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Research paper

A Checklist of Butterfly Fauna at Borajan- Bherjan Podumani Wildlife Sanctuary, Tinsukia District, Assam

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ABSTRACT

The present study compiles and presents a checklist of butterfly fauna from the Borajan-Bherjan Padumani Wildlife Sanctuary, located in the Tinsukia District of Assam. The study was carried out from the month of October 2021 to February 2022 in the Wildlife Sanctuary (27°31'30.89"N to95°22'0.53"E) and its nearby areas. A total of 63 species belonging to six families viz., Hesperidae, Nymphalidae, Pieridae, Papillionidae, Lycaenidae, and Riodinidae were identified and recorded during the study. Among these families, Nymphalidae was the most diverse family comprising 38 species with an abundance of 1003 individuals. Approximately 60% of the species documented belong to the Nymphalidae family, highlighting the highest species richness. The dominant nature of the Nymphalidae family can be attributed to the polyphagous nature of the species under the family which enables them to thrive in diverse habitats.

1. Introduction

Butterflies (Lepidoptera) are a group of insects and have fascinated the scientists and nature lovers since long. This group of holometabolus insect is classified under two superfamilies namely, Hesperioidae and Papilionoidae. Superfamily Hesperioidea includes skippers, whereas, superfamily Papilionoidae comprises "true butterflies". Superfamily Papilionoidae is again divided into five families Papilionide (Swallowtails) Pieridae (Whites and Yellows), Lycaenidae (Blue), Riodinidae (Judies and Punches), and Nymphalidae (Brush-footed butterflies). Butterflies with approximately around 18000 extant species are known to be distributed globally(except in Antarctica). The highest diversity of the butterflies is onserved in the tropical region because of its hot and humid climate which creates highly productive habitats that are generally favored by the butterflies and conductive totheir proliferation (Novak, 1990).

Butterflies play an crucial role in the ecosystem for several reasons: (i) they serve as pollinators, (ii) they are a noteworthy constituent of food chains which are eaten by various other predatory animals (Thomas et al., 1998), and (iii) They ct as an effective bio indicator of various environmental issues such as climate change, pollution, habitat loss and alteration (Wood and Gillman, 1998). These faunal species have four distinct stages of metamorphosis viz. egg, caterpillar, chrysalis and adult butterfly. These vibrantly

colured scaly-winged jwels have captivated the attention of professionals and amateur since long. However, for many large and colorful species of butterflies, their aesthetic values have led to a significant threat to their survival, as large numbers of these butterflies are trafficked globally (New et al., 1995).

Research indicates that the rate of decline in the insects populations is occurring at a rapid pace than the declining rate observed in populations of birds, reptiles and mammals. The key factors of this declining rate in the insects are habitat loss, anthropogenic activities, deforestation, fragmentation, introduction of invasive species and global climate change (Sánchez-Bayo & Wyckhuys, 2019). Additionally, urbanization significantly alters the distribution patterns of these insects (Bergerot et al., 2011). Butterflies are highly sensitive to variations in local weather, climate and light levels, serve as an excellent indication of environmental shifts. Butterflies are currently facing several threats and challenges as a result of a series of anthropogenic activities globally leading to a decline in both species diversity and abundance(Blair and Launer, 1997). Butterflies can be classified as either Generalists or Specialists based on their habitat requirements and niche breadth/width. The generalists have widespread and continuous distribution, while the specialists are often found in patchy, discontinuous or fragmented and many a times locally restricted areas. (Kitahara and Fuji, 1994; Kitahara et al., 2000).

India, which is a mega biodiverse country, consists of one-fifth of the world's total butterfly species. The North-East India, though it represents only 7.7% of the county's total landmass, it is a home to an impressive 66.85% of India's butterfly diversity (Gogoi, 2015).

Assam, situated in the North Eastern region of India, is one of the most biologically diverse regions in the country. This high diversity and richness is due to its distinctive geographical location, diverse topography, and ideal climatic conditions. North East India where Assam is present, lies in the transition zone of Himalaya and Indo Malayan hotspot. Around 37% of the state is covered by greenery and nearly 4% of the area is designated under protected area network (Assam State Biodiversity Board, 2013). The state, however, is experiencing a significant amount of loss of forest land due to extensive exploitation of natural resources particularly, forest products. Therefore research in various aspects of biodiversity is essential to comprehend the region's natural wealth and to formulate conservation strategies in order to prevent the further loss of biodiversity (Bhardwaj et al., 2011).

A recent approach has been taken to assess the efficiency of sustainable agricultural practices in conserving biodiversity. The effective management of the agricultural systems can help maintain overall biodiversity and enhance the success of particular species.

Assam is blessed with exceptionally fertile soil and climatic conditions which favour diverse agriculture. The primary agricultural products that account the economic and real sector growth in most of the districts of the state are rice, tea, mustard, pulses, sugarcane, potatoes, coconut, betel, black pepper, banana and citrus fruits (Nath, 2016). The agricultural landscape in Assam not only provides food security but also provides a sanctuary for diverse wildlife, including butterflies.

While numerous studies are being undertaken on butterflies in different parts of the world, they are often treated as non-target species in wildlife conservation and management. The Northeastern part of India, which is home to many butterfly species, has not been fully explored, warranting a need for further research in the region.

Therefore, keeping all in mind, this preliminary research was carried out to bridge the research and knowledge gaps by preparing a checklist of butterflies in Borajan- Bherjan Padumani, an unexplored wildlife sanctuary in Tinsukia District of Assam, North-East India.

2. Materials and Methods

2.1 Study Area

The study was conducted to prepare the checklist of butterfly fauna in one of the seventeen wildlife sanctuaries present in Assam, i.e., Borajan-Bherjan Podumani Wildlife Sanctuary of Tinsukia district (Table 1).

Tinsukia district is located in the North-Eastern part of Assam between 27.25º N to 27.30º N latitude and 94.50º E to 95 º E longitudes. It stands at an elevation of 116 meters (380 feet) above sea level. The district is bordered by Dibrugarh and Dhemaji to the West and North-West and in the South, it shares an international border with Myanmar. The total area coverage of the district is 3790 sq. km. and is characterized by a subtropical climate, with an average minimum temperature of around 8.5ºC and maximum temperature reaching approximately 33.4º C. The area receives an average rainfall of about 2768 mm per annum accompanied by a relative humidity of about 78% (Bora and Meitei, 2014)

Table 1 Details of transects established for sampling butterflies in three different habitats of Tinsukia district, Assam, India

Habitat Types	Latitude (◦ ' "N)	Longitude (◦ ' "E)
Borajan-Bherjan Podumani	27°31'30.89"N	95°22'0.53"E

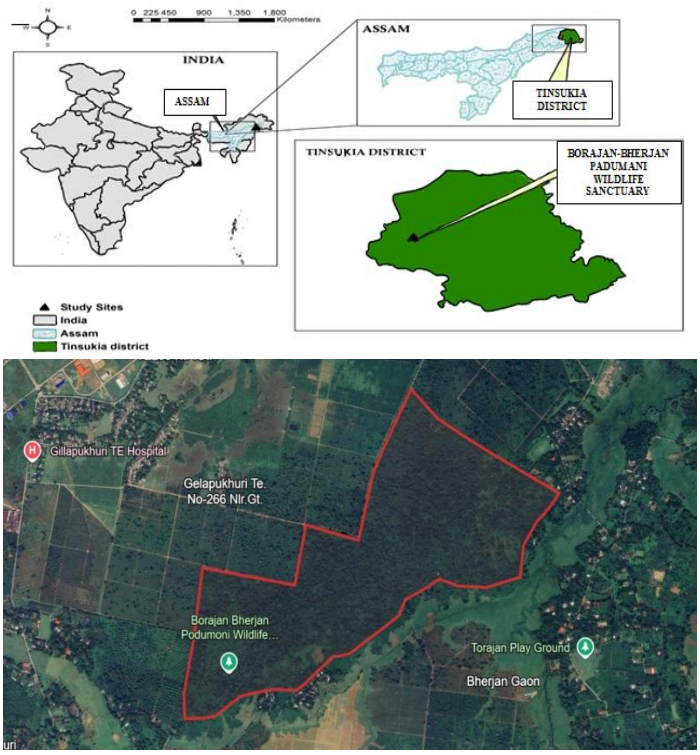

Fig. 1 Map showing the habitat considered for butterfly study in Tinsukia district, Assam, India

Fig. 2 Picture showing the view inside the study site i.e. Borajan-Bherjan Padumani Wildlife Sanctuary

Borajan-Bherjan –Podumani Wildlife Sanctuary

Currently there are 17 wildlife sanctuaries recognized in Assam. The Borajan-Bherjan-podumani Wildlife Sanctuary, covering the area of approximately 7.22 sq. km is located in the Tinsukia District of Assam with three separate blocks namely Borajan, Bherjan and Podumani. This sanctuary harbors suitable habitats for primates such as *Macaca nemestrina* (Pig-tailed Macaque), *Macaca mulatta* (Rhesus Macaque) and *Hoolock Hoolock* (Hoolock Gibbon) other species such as Leopards, Wild Pigs and Giant Flying Squirrel are also present in the wildlife sanctuary. Around 84 species of birds including Osprey, Kingfisher, Indian Pied Hornbill, Lineated Barbet, Woodpecker, Drongo, Common Mynah, Bulbul, Magpie Robin, Wagtail and varieties of woodland birds have been found in this sanctuary (Environment and Forest, Government of Assam).

2.2 Butterfly Sampling Method

Butterflies were sampled using 'Pollard Walk Method' in the study area following Pollard (1992), Bora and Boruah (2015) and Medhi et al. (2018). Using this method, transects of varied lengths (50-100m) were established in the habitat. In each transect, the number of individuals and species was counted by slowly walking at a stable pace from the starting point to the end. Observations of butterflies along with their number and the identity of species seen in transects were recorded. A total of 20 transect counts were made in the habitat. The identification of the butterfly species was done using the photographic guide provided in Kehimkar (2016) and photographs were captured in instances where identification was not feasible, and later identified using various resources including ifoundbutterflies.org (Kunte et.al 2017). Transects were visited from 9:00AM to 3:30 PM twice a month from October 2021 to February 2022.

3. Results

3.1 Species Richness, abundance and family level analysis

During this study, a total of 1664 individuals of 63 butterfly species belonging to six families were recorded after the completion of 20 transect counts in the study area.

The observed butterflies of the habitat Borajan-Bherjan Padumani wildlife sanctuary, in Tinsukia, Assam represent six families namely, Hesperiidae, Nymphalidae, Papillionidae, Lycaenidae, Pieridae and Riodinidae. Among these, maximum species were observed from the family Nymphalidae followed by Lycaenidae, Pieridae Hesperidae, Papillionidae, and Riodinidae (Fig. 4). Nymphalidae was the most dominant family with 38 species and 1003 individuals, Lycaenidae with 230 individuals of 9 species; Pieridae with 168 individuals of 5 species, Hesperidae with 153 individuals of 7 species, Papillionidae with 84 individuals of three species and family Riodinidae with 26 individuals of only one species.

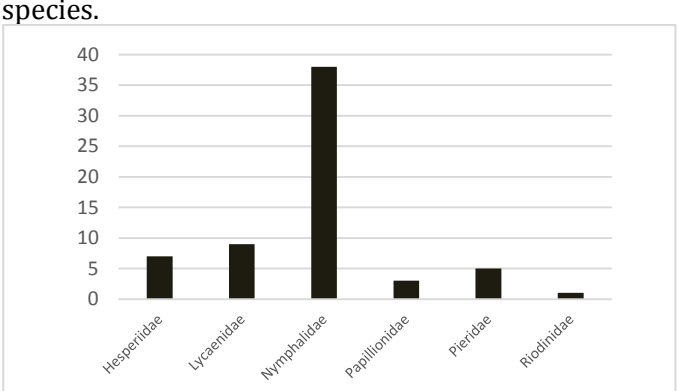

Fig. 4 Family-wise species richness of butterflies observed in Borajan -Bherjan Padumani Wildlife Sanctuary, Tinsukia District, Assam

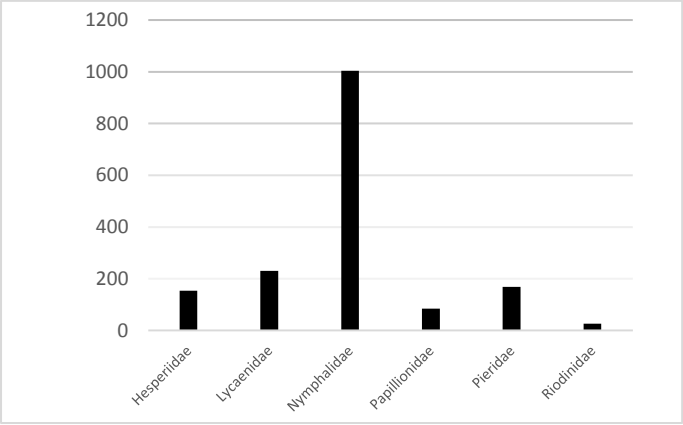

Fig. 5 Family wise butterfly abundance observed in Borajan-Bheerjan Padumani Wildlife Sanctuary, Tinsukia District, Assam

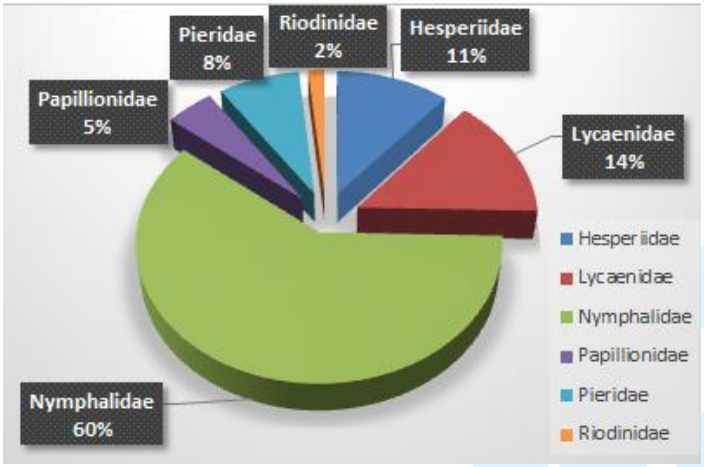

Fig. 6 Pie diagram showing percentages of species richness observed in the Borajan-Bherjan Padumani Wildlife Sanctuary

4. Discussion

In this study, a total of 63 butterfly species belonging to six families were observed in the wildlife sanctuary in the Tinsukia district, which represents 16.8 % among the 375 species that occur in eastern Assam (Singh, 2017) and 6.54 % of 962 of total butterflies in the entire state of Assam. This reveals that species richness and abundance of butterfly fauna were quite high in the wildlife sanctuary.

Another research conducted by Gogoi et. Al (2016) demonstrated a similar trend in research where higher species richness was observed in the Wildlife Sanctuary. It is because the wildlife sanctuary is comprised of an intact and undisturbed patch of vegetation with a variety of trees and abundant flowering plants, creating an ideal habitat for butterflies.

Among the six observed families, the most dominant one with highest species is the Nymphalidae followed by Lycaenidae, Pieridae, Hesperidae, Papillionidae, and Riodinidae. This is the usual butterfly composition trend in almost all habitats. A similar pattern of dominance of Nymphalidae is also reported in other studies (Kaushik et at., 2020, Joshi and Dhyani, 2014, Mukherjee et al., 2022). As supported by the findings of this research, the highest species richness of the Nymphalidae family is because of their polyphagous nature and strong tolerance towards disturbance, allowing them to flourish in a wide range of habitats. Similarly, Lycaenidae, Pieridae, Hesperidae, Papillionidae, and Riodinidae families are capable of thriving in moderately disturbed habitats.

Table 2 Checklist of butterflies observed during the study. The numbers in the columns are the numbers of individuals observed during sampling in Borajan -Bherjan Padumani Wildlife Sanctuary

Common Name	Scientific Name	Family	IUCN Status	Wildlife Sanctuary
Brown Pied Flat	*Coladenia agni* (de Nicéville)	Hesperiidae	NA	19
Chocolate Demon	*Ancistroides nigrita* (Latreille)	Hesperiidae	NA	33
Common Snow Flat	*Tagiades japetus* (Stoll)	Hesperiidae	NA	36
Continental Swift	*Parnara Ganga* (Evans)	Hesperiidae	NA	15
Hooked Awlking	*Choaspes furcata* (Evans)	Hesperiidae	NA	21
Spotted Snow Flat	*Tagiades menaka* (Moore)	Hesperiidae	NA	17
Suffused Snow Flat	*Tagiades gana alica* (Moore)	Hesperiidae	NA	12
Apefly	*Spalgis epius* (Westwood)	Lycaenidae	NA	21
Blue Imperial	*Ticherra acte* (Moore)	Lycaenidae	NA	19
Common Cerulean	*Jamides celeno* (Cramer)	Lycaenidae	NA	20
Common	*Poritia hewitsoni* (	Lycaenidae	NA	51

Gem	Moore)			
Common Imperial	*Cheritra freja* (Fabricius)	Lycaenidae	LC	31
Copper Flesh	*Rapala pheretima* (Hewitson)	Lycaenidae	NA	26
Flufy Tit	*Zeltus amasa* (Hewitson)	Lycaenidae	NA	22
Indian Purple Saphire	*Heliophorus indicus* (Fruhstorofer)	Lycaenidae	NA	23
Purple Saphire	*Heliophorus epicles* (Godart)	Lycaenidae	NA	17
Angled Red Forester	*Lethe chandica* (Moore)	Nymphalidae	NA	31
Assam Powdered Baron	*Euthalia monina* (Fabricius)	Nymphalidae	NA	16
Bengal Stiped Blue Crow	*Euploea mulciber (*Cramer)	Nymphalidae	NA	35
Chocolate Pansy	*Junonia iphita* (Cramer)	Nymphalidae	NA	36
Clear Sailer	*Neptis clinia susruta* (Moore)	Nymphalidae	NA	20
Colour Sergeant	*Athyma nefte inara* (Westwood)	Nymphalidae	NA	23
Commander	*Moduza procris* (Cramer)	Nymphalidae	NA	18
Common Baron	*Euthalia aconthea* (Cramer)	Nymphalidae	NA	23
Common Bush Brown	*Mycalesis perseus* (Fabricius)	Nymphalidae	NA	28
Common Crow	*Euploea core* (Cramer)	Nymphalidae	LC	31
Common Earl	*Tanaecia julii* (Lesson)	Nymphalidae	NA	16
Common Evening Brown	*Melanitis leda* (Linnaeus)	Nymphalidae	LC	24
Common Four-Ring	*Ypthima huebneri* (Kriby)	Nymphalidae	NA	24
Common Leopard	*Phalanta phalantha* (Drury)	Nymphalidae	LC	34
Common Mapwing	*Cyrestis thyodamas* (Boisduval)	Nymphalidae	NA	26
Common Palmfly	*Elymnias hypermnestra undularis* (Drury)	Nymphalidae	NA	49
Common Yeoman	*Cirrochroa tyche* (Felder & Felder)	Nymphalidae	NA	13
Common-Five Ring	*Ypthima baldus* (Fabricius)	Nymphalidae	NA	21
Dark Archduke	*Lexias dirtea* (Fabricius)	Nymphalidae	NA	12
Dark Band Bushbrown	*Mycalesis mineus* (Linnaeus)	Nymphalidae	NA	45
Dark Evening Brown	*Melanitis phedima varaha* (Moore)	Nymphalidae	NA	40
Glassy Tiger	*Parantica aglea* (Stoll)	Nymphalidae	NA	55
Great Archduke	*Lexias cyanipardus* (Butler)	Nymphalidae	NA	19
Great Eggfly	*Hypolimnas bolina* (Linnaeus)	Nymphalidae	NA	34
Grey Count	*Cynitia lepidea* (Butler)	Nymphalidae	NA	27
Grey Pansy	*Junonia atlites* (Linnaeus)	Nymphalidae	NA	26
Himlayan Blackvein Sergeant	*Athyma ranga* (Moore)	Nymphalidae	NA	12
Himlayan Vagrent	*Vagrans sinha* (Kollar)	Nymphalidae	NA	24

Indian Nawab	*Polyura agraria* (Swinhoe)	Nymphalidae	NA	31
Knight	*Lebadea martha* (Fabricius)	Nymphalidae	NA	9
Large Yeoman	*Cirrochroa aoris* (Doubleday)	Nymphalidae	NA	28
Lemon Pansy	*Junonia lemonias* (Linnaeus)	Nymphalidae	NA	46
Magpie Crow	*Euploea radamanthus* (Fabricius)	Nymphalidae	NA	16
Peacock Pansy	*Junonia almana* (Linnaeus)	Nymphalidae	LC	23
Plain Tiger	*Danaus chrysippus* (Linnaeus)	Nymphalidae	LC	26
Spotted Palmfly	*Elymnias malelas* (Hewitson)	Nymphalidae	NA	13
Stripped Tiger	*Danaus genutia* (Cramer)	Nymphalidae	NA	29
Tiger Palmfly	*Elymnias nesaea* (Linnaeus)	Nymphalidae	NA	20
Common Bluebottle	*Graphium sarpedon*(Linnaeus)	Papillionidae	LC	36
Tailed Jay	*Graphium agamenon*(Linnaeus)	Papillionidae	NA	22
Yellow Helen	*Papilio nephelus* (Boisduval)	Papillionidae	NA	26
Chocolate Albatross	*Appias lyncida* (Crmer)	Pieridae	NA	51
Common Grass Yellow	*Eurema hecabe*(Linnaeus)	Pieridae	NA	34
Indian Cabbage White	*Pieris canidia* (Linnaeus)	Pieridae	NA	31
Redbase Jazebel	*Delias pasithoe* (Linnaeus)	Pieridae	NA	24
Red-Spot Jazebel	*Delias descombesi* (Boisduval)	Pieridae	NA	28
Punchinello	*Zemeros flegyas* (Cramer)	Riodinidae	NA	26
Total Abundance				**1664**


A


B


C


D


E


F


G


H


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S


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Photoplate Some butterfly species recorded during the study

A. Himalayan Large Yeoman (*Cirrochroa aoris*) **B.** Tiger Palmfly (*Elymnias nesaea*) **C.** Common Gem (*Poritia hewitsoni*)
D. Common Mapwing (*Cyrestis thyodamas*) **E.** Hooked Awlking (*Choaspes furcate*, Evans) **F.** Blue Imperial (*Ticherra acte*, Moore)
G. Flufy Tit (*Zeltus amasa*, Hewitson) **H.** Lemon pansy (*Junonia lemonias*, Linnaeus) **I.** Striped Tiger (*Danaus genutia*, Cramer)
J. Spotted Snow Flat (*Tagiades menaka*, Moore) **K.** Magpie Crow (*Euploea radamanthus*, Fabricius) **L.** Punchinello (*Zemeros flegyas*, Cramer)
M. Grey Count (*Cynitia lepidea*, Butler) **N.** Common Bluebottle (*Graphium sarpedon*, Linnaeus) **O.** Great Archduke (*Lexias cyanipardus*)
P. Indian Nawab (*Polyura agrarian*, Swinhoe) **Q.** Knight (*Lebadea Martha*, Fabricius) **R.** Common Leopared (*Phalanta phalantha*, Drury)
S. Common Snow Flat (*Tagiades japetus*, Stoll) **T.** Himalayan Vegrant (*Vagrans sinha*, Kollar)

5. Conclusion

This research is an inaugural investigation carried out to generate a preliminary checklist of butterfly species across the Borajan -Bherjan Padumani Wildlife Sanctuary, Tinsukia District of Assam. The results from this study reflect high floral and faunal diversity in the wildlife sanctuary which provides favourable conditions for survival of butterflies belonging to different families and it also provides a platform for further in-depth research.

Moreover, the diverse pattern and such a high number of butterfly species in a single habitat provide an important indication of vegetation structure, as well as the overall health and stability of the ecosystem and the environment of the study area. The study also suggests that further exploration in other areas of the wildlife sanctuary could yield more species. Prioritizing Conservation efforts for species of butterflies in potential areas within the wildlife sanctuary will be a step towards conserving and protecting rare and endemic butterfly species. Throughout the study period, the major threat identified within the sanctuary area was the construction of new roads, which resulted in many butterfly fatalities due to vehicle collisions, most of the butterflies basking on the road were seen dead along the roadside.

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