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Diversity and abundance of moth fauna in college campus, Chhindwara district (M.P.), India

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Abstract
A systematic survey was conducted within the campus of PMCOE, Government Post Graduate College, Chhindwara District, Madhya Pradesh, India, to document the baseline diversity and distribution of moth fauna. Field observations were carried out from January 2024 to December 2024 using visual encounter surveys and bait traps. A total of 417 individuals representing 44 species, 40 genera, and 9 families were recorded. Family Geometridae was the most dominant, contributing 38% of the total individuals, followed by Erebidae (29.21%), Crambidae (15.35%), Noctuidae (8.63%), Eupterotidae (3.12%), Sphingidae (2.88%), Saturniidae (1.68%), Thyrididae (0.48%), and Lasiocampidae (0.24%). Diversity analysis revealed a high Shannon–Wiener index (H′ = 3.56), high evenness (J = 0.94), and low dominance (D = 0.033), indicating a stable and diverse moth community. The generated checklist provides valuable baseline data and highlights the ecological significance of campus habitats for moth conservation and biodiversity management.

Keywords: Moth diversity, Lepidoptera, Biodiversity indices, Campus ecosystem, Conservation

Introduction

Insects represent the most diverse group of organisms on Earth, accounting for nearly 90% of the biomass in tropical forests (Wagner *et al*., 2021) [35]. Among them, Lepidoptera is one of the most species-rich orders, including both butterflies and moths, with moths forming the majority of described species worldwide (Benton, 1995) [4]. Globally, approximately 160,000 species of Lepidoptera have been reported, and India alone hosts between 10,000 and 12,000 moth species, highlighting the country's rich lepidopteran diversity (Chandra & Nema, 2007; Shubhalaxmi, 2018) [5, 29].

Moths inhabit a wide range of ecosystems, including forests, deserts, agricultural fields, and urban environments (Joshi *et al*., 2004; Gurule & Nikam, 2011; Kathirvelu *et al*., 2019; Paunikar & Sharma, 2023) [8, 14, 15, 23]. They play crucial ecological roles as pollinators, herbivores, and prey for higher trophic levels including birds, bats, and rodents (Regier *et al*., 2009; Bates *et al*., 2014) [2, 26]. Their sensitivity to environmental changes makes them effective bio-indicators of ecosystem health and biodiversity conservation (Ahire & Khobragade, 2021) [1].

Despite the ecological importance of moths, their diversity and distribution remain underexplored in many parts of Madhya Pradesh. Previous surveys have documented moth fauna in Jabalpur (Shukla & Tiwari, 2024; Paunikar, Kulkarni, & Barve, 2023) [24, 30], Balaghat (Tabassum & Bisen, 2022) [32], and Gandhisagar Wildlife Sanctuary (Paunikar & Nair, 2025) [22], but baseline data from Chhindwara district are lacking. The present study was therefore undertaken to assess moth diversity within the campus of PMCOE, Government Post Graduate College, Chhindwara. By generating a preliminary checklist and analyzing diversity indices, this research aims to:

- Document the baseline diversity and distribution of moth fauna in the study area.
- To evaluate species richness, evenness, and dominance using ecological indices.
- Highlight the ecological significance of campus ecosystems in sustaining moth populations.

This study contributes to the growing body of literature on moth diversity in India and provides valuable baseline data for future ecological monitoring and conservation planning in Central India.

Materials and Methods

1. Study area and sampling site

The present study was carried out in Chhindwara district Madhya Pradesh. The study area is situated between the North latitude 22.0713° ′N and at the longitude 78.9483° ′E with an altitude of m (ft.) and it is located in the southern part of Madhya Pradesh state. The climate of the study area is hot summers with the maximum temperature of 40°C during May to June and around 4-10°C in January. On an average, the area receives an annual rainfall of 1100 to 1200 mm. The sampling was carried out at the campus of the PMCOE, Government Post Graduate College, Chhindwara, located in the Dharam Tekari area of Chhindwara district (Fig.1). The college campus covers an area of approximately 44.68 acres and comprises a diverse range of habitats, including open grounds, garden, trees, Streets and College building. Together, these habitats provide suitable conditions for ecological and biodiversity studies.

2. Survey Method

Field surveys on moth diversity were conducted from January 2024 to December 2024 at the selected study site. Surveys were conducted using the visual encounter and light trapping methods, a standard and widely adopted approach in moth diversity studies (Gurule & Nikam, 2011; Van Nieukerken *et al*., 2011) [8, 34].

Sampling was conducted across different habitat types on campus, including college buildings, residential areas, gardens, open grounds, streets, and vegetated patches.
Random observations were made during evening and early morning hours, when moth activity is generally high. Moths attracted to artificial light sources were visually observed, counted, and photographed using a smartphone camera (Redmi Note 9 Pro Max) to support further identification. No specimens were collected or killed during the study.

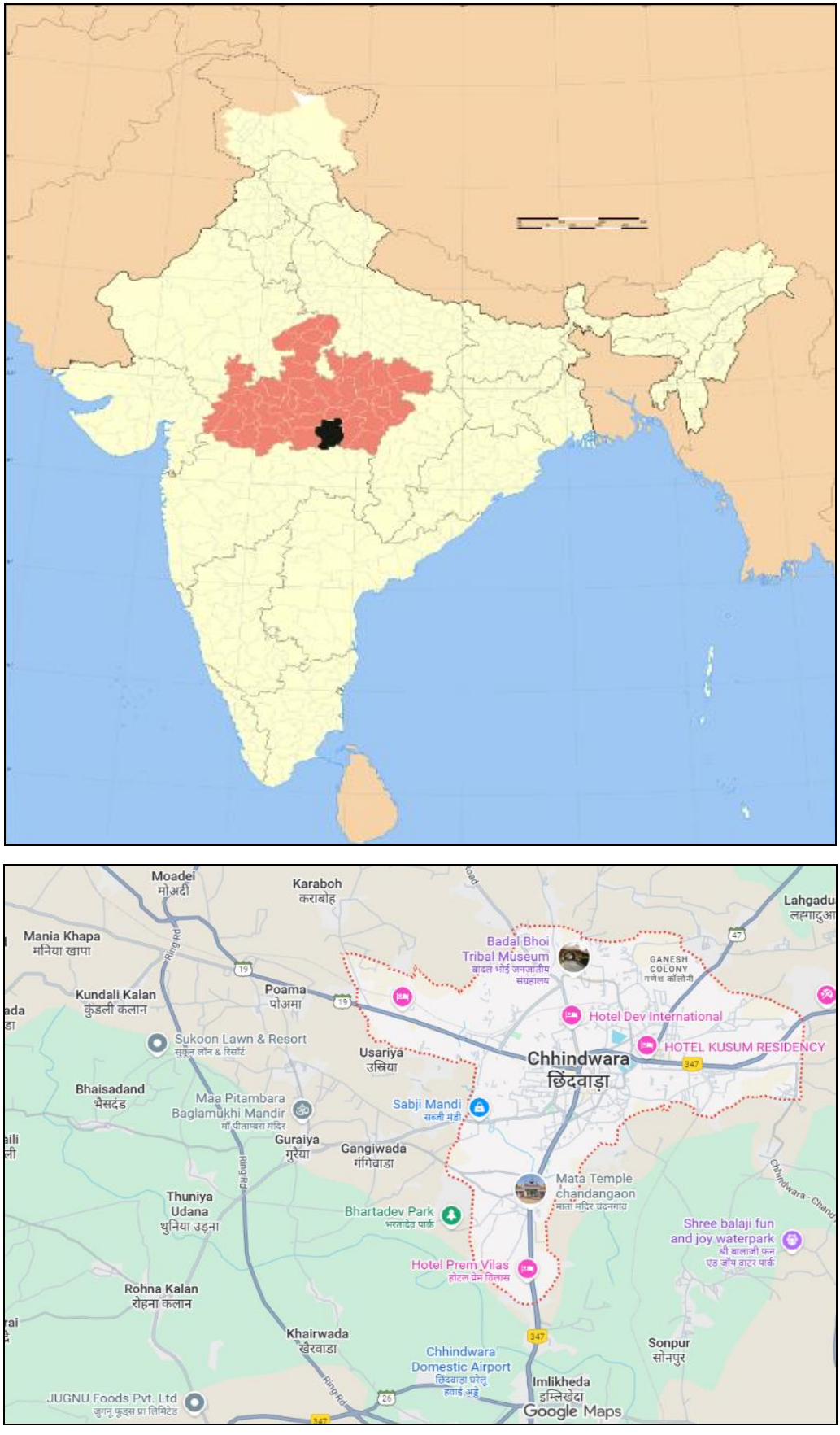

Fig 1: Location Map of sampling area

3. Identification of Moth Species

Identification of moth species was primarily carried out using field photographs, focusing on diagnostic morphological characters such as colour patterns, body size, wing shape, wing venation, and markings. The photographed specimens were compared with standard taxonomic literature and identification keys, including works by Hampson (1893–1896), Bell and Scott (1937) [3], Holloway (1987, 1999, 2005), Schintlmeister and Pinratana (2007) [28], Kononenko and Pinratana (2013) [18], and Kirti and Singh (2015) [16].

In addition, several web sources were used to confirm species identity, including www.jpmoths.org; Moths of India (http://www.mothsofindia.org/; Sondhi *et al*., 2020) [31], and iNaturalist (https://www.inaturalist.org). Species identifications were further validated with expert consultation, and individuals that could not be identified to species level were categorized up to genus level.

Top of Form

Bottom of Form

4. Diversity indices

To evaluate species diversity, richness, dominance, and evenness of moth fauna in the study area, different diversity indices were calculated using standard ecological formulas.

4.1 Species Richness

Species richness was determined by counting the total number of moth species recorded during the study period:

Higher values of **S** indicate greater species diversity within the community.

S = Total number of species

4.2 Shannon–Wiener Diversity Index (H′)

The Shannon–Wiener diversity index was used to assess moth species diversity, accounting for species richness and relative abundance. The index was calculated using the following formula:

$$H = -\sum_{j=1}^{S} p_i \ln p_i$$

where:

H=Shannon Wiener index for species diversity,

S=Number of species,

Pi = Proportion of total sample belonging to the i^{th} species, and

ln = Natural logarithm.

The value of H′ ranges from 0 to 5 in natural ecosystems. Higher values indicate greater diversity and a more stable and complex community structure

4.3 Simpson's Index (Simpson's Index of Dominance)

Simpson's index was used to measure species dominance within the moth community. It was calculated using the formula:

where:

$$D = \sum p_i^2$$

D = Simpson's index of dominance,

p_i = proportion of individuals belonging to the *i*th species.

The value of D ranges between 0 and 1. Lower values of D indicate higher species diversity whereas higher values of D indicate lower species diversity.

4.4 Simpson's Index of Diversity (1 − D)

To express diversity in a more intuitive manner, Simpson's index of diversity was calculated as:

The value of (1 − D) ranges from 0 to 1, with values closer to 1 indicating higher species diversity and lower dominance.

$$1 - D = 1 - \sum p_i^2$$

4.5 Species Evenness (Pielou's Evenness Index)

Species evenness was calculated to assess the uniformity of individual distribution among species using Pielou's index:

where:

$$J = \frac{H'}{\ln S}$$

J = species evenness index,

H′ = Shannon–Wiener diversity index, and

S = total number of species.

The J value ranges from 0 to 1, with values closer to 1 indicating a more even distribution of individuals among species.

4.6 Margalef's Richness Index

Margalef's richness index was calculated to express species richness in relation to the total number of individuals sampled:

$$d = \frac{S - 1}{\ln N}$$

where:

d = Margalef's richness index,

S = total number of species, and

N = total number of individuals recorded

Margalef's index has values greater than zero, with higher values indicating greater species richness and a more diverse community.

5. Statistical data analysis

Statistical data analysis and graphical representations of data were performed using Microsoft Office Excel, 2019

Result and Discussion

The present study recorded a total of 417 moth individuals belonging to 44 species, 40 genera, and 9 families from the college campus of PMCOE, Chhindwara (Table 1). The family Geometridae was the most dominant, contributing 38% of the total individuals, followed by Erebidae (29.21%), Crambidae (15.35%), and Noctuidae (8.63%), while the remaining families were represented by comparatively fewer individuals (Fig 4). The distribution of moth individuals across different habitats within the campus is presented in Fig 2, whereas the overall abundance pattern of recorded species is shown in Fig 3.

Based on abundance data, moth species were categorized into four occurrence classes, namely Rare (≤2 individuals), Occasional (3–10 individuals), Common (11–20 individuals), and Abundant (>20 individuals) (Table 1). Rare species included *Antheraea mylitta*, *Eumelea sp.*, *Cydalima laticostalis*, *Striglina scitaria*, and *Gastropacha pardale*, indicating restricted occurrence within the study area. Occasional species formed the largest group with 22 species, suggesting moderate adaptability to the campus environment. A total of 14 species were categorized as

common, some of which including *Daphnis nerii*, *Scopula pulchellata*, *Biston suppressaria*, and *Eupterote undata*, reflecting favorable habitat conditions and host plant availability. Abundant species such as *Chiasma eleonora*, *Syntomoides imaon*, and *Dysgonia algira* showed strong establishment and wide distribution across the campus (Table 1, Fig 3).

Diversity indices calculated for the study area are presented in Table 2. The high Shannon–Wiener diversity index (H′ = 3.56) indicates rich species diversity, while the low Simpson's dominance value (D = 0.033) suggests minimal dominance by any single species. The high evenness value (J = 0.94) reflects a uniform distribution of individuals among species. Furthermore, Margalef's richness index (d = 7.12) confirms very high species richness within the campus ecosystem (Table 2).

The dominance of Geometridae and Erebidae may be attributed to the availability of diverse vegetation, ornamental plants, and semi-natural habitats within the college campus, which provide suitable larval host plants and favorable microhabitats. Similar dominance patterns of these families have been reported from other institutional and semi-urban ecosystems, emphasizing the ecological importance of managed green spaces in sustaining moth diversity.

1.Actias selene

2.Anthaerea mylitta

3.Daphnis nerri

4.Hyposidra talaca

5.Scopula opicata

6.Scopula pulchellata

7.Scopula fibulata

8.Scopula flaccidaria

9.Agathia laetata

10.Achrosis rondelaria

11.Traminda mundissima

12.Thalassodes immissaria

13.Biston suppressaria

14.Chiasma eleonora

15.Chiasma nora

16.Eumelea

17.Hyposidra talaca

18.Isturgia disputaria

19.Olepa ricini

20.Creatonotes gangis

21.Syntomoides imaon

22.Achaea sreva

23.Trigonodes hyppasia

24.Artaxa guttata

25.Eublemma accedens

26.Eudocima phalonia

27.Hydrillodes

28.Siccia taprobanis

29.Dysgonia algira

30.Spodoptera litura

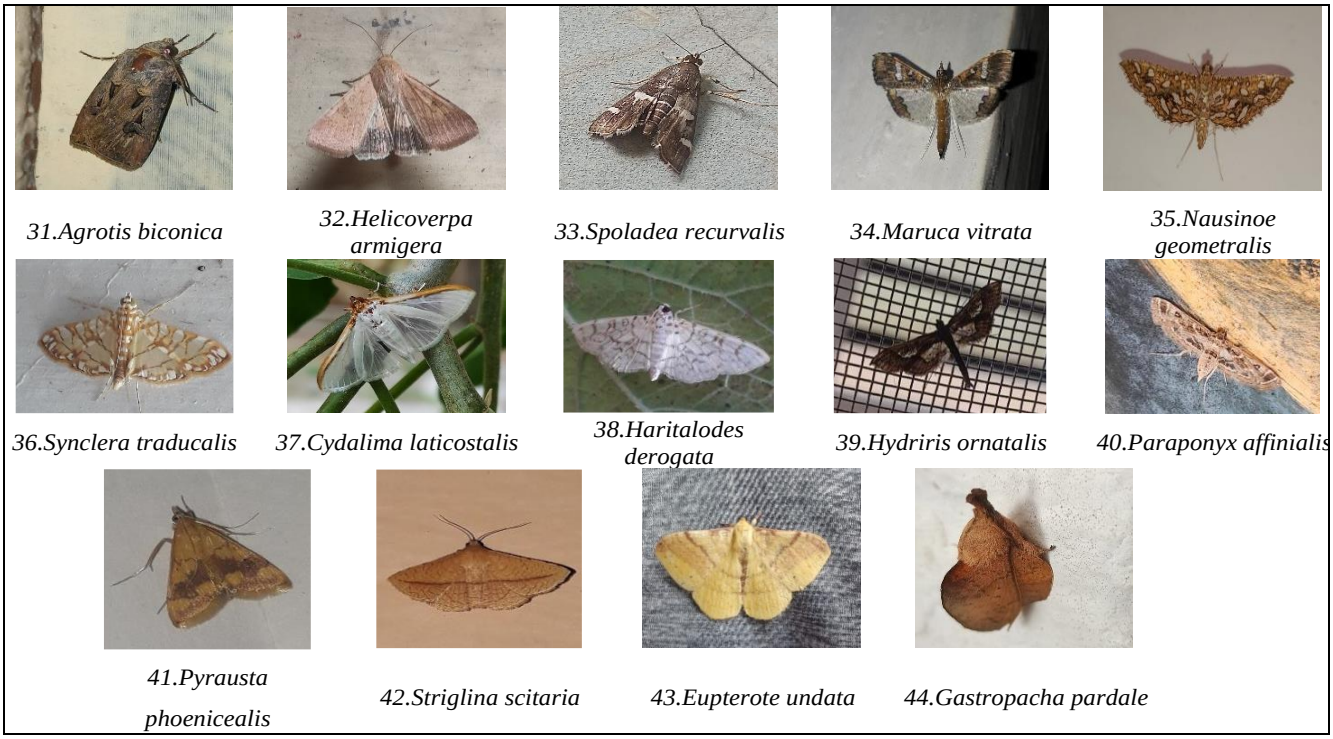

Fig 2: Moths recorded from different habitats of College Campus

Table 1: List of Moth Fauna reported on study site Occurrence category: -Rare (R): ≤ 2 individuals, Occasional (O): 3–10 individuals, Common (C): 11–20 individuals, Abundant (A): > 20 individuals

S.N.	Species	Family	No. of Individuals	Occurrence
1	*Actias selene*	Saturniidae	5	Occasional
2	*Antheraea mylitta*	Saturniidae	2	Rare
3	*Daphnis nerii*	Sphingidae	12	Common
4	*Hyposidra talaca*	Geometridae	8	Occasional
5	*Scopula opicata*	Geometridae	6	Occasional
6	*Scopula pulchellata*	Geometridae	20	Common
7	*Scopula fibulata*	Geometridae	13	Common
8	*Scopula flaccidaria*	Geometridae	18	Common
9	*Agathia laetata*	Geometridae	3	Occasional
10	*Achrosis rondelaria*	Geometridae	5	Occasional
11	*Traminda mundissima*	Geometridae	3	Occasional
12	*Thalassodes immissaria*	Geometridae	3	Occasional
13	*Biston suppressaria*	Geometridae	13	Common
14	*Chiasma eleonora*	Geometridae	26	Abundant
15	*Chiasma nora*	Geometridae	15	Common
16	*Eumelea* sp.	Geometridae	2	Rare
17	*Hyposidra talaca*	Geometridae	8	Occasional
18	*Isturgia disputaria*	Geometridae	17	Common
19	*Olepa ricini*	Erebidae	16	Common
20	*Creatonotes gangis*	Erebidae	17	Common
21	*Syntomoides imaon*	Erebidae	25	Abundant
22	*Achaea sreva*	Erebidae	14	Common
23	*Trigonodes hyppasia*	Erebidae	15	Common
24	*Artaxa guttata*	Erebidae	4	Occasional
25	*Eublemma accedens*	Erebidae	9	Occasional
26	*Eudocima phalonia*	Erebidae	4	Occasional
27	*Hydrillodes* sp.	Erebidae	7	Occasional
28	*Siccia taprobanis*	Erebidae	11	Common
29	*Dysgonia algira*	Noctuidae	22	Abundant
30	*Spodoptera litura*	Noctuidae	4	Occasional
31	*Agrotis biconica*	Noctuidae	4	Occasional
32	*Helicoverpa armigera*	Noctuidae	6	Occasional
33	*Spoladea recurvalis*	Crambidae	12	Common
34	*Maruca vitrata*	Crambidae	8	Occasional
35	*Nausinoe geometralis*	Crambidae	10	Occasional
36	*Synclera traducalis*	Crambidae	7	Occasional
37	*Cydalima laticostalis*	Crambidae	2	Rare

38	*Haritalodes derogata*	Crambidae	9	Occasional
39	*Hydriris ornatalis*	Crambidae	7	Occasional
40	*Paraponyx affinialis*	Crambidae	3	Occasional
41	*Pyrausta phoenicealis*	Crambidae	6	Occasional
42	*Striglina scitaria*	Thyrididae	2	Rare
43	*Eupterote undata*	Eupterotidae	13	Common
44	*Gastropacha pardale*	Lasiocampidae	1	Rare

Table 2 Alpha diversity indices of moth fauna at study sites

S. No.	Diversity Index	Formula	Value
1	Species Richness (S)	S = Total number of species	44
2	Shannon–Wiener Index (H′)	$H' = -\Sigma$ (pi ln pi)	3.56
3	Simpson's Index (D)	$D = \Sigma\ pi^2$	0.033
4	Simpson's Index of Diversity (1 − D)	$1 - \Sigma\ pi^2$	0.967
5	Species Evenness (J)	J = H′ / ln(S)	0.94
6	Margalef's Richness Index (d)	(S − 1) / ln N	7.12

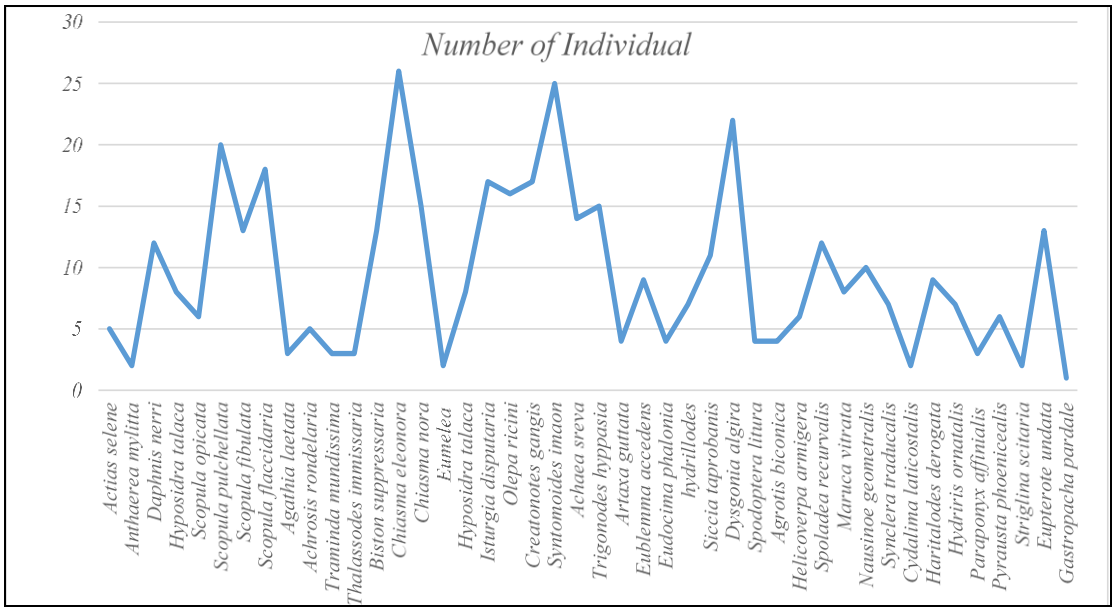

Fig 3: No. of Individual count of Moth fauna at study site

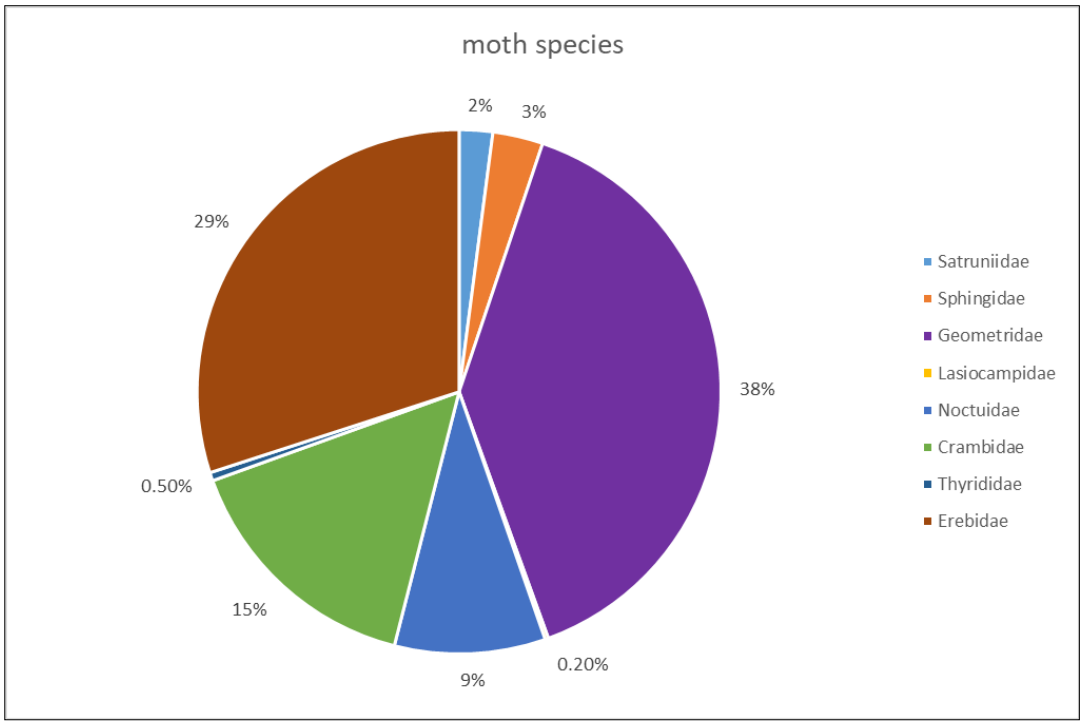

Fig 4: Percent occurrence of moth species under different families

Conclusion

The present investigation reveals that the college campus of PMCOE, Chhindwara, supports a high diversity and richness of moth fauna, indicating the ecological significance of institutional green spaces. The high values of Shannon–Wiener diversity and species evenness, coupled with low dominance, reflect a stable and well-structured moth community. The dominance of families such as Geometridae and Erebidae suggests the availability of suitable host plants and favorable microhabitats within the campus.

Moths occupy an important position in local food webs, serving as a crucial food source for higher trophic levels and contributing to essential ecosystem functions such as pollination. The findings of the present study emphasize the need for conservation-oriented campus planning and habitat management to sustain moth populations and overall biodiversity. The checklist generated through this study provides valuable baseline data for future ecological monitoring and long-term conservation efforts in the region.

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