HOLISTIC SURVEY ON BUTTERFLY DIVERSITY AT TWO SELECTED REGIONS OF THE NORTHERN PARTS OF BENGAL, INDIA

Supratim Pal[1*], Debashis Das[2], Abhisek Saha[3] and Kaushik Chakraborty[1]

[1]Department of Zoology, University of Gour Banga, Mokdumpur, Malda, West Bengal, 732103

[2]Department of Zoology, Tufanganj Mahavidyalaya,Tufanganj, West Bengal, 736160

[3]Department of Chemistry, Tufanganj Mahavidyalaya,Tufanganj, West Bengal, 736160

ABSTRACT

Butterflies, in gross, are important taxonomic groups and are also considered as prospective bio-indicator which should be protected to conserve the biodiversity at initial level and the environment at the total point. Assessment on diversity of butterfly species was carried out at two altitudinal regions; one from *Dooars* and the rest one from *Terai* plains of Northern parts of Bengal, India during the consecutive period of 2012-2014. Grossly a total of 91 butterfly species belonging to 10 families of order Lepidoptera were primarily recorded. Study reveals that these two regions, in general, encompass the butterfly families of Papilionidae (12 species from *Dooars* and 5 species from *Terai* plains respectively), Pieridae (18 species from *Dooars* and 12 species from *Terai* plains respectively), Danaidae (9 species from *Dooars* and 6 species from *Terai* plains respectively), Acraeidae (2 species from Dooars and 1 species from *Terai* plains respectively), Satyridae (10 species from *Dooars* and 5 species from *Terai* plains respectively), Nymphalidae (21 species from *Dooars* and 10 species from *Terai* plains respectively), Erycinidae (1 species from *Dooars* and 0 species from *Terai* plains respectively), Lycaenidae (14 species from *Dooars* and 7 species from *Terai* plains respectively), Hespiriidae (3 species from *Dooars* and 1 species from *Terai* plains respectively) and Riodinidae (1 species from *Dooars* and 1 species from *Terai* plains respectively). Further out of the 91 species so observed, 4 species are enlisted under Indian Wildlife (Protection) Act, 1972 and hence requires special attention. The area is rich in butterfly diversity and there is an urgent need to adopt befitted and suitable conservation strategies.

Key words: *Butterfly, Diversity, Dooars, Terai plains, Conservation.*

1. INTRODUCTION

Butterflies are regarded as one of the best taxonomically studied groups of insects (Robbins *et al*., 1997) and belongs to the order Lepidoptera of class Insecta. They are the best rapid indicator of the available habitat quality and are also sensitive to environmental degradation (Ramana, 2010). India is considered as a 'butterfly paradise' harboring a number of colourful butterfly species (Venkataramani, 1986). So far 19,238 butterfly species were documented worldwide (Heppner, 1998) of which, 1,504 species was reported from India (Kunte, 2009). Out of that, 100 are (15%) endemic and 26 are (1.8%) globally threatened species (Singh *et al*., 2004). From Peninsular India, 334 butterfly species were reported from the Western Ghats (Tiple *et al*., 2009) and 150 species from the Eastern Ghats region respectively (Gunathilagaraj *et al*., 1998). Butterflies are good indicators to assess the anthropogenic annoyance and habitat and surface topographic alteration (Kocher *et al.,* 2000) as they display high host plant specificity (Munguira *et al*., 2009). The niches of the immature butterfly stages are often very restricted (Garcia-Barros *et al.,* 2009). Consequently most species form meta-populations depending on a network of suitable habitats (Thomas *et al*., 2001; Anthes *et al*., 2003 and Eichel *et al.,* 2008). Due to this butterfly population faces comparatively high chances of extinction than the contemporary any zoo-fauna (Thomas *et al*., 2004 and Thomas, 2005). Thus, they are an important model group in population ecology for meta-population analysis and accordingly to adopt suitable conservation strategies (Watt *et al.,* 2003 and Ehrlich *et al.,* 2004).

North eastern region of India extending from Sikkim through Assam to north Myanmar and up to Shan state is one of the appealing and richest butterfly areas in the world (Evans, 1932). Presence of huge variety of flowering plants, suitable habitats, topography and climates are affable and congenial to support butterfly distribution, diversity and abundance. Fifty eight percent of the butterflies that occur in the Indian sub-continent and Myanmar are found in eastern Himalayan part as well as in north-eastern region of India alone (Evans, 1932).

In spite of that, very scanty works have been done on the assessment of the butterfly species diversity, their relative species composition and their distribution pattern in north eastern region in general and *Dooars* and *Terai* plains of Northern parts of Bengal in particular. The conservation programmes, whatever was taken, are based mostly on larger,

charismatic species and the threats of many less glamorous taxa (such as butterflies and herpetofauna), though play imperative role in ecosystem, go unnoticed and underscored. In this backdrop a checklist of butterfly species by holistic survey was prepared at two altitudinal regions of the northern parts of Bengal. One from *Dooars* and the rest one from *Terai* plains of Northern parts of Bengal, India during the consecutive period of 2012-2014.

2. MATERIALS AND METHODS

2.1. The Study area (Fig.1): The *Terai* and *Dooars* region cover the administrative boundary of the plains of Darjeeling District, the entire land area of both Jalpaiguri and Alipurduar district and upper region of Cooch Behar District of West Bengal.

2.1.1. Study at *Dooars* region*:* The *Dooars* or *Duars* are the floodplains and foothills of the eastern Himalayas in North-East India adjacent to the neighboring state Bhutan. The river *Sankosh* divides this region into the Eastern and the Western *Dooars*. The total area grossly encompasses 8,800 km². The *Western Dooars* is known as the *Bengal Dooars* and the Eastern *Dooars* as the *Assam Dooars*. The average rainfall of this area is about 3,500 mm. Monsoon generally starts from the middle of May and continues till the end of September. Winters are cold with foggy both at morning and at nights. Summer is mild and covers a very short period in the calendar year. Our study covers the areas named *Jayanti*, *Boxa*, *Raimatang*, *Hatipota*, *Kalchini* and *Nararthali* of Bengal *Dooars* having different locations within the periphery of *Dooars.*

2.1.2. Study at *Terai* region: The *Terai* ("moist land") is a belt of marshy grasslands, savannas, and forests located south of the outer foothills of the Himalaya, the Siwalik Hills, and north of the *Indo-Gangetic* Plain of the Ganges, Brahmaputra and their tributaries. The Terai zone is inundated yearly by the monsoon-swollen rivers of the Himalaya. Our study covers the areas named *Coochbehar, Dinhata, Tufanganj, Sitai, Sitalkuchi, Haldibari* and *Rasik beel* of *Terai* plains of North Bengal.

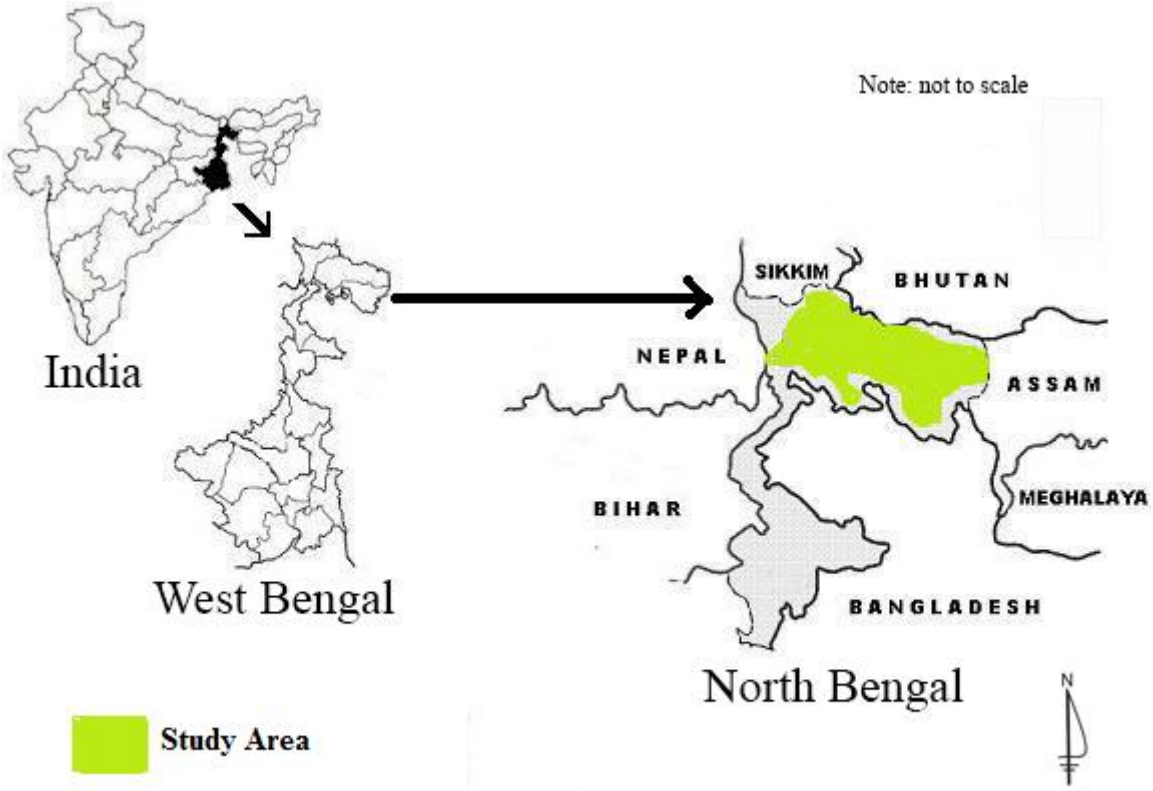


Fig.1: Study area of Dooars and Terai Plains of North Bengal.

2.2. Observation procedure:

2.2.1. By trapping: Collection for observation was made with the help of a sweep net (ring circumference 37", pole length 35" and bag depth 31") at different plant canopy (Gadagkar *et al.*, 1990). Reference sample was collected at marginal level. The collection was mainly done at early morning following sunrise. Voucher specimens, if required, were taken in plastic jar, subsequently dried after spreading in boards and ultimately preserved with proper documentation and labeling (Arora, 1990).

2.2.2. By visual searching: Most of the sample individuals were released after visual examination and after taking photography in the field condition. Binocular as an observational tool used, when required.

2.2.3. Photographing: Photography of the sample at their normal abode was done using a Panasonic semi DSLR (FZ50) camera with 12X optical zoom and 10.2 mega pixels.

2.2.4. Record of incidence: In consideration of the relative incidence at two selected place a 5 hedonic scale system was adopted to record the incidence of the butterfly species. Butterfly that are very common and plenty in abundance is represented as '++++'. The other grades in descending order are Common (+++), Few (++), Occasional (+). If the desired specimen is totally absent at a area, it is designated as NR, *i.e.* a Not Recorded species.

2.3. Taxonomic identification: Identification of species was done with the help of description given by Marshall and De Niceville (1890), Evans (1932) and Wynter-Blyth (1957). The nomenclature and systematic position were adopted following Varshney (1983), Gunathilagaraj *et al*. (1998) and Kunte *et al.* (2014).

3. RESULTS AND DISCUSSION

Assessment on diversity of butterfly species was carried out at two altitudinal regions; one from *Dooars* and the rest one from *Terai* plains of Northern parts of Bengal, India during the consecutive period of 2012-2014. The results are delineated below:

3.1. In relation to total butterfly species (Table-1): A total of 91 butterfly species belonging to 10 families of order Lepidoptera were primarily recorded during the study period. Study reveals that these two regions cover the butterfly families of Papilionidae (12 species from *Dooars* and 5 species from *Terai* plains respectively),), Pieridae (18 species from *Dooars* and 12 species from *Terai* plains respectively), Danaidae (9 species from *Dooars* and 6 species from *Terai* plains respectively), Acraeidae (2 species from *Dooars* and 1 species from *Terai* plains respectively), Satyridae (10 species from *Dooars* and 5 species from *Terai* plains respectively), Nymphalidae (21 species from *Dooars* and 10 species from *Terai* plains respectively), Erycinidae (1 species from *Dooars* and 0 species from *Terai* plains respectively), Lycaenidae (14 species from *Dooars* and 7 species from *Terai* plains respectively), Hespiriidae (3 species from *Dooars* and 1 species from *Terai* plains respectively) and Riodinidae (1 species from *Dooars* and 1 species from *Terai* plains respectively).

Table-1: Comparative check list of butterflies of two regions

Sl. No.	COMMON ENGLISH NAME/ LOCAL NAME	SCIENTIFIC NAME	RELATIVE OCCURRENCE	
			DOOARS	TERAI PLAINS
	Family: Papilionidae			
1.	The Common Rose	*Pachliopta aristolochiae* (Fabricius)	+++	+
2.	The Tawny Mime	*Papilio agestor* Grey	++	NR
3.	The Common Mime	*Chilasa chytia* (Linnaeus)	+	NR
4.	The Common Peacock	*Papilio polyctor* Boisduval	+	NR
5.	The Common Mormon	*Papilio polytes* Linnaeus	+++	++
6.	The Red Helen	*Papilio helenus* (Linnaeus)	+++	NR
7.	The Lime Butterfly	*Papilio demoleus* Linnaeus	+++	++
8.	The Paris Peacock	*Papilio paris* (Linnaeus)	+	NR
9.	The Common Blue Bottle	*Graphium sarpedon* (Linnaeus)	++	NR
10.	The Tailed Jay	*Graphium agamemnon* (Linnaeus)	++	+
11.	The Common Jay	*Graphium doson* (C&R Felder)	+++	+
12.	The Common Birdwing	*Troides Helena* (Linnaeus)	++	NR
	Family: Pieridae			
	Sub Family: Pierinae			
13.	The Psyche Butterfly	*Leptosia nina* (Fabricius)	+++	++++
14.	The Common Jezebel	*Delias eucharis* (Drury)	+++	+++
15.	The Red Spot Jezebel	*Delias descombesi* Bosiduval	++	+
16.	The Red-base Jezebel	*Delias aglaia* (Linnaeus)	+	+
17.	The Common Gull	*Cepora nerissa* Fabricius	+++	++
18.	The Pioneer	*Belenois aurota* (Fabricius)	++	+++
19.	The Common Cabbage White	*Pieris canidia* (Sparrman)	+++	++++
20.	The Large Cabbage White	*Pieris brassicae* (Linnaeus)	+++	NR
21.	The Great Orange Tip	*Hebomoia glaucippe* (Linnaeus)	++++	NR
22.	The Yellow Orange Tip	*Ixias pyrene* Linnaeus	+++	NR
23.	The Common Wanderer	*Pareronia valeria* (Cramer)	++	+
24.	Chocolate Albatross	*Appias lyncida* Cramer	++	NR
25.	Great Blackvein	*Aporia agathon* (Gray)	+	NR
	Sub Family: Coliadinae			

26.	The Mottled Emigrant	*Catopsilia pyranthe* (Linnaeus)	+++	+++
27.	Common Emigrant Butterfly	*Catopsilia crocale* Fabricius	++	++
28.	The Spotless Grass Yellow	*Eurema laeta* Boisduval	+++	++
29.	The Common Grass Yellow	*Eurema hecabe* (Linnaeus)	+++	++
30.	The Tree yellow	*Gandaca harina* (Horsfield)	++	NR
	Family: Danaidae			
31.	The Plain Tiger	*Danaus chrysippus* (Linnaeus)	+++	++
32.	The Common Tiger	*Danaus genutia* (Cramer)	++++	+++
33.	The Blue Tiger	*Tirumala limniace* (Cramer)	++++	+++
34.	The Dark Blue Tiger	*Tirumala hamata* (MacLeay)	++	NR
35.	The Glassy Tiger	*Parantica aglea* (Stoll)	+++	NR
36.	The Chocolate Tiger	*Parantica melaneus* (Cramer)	+++	NR
37.	The Chestnut Tiger	*Parantica sita* (Kollar)	+++	+
38.	The Common Indian Crow	*Euploea core* (Cramer)	+++	++
39.	The Striped Blue Crow	*Euploea mulciber* (Cramer)	++++	+
	Family: Acraeidae			
40.	Tawny Coster	*Acraea violae* (Fabricius)	++	+
41.	Yellow costar	*Acraea issoria* (Hubner)	+	NR
	Family: Satyridae			
42.	The Dark-Brand Bush Brown	*Mycalesis mineus* (Linnaeus)	+++	+
43.	The Barred Wood Brown	*Lethe maitrya* (De Nicegille)	++	NR
44.	The Banded Tree Brown	*Lethe confusa* Aurivillius	++	+
45.	Straight-Banded Tree Brown	*Lethe verma* (Kollar)	++	NR
46.	The Great Satyr	*Aulocera padma* Kollar	++	NR
47.	The Common Satyr	*Aulocera swaha* Kollar	++	NR
48.	The Himalayan Five-ring	*Ypthima Sakra* Moore	+	NR
49.	The Common Fivering	*Ypthima baldus* (Fabricius)	+++	++
50.	The Common Four-ring	*Ypthima ceylonica* (Hewitson)	+++	++
51.	The Common Evening Brown	*Melanitis leda* (Linnaeus)	+++	++++
	Family: Nymphalidae			
52.	The Siren	*Diagora persimilis* (Westwood)	+	NR
53.	The Common Sailer	*Neptis hylas* (Linnaeus)	+++	++
54.	The Small Yellow Sailer	*Neptis miah* Moore	++	NR
55.	The Yellow Jack Sailer	*Lassipa viraja* (Moore)	+	NR

56.	The Common Map Butterfly	*Cyrestis thyodamas* Boisduval	++	NR
57.	The Danaid Eggfly	*Hypolimnas misippus* (Linnaeus)	++	+
58.	The Great Eggfly	*Hypolimnas bolina* (Linnaeus)	+++	++
59.	The Blue Pansy	*Junonia orithya* (Linnaeus)	++	NR
60.	The Lemon Pansy	*Junonia lemonias* (Linnaeus)	++	NR
61.	The Peacock Pansy	*Junonia almana* (Linnaeus)	++	++
62.	The Grey Pansy	*Junonia atlites* (Linnaeus)	+++	+++
63.	The Chocolate Pansy	*Junonia iphita* (Cramer)	+++	++
64.	The Indian Fritillary	*Argyreus hyperbius* (Linnaeus)	+	NR
65.	The Common Leopard	*Phalanta Phalantha* (Drury)	+	+
66.	The Indian Tortoiseshell	*Aglais kaschmirensis* (Kollar)	++	+
67.	The Autumn Leaf	*Doleschallia bisaltide* (Cramer)	+++	NR
68.	The Common Earl	*Tanaecia julii* (Bouganville)	++	NR
69.	The Grey Count	*Tanaecia lepidea* (Butler)	++	NR
70.	The Tawny Rajah	*Charaxes bernardus* (Fabricius)	++++	+
71.	The Common Baron	*Euthalia aconthea* (Hewitson)	++	+
72.	The Leopard Lacewing	*Cethosia cyane* (Drury)	++	NR
	Family: Erycinidae			
73.	The Common Beak	*Libythea lepita* Moore	++	NR
	Family: Lycaenidae			
74.	The Common Pierrot	*Castalius rosimon* (Fabricius)	++++	+++
75.	The Elbowed Pierrot	*Pycnophallium elna* (Hewitson)	++	NR
76.	The Pale Grass Blue	*Pseudozizeeria maha* (Kollar)	+++	++
77.	The Grass Jewell	*Freyeria putli* Kollar	++	+++
78.	The Common Silverline	*Spindasis vulcanus* (Fabricius)	+	NR
79.	Purple Sapphire	*Heliophorus epicles* Godart	++	NR
80.	The Yamfly	*Loxura atymnus* (Cramer)	++	NR
81.	The Tailless Lineblue	*Prosotas dubiosa* (Semper)	+++	++
82.	The Common Hedge Blue	*Acytolepis puspa* (Horsfield)	+++	+++
83.	The Fluffy Tit	*Zeltus etolus* (Fabricius)	+++	NR
84.	The Orchid Tit	*Chliaria othona* (Hewitson)	++	NR
85.	The Common Tit	*Hypolycaena erylus* (Godart)	+++	++
86.	The Dark Cerulean	*Jamides bochus* Stoll	+++	++
87.	The Forest Pierrot	*Taraka hamada* (Herbert Druce)	++	NR
	Family: Hespiriidae			

88.	The Spotted Snow Flat	*Tagiades menaka* (Moore)	+	NR
89.	The Grass Demon	*Udaspes folus* (Cramer)	++	+
90.	The Tree Flitter	*Hyarotis adrastus* (Cramer)	+	NR
	Family: Riodinidae			
91.	The Punchinello	*Zemeros flegyas* (Guerin)	++	++
++++= Very Common, +++= Common, ++= Few, += Occasional, NR=Not Recorded				

3.2. In relation to the relative abundance of different butterfly families (Fig.2, 3 and 4): The present study reveals that the diversity of Nymphalidae was the largest with maximum number of species followed by Pieridae and Lycaenidae at *Dooars* but at *Terai* plains Pieridae was the largest with maximum number of species followed by Nymphalidae and Lycaenidae. Comparative abundance of the butterflies under various families is graphically presented in Fig.4. The least diversity observed in Acraeidae and Riodinidae at both the areas. At *Dooars* the families of Papilionidae (13.19%), Pieridae (19.78%), Danaidae (9.89%), Acraeidae (2.20%), Satyridae (10.99%), Nymphalidae (23.08%), Erycinidae (1.10%), Lycaenidae (15.38%), Hespiriidae (3.30%) and Riodinidae (1.10%) constitute the total butterfly community. At *Terai* plains the families of Papilionidae (10.42%), Pieridae (25%), Danaidae (12.5%), Acraeidae (2.08%), Satyridae (10.42%), Nymphalidae (20.83%), Lycaenidae (14.58%), Hespiriidae (2.08%) and Riodinidae (2.08%) constitute the total butterfly community. The family Erycinidae was not found at *Terai* plains. Our overall study indicates that the two regions reflect the same family type of butterfly diversity.

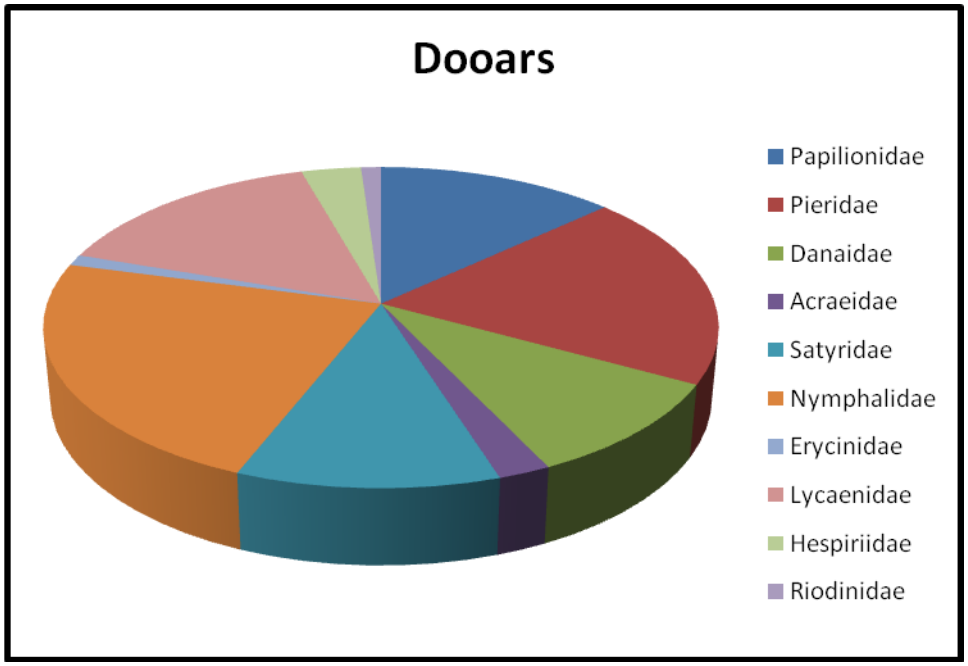


Fig.2: Relative abundance of different butterfly families of *Dooars* (North Bengal).

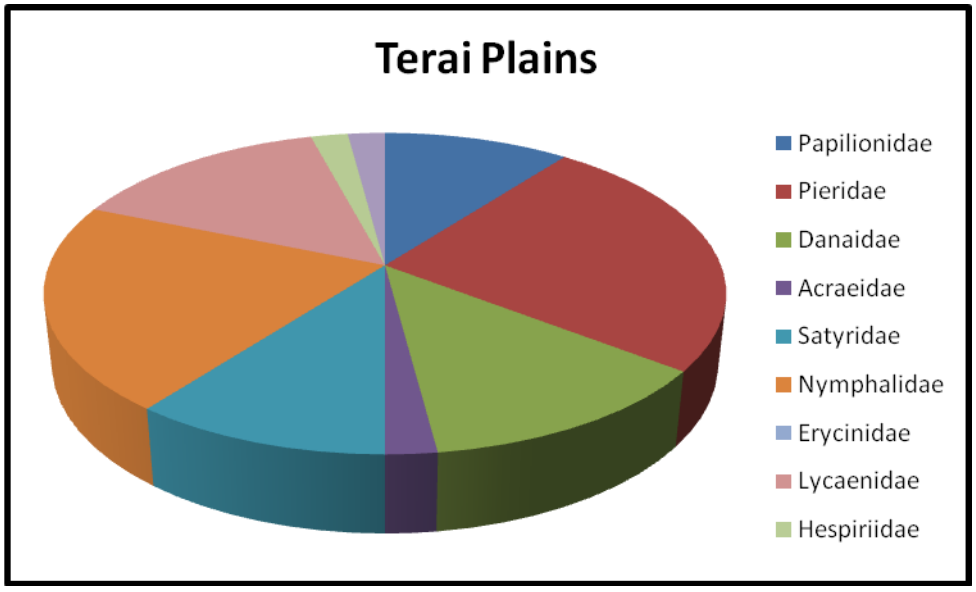


Fig.3: Relative abundance of different butterfly families of *Terai* Plains of North Bengal.

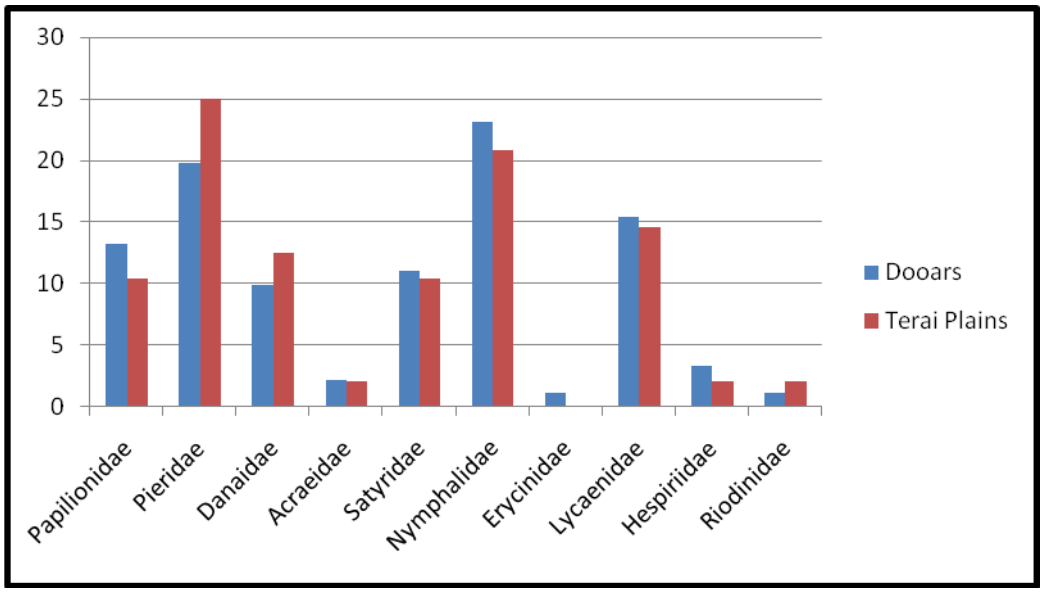
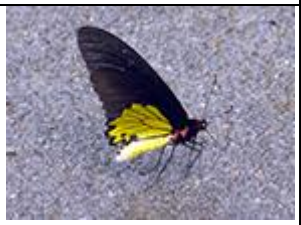


Fig.4: Comparative abundance (in percentage) of different butterfly families of *Dooars* and *Terai* Plains of North Bengal.

3.3. In relation to the relative abundance of the major species (Fig.5): Out of the total 91 species so far recorded at *Dooars*, 6 species are 'very common', 34 species are 'common', 37 species are 'few' and the remaining 14 species are 'occasional' in consideration of their occurrence. Contrary to that, among the total 48 species of *Terai* plains 3 species are found 'very common', 9 species are found 'common', 19 species are found in the category of 'few', 17 species are found 'occasional' and 43 species are not recorded from the regions which were recorded from adjacent *Dooars* region.

			
Pachliopta aristolochiae	*Papilio paris*	*Graphuim sarpedon*	*Graphium Agamemnon*
			
Graphium doson	*Troides Helena*	*Delias aglaia*	*Hebomoia glaucippe*

 *Appias lyncida*	 *Catopsilia crocale*	 *Eurema hecabe*	 *Tirumala limniace*
 *Zemeros flegyas*	 *Euploea mulciber*	 *Acraea violae*	 *Mycalesis mineus*
 *Neptis miah*	 *Hypolimnas bolina*	 *Junonia orithya*	 *Argyreus hyperbius*
 *Aglais kaschmirensis*	 *Doleschallia bisaltide*	 *Charaxes bernardus*	 *Pycnophallium elna*
 *Heliophorus epicles*	 *Loxura atymnus*	 *Zeltus etolus*	 *Chliaria othona*

Fig.5: Photographs of some selected butterfly species at their natural abode.

All the 91 species of butterflies so far recorded from this area are mostly ‘common’ and ‘generalist’ species. No threatened species was recorded. However *Hypolimnas misippus*, *Pareronia valeria*, *Euploea core*, *Catalius rosimon* are listed under Indian Wildlife (Protection) Act, 1972.

Diversity of the butterfly is directly related to the floristic regime of this region. Both the *Doors* and the *Tarai* region endeavor a variable range of flowering plants throughout the

season. Padhye *et al.* (2012) had noted that floristic diversity directly dictated the butterfly abundance. The climatic condition is further congenial for the development of butterfly generation. Mathew *et al.* (2007) had mentioned that on average 25^0C temperature and 80-100% relative humidity is very prudent for the promulgation for butterfly population. Area under observation offers nearly that condition.

A list of 371 species of butterflies was recorded from the Western Himalayan region of India which includes the eight districts of *Garhwal* region and five districts of Kumaun region respectively (Hannyngton, 1910). Further, from Eastern and Western Himalayan region 415 species and 835 species of butterflies was respectively reported (Wynter-Blyth, 1957). From Silent Valley National Park, Kerala, 100 species of butterflies belonging to 9 families was observed in which Nymphalidae and Papilionidae were the dominant families (Mathew, 1994). Present study areas encounter a total of 91 butterfly species belonging to 10 families.

4. CONCLUSION

The study reflects the baseline information on these beautiful groups of insects and enriches the butterfly checklist of *Dooars* and *Terai* plains of North Bengal, India. The area was found to be rich in butterfly diversity. More studies are needed to understand the population dynamics and seasonal patterns of butterflies in this particular geographical area. Although, study area supports a good number of butterfly species but much has still to be explored. In addition, it is necessary to identify the rare butterfly species and conserve them by establishing conservatories or butterfly parks.

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