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Research Paper

Alpha Diversity of Moths (Lepidoptera - Insecta) in Veerangana Durgavati Wildlife Sanctuary, Damoh, Madhya Pradesh.

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Abstract: The present paper deals with the species diversity and richness of moth fauna of Veerangana Durgavati Wildlife Sanctuary (VDWLS), Madhya-Pradesh. Alpha diversity represents the diversity within a community or ecosystem, and often expressed by the species richness in that particular ecosystem. Intensive and extensive collection cum survey tours were conducted during June 2009 to November 2011 in the localities of Veerangana Durgavati Wildlife Sanctuary (VDWLS), Madhya Pradesh. Moths were collected by using light trap method and were pinned, relaxed, labeled and identified up to species level. All - specimens of moths are deposited in the National Zoological Collection (NZC) of - Zoological Survey of India, Central Zone Regional Centre, Jabalpur. During the study period, a total of 437 individuals were collected, which belong to 95 species, under 85 genera in 13 families. Family Erebidae is a dominant family of the sanctuary with 38 species under 31 genera. Based on the studies conducted, the diversity indices were also calculated for 11 study sites. The highest species richness (S) of moths were recorded from Bhainshaghat region (40 species) and second highest was found from Danital region (30 species) of VDWLS. Margalef index lies between 8.544 to 0.72 and Menhinick index ranges between 4.143 to 1 for moth species. The Shannon-Wiener index (H) varies from 3.307 to 0.56 and Simpson's diversity index (1-D) ranges between 0.946 to 0.375 for the different localities of the sanctuary. The highest species diversity was recorded from Bhainshaghat region (H= 3.307, 1-D= 0.9466) and minimum at Sajtalaiya (H= 0.5623, 1-D= 0.375). Extensive sampling resulted in many varieties of species, this indicates that the faunal diversity of moth at VDWLS is very high and further surveys will yield more data.

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Keywords: Alpha diversity, Indices, Lepidoptera, Moths, Madhya Pradesh, Veerangana Durgavati Wildlife Sanctuary (VDWLS).

Introduction:

Order Lepidoptera constitutes scaly winged holometabolous endopterygote insects, which includes butterflies and moths. They are one of the most efficient indicator species of the changing environment. These insects encompassing over 1, 80,000 described species in 126 families & 46 super families (Zhang *et al*. 2019). Recent estimate of diversity within order Lepidoptera from the Indian sub region reveals that the group comprises over 11,300 species (Smetacek, 2011). Moth fauna of Madhya Pradesh and Chhattisgarh was also studied by Chandra and Nema (2007), who studied and compiled 313 species of moths belonging to 221 genera and 25 families. Earlier, studies on the moths fauna of Veerangana Durgavati Wildlife Sanctuary, Damoh were also published by Sambath and Chandra (2012), Chandra *et. al*., (2013; 2013a; and 2014), Chandra and Sambath (2016).

Moths are taxonomically well known and critical to the functioning of many ecosystems, with the species having functional roles as selective herbivores, pollinators and prey for birds and small mammals (Schowalter *et. al*. 1986, Perry 1994). The caterpillars of moth are pests of variety of vegetables, crops and forest plants; therefore, they are treated as economically important group (Shah and Mitra, 2015). Several features of the butterflies and moths make them good candidates for indicator, umbrella or flagship species (New 1997, Fleishman. 2000, Maes and Van Dyck 2001). Despite their fundamental role in nature, invertebrates have been systematically ignored in all conservation studies (Franklin 1993). Only a little information is available about Lepidoptera because of the preference of researchers to work on less diverse taxa (Gurule and Nikam, 2013). The deficiency of knowledge of systematics of insect fauna is a problem in assessing insect diversity which is due in part to lesser conservation efforts for invertebrates over larger vertebrates and plants (Mahajan, 2004). Therefore, Extensive and intensive surveys would yield more data of moth fauna of the sanctuary which would be used as base line information for conservation and management of insect biodiversity particularly on moths. Fragmentary information is available on moths of the Veerangana Durgavati Wildlife Sanctuary. Hence, the present study helps to understand - the current status of existence of moth diversity which has a great role in estimating the health of ecosystem of the sanctuary and appropriate conservation measures are discussed in the light of the results.

Study Site:

Veerangana Durgavati Wildlife Sanctuary situated in Damoh district in the forest area of Sangrampur of Madhya Pradesh, India. The sanctuary was created in the year 1996 vide Government of Madhya Pradesh Notification no. F- 14-33-94-(X)-2, dated 6-1-1997. The area of the sanctuary is 24 sq. kms. The sanctuary lies between 23°30’9” & 24°35’N latitudes & between 79°51’0” & 79°51’13”E longitudes. It is well connected with Jabalpur city and Damoh town which is also the nearest rail heads. The sanctuary belongs to Indo Malayan realm. The biotic province is Deccan peninsula. It represents mixed Dry deciduous forest Biome.

The sanctuary possesses an entire ecosystem and therefore it is self-sufficient. All important wildlife species complete their

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different stages of life cycle within the Sanctuary. (Tiwari, 2003).

Based on the observations, selected 11 sampling sites viz. (Figure -1)

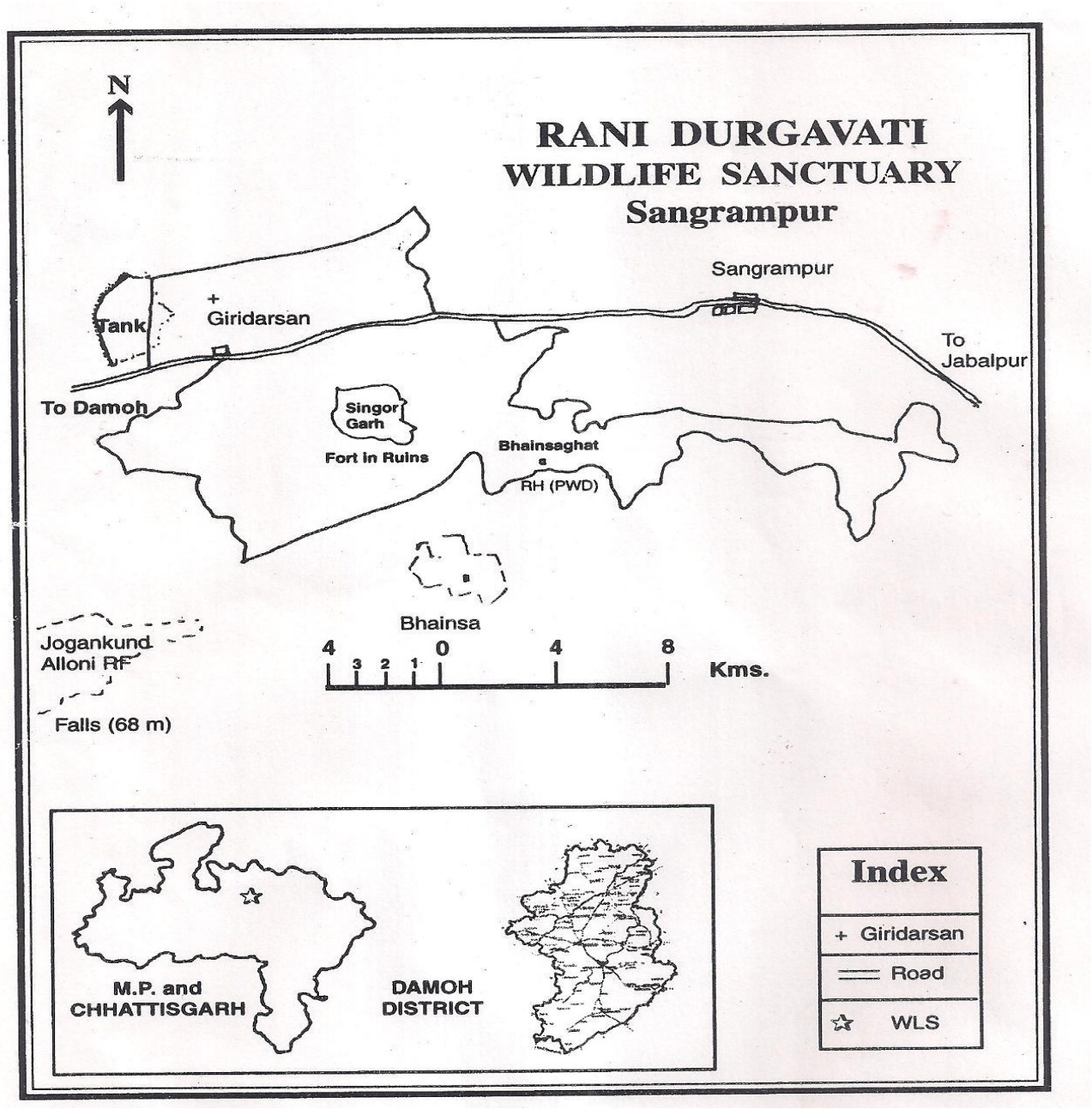

Figure 1 . Map (Not to scale) showing the location of the study area.

1. Bhainshaghat 2. Danital **3**. Thilgula Patrolling **4**. Giridarshan Watch Tower **5.** Forest Rest House **6**. Sangrampur **7.** Singorgarh fort **8**. Koda Kalam 9**.** Bandar Kola **10.** Nazara View Point 11. Sajtalaiya.

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Material and Method:

The present study is based on the collections made within the period of 2009- 2011 in the different localities of the Veerangana Durgavati Wildlife Sanctuary. Field collection trips were arranged to various climatically different regions for collecting moth fauna from a variety of habitats. The collection of adult moths was planned in a systematic manner from June 2009 to November 2011. The entire year was divided into three seasons- summer (April to June), monsoon (July to October) and winter (November to March). In 2009, undertaken three surveys in the month of June, August and November, similarly in 2010, February, June and September and in - 2011, February, April, July and November respectively. Initially, 11 trap sites within sampling sites were chosen in order to obtain comprehensive representation of different moth species.

Generally, the moths are nocturnal in habit. The collection of moths was made through the light traps, using 160-watt mercury bulb connected with the light sources. For collecting moths, white cloth sheet (10'x 6') was hung between two vertical poles in such a way that it touches the surface and extends forwards over the ground for a few feet so that all those insects, which are settling on the ground slightly away from the direct source of light are also caught (Chandra and Sambath, 2013). Among all the methods employed for collection, light trap was found to be the best method in all (Kathirvelu, 2019).

Larger specimens can be taken in a killing jar in small numbers; smaller moths should be collected individually in small glass tubes. After collecting the moths from the field were killed in the killing bottle, which is filled with Benzene vapors as a killing agent. For temporary storage in the field they were kept in the insect envelops with labels and envelops are kept in the ordinary cardboard boxes with naphthalene balls (Alfred and Ramakrishna, 2004). The collected specimens of Moths were relaxed, pinned and labeled at the laboratory. Photographs were taken by Nikon coolpicks L120.

The collected specimens were identified and classified with the help of all available traditional taxonomic literature (Hampson (1892, 94, 95, 96), Bell and Scott (1937), Common (1990), Kristensen (1999), Holloway (1985), for the group. The identification was also done by the comparison with the reference collections lying in museum of Central Zone Regional Centre, Zoological Survey of India, Jabalpur (M.P.). Dissections of the abdomen of male and female moths of different species were performed to examine genitalic attributes which are highly species specific in this order. Mounting of male and female genitalia were followed as per the procedure given by Robinson (1976). The systematic account of moths of VDWLS is based mainly on the higher classification of van Nieukerken *et al*. (2011) up to family level. The current nomenclature used for species identification is based on LEPINDEX (Beccaloni *et al*. 2003).

DATA ANALYSIS

Diversity index enables the researcher to describe the moth fauna mathematically and to compare their diversity between different habitats. Species diversity, in essence, has always been defined by the indices to measure it (Peet, 1974). A diversity index takes into account the number of species present as well as the abundance of each species of Moth (Magurran, 1988). Diversity Indices, species richness and evenness, dominance of moth species were assessed for each study site and calculated by using Shannon-Wiener diversity index (1949), Margalef's index (1958) and evenness index

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(Pielou, 1966) (Magurran,1988). Fisher alpha diversity (Fisher *et al.*, 1943) was also calculated which is often considered the best diversity index for many communities of species, including Lepidoptera (Robinson and Tuck, 1993; Wolda *et al*., 1994, Chey *et al*., 1997). The pattern of abundance of species that determine the dominance of each moth family in the study area was determined by calculating the dominance index. The most common indices of species diversity are dominance index, Shannon index and Simpson index. In spite of these basic indices, there are some other modified indices are also used in this study. The first measure of diversity is the Shannon index**.** Shannon diversity index was used for comparing diversity between different sampling sites of the sanctuary taking into account the number of individuals as well as number of taxa. Shannon diversity index varies from 0 for communities with only a single taxon to high values for communities with many taxa; Shannon values vary between 1.3 and 3.5 and may exceeds 4.0.

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

Where p is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), ln is the natural log, Σ is the sum of the calculations, and s is the number of species.

Species richness and diversity both are used in ecological studies for assessing the ecological health. Species richness is an actual number of different species of the sample. For this we can use Margalef and Menhinick indices. Margalef richness index is a count of the number of different species in a given area or community.

$$D_{Mg} = \frac{(S-1)}{lnN}$$

Menhinick richness index represents the ratio of the number of taxa to the square root of the sample size. This index assessing the evenness with which individuals are divided among the taxa present. The greater the number of species entered, the greater the value of index. One of the most important advantages of the Margalef and Menhinick indices is its easy calculation and being used successfully in several scientific papers (Magurran, 2004).

$$D_{Mn} = \frac{S}{\sqrt{N}}$$

The indices based on dominance (D) are inverse parameters for the concepts of uniformity of the community. For this we can use Simpson index, which shows the probability that two individuals taken at random from a given sample are of different species. The value of D ranges between 0 and 1, 0 represents infinite diversity and 1 for no diversity. For Simpson index of diversity D is often subtracted from1. The value of this also ranges between 0 to 1 but now, the greater the value, the greater the sample diversity.

$$SI = 1 - (\sum_{i=1}^{s} (pi)^2)$$

Where pi is the proportion of the i th species and s is the number of individuals of all the species.

Berger-Parker index calculate the proportional importance of the most abundant type. Its equals the maximum pi value in the dataset of sample. This corresponds to the weighted generalized mean of the pi values when q approaches infinity and hence equals the inverse of true diversity of order infinity.

$$D = \frac{N_{max}}{N}$$

Where Nmax is the number of individuals in the most abundant species and N is the total number of individuals in the sample. The

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reciprocal of the index, 1/d, is generally used, thus an increase in the value of the index accompanies an increase in species diversity and a reduction in dominance.

The distribution of individuals over species is called evenness (Heip, 1998). Buzas and Gibsons's evenness ranges from 0 to 1, 0 means no evenness and 1 means complete evenness. Equitability J or Pielou index represents the Shannon diversity divided by the logarithm of number of taxa of the sanctuary. This measures the evenness with which individuals are divided among the present taxa (Harper 1999). This measure of equitability compares the observed Shannon Wiener index against the distribution of individuals between the observed species which would maximize diversity.

$$J' = \frac{H'}{H'_{max}}$$

Where H' is the number derived from the Shannon diversity index and H'max is the maximum possible value of H'.

Brillouin index measures the diversity of a known collection as opposite to the Shannon index which measures a random sample. The value obtained from the data rarely exceeds 4.5 and Brillouin index and Shannon index both tend to give similar comparative measures. This index is more sensitive to species abundance.

Another index is Fisher's alpha index is widely used as a diversity index to compare among communities varying in number of specimens. It is a scale independent indicator of diversity we can calculate the index only with species richness (S) and total number of individuals (N) of the sample.

$$S = a^* \ln(1 + \frac{n}{a})$$

Where *S* is number of taxa, *n* is number of individuals and *a* is the Fisher's alpha.

Chao 1 is a nonparametric method for estimating the number of species in a community. It is based on the concept that rare species infer the most information about the number of missing species in a sample.

$$S_{Chao\,1} = S_{obs} + \frac{F_1^2}{2F_2}$$

Where S_{obs} = the number of species in the sample

F_1= the number of observed species represented by a single individuals

F_2= the number of observed species represented by two individuals. (Magurran, 2004)

PAST version 3.25 was used to calculate diversity indices (Hammer *et al*., 2001). PAST has been grown into a comprehensive statistical package that is used not only by paleontologists, but in many fields of life sciences, earth science and even engineering and economics (Hossain *et al*., 2012).

Result and Discussion:

The present study gives the detailed information on Moth Fauna of Veerangana Durgavati Wildlife Sanctuary, Madhya Pradesh. During the study, more than 437 specimens of moths were collected and identified, which reveals the record of 95 species of moths pertaining to 85 genera under 13 families.

The largest number of species belongs to Family Erebidae, which is represented by 38 species under 31 genera. Sphingidae by 12 species referable to 10 genera. The family Crambidae is represented by 11 species under 11 genera. The family Noctuidae by 10 species under 10 genera.

The largest number of species of Moths found in Bhainshaghat which is 40 species belonging to 37 genera under 7 families. Next is Danital by 30 species belonging to 30 genera under 8 families. The number of species, genera, families and individuals representing each locality are given in the following Table-1.

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Table 1. Different diversity indices of the 11 different study sites.

Diversity Indices/Study sites	BG	DT	TP	FRH	GWT	SAN	SGF	KK	BK	NVP	ST
Family	7	8	9	9	11	11	5	3	3	2	2
Genera	37	30	28	26	27	20	5	5	3	2	2
Taxa_S	40	30	30	29	27	21	5	5	3	2	2
Individuals	96	99	60	49	76	35	6	6	4	2	4
Dominance_D	0.05339	0.0756	0.04889	0.0454	0.05367	0.0694	0.2222	0.2222	0.375	0.5	0.625
Simpson_1-D	0.9466	0.9244	0.9511	0.9546	0.9463	0.9306	0.7778	0.7778	0.625	0.5	0.375
Shannon_H	3.307	2.986	3.195	3.227	3.083	2.86	1.561	1.561	1.04	0.6931	0.5623
Evenness_e^H/S	0.6825	0.6601	0.8137	0.8688	0.808	0.8314	0.9524	0.9524	0.9428	1	0.8774
Brillouin	2.819	2.602	2.633	2.589	2.638	2.243	0.981	0.981	0.6212	0.3466	0.3466
Menhinick	4.082	3.015	3.873	4.143	3.097	3.55	2.041	2.041	1.5	1.414	1
Margalef	8.544	6.311	7.083	7.195	6.004	5.625	2.232	2.232	1.443	1.443	0.7213
Equitability_J	0.8964	0.8779	0.9394	0.9582	0.9353	0.9393	0.9697	0.9697	0.9464	1	0.8113
Fisher_alpha	25.75	14.64	23.88	29.86	14.96	22.17	14.12	14.12	5.453	0	1.592
Berger-Parker	0.125	0.202	0.08333	0.08163	0.09211	0.1429	0.3333	0.3333	0.5	0.5	0.75
Chao-1	59.09	43.2	57.2	48.43	38.25	43.75	8	8	3.5	3	2

Abbreviations-: Giridarashan Watch Tower- GWT, Sangrampur-SAN, Thilgula patrolling- TP, Bhainshaghat-BG, Danital-DT, Forest rest house-FRH, Sajtalaiya-ST, Singorgarh fort-SGF, Nazara view point-NVP, Bandar kola-BK, Koda kalam-KK.

SPECIES DIVERSITY: The Diversity indices of the 11 different study sites were also calculated (Table-1). The study site wise values of Shannon diversity index is ranges from 3.307 to 0.562, highest at Bhainshaghat and lowest at Sajtalaiya. As the value of H' is near 4.021 for the sanctuary, which predicts that the numbers of individuals of all moth species were evenly distributed in study area. Singorgarh fort The Shannon's diversity index (H') was 3.307 at Bhainshaghat, 3.227 at Forest Rest House, 3.195 at Thilgula Patrolling, 3.083 at Giridarashan Watch Tower, 2.986 at Danital, 2.86 at Sangrampur, 1.561 at Singorgarh fort, 1.561 at Koda Kalam, 1.04 at Bandar Kola, 0.6931 at Nazara View Point and 0.5623 at Sajtalaiya. The diversity according to the Shannon index H' shows significant differences between 11 study sites. Species richness (S) was at its maximum with 40 species at Bhainshaghat region and minimum at Nazara view point and Sajtalaiya with occurrence of 2 species. For quantifying species richness we use Margalef Index and Menhinick Index. According to the Margalef Index we found that 11 different study sites of sanctuary were slightly different in species richness Bhainshaghat region has the highest species richness (8.55) followed by Danital (6.31) and Sajtalaiya were at its lowest diversity with 0.72 value. Menhinick richness index denoted high diversity through the value of 4.55 for the sanctuary, 4.08 for Bhainshaghat region when compared to other areas of the sanctuary and 1 for

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Sajtalaiya which is least among all 11 study sites which shows the low diversity of the sajtalaiya region.

Dominance index express that sampled area is dominated by one of few species, thus the dominance index D is minimum at Bhainshaghat (0.053) which shows low dominance at the area and maximum at Sajtalaiya (0.63) which shows that only 2 species were dominate the area.

The value of Berger Parker dominance index is least at Thilgula Patrolling and Forest rest house with value 0.083 and 0.081 and Highest at Sajtalaiya (0.75).

Simpson index (1-D) ranges between 0 to 1 denotes that the greater the value, the greater the moth diversity. So, according to the Simpson index value (0.957) the Bhaisanghat region show highest diversity.

Evenness or Equitability index measures the evenness of species abundance and predict how the individuals of various species are distributed in the sanctuary. According to Buzas and Gibson's index maximum evenness observed was 1 at Nazara view point and 0.952 at Singorgarh fort and Koda kalam and minimum evenness was 0.66 at Danital. (Table-1).

Equitability index-J (Pielou index) denotes less or greater uniformity in the sample. The value of Pielou index is 1 for Nazara view point, 0.97 for Singorgarh fort & Koda kalam which denotes high uniformity in composition of species in the sanctuary.

Highest value of Brillouin index was recorded at Bhainshaghat (2.81) and lowest value (0.35) at Nazara view point and Sajtalaiya. Singorgarh fort, Bandar kola & Koda kalam also exhibited low values. (Table-1) This index is more sensitive to species abundance.

Fisher alpha is predicting the comparison among communities varying in number of specimens. According to this index Forest rest house is rich in diversity (29.8) followed by 25.7 (Bhainshaghat), 23.8 (Thilgula Patrolling), 22.1 (Sangrampur) and 0 at Nazara view point. In this present study diversity indices shows that the Bhaishaghat, Danital, Giridarashan watch tower, Thilgula patrolling, Sangrampur and Forest rest house were the highly diverse study site where as Nazara view point, Bandar kola, Koda kalam, Sajtalaiya and were the less diverse localities. The abundance and diversity of moth fauna is highly correlated with the availability of food plants in the study area. The study area represents the mosaic of different habitats which help in supporting high diversity of flora so as moth fauna.

SYSTEMATIC ACCOUNT

The classification used in the present study is mainly based on van Nieukerken *et al*. (2011).

ORDER: LEPIDOPTERA Linnaeus, 1758
I. CLADE- APODITRYSIA Minet, 1983
Superfamily – Cossoidea Leach, 1815
Family-Cossidae Leach, 1815
Subfamily: Zeuzerinae Boisduval, (1828)
1. *Xyleutes persona* Le Guillou, 1841
2. *Neurozerra conferta* Walker, - 1865
Superfamily – Zygaenoidea Latreille, 1809
Family – Limacodidae Duponchel, 1845
3. *Birthamoides junctura* Walker, - 1865
Subfamily: Limacodinae Duponchel, 1845
4. *Miresa albipuncta* Herrich-Schaffer, 1854
5. *Parasa pastoralis* Butler, 1885
II. CLADE – OBTECTOMERA Minet, 1986
Superfamily – Hyblaeoidea Hampson, 1903
Family – Hyblaeidae Hampson, 1903
6. *Hyblaea puera* Cramer, 1777
Superfamily – Pyraloidea Latreille, 1809
Family – Crambidae Latreille, 1810
Subfamily: Spilomelinae Guenee, 1854
7. *Agathodes ostentalis* Geyer, 1837
8. *Botyodes asialis* Guenee, 1854
9. *Cydalima conchylalis* Guenee, 1854
10. *Glyphodes bicolor* Swainson, [1821]

11. *Maruca vitrata* Fabricius, 1787
12. *Pygospila tyres* Cramer, 1780
13. *Sameodes cancellalis* Zeller, 1852
14. *Spoladia recurvalis* Fabricius, 1775
15. *Tyspanodes linealis* Moore, 1867

Subfamily: Pyraustinae Meyrick, 1890

16. *Conogethes punctiferalis* Guenee, 1854
17. *Euclasta defamatalis* Walker,F., 1859

III. CLADE – MACROHETEROCERA Chapman, 1893

Superfamily – Bombycoidea Latreille, 1802

Family – Eupterotidae Swinhoe, 1892

18. *Eupterote undata* Blanchard, 1844
19. *Ganisa plana* Walker, F., 1855

Family – Saturniidae Boisduval, 1839

Subfamily – Saturniinae Boisduval, 1837

20. *Actias selene* Hubner, 1806

Family – Sphingidae Latreille, 1802

Subfamily – Sphinginae Latreille, 1802

21. *Acherontia lachesis* Fabricius, 1798
22. *Acherontia styx* Westwood, 1847
23. *Agrius convolvuli* Linnaeus, 1758
24. *Psilogramma menephron* Cramer, 1780

Subfamily: Macroglossinae Harris, 1839

25. *Daphnis nerii* Linnaeus, 1758
26. *Hippotion boerhaviae* Fabricius, 1775
27. *Nephele comma* Hopffer, 1857
28. *Theretra alecto* Linnaeus, 1758
29. *Theretra oldenlandiae* Fabricius, 1775

Subfamily: Smerinthinae Grote & Robinson, 1865

30. *Agnosia microta* Hampson, 1907
31. *Marumba dyras* Walker, 1856
32. *Polyptychus dentatus* Cramer, 1777

Super family – Geometroidea Leach, 1815

Family – Uraniidae Leach, 1815

Subfamily: Microniinae Guenee, 1857

33. *Micronia aculeata* Guenee, 1857

Family – Geometridae Leach, 1815

Subfamily: Ennominae Duponchel, 1845

34. *Ascotis selenaria* [Denis & Schiffer-muller], 1775
35. *Biston suppressaria* Guenee, [1858]
36. *Hyposidra talaca* Walker, F., 1860
37. *Petelia delostigma* Prout, 1932
38. *Petelia medardaria* Herrich- Schaffer, [1856]
39. *Chiasmia eleonora* Cramer, [1780]

Subfamily: Larentiinae Duponchel, 1845

40. *Hydrelia ornata* Moore, 1868

Subfamily: Sterrhinae Meyrick, 1892

41. *Antitrygodes cuneilinea* Walker, (1863)

Superfamily – Noctuoidea Latreille, 1809

Family – Notodontidae Stephens, 1829

Subfamily: Phalerinae Butler, 1886

42. *Antheua servula* Drury, 1773
43. *Phalera raya* Moore, 1859

Subfamily: Cerurinae Butler 1881

44. *Neocerura liturata* Walker, F., 1855

Subfamily: Dicranurinae Duponchel 1845

45. *Teleclita strigata* Moore, 1879

Family – Erebidae Leach, 1815

Subfamily: Arctiinae Leach, 1815

46. *Argina astrea* Drury, 1773
47. *Creatonotos gangis* Linnaeus, 1763
48. *Aloa lactinea* (Cramer, 1777)
49. *Estigmene perrotteti* Guerin-Meneville, 1844
50. *Estigmene nigricans* Moore, 1872
51. *Pericallia ricini* Fabricius, 1775
52. *Utetheisa pulchelloides* Hampson, 1907
53. *Cyana puella* Drury, 1773

Subfamily: Syntominae

54. *Amata cyssea* Stoll, 1782

Subfamily: Lymantriinae Hampson, 1893

55. *Arctornis comma* Hutton, 1865
56. *Euproctis bimaculata* Walker, 1855
57. *Lymantria incerta* Walker, 1855
58. *Perina nuda* Fabricius, 1787

Subfamily: Aganainae Lafontaine & Fibiger, 2006

59. *Asota caricae* Fabricius, 1775
60. *Asota ficus* Fabricius, 1775

Subfamily: Erebinae Leach, (1815)

61. *Achaea janata* Linnaeus, 1758
62. *Anomis flava* Fabricius, 1775
63. *Anomis fulvida* Guenee, 1852
64. *Thyas coronata* Fabricius, 1775
65. *Ophiusa triphaenoides* Walker, 1858
66. *Artena dotata* Fabricius, 1794

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67. *Dysgonia algira* Linnaeus, 1767
68. *Chalciope mygdon* Cramer, [1777]
69. *Grammodes stolida* Fabricius, 1775
70. *Ophiusa tirhaca* Cramer, 1773
71. *Dysgonia conficiens* Walker, F., 1858
72. *Pericyma crueqeri* Butler, 1886
73. *Mocis frugalis* Fabricius, 1775
74. *Mocis undata* Fabricius, 1775
75. *Attatha regalis* Moore, 1872
76. *Trigonodes hyppasia* Cramer, [1779]
77. *Spirama retorta* Clerck, 1764

Subfamily: Calpinae, Boisduval, 1840

78. *Episparis liturata* Fabricius, 1787
79. *Fodina stola* Guenee, 1852
80. *Hypocala deflorata* Fabricius, 1794
81. *Eudocima fullonica* Linnaeus, 1767
82. *Pandesma anysa* Guenee, 1852
83. *Psimada quadripennis* Walker, - 1858

Family – Nolidae Bruand, 1847

Subfamily: Chloephorinae Stainton, 1859

84. *Carea ang*ulata Fabricius, 1793

Subfamily: Westermanniinae Hampson, 1918

85. *Westermannia argentea* Hampson, 1891

Family: Noctuidae Latreille, 1809

Subfamily: Agaristinae Herrich-Schaffer, 1858

86. *Aegocera bimacula* Walker, F., 1854
87. *Sarbanissa transiens* Walker, F., 1855

Subfamily: Plusiinae Boisduval 1829

88. *Chrysodeixis eriosoma* Doubleday, 1843
89. *Thysanoplusia orichalcea* Fabricius, 1775

Subfamily: Noctuinae Latreille, 1809

90. *Callyna costiplaga* Moore, 1885
91. *Polytela gloriosae* Fabricius, 1781
92. *Spodoptera litura* Fabricius, 1775
93. *Xestia semiherbida* Walker, 1857

Subfamily: Heliothinae Boisduval, 1828

94. *Helicoverpa armigera* Hubner, [1803-1808]

Subfamily: Bagisarinae Crumb, 1956

95. *Amyna axis* Guenee, 1852

Conclusion:

It is concluded from the present study that in all the study sites Erebidae was the dominant family, the species richness and species diversity were high at Bhainshaghat site. This is because the Erebidae is the biggest family of Lepidoptera with 1,760 genera and 24,569 described species (Nieukerken *et. al*. 2011). Majority of the moths of family Erebidae are polyphagus in nature. In Veerangana Durgavati Wild life Sanctuary there are mixed jungle with teak as the dominant tree, this may another reason for its huge diversity. The rich biodiversity of moth fauna of Veerangana Durgavati Wild life sanctuary is mainly due to rich vegetation and play a greater role for the existence of moth fauna in a particular community as it provides main source of food and shelter for their survivorship.

This work was an attempt to describe some aspects of biodiversity of moth fauna of Veerangana Durgavati Wild life Sanctuary of Madhya Pradesh. Further, systematic and intensive work is also necessary for getting a detailed periodic estimate of the moth diversity at Veerangana Durgavati Wild life Sanctuary. Most of the species of moths (Lepidoptera) are now in a state of decline. We should protect and save them from the verge of extinction.

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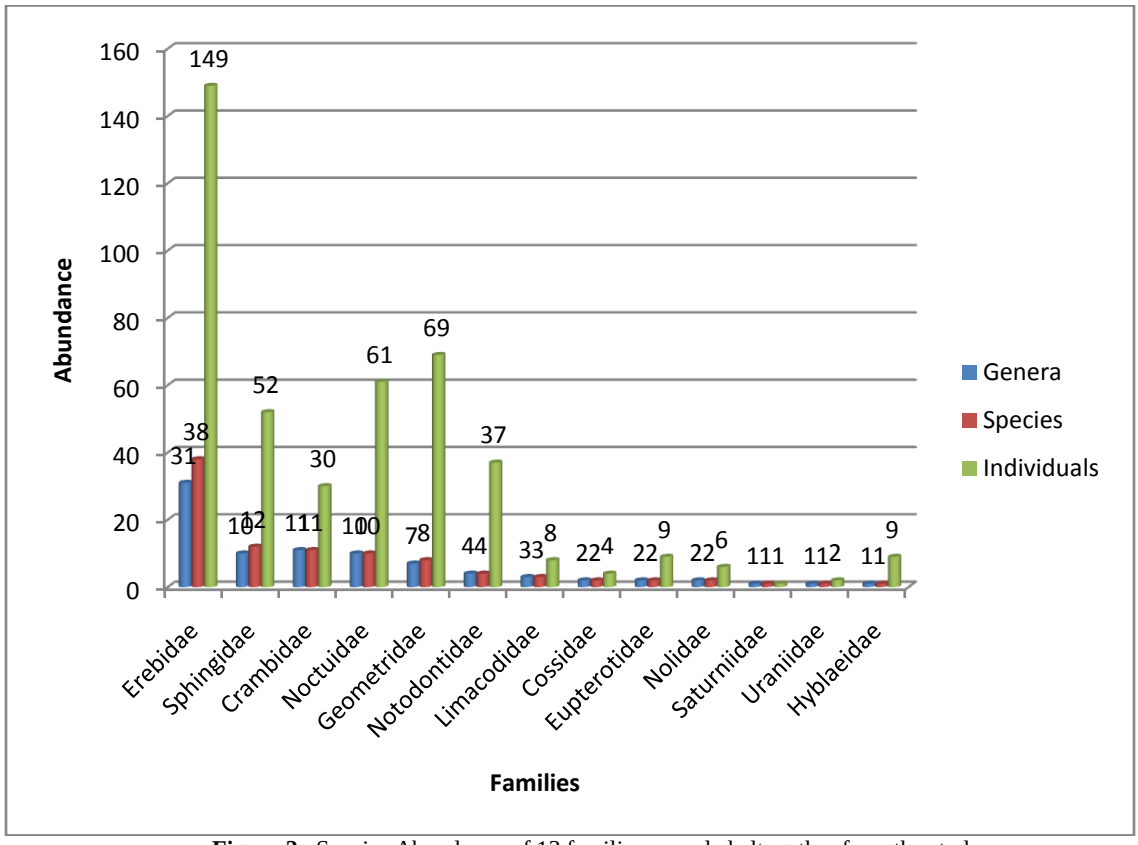

Figure 2 , Species Abundance of 13 families recorded altogether from the study area.

As far as the scope for further research is concerned, it has been stressed that in order to revise this economically important group of Lepidoptera from India the need for fresh surveys to collect adult moths from different unexplored areas of this vast country is the immediate need of the hour. It has also been pointed out that sorting and solving of species complexes which are difficult to sort out on the basis of morphological characters including genitalia, the help of molecular taxonomy and taxonomic database is also warranted.

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