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Exploring Moth Diversity in the Ecosystem of Mangalore University Campus, Karnataka

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Abstract

The moth is one of the genera of insects of the order Lepidoptera, where butterflies share the same genus. They have nocturnal habits and a high attraction to light. Moths have various sizes, shapes, and colors, with many having duller colors. A study was conducted on the diversity of moth species in Mangalore University campus, Mangalore, Karnataka, for eight months (August 2006 to March 2007). We recorded 39 moths belonging to 7 families and 24 genera. This study shows that Erebidae (30.8%) was the most dominant family according to the total number of individuals, followed by Sphingidae (28.2%) and Noctuidae (12.8%). Saturniidae and Geometridae represent 10.3% each, followed by Eupterotidae (5.1%) and Uraniidae (2.6%). Only one unidentified species from each family, Geometridae and Noctuidae, was discovered. Based on wingspan, Plecoptera sp. (family Erebidae) was the tiniest moth, while Attacus atlas (family Saturniidae) was the largest. We updated the scientific and family names of moth species with the help of the Global Biodiversity Information Facility (GBIF) database. The Hostel Old Block had the most extensive documented diversity of moth species in our study. On the other hand, the Survana Hostel had the fewest species of moths recorded. In the environment, moths act as excellent pollinators and, at the same time, serve as good food items for other animals. The present study reveals that the forest provides suitable environmental conditions for moths. We suggest further research to explore different aspects of lepidopteran ecology, like behaviour, population dynamics, and responses to environmental changes in the university campus.

Keywords: Diversity, GBIF, Moths, Lepidoptera, Mangalore

INTRODUCTION

Arthropod members are essential to the provision of ecological services. With 1,57,424 known species worldwide, Lepidoptera is one of the most diverse groupings [39, 40]. It makes up 10% of all the species of living things described [33]. Approximately 85% of all Lepidoptera are known to be moths, with over 12,000 species known to originate from the Indian subcontinent [3]. For food, moths and butterflies rely primarily on plants. The rules controlling plant life restrict their ability to exist. Tropical Lepidoptera is the most diverse species and has the brightest colors. When discussing Lepidopterans, people always refer to butterflies even though moths are far more abundant than butterflies.

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[1] States that the Lepidoptera order is the second largest and most diverse class of Insecta. It is an integral part of the herbivore assemblage, with lepidopterist species serving primarily as pollinators in the ecosystem and their larval stage insects serving as prey for other predators. Lepidoptera is a model organism that most biologists use to evaluate the effects of pollution and human disturbance on forest ecosystem management techniques [32]. According to [7], the

diversity and abundance of moths worldwide have gradually decreased due to several factors, including fast urbanization, habitat loss, artificial light, intensified agriculture, pesticide use, reduced resource availability, extreme weather, and inadequate policies for conservation. They are hardly considered for cautious evaluation [18]. Furthermore, plantation woods have low biodiversity due to their monoculture practices, and we should undertake control measures to eradicate these insects.

There was either a total extinction of insect species or an explosion of pest populations due to the usage of pesticides and habitat degradation brought on by faulty plantation methods. Despite being voracious eaters, caterpillars rarely cause much harm on their own. Furthermore, improper pruning degrades the state of trees and suggests an inevitable loss of ecosystem services such as food for pollinators and predators [5, 10, 36, 37]. These species can find ideal homes in university campuses with their diversified vegetation and green spaces. However, their variety in the Mangalore University campus is still little known. It is crucial to comprehend the diversity of Lepidoptera in such environments to manage and conserve them.

MATERIALS AND METHODS

We present the findings based on random surveys carried out for eight months (August 2006-March 2007) in the Mangalore University campus. Twice a week, we conducted a routine survey in the morning between 5:00 and 7:00 am and in the evening between 6:00 and 10:00 pm. Mangalore University lies at a picturesque hillock with over 350 acres of land at Mangalagangothri (Karnataka), around 18 km southeast of the historic coastal town of Mangaluru, in Karnataka, India. Selected areas (Figure 1) included Site 1 (Hostel Old Block, 12°48'50.97"N; 74°55'13.92"E), Site 2 (Sowparnika Hostel, 12°48'50.91"N; 74°55'15.99"E), Site 3 (Survana Hostel, 12°48'48.34"N; 74°55'14.94"E) and Site 4 (Men's Hostel Mess, 12°48'49.28"N; 74°55'17.61"E). There is also a dense forest next to the Hostel Old Block. Moths are nocturnal, so we used simple light traps to collect moths. In addition to this, we adopted visual observations, sweep netting, and handpicking methods. After we caught the moths, we kept them in killing bottles containing chloroform. Figure 1 shows a section of the Mangalore University campus, highlighting four key locations. This map provides a clear overview of the campus layout and the proximity of these residential and dining facilities.

Figure 1. Showing a part of the map of Mangalore University campus: Site 1 (Hostel Old Block), Site 2 (Sowparnika Hostel), Site 3 (Survana Hostel) and Site 4 (Men's Hostel Mess).

Later, they were photographed and pinned on an insect stretching board using entomological pins. All specimens were well labeled and preserved in an airtight zip bag, having naphthalene balls as a fumigant for later identification. We identified the moths with the help of available literature [11-31]. We updated the scientific and family names of moth species with the help of the Global Biodiversity Information Facility (GBIF) database.

RESULTS AND DISCUSSION

We documented thirty-nine species under 24 genera from the Mangalore University campus (MUC) from August 2006 to March 2007 (Table 1). Out of 7 recorded families of moth, family Erebidae dominated with 30.8% (12 species), followed by Sphingidae (28.2%, 11 species) and Noctuidae (12.8%, five species). Saturniidae (4 species) and Geometridae (4 species) represent 10.3% each, followed by Eupterotidae (5.1%, two species) and Uraniidae (2.6%, one species) (Figure 2, Table 2). Due to a dense forest nearby, the Hostel Old Block (Site 1) had the most significant documented number of moth species compared to other sites. On the other hand, the Survana Hostel had the fewest species of moths recorded. Based on wingspan, *Plecoptera* sp. (family Erebidae) was the tiniest moth, while *Attacus atlas* (family Saturniidae) was the largest in the present study.

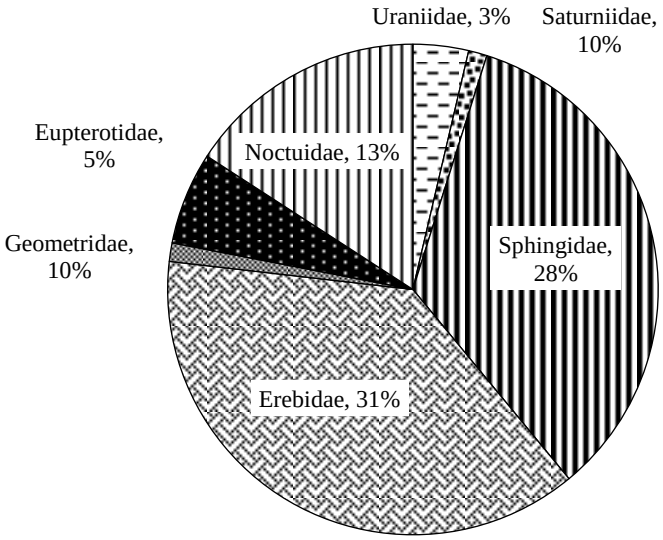

Figure 2. Pie chart showing family-wise present occurrence of moth species in the study area.

Among 39 species, 11 moths in the present study are the same as those in the Goa University campus (GUC). However, only one species is the same as that in the Gulbarga University Campus (GGUC) and Karnatak University campus (KUC) (Table 3). We observed variation in species richness in the university campuses, i.e., 200 species in GUC, 10 in GGUC, 52 in KUC, and 39 in MUC. We observed maximum and minimum species diversity from GUC and GGUC, respectively. [38] prepared a preliminary checklist of the moths of Kerala, India. The Erebidae family, with 264 species, was dominated by Crambidae, 184 species, and Geometridae, 178 species. Mishra et al. (2015) reported one hundred seventeen species of moths belonging to 102 genera, 28 sub-families, 17 families, and 9 superfamilies from Kodagu District in the Central Western Ghats of Karnataka by [34]. Gurule and Brookes (2021) carried out a preliminary study of moths at the Goa University Campus, Goa. It was the first documentation of the moth fauna of Goa. In their study, Erebidae was the dominant family, with 72 species (36%), followed by Crambidae, with 44 species (22%). Similarly, Erebidae was the dominant family in the present study. In the Gulbarga University Campus [9], recorded ten species of moths belonging to 10 genera and 6 families. The authors carried out surveys of moth caterpillars in five different sites of the Karnataka University Campus. They recorded 52 species, correctly identifying 25 species belonging to 11 families. More number (4) species were

recorded under the families Lymantriidae, Nymphalidae Sphingidae, followed by Arctidae with three species, and Erebidae, Noctuidae, and Papilionidae with two species each. There is a record of only one species for the families Crimbidae, Plutellidae, Geometridae, and Hesperiidae [4]. Dominant families were Lymantriidae, Nymphalidae, and Sphingidae, with four species (16%) each, followed by the family Arctidae with three species (12%) in their report. However, in the present study, the dominant family was Erebidae, followed by Sphingidae and Noctuidae. This fluctuation could be due to habitat conditions, floristic diversity, altitude, latitude, and associated factors prevailing in the respective regions.

Table 1. List of recorded moth species and families

S. N.	Scientific name	Family
1	*Antheraea paphia* Linnaeus, 1758	Saturniidae
2	*Antheraea mylitta* Drury, 1773	Saturniidae
3	*Actias selene* Hübner, 1806	Saturniidae
4	*Attacus atlas* (Linnaeus, 1758)	Saturniidae
5	*Deilephila elpenor* Linnaeus, 1758	Sphingidae
6	*Hippotion* sp.	Sphingidae
7	*Theretra oldenlandiae* Fabricius, 1775	Sphingidae
8	*T. castanea* Moore, 1872	Sphingidae
9	*Sphinx pinastri* Linnaeus, 1758	Sphingidae
10	*Daphnis nerii* Linnaeus, 1758	Sphingidae
11	*Pseudodolbina* sp. 1	Sphingidae
12	*Pseudodolbina* sp. 2	Sphingidae
13	*Macroglossum gyrans* Walker, 1856	Sphingidae
14	*Marumba* sp.	Sphingidae
15	*Psilogramma vates* Butler, 1875	Sphingidae
16	*Syntomoides imaon* (Cramer, 1780)	Erebidae
17	*Plecoptera* sp.	Erebidae
18	*Erebus macrops* (Linnaeus, 1768)	Erebidae
19	*E. ephesperis* (Hübner, 1827)	Erebidae
20	*Erebus* sp.	Erebidae
21	*Spirama helicina* Hübner, 1827	Erebidae
22	*S. retorta* Clerck, 1764	Erebidae
23	*Eudocima materna* (Linnaeus, 1767)	Erebidae
24	*Eudocima* sp.	Erebidae
25	*Asota plana* Walker, 1854	Erebidae
26	*A. caricae* (Fabricius, 1775)	Erebidae
27	*Asota* sp.	Erebidae
28	*Hypomecis* sp.	Geometridae
29	*Aplochlora vivilaca* Walker, 1861	Geometridae
30	*Biston strigaria* (Moore, 1879)	Geometridae
31	Unknown sp. 1	Geometridae
32	*Eupterote mollifera* Walker, 1865	Eupterotidae
33	*Eupterote* sp.	Eupterotidae
34	*Noctua janthina* (Denis & Schiffermüller) 1775	Noctuidae
35	*Noctua* sp. 1	Noctuidae
36	*Noctua* sp. 2	Noctuidae
37	*Noctua* sp. 3	Noctuidae
38	Unknown sp. 1	Noctuidae

39	*Micronia aculeata* Guenée, 1857	Uraniidae

Table 2. Family-wise distribution of moth species.

S.N.	Family	No. of species	Percentage of species
1	Saturniidae	4	10.26
2	Sphingidae	11	28.21
3	Erebidae	12	30.77
4	Geometridae	4	10.26
5	Eupterotidae	2	5.13
6	Noctuidae	5	12.82
7	Uraniidae	1	2.56

Table 3. The same occurrence of moths from the three Indian university campuses (located in the Western Ghats)

S.N.	Scientific name	Mangalore University Campus (Present study)	Gulbarga University Campus (Fatima and Vijaykumar, 2023)	Karnatak University Campus (Channi et al., 2017)	Goa University Campus (Gurule and Brookes, 2021)
1	*Antheraea paphia* Linnaeus, 1758	✓			
2	*Antheraea mylitta* Drury, 1773	✓			✓
3	*Actias selene* Hübner, 1806	✓			✓
4	*Attacus atlas* (Linnaeus, 1758)	✓			
5	*Deilephila Elpenor* Linnaeus, 1758	✓		✓	
6	*Hippotion* sp.	✓	✓		✓
7	*Theretra oldenlandiae* Fabricius, 1775	✓			
8	*T. castanea* Moore, 1872	✓			
9	*Daphnis nerii* Linnaeus, 1758	✓			✓
10	*Pseudodolbina* sp. 1	✓			
11	*Pseudodolbina* sp. 2	✓			
12	*Sphinx pinastri* Linnaeus, 1758	✓			
13	*Macroglossum gyrans* Walker, 1856	✓			
14	*Marumba* sp.	✓			
15	*Psilogramma vates* Butler, 1875	✓			
16	*Syntomoides imaon* (Cramer, 1780)	✓			✓
17	*Plecoptera* sp.	✓			
18	*Erebus macrops* (Linnaeus, 1768)	✓			
19	*E. ephesperis* (Hübner, 1827)	✓			✓
20	*Erebus* sp.	✓			
21	*Spirama helicina* Hübner, 1827	✓			
22	*S. retorta* Clerck, 1764	✓			✓
23	*Eudocima maternal* (Linnaeus, 1767)	✓			✓
24	*Eudocima* sp.	✓			
25	*Asota plana* Walker, 1854	✓			
26	*A. caricae* (Fabricius, 1775)	✓			✓
27	*Asota* sp.	✓			
28	*Hypomecis* sp.	✓			
29	*Aplochlora vivilaca* Walker, 1861	✓			✓
30	*Biston strigaria* (Moore, 1879)	✓			
31	Unknown sp. 1	✓			
32	*Eupterote mollifera* Walker, 1865	✓			
33	*Eupterote* sp.	✓			
34	*Noctua janthina* (Denis & Schiffermüller) 1775	✓			
35	*Noctua* sp. 1	✓			
36	*Noctua* sp. 2	✓			
37	*Noctua* sp. 3	✓			

38	Unknown sp. 1	✓			
39	*Micronia aculeata* Guenée, 1857	✓			✓

By keeping an eye on their population and habitat ranges, it is possible to evaluate the effects of new farming techniques, pesticides, air pollution, and climate change, among other factors, on these precious indicator species [27]. Moths impact the environment, human prosperity, and economics positively and negatively. In every ecosystem, they are an essential component [8].

The most crucial factor for the steep decrease in Lepidoptera is using insecticides, herbicides, biopesticides, and other chemicals to increase yield in agriculture and horticulture. There are recommendations for *Bacillus thuringenisis,* a pathogen recommended for insect pests, which is specific to killing caterpillars of butterflies and moths. Many other chemicals, of which the use is increasing daily, take a toll on a more significant number of insects in gardens and orchards [2].

The family Erebidae is widespread and widely distributed, supporting the findings of [6] who claimed that Erebid moths predominated in Rajasthan's Aravalli Hill region [35]. Study on moth diversity in three distinct vegetative habitats—forest, farmland, and urban areas in south Goa—showed that the family Erebidae consistently dominated the field. Valappil (2020) included a maximum of 264 species of moths belonging to this family in the Kerala moth checklist. Similarly, in the present study, the dominant family, Erebidae, occurred in the MUC. Future research can incorporate ecological studies on these species, life cycles, habitat preferences, and moth assemblage composition, particularly of endemic species, to gain knowledge of habitat restoration and species conservation programs. The study recorded a significant number of moth species and families (Table 1). The distribution of species was further categorized by family (Table 2). Interestingly, the occurrence of moths was similar across the three Indian university campuses located in the Western Ghats (Table 3).

CONCLUSION

This study offers insightful information about the variety of lepidopterous species seen on the Mangalore University campus. This communication aims to provide the reader with an overview of the diversity in this area through a generalized report on the moths found on this university campus. We can further explore the isolated parts of this campus; many more species may be discovered and added to the list. Further studies should be investigated to know other facets of lepidopteran ecology, like population dynamics, behaviour, and how they react to environmental changes on the university campus.

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