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Diversity and abundance of butterfly fauna of Chhindwara district, Madhya Pradesh

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Abstract
Butterflies are part of our natural heritage which adds to increase the aesthetic value of our nature. They form an important biota of the class Insecta, belonging to the order Lepidoptera. During present investigation 38 species of butterflies belonging to 26 genera and 6 families were collected from Chhindwara district, Madhya Pradesh. Present study revealed that family Nymphalidae most dominating one contribute about 42% followed by family Pieridae contribute about 18%, Papilionidae 13%, Danaidae 11%, Hesperiidae 8%, and 8%. Species diversity, Evenness and species richness was calculated by Shannon-Weiner diversity index, Pielou's index and Margalef Index. Species diversity was found highest in Nimphalidae (2.61) and lowest in family Hesperiidae (1.02). Thus the present study was the first attempt to study the butterfly diversity and abundance from Chhindwara district.

Keywords: butterflies, species, family, diversity, Madhya Pradesh

Introduction
Butterflies are the most beautiful and colourful creatures on the earth and have a great aesthetic value. Generally observed, butterflies play an important role in maintaining the balance of nature and health of the living world. Worldwide there are more than 28,000 species of butterflies and about 80 percent of them found in tropical regions (Robbins *et al*, 1997) [17] and absent in Antarctica continent while according to Gaonkar, (1996) [3] and Kunte (2000) [13] there are about 17,200 species of butterflies found throughout the world. India host about 1504 species of butterfly fauna (Tiple, 2011) [26]. Some butterflies are migratory. They fly thousands of miles in the winter to places having a warmer climate and return back in the spring. Butterflies serve as important plant pollinators in the local environment and help to pollinate more than 50 economically important plant crops (Borges *et al*., 2003) [1]. Butterflies are also good indicators of environmental change as they are sensitive to habitat degradation and climate changes (Kunte, 2000) [13]. Chhindwara district located on the south– west region of Satpura Mountain. It is spread from 21.28 to 22.49 Deg. North (Latitude) and 78.40 to 79.24 Deg. East (longitulde) over an area of 11815 sq.km. District is surrounded by lush green fields, rivers and by dams forest with diverse flora. Average temperature is 24.3 0C with precipitation 1133 mm. The forest of the plane area are broadly classified into teak and mixed forest. Teak is the main species in over wood. The associate species in the top storey are saja, Dhaora, lendia, salai, Bija, Rohan etc. The important species of under story are Aonla, Tendu, Dhaman, Achar, Tinsa etc. (Rai, 2016) [15].

2. Materials and Methods
2.1 Study site
The present study was conducted during April 2017 to December 2019. Survey was carried out in selected sites of three ranges of Chhindwara district *viz*. Batkakhapa - East (N22°31'49.9" E79°2'52.5") Delakhari – West (N 22°25'47.9" E 78°36'52.3") Khutama - South (N 21°45'31.6" E 78°49'56.3").

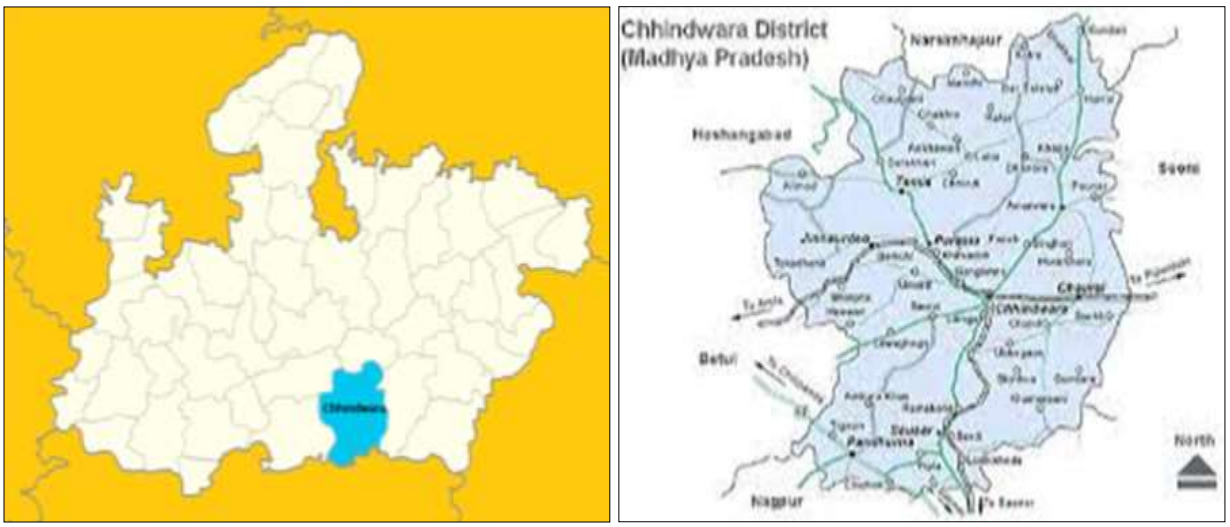

Fig 1: Map of Madhya Pradesh with Chhindwara district

2.2 Collection and Identification

The random survey on butterflies was carried out on sunny days seasonally from April 2017 to December 2019. Butterflies were primarily identified directly in the field or in difficult cases, following capture or photography. In critical conditions specimens were collected only with and led aerial sweep nets. Each specimen was placed in a plastic bottle and carried to laboratory. All the specimens of butterflies were pinned dried & were transferred to air tight insect boxes containing powdered naphthalene (Gadagkar *et al* 1990). Species of butterflies were identified referring (Evans, 1932) [10], Talbot (1939 & 1949) [24] Wynter– Blyth (1957), Kunte (2000) [13] & Kehimkar (2008) [12]. Some species was identified after their comparison with reference collection housed at TFRI, ZSI and Jabalpur. All scientific names followed in the present study are in accordance to Varshney (1983) [28]. The observed butterflies were categorized in five categories on the basis of their abundance in the selected sites of Chhindwara district. VC-Very common (>100sightings), C–Common (50–100sightings), NR-not rare (2–15 sightings) VR–Very rare (1–2sightings) (Tiple *et al*., 2006).

3. Statistical analysis

Shannon-Weiner diversity index

The species diversity was calculated following Shannon – Weiner diversity index (H), 1963

$H=-\Sigma PiInPi$

Where, $Pi=S/N$

H = Shannon and Wiener diversity index

S= total number of species, N=total number of individuals, In = logarithm to base e Margalef's index

Margalef's index was used as a simple measure of species richness (Margalef, 1958)

Margalef's index = $(S–1)/InN$

Where, S = total number of species, N = total number of individuals in the sample,

In = natural logarithm

Evenness index

Evenness index was calculated as per (Pielou, 1966)

$e=H/InS$

Where, H=Shannon and Wiener diversity index, in = natural logarithm

S=total number of species in the sample

4. Results and Discussion

During present study a total of 38 species of butterflies belonging to 26 genera and 6 families were collected and identified (Table -1). Out of 38 species, Maximum number of species belonged to the family Nymphalidae represented by 16 species (11 genera) followed by Pieridae 7 species (4 genera), Papilionidae 5 species (3 genera), Danaidae 4 species (2 genera), Hesperiidae 3 species (3 genera) and Lycaenidae 3 species (3 genera). As far as percentage family composition is concerned the species belonged to family Nymphalidae (42%) was the most dominant followed by family Pieridae (18%) Papilionidae (13%) Danaidae (11%) Hesperiidae (8%) Lycaenidae (8%) (Fig.2). Analysis of species diversity of butterfly revealed that the family Nymphalidae (2.61) was the highest followed by family Pieridae (1.84), Papilionidae (1.57) Danaidae (1.26) Lycaenidae (1.08) Hesperiidae (1.02). Evenness was highest in family Nymphalidae (0.89) and lowest in Danaidae (0.41). Similarly species richness was highest in family Hesperiidae (6.37) followed by Pieridae (5.79) Papilionidae (5.75) Danaidae (5.72) Lycaenidae (5.18) Nymphalidae (3.55). (Table 2, Fig. 4). As far as the enlisting of different species in the Wild life Protection Act, 1972 is concerned five species are enlisted in the act (Kunte 2000 [13]; Gupta & Mondal 2005). Based on relative abundance study on 38 species of butterflies about 38% Species were very common, 35% were common, 6% not rare, 12% rare and 9% very rare (Fig.3). Relative abundance was highest for the family Nymphalidae (16 species, 42%) and lowest for families Hesperiidae (3 species, 8%) and Lycaenidae (3 species, 8%). The rich diversity of butterflies, especially the Nymphalids in Chhindwara district indicates a varied assemblage of floral species and healthy climatic conditions. Among 38 species of butterflies 28 species abundance increases from beginning of the monsoon (June- July) till early winter (August - November) and decline species abundance from late winter (January - February) to the end of summer (Table-1).

Butterfly diversity studies carried out at various places showed a varied pattern. Singh and Chandra (2006) [5] found 49 species of butterflies of six families from the Achankmar –Amarkantak Biosphere Reserve. Chandra *et al* (2007) [6, 8] studied butterflies from various districts and conservation areas of Vidarbha, M. P. and together listed 174 species of butterflies belonging to 100 genera and 8 families. Tiple (2012) [27] made efforts on diversity, relative abundance and status of butterflies in Tropical Forest Research Institute, Jabalpur, Madhya Pradesh, Central India and recorded 66 species of butterflies belonging to 47 genera and five families. Tiwari *et al* (2010) recorded 126 butterfly species belonging to 74 genera and 5 families from Pench Tiger Reserve, Madhya Pradesh. Whereas in the present study in all 38 species of butterflies were encountered.

Table 1: Check list of butterfly species collected from Chhindwara district, Madhya Pradesh

S.N.	Scientific name	Family	Occurrence	Status
1.	*Danais chrysippus* (Linnaeus)	Danaidae	September-December	VC
2.	*Danais genutia* (Cramer)	Danaidae	September-November	C
3.	*Danais limniace* (Cramer)	Danaidae	September-October	VC
4.	*Euploea core core* (Cramer)*	Danaidae	January-December	VC
5.	*Hasora chromus* (Cramer)	Hesperiidae	June-October	C
6.	*Pelopidas mathias* (Fabricius)	Hesperiidae	October	C
7.	*Telicota colon* (Fabricius)	Hesperiidae	August-September	VR
8.	*Euchrysops pandava* (Horsefield)	Lycaenidae	September	C
9.	*Jamides celeno*(Cramer)	Lycaenidae	February	C
10.	*Lampides boeticus* (Linnaeus)*	Lycaenidae	September-February	C
11.	*Acraea violae*(Fabricius)	Nymphalidae	June-December	C

12.	*Ariadne ariadne* (Linnaeus)	Nymphalidae	June-November	C
13.	*Charaxes bharata* (Felder)	Nymphalidae	August-September	VR
14.	*Hypolimnas bolina* (Linnaeus)	Nymphalidae	June-January	C
15.	*Hypolimnas missipus* (Linnaeus)*	Nymphalidae	January-December	C
16.	*Neptis hylas* (Linnaeus)	Nymphalidae	July -December	VC
17.	*Neptis jumbah* (Moore)*	Nymphalidae	December-March	R
18.	*Pentaporia perius* (Linnaeus)	Nymphalidae	December-January	R
19.	*Phalanta phalanta* (Drury)	Nymphalidae	June-January	VC
20.	*Euthalia nais* (Forester)	Nymphalidae	August-March	VC
21.	*Melantis leda* (Linnaeus)	Nymphalidae	September-October	VC
22.	*Mycalesis mineus* (Linnaeus)	Nymphalidae	September-November	VC
23.	*Precis iphita* (Cramer)	Nymphalidae	August-November	C
24.	*Precis lemnios* (Linnaeus)	Nymphalidae	January-December	VC
25.	*Precis hierta* (Fabricius)	Nymphalidae	January-February	VR
26.	*Precis orithya* (Linnaeus)	Nymphalidae	October-March	NR
27.	*Graphium doson* (Felder)	Papilionidae	July-December	C
28.	*Pachliopta aristolochiae* (Fabricius)	Papilionidae	July-December	NR
29.	*Papilio demoleus* (Linnaeus)	Papilionidae	January-December	VC
30.	*Papilio polytes* (Linnaeus)	Papilionidae	July-February	*C*
31.	*Papilio nomius* (Esper)	Papilionidae	March-July	*R*
32.	*Eurema blanda* (*Boisduval*)	Pieridae	July-November	*C*
33.	*Eurema hecabe* (Linnaeus)	Pieridae	January-December	VC
34.	*Cepora nerissa* (Fabricius)*	Pieridae	July-February	R
35.	*Delias eucharis* (Drury)	Pieridae	September-March	C
36.	*Catopsilia crocale* (Cramer)	Pieridae	July-November	VC
37.	*Catopsilia pyranthe* (Linn.)	Pieridae	August-November	VC
38.	*Catopsilia Pomona* (Fabricius)	Pieridae	July-March	C

VC-Very common (>100sightings), C-Common (50-100sightings), NR-not rare (15-50 sightings) R-rare (2-15sightings) VR-Very rare (1-2sightings),*-Listed in Indian Wildlife (Protection) Act 1972

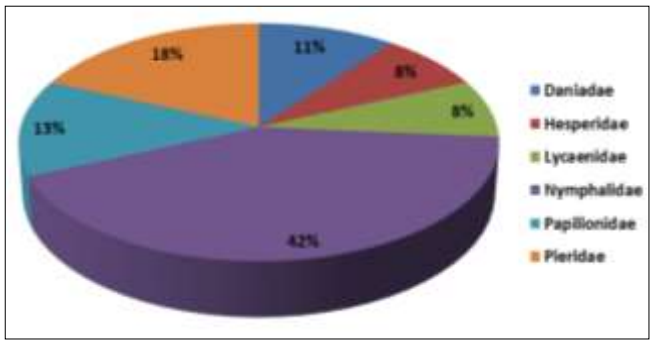

Fig 2: Percentage composition of each family of butterflies in Chhindwara

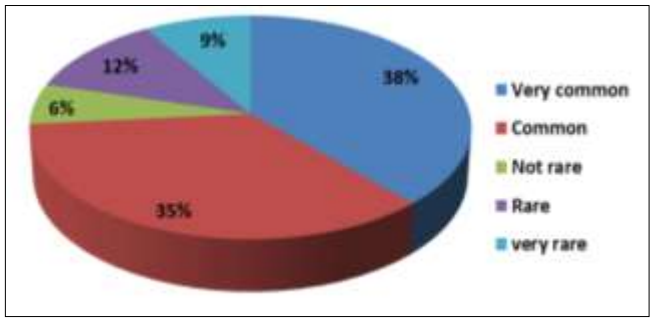

Fig 3: Percentage composition of status of butterfly species in Chhindwara

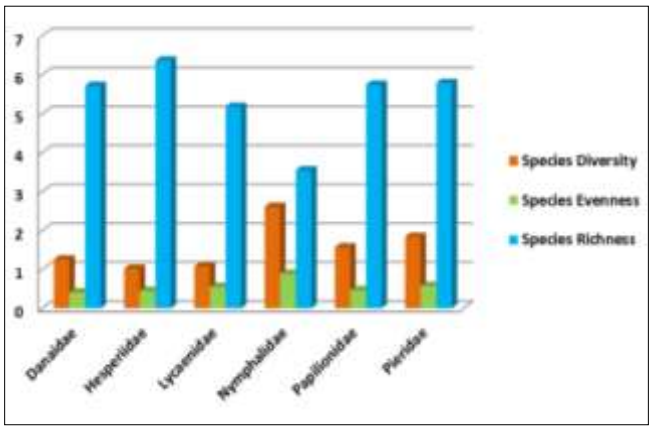

Fig 4: Species diversity, species richness and species evenness

Table 2: Showing Species diversity, richness and evenness of different families of butterflies

Family	Number of species	Species Diversity	Species Evenness	Species Richness
Danaidae	4	1.26	0.41	5.72
Hesperiidae	3	1.02	0.45	6.37
Lycaenidae	3	1.08	0.55	5.18
Nymphalidae	16	2.61	0.89	3.55
Papilionidae	5	1.57	0.47	5.75
Pieridae	7	1.84	0.58	5.79

5. Conclusion

The present study is the first effort in exploring the butterfly diversity of Chhindwara district in Madhya Pradesh. During the study family Nymphalidae carries the maximum number of species 16 (42%) than the remaining families. Due to increasing needs of the growing human population in India, forest as well as greeneries are being cut for urbanization causing overgrazing, pollution and other hazardous effects. Owing to habitat destruction for developmental activities in urban areas and unscientific management of natural resources, much of our native butterflies are fast disappearing and at present, their survival is under threat. For conserving local wildlife and butterflies, plantation of endemic trees and other supporting plants needs to be done. This will help to prevent the extinction of common species. Careful planning and proper maintenance of the plantation can provide grounds for not only an increase in diversity of butterflies but also in its conservation and research.

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