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Diversity of Moth (Lepidoptera: Heterocera) Assemblages in Different Vegetation Zones on Mangalore University Campus

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Abstract: Lepidopterans including butterflies and moths are important as bio-indicators of ecosystem quality, health and change. The objective of the study was to investigate the moth species composition in different vegetation zones within the Mangalore University campus. The present study deals with the diversity of moths along the contrasting three selected landscapes and two seasons in Konaje, Mangalore, India for the years 2018–19, 2019–20 and 2021-22. We recorded 1778 day flying and nocturnal moths of 18 families. Among the 126 species of moths recorded, relative abundance of family Erebidae (40%) was found to be the highest followed by Geometridae(24%) and Crambidae (13%). Species diversity was found to be the highest during monsoon season, whereas among the study sites, area with buildings not only had the highest relative abundance of moth species (35-51%) but also the highest biodiversity indices. The family Erebidae with 43 species was found to be the most abundant family across all the sampling plots.The family Geometridae with 20 species and Crambidae with 22 species were recorded. The findings of this study indicate the significance of the urban green areas in the campus to support a wide array of moths. The most common species, Micronia aculeate, (Guenée, 1857) of family Uraniidae comprised high number(79 individuals) of all specimens observed. Dysphania palmyra(Stoll, 1799) Dysphania percota (C. Swinhoe, 1891)were also seen in high number. The statistical interpretations were done using Shannon-Wiener diversity index, Shannon's equitability and Simpsons index. The species richness data of Shannon-Wiener diversity index lies between 3.2 and 3.7. Therefore, this value of species richness indicates a good biodiversity of moth and interactions with their host plants in various ecological conditions indicating Mangalore University campus as a good habitat for moth biodiversity. Our results suggest that the habitats of moth assemblages identified as indicators may constitute a useful tool for conservation purposes.

Key words: Moths, species richness, biodiversity, bioindicators, conservation.

Introduction

Lepidoptera is the second largest insect order of phylum Arthropoda consisting of 45 super families and having 15,578 genera and 157,424 species described which includes butterflies and moths(Van Nieukerken, 2011). Moths are also indicators of particular vegetation zones. So if we preserve and manage specific vegetation for these species, we are likely to be providing protection for other organisms living in the same biotopes.(Abhesh, 2011).

The more recent studies on moth fauna by Indian authors have been growing and this includes survey-based checklists on the moth fauna of specific regions. Moths are also economically significant as they damage leaves, stems, flowers and fruits and are common pests over various plants. (Anand KR, 2013). Heteroceran lepidoptera are economically important as in silk industry, as nocturnal pollinators, and as model organisms for scientific study. They are highly diverse and ecologically important group of insects that play key roles in herbivory and important element in food chain and are prey for birds, bats and insectivorous animals. Areas rich in moths are also rich in other invertebrates indicating a healthy ecosystem.(Kasambe Raju, 2016). Monitoring of the moths is essential for formulating conservation priorities and management of biodiversity.

A total of 81moth species were recorded in North East Jharkhand (Singh et al., 2017), 282 species of moths were recorded in Agastyamalai Biosphere Reserve, Kerala (Sondhi et al., 2018), 461 moth species were recorded in Jammu and Kashimir (Dar et al., 2020) and 55 species were recorded in Jammu and Kashmir, and Ladakh (Bhagat, 2020). Total 46 lepidopteran superfamilies representing all commonly encountered families of moths, butterflies, and skippers. Moths in the Central part of Western Ghats, i.e., in Chikamanglur and Shivamogga Districts of Karnataka, were of 23 families of which Erebidae stood first with 136 species (33.41%), Geometridae with 94 members (23.10%), Crambidae with 70 moth species (17.20%), Noctuidae with 29 moth taxa (7.12%).(Ravindrakumar BM, 2021).

16 families representing the common moths of India are presented in 'Moths: An Introduction to common families'(Sondhi et al., 2022).A study in Jaipur, the capital city of state of Rajasthan enlisted 65 species belonging to 13 families, grouped into 31 genera under 9 super families for Pre-monsoon, Monsoon and Post-monsoon seasons. Erebidae, Geometridae, Sphingidae, Noctuidae and Crambidae were the most commonly occurred(Ramu Savita, 2022).

Most of these works show the tendency to focus on studying regions of higher biodiversity including the Western Ghats and Eastern Himalayas. However, there has been much lesser work done in regions with higher human disturbance. A pilot assessment of moths was done in various habitats of Mangalore University campus for different vegetation zones and in different disturbance regimes. Species richness in different habitats with human interference, seasonal variation of moths and their distribution patterns are studied. Data collected can be used as bio-Indicator for future monitoring purposes.

Materials and methods

3.1. Site description

Site: Mangalagangothri

The study on Heterocera diversity was carried out in Mangalore University campus, (12°48. 95 - 12°85 N and 74°55.264-74°53 E) Konaje, Dakshina Kannada district, Karnataka. The climate of Konaje is greatly influenced by closeness to Arabian Sea. It has tropical climatic conditions with moderate temperature ranging from 28 to 32^0 centigrade. It is moderately humid (70-95%), having unimodal rain fall pattern. Long rain periods extend from June to October. It receives a total of 3000-3500mm rain fall per annum.

Vegetation profile of Mangalore University campus

The Mangalore University Campus at Mangalagangothri which is recognised as Green campus, located at a distance of about 20 Km south-east of the city of Mangalore. The campus is spread over an area of about 350 acres and is on a high elevation overlooking the Arabian Sea on the one side and the Western Ghats on the other. The area selected was measured about 150 meter^2. The vegetation found in this area mainly composed of naturally grown trees, shrubs such as Ficus, Alstonia, Terminalia, Ixora, Calotropis, etc. Cultivated plants, including cashew, mangoes, coconut, areca plants, Amaltas (Cassia fistula), Citrus (C. limon), Fig, Guava (Psidium guajava), Papaya (Carica papaya), Rose (Rosa damascena), Sesum (Delbergia latifolia), China rose (Hibiscus rosa-sinensis) Nerium, oleander, Banana (Musa acuminata) and other shrubs are also there in and around the campus. In addition, some areas support monocultures like Acacia, Eucalyptus and Casuarinas. During monsoon and until the end of post-monsoon period the large plain area in the campus is covered with tall grasses of different varieties, which remain green until October.

3.2. Field surveys

In the present study, the biodiversity of Moths of the region was studied using field surveys. Data was collected from 3 habitats at random locations including Area surrounding Applied Zoology Department and Area surrounding Administration block of Mangalore University campus. Sampling was done during three field periods (July-Dec 2018, July-Dec 2019 and July-Dec 2021) Two methods were employed for the field survey.

3.2.1. Track method

A regular visit to three habitats was carried. Moths were observed in morning (8.30 to 9.30am) as well is in night (9 to 10 pm). The surveys were conducted in the sites for the fixed duration of 30 minutes. Data collected was analysed and graphically represented.

The photographs of moths resting on the wall under the wall light and on bushes, plants were collected using Redmi 10 prime and Redmi note pro 6 mobile cameras. Number of individuals encountered, site, location, habitat and information about moth activity were recorded.

3.2.2. Trap method

Light trapping is a standard method for sampling moths (Merckx and Slade, 2014). The surveys were also conducted using light trap method by spreading a screen of white cloth (5m×2m) between two vertical poles and illuminated by white light emitting from 7W Impex Hand Lamp. Rechargeable portable light source was used as illuminator since most locations were not equipped with electrical source. The present collection method helped to avoid the killing or damaging of insects. Photographs of moths attracted to the light source were collected using Redmi 10 prime and Redmi note pro 6 mobile cameras.

The moths were photographed for subsequent identification and when identification was not possible through photographs, the individuals were collected using insect net.The specimens were first sorted into morphospecies and were identified in the field and later released. They were identified on the basis of morphological characters with the help of modern taxonomic keys and with the available literature and by comparison with the reference collections.Collection of specimens was avoided to the extent possible. The classification system adapted as per van Nieukerken et al, (2011) and Afaq ahmad dar(2020).

Information about the identity of moths, general distribution of species, and their host plants was summarized from the following Internet sites: AfroMoths (De Prins & De Prins 2018) and African Moths (Goff 2018). The species names

follow the Global Information System on Pyraloidea provided by Poltavsky et al,(2019) and Leger T et al, (2020)

3.3. Statistical data analysis

Statistical data analysis and graphical representations of data were performed using Microsoft Office Excel, 2010.diversity indices were done using PAST software.

Results

The number of moth species and the number of individuals trapped varied considerably between the vegetation zones and different habitats. We recorded 1778 individuals of 126 species(Plate 1-12) from 18 different families. (Table-1 and 2). Moth numbers varied in three different habitats studied as well as in monsoon and post monsoon seasons. The family Erebidae was the most dominant family with 43 species followed by Geometridae with 20 species and Crambidae with 22 species. A total number of 594 (2018), 620 (2019) 564 (2021) were encountered during the study Period(Table 3,4 and 5). The check list comprises of 126 species of moths belonging to 18 families with Erebidae (40%), Geometridae (24%) and Crambidae (13%) being the three dominant families. (Fig 1).

The family Erebidae was the most dominant family in all the vegetation and zones sampled, with a total of 679 moths,210 individuals(2018) 215 individuals(2019) and 254 individuals reported in 2021. This is followed by the families Geometridae with a total of 418 moths, 177 individuals (2018), 167 individuals (2019), and 74 individuals(2021), Crambidae a total of 230 moths, 25individuals (2018), 56 individuals (2019) and 149 individuals (2021). Uraniidae showed 41 individuals of single species(2018), 35 individuals (2019) and 3 individuals in 2021. Sphingidae family was represented by 74 individuals (2018), 37 individuals (2019) and 25 (2021). The other thirteen families, viz. Bombycidae, Drepanidae, Eupterotidae, Hepialidae, Lasiocampidae, Limacodinae, Noctuidae, Nolidae, Psychidae, Pterophoridae, Pyralidae, Saturniidae, Sphingidae, Thyrididae and Uraniidae had minor representations in terms of species richness as well as individuals.(Fig 2,3 and 4)

The values of Shannon index usually ranged from 0-5. Shannon index for three habitats were ranging from 2.5 to 3.6, indicating greater diversity. However, the Shannon index H for all three habitats are very close to 4 indicating that both sites are diverse. The value of Simpson index ranges between 0-1, greater the value, the greater is the diversity. Simpson index for habitat 1(0.9578) was

greater than that of other habitats. The evenness recorded was high in habitat 3(thickets) indicating the even distribution of moth species. Over all the diversity of habitat 1(buildings) was greater than other habitats. Evenness for habitat 1 ranges from 0.6052-0.7703 and habitat 2(garden) 0.631- 0.7568 indicating that the communities were semi -balanced. The t value calculated for the diversity indices of habitats is greater than its critical value indicating that there was a significant variation between the diversity indices of these sites. This significant variation between three habitats infers that the moths were distributed unevenly on the campus. A total number of species found in three habitats studied significantly increased from year 2018-2021. Results presented in the table 3, 4 and 5. Moths observed in monsoon months were more and gradually decreased in post monsoon. Shannon Weiner index for moths in the July is highest indicating rich species diversity(Table 6, 7 and 8).

Table1: Habitat wise biodiversity indices of the year 2018

	Building	Garden	Thicket
Taxa	28	27	25
Individuals	207	247	140
Dominance D	0.05603	0.06115	0.07622
Simpson 1-D	0.944	0.9388	0.9238
Shannon H	3.071	3.017	2.867
Evenness H/S	0.7703	0.7568	0.7035

Table 2: Habitat wise biodiversity indices of the year 2019

	Building	Garden	Thicket
Taxa	44	26	17
Individuals	459	104	57
Dominance D	0.05557	0.07008	0.09388
Simpson 1-D	0.9444	0.9299	0.9061
Shannon H	3.282	2.919	2.561
Evenness H/S	0.6052	0.7121	0.7613

Table 3: Habitat wise biodiversity indices of the year 2021

	Building	Garden	Thicket
Taxa	54	31	20
Individuals	238	193	133

Dominance D	0.0422	0.0693	0.0835
Simpson 1-D	0.9578	0.9307	0.9165
Shannon H	3.554	2.973	2.688
Evenness H/S	0.6471	0.631	0.7354

Table 4: Month wise biodiversity indices of the year 2018

	JULY	AUG	SEP	OCT	NOV	DEC
Taxa	29	28	22	18	16	12
Individuals	160	160	123	66	56	29
Dominance D	0.0432	0.04227	0.05691	0.073	0.08482	0.09869
Simpson 1-D	0.9568	0.9577	0.9431	0.927	0.9152	0.8109
Shannon H	3.237	3.242	2.963	2.748	2.594	1.993
Evenness H/S	0.8774	0.914	0.8794	0.8674	0.8364	0.6718

Table 5: Month wise biodiversity indices of the year 2019

	JULY	AUG	SEP	OCT	NOV	DEC
Taxa	45	44	33	39	25	19
Individuals	203	162	93	95	44	23
Dominance D	0.03031	0.03231	0.05723	0.03756	0.05992	0.06994
Simpson 1-D	0.9697	0.9677	0.9428	0.9624	0.9401	0.9301
Shannon H	3.626	3.584	3.17	3.452	3.02	2.834
Evenness H/S	0.8344	0.8183	0.7212	0.8095	0.8194	0.8956

Table 6: Month wise biodiversity indices of the year 2021

	JULY	AUG	SEP	OCT	NOV	DEC
Taxa	59	33	15	16	14	20
Individuals	236	109	69	60	45	45
Dominance D	0.02952	0.05176	0.1342	0.1133	0.09827	0.06173
Simpson 1-D	0.9705	0.9482	0.8658	0.8867	0.9017	0.9383
Shannon H	3.783	3.237	2.347	2.439	2.458	2.88

Evenness H/S	0.7447	0.7717	0.6969	0.7161	0.834	0.891

Table 7 : Number of moths of different families encountered during each year of study.

S no	**Family**	**2018**	**2019**	**2021**	**Total**
1	Bombycidae	0	0	9	9
2	Crambidae	25	56	149	230
3	Drepamidae		10	1	11
4	Erebidae	210	215	254	679
5	Eupterotidae	33	28	2	63
6	Geometridae	177	167	74	418
7	Hepialidae	0	0	6	6
8	Lasiocampidae	3	0	1	4
9	Limacodinae	3	0	0	3
10	Noctuidae	0	11	0	11
11	Nolidae	0	0	4	4
12	Psychidae	0	0	21	21
13	Pterophoridae	0	0	2	2
14	Pyralidae	0	0	6	6
15	Saturnidae	16	12	4	32
16	Sphingidae	74	37	25	136
17	Thyrididae	0	0	1	1
18	Uraniidae	41	35	3	79

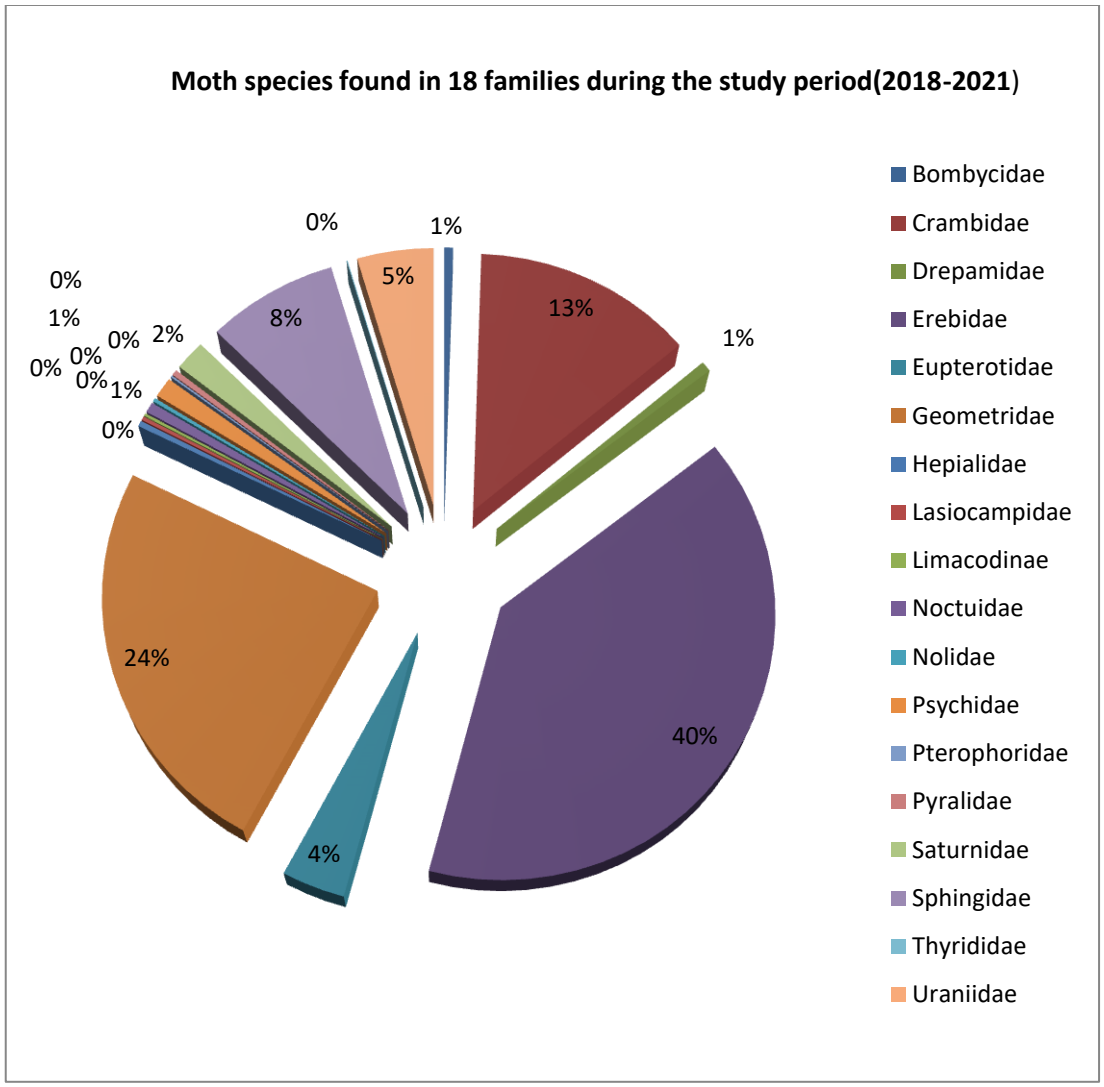


Fig 1: percentage of moth families encountered during study period.

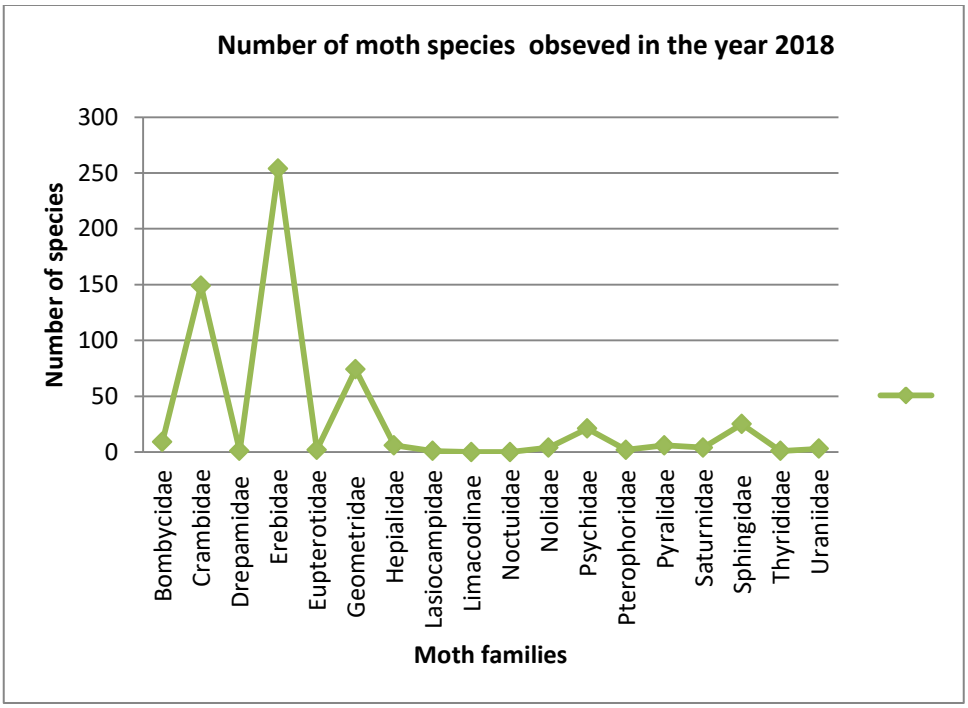


Fig 2: Moths identified during the year 2018

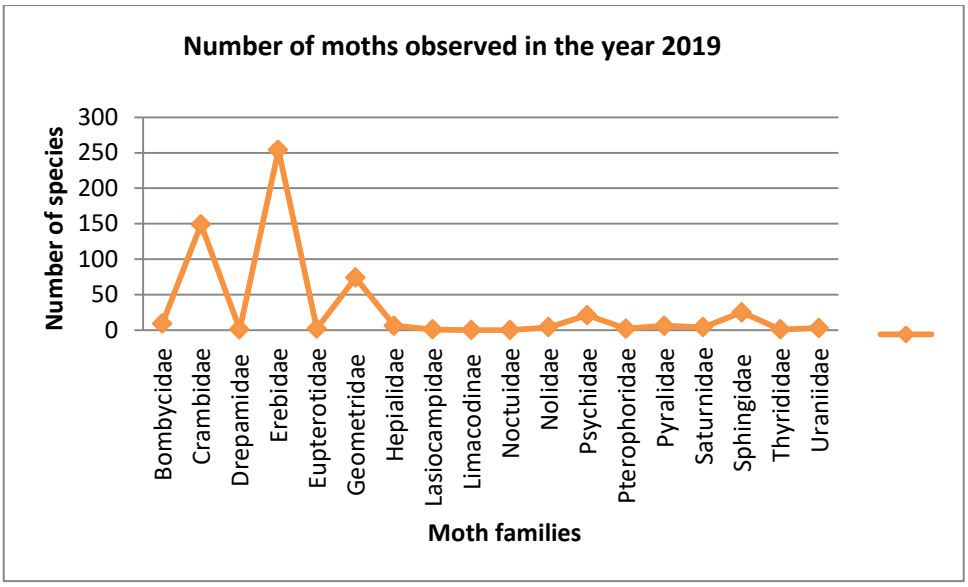


Fig 3: Moths identified during the year 2019

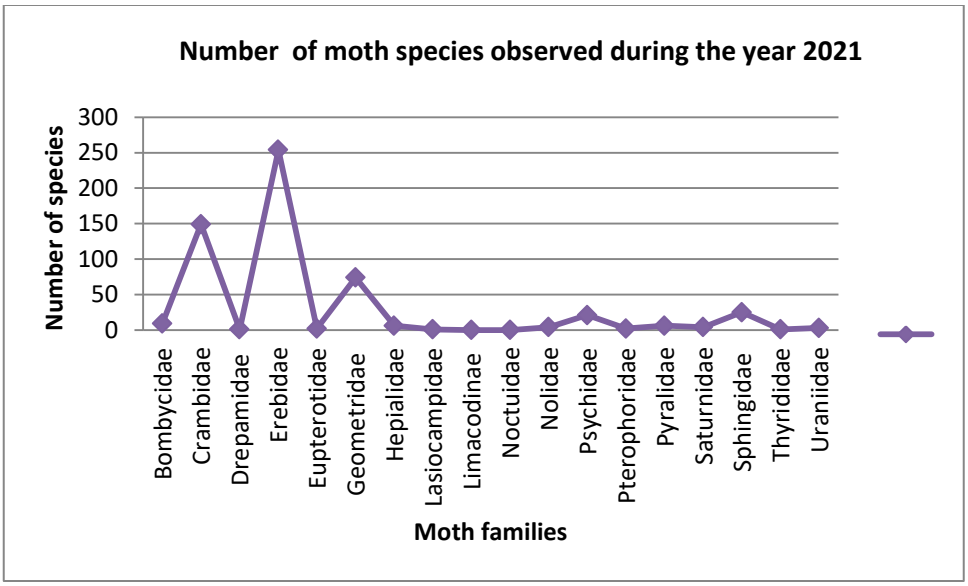


Fig 4: Moths identified during the year 2021

Table 8 : Moths of different families encountered during the study period

Sl.no	Family	Scientific name
1	Bombycidae	1. *Trilocha varians* (Walker, 1855)
2.	Crambidae	1. *Conogethes punctiferalis* (Guenée, 1854)
		2. *Cydalima laticostalis* (Guenée, 1854)
		3. *Endocrossis flavibasalis* (Moore, 1867)
		4. *Glyphodes bicolour* (Swainson, 1821)
		5. *Glyphodes bivitralis* Guenée, 1854
		6. Glyphodes onychinalis (Guenée, 1854)
		7. *Herpetogramma sp* (Lederer, 1863)
		8. *Maruca vitrata* (Fabricius, 1787)
		9. *Nausinoe geometralis* (Guenée, 1854)
		10. *Nausinoe perspectata*

		(Fabricius, 1775)
		11. Nymphicula sp.
		12. Omiodes indicata (Fabricius, 1775)
		13. Palpita annulifer Inoue, 1996
		14. Palpita sp.
		15. Paraponyx fluctualis (Meyrick, 1899)
		16. Parotis sp.
		17. Patania balteata (Fabricius, 1798*)*
		18. Pygospila tyres (Carmer,1780)
		19. Sameodes cancellalis (Zeller, 1852)
		20. Scirpophaga incertulas (Walker, 1863)
		21. Spoladea recurvalis (Fabricius, 1775)
		22. Talanga sp (Moore, 1885)
3	Drepamidae	*1. Phalacra sp* (Walker,1866)
4	Erebidae	*1. Amata phegea* (Linnaeus, 1758*)*
		2. Amata fortunei(d'Orza,1869)
		3. Amerila astreus(Drury, 1773*)*
		4. Arctornis sp.(Hutton,1865*)*
		*5. Artaxa guttata (*Walker,1855*)*
		6. Artena dotata
		*7. Asota canaraica (*Moore, 1878)
		8. Asota caricae (Fabricius, 1775)
		*9. Asota egens (*Walker, 1854)
		*10. Asota plana (*Walker, 1854)
		11. *Asota producta* (Butler, 1875)
		12. Cretanotus gangis
		13. Creatonotus sp.
		14. Cyana puella (Drury, 1773)
		15. Egnasia ephyrodalis Walker, 1858
		16. Erebus ephesperis (Hubner,1823)
		17. Erebus hieroglyphica (Drury, 1773)

		18. Eressa sp. (Walker, 1854)
		19. Ericeia sp.(Walker, 1858)
		20. Erygia spissa (Guenée, 1852)
		21. Euchromia polymena (Linnaeus, 1758)
		22. Eudocima homaena (Hübner, 1816)
		23. Eudocima hypermnestra (Cramer, 1780)
		24. Eudocima materna (Linnaeus, 1767)
		25. Euproctis fraternae (Moore, 1883)
		26. Euproctis lunata (Francis Walker, 1855)
		27. Euproctis similis ((Füssli, 1775)
		28. Euproctis varians (Walker, 1855)
		29. Lopharthrum comprimens (Walker, 1858)
		30. Lyclene sp.(Moore,1860)
		31. Lymantria dispar (Linnaeus, 1758)
		32. Lymantria monacha (Linnaeus, 1758)
		33. Miltochrista terminospota (Singh, Kirti and Joshi, 2015)
		34. Olene mendosa
		35. Olepa ricini (Fabricius, 1775)
		36. Pangora matherana (Moore, 1879)
		37. Pareuchaetes pseudoinsulata (Régo Barros, 1956)
		38. Pericyma sp
		39. Perina nuda (Fabricius, 1787)
		40. Rajendra biguttata (Walker, 1855)
		41. Spirama sp.
		42. Syntomoides imaon (Cramer, 1780)
		43. Thyas honesta Hübner, 1824
5	Eupterotidae	*1. Eupterote pallida (Walker, 1855)*

		2. *Eupterote mollifera(Walker, 1865)*
		3. *Eupterote sp*
		4. *Eupterote undata.* (Blanchard, 1844)
6	Geometridae	1. *Agathia laetata (Fabricius, 1794)*
		2. *Agathia lycaenaria (Kollar, 1848)*
		3. *Agathia pisina (Butler, 1887)*
		4. *Aporandria specularia* a. *(Guenée, 1857)*
		5. *Cabera exanthemata* a. *(Scopoli, 1763)*
		6. *Chiasmia emersaria* a. *(Walker, 1861)*
		7. *Chiasmia nora (Walker,1861)*
		8. *Comostola laesaria (Walker, 1861)*
		9. *Dysphania palmyra (Stoll, 1799)*
		10. *Dysphania percota (C. Swinhoe, 1891)*
		11. *Ectropis bhurmitra (Walker, 1860)*
		12. *Eumelea ludovicata (Guenée, 1858)*
		13. *Hemithea aestivaria (Hübner, 1799)*
		14. *Maxates sp.*
		15. *Problepsis vulgaris(Butler, 1889)*
		16. *Scopula caesaria (Walker, 1861)*
		17. *Scopula divisaria (Walker,1861)*
		18. *Scopula sp.*
		19. *Thalassodes sp.*(Guenée, 1857)
		20. *Thalassodes dissista* (Walker, 1861)
7	Hepialidae	1. *Endoclita malabaricus* (Moore, 1879)
8	Lasciocampidae	1. *Streblote siva* (Lefèbvre, 1827)
9	Limacodinae	1.*Miresa* sp.

10	Noctuidae	1. *Bamra albicola* (Walker,1858)
		2. *Bastilla sp*
		3. *Dysgonia algira (Linnaeus, 1767)*
		4. *Ischyja manlia (Cramer, [1776])*
		5. *Penicillaria jocosatrix Guenée, 1852*
		6. *Polytela gloriosae (Fabricius, 1781)*
11	Nolidae	1. *Eligma narcissus (Cramer, 1775)*
		2. *Selepa celtis (Moore, 1858)*
12	Pterophoridae	1. *Sphenarches sp.*
13	Psychidae	1. *Eumeta sp.*
14	Pyralidae	1. *Endotricha sp.*
		2. *Hypsopygia sp.*
15	Saturiniidae	1. *Actias selene (Hübner, 1807)*
		2. *Antheraea mylitta(*
		3. *Antheraea paphia (Linnaeus, 1758)*
		4. *Attacus atlas (Linnaeus, 1758)*
16	Sphingidae	1. *Acosmeryx sp.*
		2. *Daphnis nerii (Linnaeus, 1758)*
		3. *Macroglossum gyrans (Walker, 1856)*
		4. *Macroglossum sp*
		5. *Marumba dyras (Walker, 1856*
		6. *Theretra clotho (Drury, 1773)*
		7. *Theretra nessus (Drury, 1773)*
17	Thyrididae	1. *Striglina sp.* (Moore, 1882)
18	Uraniidae	1. *Micronia aculeata, Guenée, 1857*

Family 1: Bombycidae

Trilocha varians

PLATE -1

Family 2: Crambidae

Conogethes punctiferalis

Cydalima laticostalis

Endocrossis flavibasalis

Glyphodes bicolor

Glyphodes bivitralis

Glyphodes onychinalis

Herpetogramma sp

Maruca vitrata

Nausinoe geometralis

Nausinoe perspectata

Nymphicula sp

Omiodes indicata

PLATE-2

Palpita annulifer

Palpita sp

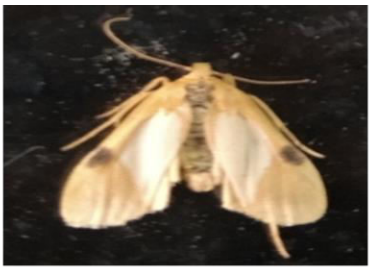
Paraponyx fluctualis

Parotis sp.

Patania balteata

Pygospila tyres

Sameodes cancellalis



Scirpophaga incertulas

Spoladea recurvalis

Talanga species

PLATE-3

Family 3: Drepamidae

Phalacra sp

Family 4: Erebidae

Amata phegea

Amata fortunei

Amerila astreus

Arctornis sp.

Artaxa guttata

Artena dotata

Asota canaraica

Asota caricae

Asota egens

Asota plana

Asota plana

Asota producta

PLATE-4

Creatonotus gangis

Creatonotus sp.

Cyana puella

Egnasia ephyrodalis

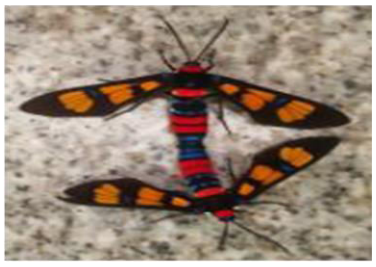
Erebus ephesperis

Erebus hieroglyphica

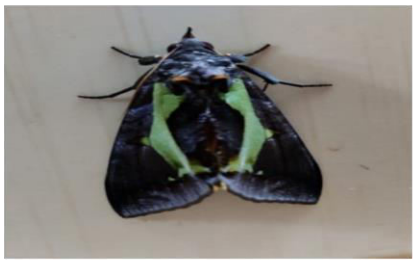
Eressa sp

Ericeia sp.

Erygia spissa



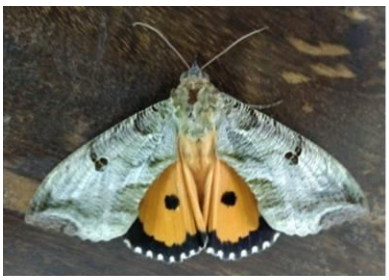
Euchromia polymena



Eudocima homaena

Eudocima hypermnestra

PLATE-5

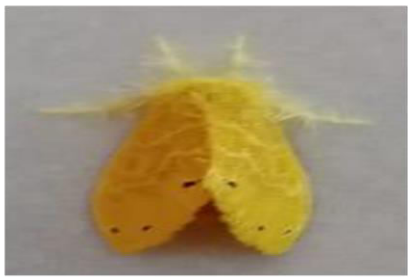


Eudocima materna

Euproctis fraterna

Euproctis lunata

Euproctis similis



Euproctis varians

Lopharthrum comprimens

Lyclene sp

Lymantria dispar

Lymantria monacha

Miltochrista terminospota

Olene mendosa

Olepa ricini

PLATE-6

Pangora matherana

Pareuchaetes pseudoinsulata

Pericyma sp.

Perina nuda (male)

Perina nuda (female)

Rajendra biguttata

Spirama sp.

Syntomoides imaon

Thyas honesta

Family 5: Eupterotidae

Eupterote pallida

Eupterote mollifera

Eupterote sp.

Eupterote sp.

Eupterote undata

PLATF -7

Family 6: Geometridae

Agathia laetata

Agathia lycaenaria

Agathia pisina

Aporandria specularia

Cabera exanthemata

Chiasmia emersaria

Chiasmia nora

Comostola laesaria

Comostola laesaria

Dysphania palmyra

Dysphania percota

Ectropis bhurmitra

PLATE-8

Eumelea ludovicata

Hemithea aestivaria

Maxates sp.

Problepsis vulgaris

Scopula caesaria

Scopula divisaria

Scopula sp.

Thalassodes sp.

Thalassodes dissista

Family 7 : Hepialidae

Endoclita malabaricus

Family: 8 Lasciocampidae

Streblote siva

PLATE-9

Family 9 :Limacodinae

Miresa sp.

Family 10: Noctuidae

Bamra albicola

Bastilla sp

Dysgonia algira

Ischyja manlia (male)

Penicillaria jocosatrix

Polytela gloriosae

Family 11: Nolidae

Eligma narcissus

Selepa celtis

PLATE-10

Family 12: Pterophoridae

Sphenarches sp.

Family 13: Psychidae

Eumeta sp.

Family 14 : Pyralidae

Endotricha sp

Hypsopygia sp.

Family 15: Saturniidae

Actias selene

Antheraea paphia

Antheraea mylitta

Attacus atlas

PLATE-11

Family 16: Sphingidae

Acosmeryx sp

Daphnis nerii

Macroglossum gyrans

Marumba dyras

Theretra clotho

Theretra nessus

Family 17: Thyrididae

Striglina sp

Family 18: Uraniidae

Micronia aculeata

PLATE -12

Discussion

Macromoth community structure and diversity Changes from year to year, which may be due to differential distribution of their host-plants and climatic limits. Nocturnal moths are good indicators of changing climate conditions in local and regional landscapes. Moths respond to fluctuations in temperatures, exhibiting preponed or postponed maturation. This may affect food webs, especially in the spring when migratory birds and bats rely heavily upon caterpillars and adult moths for food. Thus to maintain ecosystem health, Nocturnal macro moths play vital role as important indicators.(Steven, 2013).

Lintott P(2014) concluded that mature broadleaved woodlands supported the highest abundance and diversity of moths than small complex woodlands.

An estimated 1,65,000 species of moths have been reported worldwide (Khan and Parveen, 2015). Moth diversity was assessed in Kodagu district, which lies in the central Western Ghats region of peninsular India. A total of 117 species belonging to 102 genera, 28 sub-families, 17 families and 9 super families were recorded in the study. The family Erebidae dominated with 32.48% of the total species recorded, followed by Crambidae (20.51%) and Geometridae (19.66%). (Bhushan SM, 2016). Zenker MM and his group, 2016 emphasized that, DNA barcoding data along with morphology would better support the exact taxonomy of diverse moths.

Nayak A (2020), reported 1084 individual moths from 12 families, 29 subfamilies, 71 genera and 78 morphospecies of monsoon moth fauna of Midnapore town in West Bengal, India in 2019. Swafvan K and P M Sureshan(2021) observed1085 specimens and 121 species under 83 genera in ten subfamilies in the agro ecosystems of Northern Kerala(Malappuram, Kozhikode, Wayanad, Kannur and Kasaragod) during March 2018 to 2020. Moths of Delhi, the national capital region of India were studied by Komal J et al, (2021),and the checklist comprises moths from 32 families spanning 14 superfamilies with Noctuoidea (48.5%) and Pyraloidea (20.4%) being the two most dominant superfamilies.

Pattanaik N et al,(2021) studied the moth diversity of Bhubaneswar, Odisha, an eastern state of India and recorded a total of 154 species belonging to 129 genera and 19 families. The highest diversity of moths was recorded in the family Crambidae (48 species, 38 genera), followedby the families Erebidae (42 species, 37 genera), Geometridae (15 species, 12 genera), Noctuidae (13 species,11 genera). Our study at Mangalore University campus also exhibited similar results with three dominant families(Erebidae (40%), Geometridae (24%) and Crambidae (13%)) synchronizing with above studies.(Fig 1)

Tropical regions of the world provide most suitable conditions for the development of moths, being rich in moth diversity. Only little information is available on this group, because of the preference of researchers to work on less diverse taxa. The current study emphasises on distributional pattern of Moths in Mangalore University campus, Mangalagangothri. In the present

study, the biodiversity of Moths was studied using field surveys in three habitats from the month of July 2018 to December 2021. The sightings include rare moth species such as Attacus atlas (Linnaeus, 1758), Actias selene (Hubner, 1807), Daphnis nerii (Linnaeus, 1758), Marumba dyras (Walker, 1856). A total of 28, 44, and 54 species were found in habitat 1 respectively in 2018, 2019 and 2021. Over all the diversity of habitat 1(buildings) was greater. Study also suggested that the diversity of moths in the campus and its distribution are uneven and are clearly influenced by human inhabitation and monoculture.

Moths are important component of ecosystem. They play important roles such as pollination and biological control of weeds. Variation in diversity of moths in different habitats,indicates that monoculture and artificial light has a negative impact on moth ecology. High numbers of moths resting on inner walls of buildings during day time suggests their adaptations to human habitats. The current study emphasizes on various factors such as diversity, richness and distribution patterns of Moths in Mangalore University campus.

Conclusion

Moths constitute the sub-order Heterocera of order Lepidoptera. Tropical regions of the world are rich in moth diversity as they provide most suitable conditions for the development of moths. We present a comprehensive checklist of 126 moth species using 3 years data(2018,2019 and 2021) observing about 1778 specimens from Mangalore University campus. The checklist comprises moths from 18 families with Erebidae (40%) and Geometridae (24%) being the two most dominant families. This documentation of moth fauna of campus of Mangalore University in Karnataka will serve as baseline data of the region.

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