Whereas, a sharp increase habitation area was seen during this time frame. The occurrence of common butterfly species declined drastically between 2017-18 and 2020-21, while the rarity of species increased by more than twofold. According to the findings, increasing urbanisation is taking place in Rajarhat Newtown, resulting in habitat degradation and a decrease in butterfly species diversity in the area.

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