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A Study on butterfly diversity and abundance in Vicinity of Indira Gandhi National Tribal University campus, Amarkantak (MP)India

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Abstract
Among insects, butterflies are the most captivating, alluring, and exquisite creatures. They are highly sensitive to environmental changes and serve as excellent bio-indicators of the ecosystem. In this regard, a study was conducted to document and analyse the community structure, richness and diversity of butterflies in Indira Gandhi National Tribal University, Amarkantak, M.P. The species diversity was found to be 2.85, calculated by using Shannon diversity index. The survey has recorded 532 individuals from 39 different species across 5 groups. The university was divided into three distinct habitat areas for this study: an urbanised area, a crop field, and a shrub area. Eurema blanda represents highest percentage 18.42% of abundance followed by *Eurema hecabe* 15.97% within the field of study area. Nymphalidae family consists of up to 22 species of butterflies followed by Pieridae 5 species, Papilionidae 4 species, Lycaenidae 4 species, and Hesperiidae 4 species respectively.

Keywords: Diversity, Amarkantak, butterflies

Introduction

Butterflies are the most charismatic and alluring elements of biodiversity on Earth. Butterfly comes from the two Greek words Lepis, meaning scales and Ptera, meaning wings, so their order is named as Lepidoptera. They are part of the hierarchy order Lepidoptera of the class Insecta of phylum Arthropoda. Order Lepidoptera is classified into two distinct superfamilies one is superfamily Papilionoidea which comprise of six families, namely Papilionidae, Pieridae, Nymphalidae, Lycaenidae, Roidinidae and Hesperiidae and the other superfamily Hedyloidae, which contain only one family Hedylidae and found in all types of habitats, which include wetland, grassland, forest, desert, alpine, and urbanized areas. Butterflies are closely related to moths, from which they evolved about 56 million years ago. Being diurnal animal, mostly active on day time but highly active on 3-4 hours after sunrise and 3-4 hours earlier of sunset.

Butterflies are very important component of ecosystem, they play a vital part in the ecosystem. After bees, butterflies considered second best pollinators. They are very sensitive to the environment, humidity and rainfall. They are a great indicator of a healthy environment and a good ecosystem. Most butterfly species found in the tropical region on the earth. Species diversity and abundance depends on their habitat. The species diversity of Butterfly count is directly relative to the vegetation of the given area. Due to the urbanization, fire, uses of pesticides and destruction of their habitat some have become extinct and some are on the verge of extinction. Madhya Pradesh is a central state in the tropical range of India. About 1400 -1500 species of butterflies have been identified in India. More than 170 species under the 8 families have been recorded in the Madhya Pradesh. The Indira Gandhi National Tribal University Campus in Amarkantak is situated in the Anuppur district of Madhya Pradesh serves as the study area. The study area comes under the Amarkantak range. The Amarkantak region is a unique nature heritage area. It is surrounded by dense Sal forest. The current study aims to survey the diversity and abundance of butterflies across three different habitats, namely open herbs and scrubs, crop fields and urbanized areas on this campus.

Materials and methods

Study AreaThe current study deals with the diversity of butterfly in IGNTU campus Amarkantak Madhya Pradesh. Amarkantak is located in Central India's Maikal range. It is well-known for being the source of the three holy rivers, the Johila, the Sone and the Narmada. The area is encircled by a thick Sal woodland. The location of Amarkantak is in the Madhya Pradesh of Anuppur. Situated between 22°67'N to 81°75'E. The study conducted an area of 151 hectare (372 acres) campus. It was conducted in 10 transects. Transects were categorized into three habitats for our study based on the overall characteristic of the environment and the types of plants found there. The following were the main categories of habitats: open herb and shrub, Crop field and urbanized area. For the three months from October to December of 2023, a field survey on butterflies was conducted in the research region three times per week fig 1.

In the research area, butterflies were accessible from 08:00 am to 10:00 am and from 02:00 am to 05:00 pm within the afternoon table 1. Random observation and opportunistic sampling were conducted in every habitat on campus, including the roadway, agriculture areas, flower gardens, residential vegetation etc. Camera (Canon EOS 750 D with micro lens) were used to take pictures of the specimens in the field.

Fig 1: Transect showing various Habitas

Table 1: Study Time

Sl. no.	Study Sites	Date	Survey time
1.	Site-1 to site-2	15/10/2023 to 22/12/2023	07:00 am -10:00 am and 02:00 pm -05:00 pm
2.	Site-3 to site-4	15/10/2023 to 22/12/2023	07:00 am -10:00 am and 02:00 pm -05:00 pm
3.	Site-5 to site-6	15/10/2023 to 22/12/2023	07:00 am -10:00 am and 02:00 pm -05:00 pm
4.	Site-7 to site-8	15/10/2023 to 22/12/2023	07:00 am -10:00 am and 02:00 pm -05:00 pm
5.	Site-9 to site-10	15/10/2023 to 22/12/2023	07:00 am -10:00 am and 02:00 pm -05:00 pm

Required equipment

Camera: Canon EOS 750D with micro lens, Field note, Pen.

The identification of the butterfly species was done using the photos of the butterflies. The identification of butterfly species was based on appropriate information and photos, the colours, patterns, sizes, shapes and designs of the butterflies. Relevant images were consulted, along with descriptions provided by the Kehimkar (2008) [3], Tiple (2010) and Narmadha *et al*. (2023).

Statistics

Using diversity indexes, the research area's butterfly is determined by

Shannon Index (*H*'). The Shannon Index was used to calculate species diversity [Narmadha *et al*.2023**:**

$H' = -\sum spi \ln pi$

Where In is the natural logarithm, s is the number of species, and *pi* is the percentage of the *i*th species in the entire sample. The two factors that determine *H'* are the total number of species (species richness) in the community and the evenness of their abundance (or equitability).

(B) Pielou's Equity (Evenness) Index, or *J*'. The percentage of individuals within a species is known as its evenness. According to [Narmadha *et al*.2023], the evenness of a species reveals its relative abundance on the site:

$J' = H'/\ln S$

Here, S is the total number of species found at the location.

Observation

During the course of the study, 39 species belonging to 5 families were identified. With 22 species, the family Nymphalidae dominates the butterfly population at IGNTU campus. It is followed by the pieridae (5 species), Papilionidae (4 species), Lycaenidae (4 species) and Hesparidae (4 species). Just the Nymphalidae family makes up 56% of all species. Based on the current survey. Eurema blanda is the species that is the most common in IGNTU campus with 98 individual followed by Eurema lisa 86 individual, Eurema hecabe 79 individual, Cupido argiades 70 individual, Junonia lemonias 45 individual and Euchrysops cnejus 40 individual (Table 2).

The study in herb and shrubs habitat reported 5 different families which consist of 34 species of butterflies. The survey in crop habitat reported 17 species with 4 different families and the study in urbanized habitat reported 15 species with 4 different familiesdisplays the variety of butterfly species found on the IGNTU Campus across three distinct habitat categories. (Table 3). Nymphalidae was the most frequently documented, making up 56% (n = 22) of all species reported followed by Lycaenidae 12% (n = 5), Pieridae 10% (n = 4), Hesperiidae 10% (n=4) and Papilionidae 10% (n=4), here n is number of species (Figure 2). Highlights the proportion of Rare species typically increase from open herb & shrub to crop field to urbanized area (Figure 3).

Table 2: List of Butterflies and their status in IGNTU Campus, Amarkantak, M.P. Butterflies of the IGNTU campus in Different Sites 1,2,3,4,5,6,7,8,9,10.

S. n	Common name	Scientific name	Family	Status	Total no. of individual
1	Common yellow swallowtail	*Papilio machaon*	Papilionidae	R	1
2	Lime butterfly	*Papilio demoleus*	Papilionidae	R	2

3	Common rose	*Pachliopta aristolochia*	Papilionidae	R	4
4	Common mormon	*Papilio polytes*	Papilionidae	R	3
5	Chocolate pansy	*Junonia iphita*	Nymphalidae	UC	7
6	Lemon pansy	*Junonia lemonia*	Nymphalidae	C	45
7	Common crow	*Euploea core*	Nymphalidae	C	14
8	Bamboo tree brown	*Lethe europa*	Nymphalidae	R	4
9	Common castor	*Ariadne merione*	Nymphalidae	R	4
10	Common evening brown	*Melonitis idea*	Nymphalidae	UC	10
11	Gray pansy	*Junonia atlites*	Nymphalidae	UC	6
12	Peacock pansy	*Junonia almania*	Nymphalidae	R	3
13	Long brand bush brown	*Mycalesis visala*	Nymphalidae	UC	5
14	Dark evening brown	*Melanitis phedim*	Nymphalidae	UC	8
15	Commander	*Moduza Procris*	Nymphalidae	UC	7
16	Little yellow	*Papilio demoleus*	Pieridae	C	85
17	Common grass yellow	*Pachliopta aristolochia*	Pieridae	UC	8
18	Three spot grass yellow	*Papilio polytes*	Pieridae	C	98
19	Eufala skipper or Rice leaf folder	*Lerodea eufala*	Pieridae	UC	7
20	Common sailer	*Neptis hylas*	Nymphalidae	R	5
21	Common baron	*Euthalia aconthea*	Nymphalidae	R	3
22	Blue pansy	*Junonia orithya*	Nymphalidae	UC	4
23	Freyer's grayling	*Hipparchia fatua*	Nymphalidae	R	6
24	Wall brown	*Pararge aegeria*	Nymphalidae	R	2
25	Blue tiger	*Tirumala limniace*	Nymphalidae	UC	3
26	Plain tiger	*Danaus chrysippus*	Nymphalidae	R	5
27	Common five ring	*Ypthima baldus*	Nymphalidae	R	2
28	Striped tiger	*Danaus genutia*	Nymphalidae	R	2
29	Yellow pansy	*Junonia hierta*	Nymphalidae	R	2
30	Palm fly	*Elvmnias hypermnestra*	Nymphalidae	R	2
31	Short tail	*Cupido argiades*	Lycaenide	C	70
32	Common peirro	*Ampittia dioscorides*	Lycaenide	UC	8
33	Common zebra blue	*Potanthus omaha*	Lycaenide	C	11
34	Gram blue	*Baracus hampsoni*	Lycaenide	C	40
35	Cycad blue/ Plains cupid	*Papilio machaon*	Lycaenide	C	24
36	Chocolate grass	*Lerodea eufala*	Hesperidae	UC	7
37	Indian bush Hopper	*Ampittia dioscorides*	Hesperidae	R	4
38	Lesser dart	*Potanthus omaha*	Hesperidae	UC	8
39	Spotted hedge Hopper	*Baracus hampsoni*	Hesperidae	R	3

Abbreviation: Rare (R), Uncommon (UC), Common (C)

Papilio machaon (site 3)

Papilio demoleus (site 3)

Pachliopta aristolochiae (site 4,8,10)

Papilo polytes(site 3,5)

Eurema lisa(site 1,2,3,4,5,6,7,8,9,10)

Eurema hecabe(site 1,2,3,4,5,6,7,8,9,10)

Eurema blanda (site 1,2,3,4,5,6,7,8,9,10)

Eurema sari (site 3,8,9)

Junonia iphita (site 1,2,5,7,9)

Junonia lemonias (site 1,2,3,4,5,6,7,8,9,10)

Euploea core (site 1,2,3,4,5,8,9)

Lethe Europa(site 2,3,9)

Ariadne merione (site 1,2,4,5)

Melanitis leda (site 5,9)

Junonia atlites (site 4,6,7,10)

Junonia almanac (site 4)

Mycalesis visala (site 2,5)

Melanitis phedima (site 1,2,5)

Moduza procris (site 4,5)

Neptis hylas (site 2,9)

Euthalia aconthea (site 5,9)

Junonia orithya (site 2,9)

Hipparchia fatua (site 4,5)

Parargе aegeria (site4,9)

Tirumala limniace (site 3)

Donaus chrysippus (site 3,9)

Ypthima baldus (site 4.5)

Danaus genitia (site 3,4)

Junonia hierta (site 4)

Elymnias hypermnestra (site 6)

Table 3: Result of different ecological indices for different habitats.

S. No	Ecological indices	Open herb & shrub	Crop field	Urbanized area
1.	Evenness (*J*)	0.78	0.85	0.87
2.	Species richness (*S*)	34	17	15
3.	Total abundance	334	115	83
4.	Shannon – Wiener diversity index (*H*)	2.78	2.41	2. 36

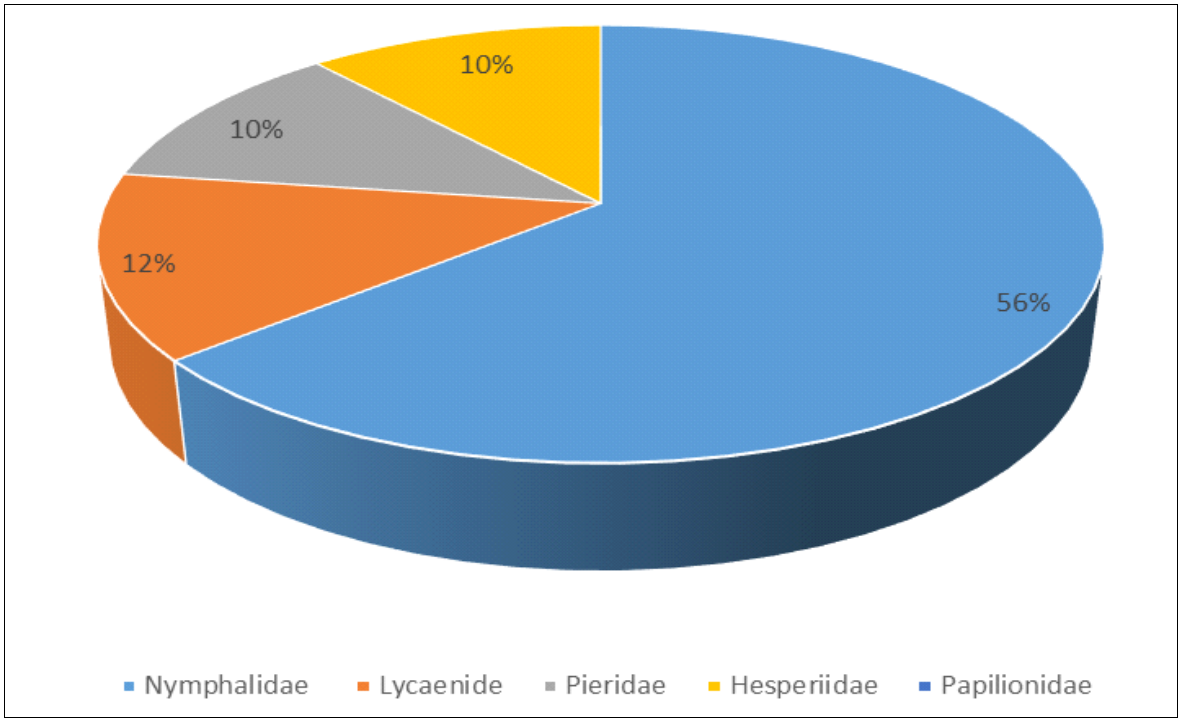

Fig 2: Proportion of Butterfly species distribution among families- IGNTU Campus.

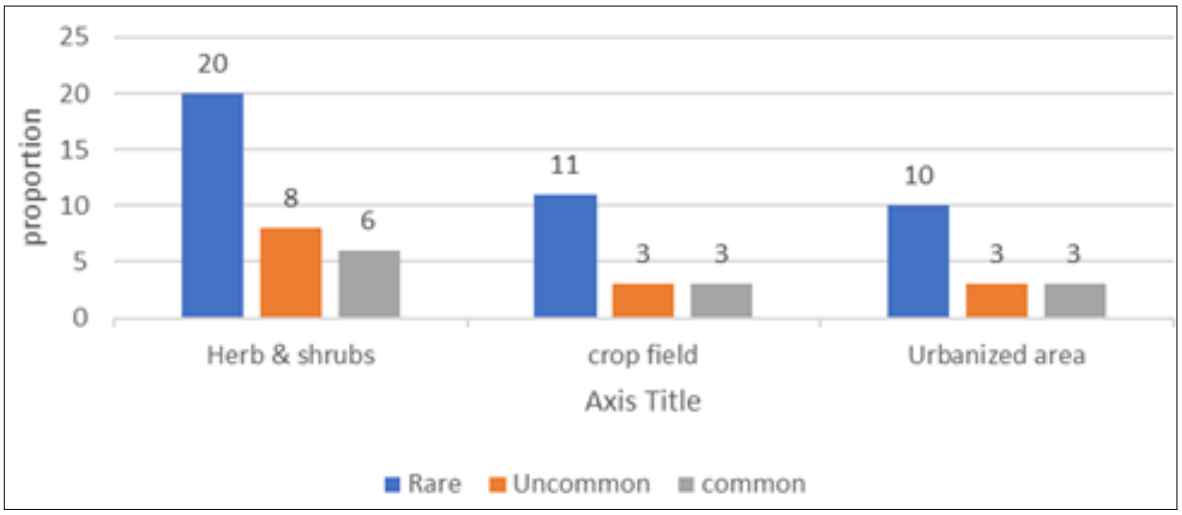

Fig 3: The percentage of each habitat's species abundance.

***Note*:** Uncommon: species with five to ten individual; **Common:** species with ten or more individuals; Rare: species with fewer than five individuals.

Results and discussion

During the period of the study, a total of 39 butterfly species were identified, with a total of 532 individuals belonging to 5 families that were photographed and recorded. In all three habitats, 17 species had the lowest individual number with an abundance of fewer than five. *Eurema blanda*, with 98 individuals, followed by *Eurema hecabe*, with 85 individuals *Cupido argiades* with 70 individuals *Junonia lemonias* are the four most abundant species. While *Euchrysops cnejus* with 40 individuals. Of these five species, the highest concentration was found in open shrub. Thirty four of the 39 species were found in open herb and shrub habitat, seventeen in crop habitat, and fifteen in urbanized habitat. The campus yielded a total of 532 individuals, of which 334 individuals were found to be abundant in crop habitat, and 83 individuals in urbanized environment (Table 2). The IGNTU vicinity showed the wide verity of the butterfly species because the area reflecting high range of vegetation and flowering plants (Table 3). Indicates that the percentage of rare species tropically increase from open herb & shrub to crop area to urbanized habitat (Figure 3). The percentage of uncommon species in crop field and urban areas is comparable, whereas it tends to grow in area with open shrubs and herbs. On the other hand the percentage of common species, indicates a declining tendency from open herb & shrub to crop field to urbanized environment.

With 34 species, the open herb and shrub habitat is the most diverse, while the urbanized habitat group comprises 15 species. The abundance and diversity indexes are positioned in the same order: open herb & shrub habitat have largest individual counts and urbanized area has lowest even though it has a lower evenness rating than crop field, open herb and shrub environment has the highest species number, which contributes to its high diversity score.

During the survey, thirty-nine species of butterflies were determined. The habitat in Open herb & shrubs, which is the least disturbed, has the highest species richness, followed by habitat in agricultural field, and the lowest in urbanized habitat, the most disturbed. The distribution of butterflies is impacted by the existence of host and larval plant species, which is the cause of these results (Harsh.S 2014) [15]. The presence of host and larval plant species, whose occurrence influences the dispersal of butterflies, is responsible for these result (Tiple,2010). The availability of preferred food plants larvae and adults is intimately correlated with the habitat selection process in butterflies (Majumdar *et al*.2015). Among the other families of butterflies, the Nymphalidae family had the greatest number and proportion of species; this could be because the species prefers its particular habitat and has adapted to it. The most biologically varied group of butterflies is the family Nymphalidae, which includes the vibrantly coloured brush-footed butterflies (Gandhi *et al*. 2018). Numerous studies have revealed that disturbed habitats or forest gaps have higher butterfly diversity than dense forests or closed canopy (Antony *et al*. 2016) [17]. The higher frequency of occurrences of the butterfly species may be attributed to the types of plant and environment found in the research area. There was a different habitat pattern at every single site. Moreover, gardens, orchards, farms, landscape areas, and other features were discovered on the locations. (Abdullahi *et al*. 2019) [25]. The season affects both the diversity and distribution and butterflies. There are mouths when they are few and months when they are plentiful (Narmadha *et al*. 2023). The statistics of common species between various habitats are an essential aspect of the study since they show the beta diversity and the degree to which the variety and abundance of species found in these habitats vary or are comparable. The habitat of open herb & shrub and crop habitat had greatest number of shared species (17 species), which make perceive given that these regions had comparatively more nectar supplies for butterflies. The species community structure varied depending on the habitat, although it was generally comparable in the habitats of crops and open herbs and shrubs. Numerous butterfly species are dependent on secondary forests or remaining vegetation (Tarun and G 2015) [16]. Therefore, any institutional camp that maintains a high plant diversity and a variety of habitats is an excellent alternative for the conservation of species in landscape that is controlled by human.

Conclusion

Present study clearly depicted the high range of butterfly diversity was present in a good range of vegetation and near

the flowering plant. The result of this study emphasizes how crucial it is that campuses be acknowledge as the ideal home for butterflies. The variety of butterflies in university campus may more risen if the gardens are well planned and organized way. It may be helpful to offering abundant opportunities for the research and butterfly conservation. Butterfly pollination helps to preserve the ecosystem. Biological pest control reduces atmospheric carbon dioxide levels, increases plant genetic dioxide levels, and increases plant genetic diversity, and enhances the aesthetic appeal of the environment.it will be helpful to maintain the ecosystem and balance of the nature.

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