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Exploring the diversity, abundance, richness and evenness of moths in SRM College of Agricultural Sciences, Baburayanpettai

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ABSTRACT:
Moths, which are phytophagous insects, are widely distributed agricultural, horticultural, and forest pests that play a role in night pollination and are predominantly active during the night, serving as potential bio-indicators. The forthcoming research will present initial findings on the diversity of species, species composition, abundance, evenness, and richness of moth fauna within the Baburayanpettai region in the Chengalpattu district. The survey in Baburayanpettai yielded a total of 220 moth specimens, representing 38 species from 10 families. The family Erebidae emerged as the most prevalent, with 14 species, while the family Saturniidae was the least prevalent, with only one species. This study marks the first instance of calculating diversity indices for moths in the Baburayanpettai area. During the survey, we computed the biodiversity index, Pielou's evenness index (J), Simpson's diversity index (D), Margalef's richness index, and Shannon Wiener index, as 1.88, 0.52, 0.83, 10.19, 1.9, respectively, indicating a rich diversity of moth fauna in the surveyed regions.

KEYWORDS: Lepidoptera, Diversity, Moth species, richness, evenness, Baburayanpettai

1.Introduction:

The diversity of invertebrates is of enormous importance in various ecosystems, encompassing species, populations, and individual organisms. The ecological services provided by members of Phylum Arthropoda are crucial [6]. Lepidoptera stands out as a highly diverse group, with a global representation of 1,57,424 described species. Recent findings indicate a global report of 1,65,000 moths, with 12,000 moth species specifically identified in India. Moths, which belong to the order Lepidoptera, are an important group for monitoring environmental changes related to climate and habitat. Their role in ecosystem services is vital due to factors such as serving as agricultural pests, food sources for mammals and birds, and night pollination activities. This study aims to assess various aspects, such as richness, diversity, and distribution patterns of moths in Baburayanpettai of Chengalpattu. The number of individuals per species quantifies species abundance, which in turn determines the total count per species. Species richness, on the other hand, refers to the wide range of species found in a particular community or ecosystem, indicating higher diversity levels and increased species richness [10]. We promptly placed the specimens in a killing jar containing the agent 'Ethyl Acetate' upon collection. After the butterflies died, we carefully transferred and stored them in paper folds for temporary preservation before mounting them. This meticulous process is crucial for handling butterflies and moths, given the delicate nature of their wings, which are prone to damage.

Furthermore, the process helps to prevent scale shedding from the immobilized insects' wings. Effective preservation is essential for studying insect structures. We meticulously mounted the collected butterflies on a setting board to spread their wings. We pinned them in the thorax region, positioning the body in a depression on the setting board. We delicately spread the wings using forceps to ensure the correct wing angle and secured them in place with butter paper pieces to prevent scale damage. We left the mounted specimens untouched for one to two days to dry. After a thorough drying, we removed excess pins and butter paper, leaving only one pin in the thorax region to support the specimen vertically. We mounted the specimen using rust-resistant stainless steel entomological pins. Precise insect pinning is essential to allow clear observation of diagnostic features. We then stored the labeled insects in wooden boxes, placing repellents such as naphthalene balls (mounted on pins) at the corners to protect them from ants and other dermestid beetles. Dr. V. Shubhalaxmi's [8]standard book, "Birdwing Field Guide to Indian Moths," served as the reference for the identification of the collected butterflies.The primary goal of this investigation was to collect, identify, and compute the biodiversity species abundance,index, evenness,and richness of moth fauna of SRMCAS, Baburayanpettai.

2. Materials and Methods:

2.1. Survey Area: Chengalpattu district, located on the northeast coast of Tamil Nadu, encompasses a geographical expanse of 2945 square kilometers. This district shares borders with Chennai to the north, Kancheepuram and Thiruvannamalai districts to the west, and Villupuram district to the south. Baburayanpettai, a village within the Acharapakkam block of Kancheepuram district in Tamil Nadu, lies within the Chengalpattu region of India, situated at coordinates 12.3873^{O}N, 79.7356^{O}E. The varying climatic and topographic conditions influence the region's diverse flora and fauna (Figure 1(a)).

2.2. Collection and identification

We used light traps to capture moth specimens in the village's vicinity, and then used a killing jar to euthanize them. For moth collection, we used a basic light trap design, which included a collection chamber with an overlaid funnel (Fig. 1).

3. Result and Discussion

3.1. Diversity indices

3.1.1. Shannon Wiener diversity index (H)[7].

An indicator of species richness and abundance termed as the Shannon index (H) was used to determine the broad spectrum of moth fauna (Table 3). The Shannon index is generated from the following equation:

$$\mathbf{H = -\sum pi * (ln\ pi)}$$

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 log

3.1.2. Biodiversity index

The diversity formula is a mathematical formula that allows you to estimate the diversity (Table 4). We make the assumption that the diversity found can be studied by using the formula,

Biodiversity Index = –2.303 x sum of pi log(pi)

Biodiversity Index = –2.303 x 0.818
= -1.883

3.1.3. Simpson's diversity index[9].

$$\mathbf{SI = 1 - \sum n(n-1)/N(N-1)}$$

Where,

SI -Simpson's diversity index
N -Total no of species
n-No.of individual species

Simpson's diversity index;

D=252/1406
=0.17
1-D =1-0.17=0.83

3.1.4. Margalef's index [3]

As a straightforward indicator of species richness, Margalef's index was employed.

Margalef's index = (S – 1)/ln N

Where:

S = Total no. of species
N = Total no. of individuals in the sample
ln = Natural logarithm

Margalef's index = 37/3.63 = 10.19

3.1.5. Pielou's evenness index (J)[6]

A species' evenness was assessed using Pielou's evenness index (e).

J = H/ln S

Where:

S = Total no. of species in the sample
H= Shannon Wiener diversity index
J = 1.9/3.6 = 0.52

The study aimed to investigate the variety of moth species in this particular region. We categorized a total of 38 distinct species into 10 distinct families (Erebidae, Arctiidae, Sphingidae, Bombycidae, Crambidae, Pyraustidae, Saturniidae, Geometridae, Noctuidae, and Eupterotidae) from a collection of 220 specimens that were collected and identified and shown in Table 1, 2. Out of all the families, Family Erebidae had the highest dominance with 14 species, while Family Saturniidae had the lowest dominance with only one species (Tasar silk moth). The Handmaiden moth exhibits dominance in this region mostly because of the plentiful presence of castor andother weed species and are shown in figure 1(b), 1(c),1(d)). The fruit-sucking moth has a position of dominance, ranking second only to the handmaiden moth. The main reason for this is the abundant cultivation of citrus orchards and vegetables in this specific area.

The department of Entomology at SRM College of Agricultural Sciences (SRMCAS) is characterized by an environmentally sustainable setting that features a wide variety of vegetation spread throughout. The soil is conducive to sustaining a diverse range of plant life. We analyses multiple abiotic factors of soil, including temperature, pH, soil moisture, and soil reductivity. Based on the following parameters: soil reductivity is low, pH varies from 7 to 8.5, temperatures range from 25°C to 40°, and soil moisture is good. These results suggest that soil affects the growth of a variety of host plants.

These findings are consistent with previous research demonstrating that 774 moth specimens were obtained using basic light traps that were set up and run every day for sixty nights, from twilight to dawn. The moths that were caught had family-level identification. In the collected samples, there were representatives of the families such as Noctuidae, Pyralidae, Arctiidae, Lymantriidae, Sphingidae and Geometridae. In Peshawar, the moth fauna's species richness, diversity index, and evenness were 5.26, 3.14, and 0.87, respectively[5].

The moths' ability to survive and reproduce are facilitated by environmental conditions that provide a favourable habitat. Host plants supply a sufficient quantity of nourishment for the larvae of the moth. Following the survey, we conducted measurements of diversity indices and determined that the value of the Simpson's Diversity Index (D) is 0.83. The Shannon Diversity Index (H) is 1.9, the Biodiversity Index is -1.88, the Margalef Index is 10.19, and the Pielou's Evenness Index (J) is 0.52. These indices collectively indicate a high level of diversity in the moth fauna of this location and are shown in Table 3, 4, 5 and 6. A recent study conducted in Bhavnagar documented a total of 232 moth species. Among these, the family Erebidae had the highest diversity with 62 species, followed by the family Crambidae with 44 species. The other 11 families displayed the lowest levels of diversity [10]. The objective of the current research was to comprehend the distribution and variety of moths in this particular area. The results of this study showed that moth assemblages in agricultural areas may serve as a useful ecological indicator for assessing habitat quality.

Since vegetation is an important supplier of nourishment and additional assets for insects, it plays an important part in the existence of insect species in a community, which is why the moth fauna in SRM College of Agricultural Sciences is so diversified as far as species richness, evenness, and diversity index.

When a community or habitat has a large number of endemic species, it is necessary to regularly monitor the biological processes and implement suitable conservation methods to preserve the habitat's great genetic diversity[4]. For instance, the preservation of the region's woods was substantially responsible for the existence of a rich and diverse fauna in various areas of the Nilgiri Biosphere Area [2].

Lunar cycles, other lights interfering, and the placement of a light trap can all greatly impact the size of the catch it captures. Because it indicates biomass rather than variety, it is crucial to properly evaluate the total number of individuals collected in the trap [1].

This study was an effort to define some aspects of the biodiversity of the SRMCAS moth fauna. More collections and substantial research are needed to acquire a comprehensive annual assessment of the faunal array of moths in this region. It is anticipated that this work will eventually lead to the creation of standard observation techniques that may prove helpful in estimating the sustainable development of areas utilised for various crops and in forecasting the impact of tropical forest destruction on the population structure of moths [1].

Conclusion:

The Department of Entomology at SRMCAS attributes the majority of its moth fauna's complexity to the region's varied vegetation. The primary food source for insect fauna is provided by vegetation, and abiotic elements are crucial to the structure of the habitat. Future research endeavours will contribute to our comprehension of the abundant species variety, seasonal fluctuations, and ecological state of moths within this area.

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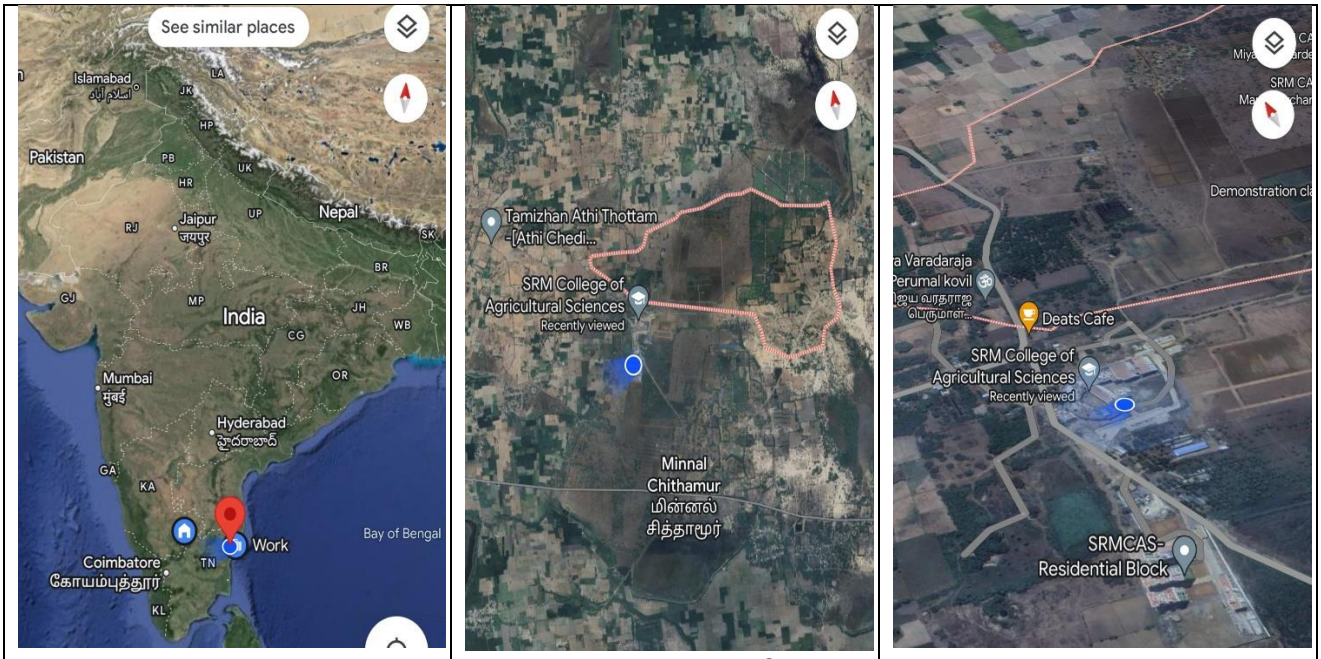

Figure 1 (a) Map of study area

Table 1. Checklist of moths

Sl.No	Common Name	Scientific Name	Family	Order	Abundance (No. of insects)
1	Fruit Sucking Moth	*Eudocimamaterna*	Erebidae	Lepidoptera	38
2	Tropical tiger moth	*Asotacaricae*	Erebidae	Lepidoptera	23
3	Hand maiden moth	*Syntomoidesimaon*	Arctiidae	Lepidoptera	44

4	Oleander Hawk Moth	*Daphnis nerii*	Sphingidae	Lepidoptera	7
5	Domestic Silk Moth	*Bombyx mori*	Bombycidae	Lepidoptera	4
6	Vine Hawk Moth	*Hippotioncelerio*	Sphingidae	Lepidoptera	15
7	Crotalaria Pod Borer	*Argina astrea*	Erebidae	Lepidoptera	2
8	Streaked Tiger	*Creatonotosgangis*	Erebidae	Lepidoptera	4
9	Elbow Banded Rajendra Moth	*Rajendra biguttata*	Erebidae	Lepidoptera	2
10	Castor Semi Looper	*Achaea janata*	Erebidae	Lepidoptera	2
11	Tiger Moth	*Mangina syringa*	Erebidae	Lepidoptera	1
12	Grass Moth	*Parotis marginata*	Crambidae	Lepidoptera	5
13	Teak Skeletonizer	*Pyraustamachaeralis*	Pyraustidae	Lepidoptera	2
14	Humming Bird Hawk Moth	*Macroglossumstellatarum*	Sphingidae	Lepidoptera	12
15	Tasar Silk Moth	*Antheraea mylitta*	Saturniidae	Lepidoptera	1
16	Death's Head Hawk Moth	*Acherontiaatropos*	Sphingidae	Lepidoptera	2
17	Eumelea	*Eumelealudovicata*	Geometridae	Lepidoptera	1
18	Triangular Striped Moth	*Chalciopemygdon*	Noctuidae	Lepidoptera	10
19	Common Owlet Moth	*Spiramaretorta*	Noctuidae	Lepidoptera	1
20	Brinjal shoot and fruit borer	*Leucinodesorbonalis*	Crambidae	Lepidoptera	2
21	Convulvulus hawk moth	*Agrius convolvuli*	Sphingidae	Lepidoptera	2
22	Bean pod borer	*Maruca vitrata*	Crambidae	Lepidoptera	1
23	Checkered snout moth	*Pygospila tyres*	Crambidae	Lepidoptera	2
24	Crepuscular hawk moth	*Nephele hespera*	Sphingidae	Lepidoptera	1
25	Crimson spotted emerald	*Agathia angustilimis*	Geometridae	Lepidoptera	1
26	Agathia moth	*Agathia laetata*	Geometridae	Lepidoptera	1

27	Tussock moth	*Selepaceltis*	Erebidae	Lepidoptera	1
28	Erebid moth	*Lygephilalusoria*	Erebidae	Lepidoptera	1
29	Gypsy moth	*Lymantria dispar*	Erebidae	Lepidoptera	2
30	Heliotrope moth	*Utetheisapulchelloides*	Erebidae	Lepidoptera	15
31	Scarce umber	*Agriopisaurantiaria*	Geometridae	Lepidoptera	1
32	Orange underwing thyas	*Thyascoronata*	Erebidae	Lepidoptera	4
33	Leaf roller	Cnaphalocrocismedinalis	Crambidae	Lepidoptera	1
34	Dark owlet moth	*Spiramaretorta*	Noctuidae	Lepidoptera	2
35	Eupterid moth	*Eupteroteundata*	Eupterotidae	Lepidoptera	1
36	Yellow monkey moth	*Eupterotebifasciata*	Eupterotidae	Lepidoptera	4
37	Erebid moth	*Chionarctia nivea*	Erebidae	Lepidoptera	1
38	Spotless owlet moth	*Hypopyravespertilio*	Erebidae	Lepidoptera	1

Fruit sucking moth

Tropical tiger moth

Hand maiden moth

 **Oleander hawk moth**	 **Domestic silk moth**	 **Vine hawk moth**
 **Crotalaria pod borer**	 **Streaked tiger**	 **Death's head hawk moth**
 **Castor semilooper**	 **Tiger moth**	 **Grass moth**
 **Teak skeletonizer**	 **Hummingbird hawk moth**	 **Tasar silk moth**

Eumelea moth

Common owlet moth

Convulvulus hawk moth

Checkered snout moth

Crimson spotted emerald

Tussock moth

Erebid moth

Gypsy moth

Heliotrope moth

Yellow monkey moth

Orange underwing thyas

Dark owlet moth

Figure 1 (b) Wide range of moths in and around SRMCAS

Table 2. Number of moths captured using light traps from each family at SRMCAS, Baburayanpettai

S.no	Family	No. of individuals of each family
1	Erebidae	**14**
2	Spingidae	**6**
3	Crambidae	**5**
4	Geometridae	**4**
5	Noctuidae	**3**
6	Eupterotidae	**2**
7	Pyraustidae	**1**
8	Arctiidae	**1**
9	Saturnidae	**1**
10	Bombycidae	**1**

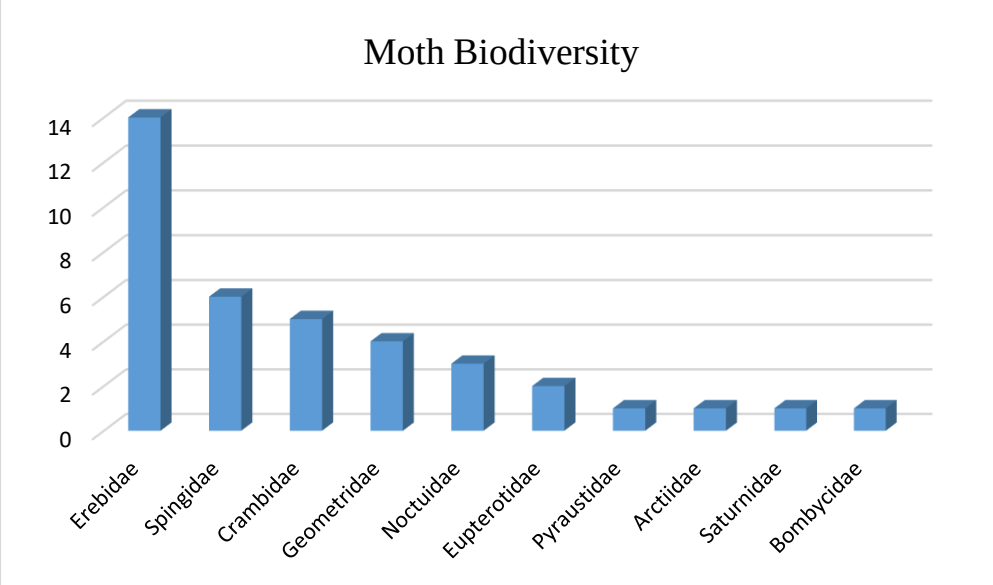

Figure 1(c) Number of individuals of each families at SRMCAS,

Baburayanpettai

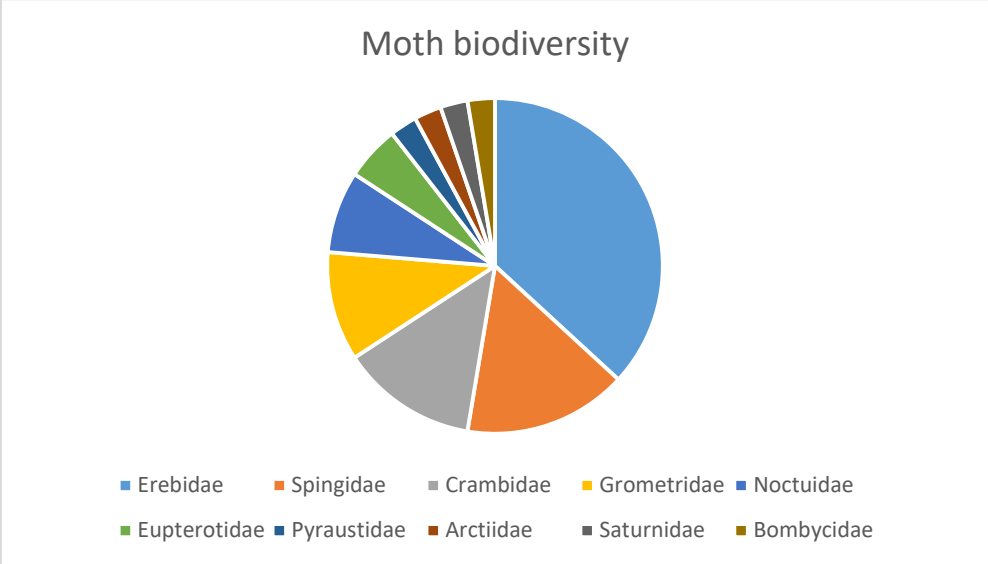

Figure 1(d) Percentage of moth families at SRMCAS in Baburayanpettai

Table 3. Shannon Wiener diversity index

S.No.	Family	No. of species	pi	ln(pi)	Pi*ln(pi)	-pi*ln(pi)
1	Erebidae	14	0.36	-1.021	-0.367	0.367
2	Sphingidae	6	0.157	-1.851	-0.290	0.29
3	Crambidae	**5**	0.131	-2.03	-0.265	0.265
4	Geometridae	4	0.105	-2.25	-0.236	0.236
5.	Noctuidae	3	0.078	-2.65	-0.185	0.185
6	Eupterotidae	2	0.052	-2.995	-0.149	0.149
7	Pyraustidae	1	0.026	-3.64	-0.094	0.094
8	Arctiidae	1	0.026	-3.64	-0.094	0.094
9	Saturniidae	1	0.026	-3.64	-0.094	0.094
10	Bombycidae	1	0.026	-3.64	-0.094	0.094
	Total	**38**				**H = -∑pi * (ln pi) = 1.9**

From this Shannon Weiner diversity index, we can conclude that Baburayanpettai region has **medium**(1.5 – 2.5) diversity of moth.

Table 4. Biodiversity index of moth species

S.no.	Family	No. of species	pi	log pi	Pi*log pi
1.	Erebidae	14	0.368	-0.434	-0.159
2.	Sphingidae	6	0.157	-0.804	-0.126

3.	Crambidae	5	0.131	-0.882	-0.115
4.	Geometridae	4	0.105	-0.978	-0.102
5.	Noctuidae	3	0.078	-1.108	-0.086
6	Eupterotidae	2	0.052	-1.284	-0.066
7	Pyraustidae	1	0.026	-1.585	-0.0412
8	Arctiidae -	1	0.026	-1.585	-0.0412
9	Saturniidae	1	0.026	-1.585	-0.0412
10.	Bombycidae	1	0.026	-1.585	-0.0412
	Total				**0.818**

Table 5. Simpson's diversity index of moth species in SRMCAS

S.NO	**Family**	**No.of species (n)**	**n(n-1)**
1	Erebidae	14	182
2	Spingidae	6	30
3	Crambidae	5	20
4	Geometridae	4	12
5	Noctuidae	3	6
6	Eupterotidae	2	2
7	Pyraustidae	1	0
8	Arctiidae	1	0
9	Saturniidae	1	0
10	Bombycidae	1	0
	Total(N)	**38**	**252**

Table 6. Species diversity,Richness, abundance and evenness of moth faunarecorded atSRMCAS, Baburayanpettai

Site	No. of species	No. of families	Shannon Weiner diversity index (H)	Biodiversity index	Simpson's diversity index (D)	Margalef's richness index	Pielou's Evenness index (J)
SRMCAS, Baburayanpettai	38	10	1.9	-1.88	0.83	10.19	0.52