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Study of Moth Diversity from Khamgaon City, Buldhana, India

*[1]Vandana R Kakde and [2]Shubhangi U Patil

*[1, 2]Department of Zoology, Jijamata Mahavidyalaya, Buldhana, Buldana, Maharashtra, India.

Abstract

Moths are phytophagous, agricultural pests, night pollinators, chiefly nocturnal and potential bioindicators. The current attempt to study of moth diversity from Khamgaon city of Buldhana district (India). Collection of moths was carried out from Khamgaon city during the time period of June 2023 to August 2023. A total number of 11 moths specimens were collected from study area by using simple light trapping method and also given photographs of moth specimens. The moths were identified up to the family level from study area viz. Families Sphingidae, Geometridae, Erebidae, Saturniidae, Attevidae and Zygaenidae were recorded from Khamgaon city. Family Sphingidae dominated among all 6 families in diversity and abundance.

Keywords: Phytophagous, Bioindicators, Night pollinators, Khamgaon City, Simple light trapping, Sphingidae

Introduction

Invertebrates' diversity plays a vital role in all ecosystems, e.g., species, population, and individual (Cardinale *et al*., 2006; Bashir, 2019; Shakeel, 2019) [5, 3, 12]. Members of Phylum Arthropoda play a pivotal role in ecological services (Rathore and Jasrai, 2013; AbouShaara, 2021; Karar, 2020) [13, 1, 8]. Besides most successful Phyllum, they dominate all types of habitats except for the oceanic benthic zone (Jamal, 2021; Abrol, 2019) [7, 2]. Lepidoptera is one of the most diverse groups, representing 1,57,424 described species globally (van Nieukerken *et al*., 2011; Sajjad, 2019) [16, 11]. According to a recent study, 1, 65,000 moths have been reported globally Khan and Perveen, (2015) [9], among which 12,000 species of moths have been reported from India (Chandra and Nema, 2007) [6]. Moths belong to Order Lepidoptera, characterized by drab colored scales on the body, epiphysis on the foreleg, phytophagous and predominantly nocturnal nature. They are very sensitive to climate changes and vegetation alterations, making them an important group for monitoring climate and habitat changes (Thomas, 2005) [15]. They are also considered vital for ecosystem services because of various roles such as agricultural pests (Sharma and Bisen, 2013) [14], food for mammals (Vaughan, 1997) [17], birds (Wilson *et al*., 1999) [18], and night pollinators (Macgregor *et al*., 2015) [10].

In this research paper we are determining various factors such as diversity, richness and distributional pattern of moths in Khamgaon city, Buldhana. Species abundance is defined as the number of individuals per species, by virtue of abundance, total number of individuals per species is detected. Species richness represents the count of different species present in a particular community or habitat. More the species richness more will be the diversity of the region. Above mentioned both factors are shown in Table 2.

Study Area

The present study was carried out in an attempt to understand and measure the status of moth diversity in and around the Khamgaon. city. Khamgaon, the urban as well as largest industrial area and taluka place, is situated in Buldana district of Maharashtra state and lies in biogeographic zone Deccan Peninsula. Vidarbha is located in Maharashtra State of India, with respect to biodiversity, Vidarbha occupies 31.6% of total area. It has 11 districts out of which Buldhana is one of them. The state of Maharashtra is located in the Deccan region of India. This area coordinates between Longitude 200 34'07"N and Latitude 760 23'21"E. Khamgaon is situated 50 km from Buldana. Moths were collected from in and around Khamgaon city. The study was carried out from June 2023 to August 2023. The area covers vegetation rich in tropical, deciduous bushy and semi-evergreen plant species of mesophytic in nature. These forests are dominated by deciduous trees, with almost 90-95% of leaf drop during the dry season. Major fauna like Leopards, sloth bears, barking deer, blue bulls, spotted deer, hyenas, jungle cats and jackals along with tigers give more attraction here.

Material and Methods

Collection of Moths

Most of the moths were attracted through the light traps technique, by using actinic tubes and mercury bulb of about 20 to 125 watt. Baiting techniques such as sugaring as well as use of fruit pulp is also successful. But the most suitable method used is sheet method. The white cloth sheet was used

*Corresponding Author: Vandana R Kakde

for attracting the moth along with a bright light source. Light trap was also set during the 6-9 pm time period using a 160w mercury vapour bulb over a 3×3m (square) white cloth sheet which was hung between two vertical poles. The moths collected were killed by ethyl acetate and later pinned in insect stretching board. All specimens were preserved in airtight insect box, having naphthalene balls as fuming moth. Each specimen was provided with a label indicating the locality and date of collection. Moths were photographed and colour images were created by using Canon digital camera (Power Shot, SX160IS, 16x, 42x optical zoom and by using a Nikon^{TM} D300 with a 105 mm macro lens or a Nikon^{TM} D60 and 18-55mm lens.

Identification of Moths

The available literature was used to identify the moths, including Moore (1880-1840), Hampson (1891-1896), Bell and Scott (1937), Holloway (1983-2011), Kendrik (2002), and Kirti and Singh (2015-2016). The classification system used by van Nieukerken *et al*. (2011) [16] was followed.

Data Analyses

Moth species listed and the complete count of the number of species presented in each habitat were done for species composition and species structure indices. Species richness was measured as the number of species recorded. The results were used to indicate the moth species diversity in agricultural field, forest and ecotone areas.

a) Shannon's Diversity Index (H'): Site wise community diversity was analyzed with Shannon's diversity index (Shannon and Weaver, 1949) as follows:

$$H = \sum_{i=1}^{S} [(Pi)\,(lnpi)]$$

Where
H = Species diversity index
S = No. of species
pi = Proportion of the total sample belonging to i th species

b) Sorensen Similarity Coefficient: This measure was first used by Czekanowski in 1913 and discovered anew by Sorensen (1948). To measure the similarity between two community samples, coefficient of Sorensen used as the following equation

$$\text{Sorensen similarity coefficient (CC)} = \frac{2C}{S1 + S2}$$

Where,
C = The number of species the two communities have in common,
S1 = The total number of species found in community 1, and
S2 = The total number of species found in community 2.
Sorenson's coefficient gives a value between 0 and 1, the closer the value is to 1, the more the communities have in common. A Complete community overlap is equal to 1; complete community dissimilarity is equal to 0.

c) Evenness: Evenness is also calculated for each sampling site by equation,

Evenness (E) = H/Hmax

Results and Observation

A comprehensive survey carried out in various habitats of region to study the diversity and distribution of moths. This survey carried out from June 2022 to August 2022 in and around study area.

i). Overall Diversity of Moth Fauna in and Around Study Area: In the present study, total 11moth species belonging to11 genera were recorded from all study sites in different ecosystems in and around the study area, which are distributed within 8 subfamilies under family Sphinginae in subfamily Macroglossinae, Ceratocampinae, Procridnae, Noctuoidea, Geometrinae, Sterrhinae, & Attevinae (Table 1).

ii). Relative Contribution of Subfamilies with Respect to Species Subfamily: Sphinginae recorded with total 02 genera and 02 species. The subfamily Macroglossinae recorded with 02 genera and 02 species. The subfamily Ceratocampinae recorded with 1 genera and 1 species. The subfamily Procridnae recorded with 1 genera and 1 species. The subfamily Noctuoidea recoded with 1 genera and 1 species. The subfamily Geometrinae recoded with 1 genera and 1 species. The subfamily Sterrhinae recoded with 02 genera and 02 species. & the subfamily Attevinae recoded with 1 genera and 1 species (Table 1 and fig 2). Subfamily Sphinginae makes up highest contribution i.e. 18.18% following it the subfamily Macroglossinae constituted with 18.18%, subfamily Ceratocampinae contributed with 9.09%, subfamily Procridnae contributed with 9.09%, subfamily Noctuoidea contributed with 9.09%, subfamily Geometrinae contributed with 9.09%, subfamily Sterrhinae contributed with 18.18%, subfamily Attevinae contributed with 9.09% was observed each for subfamily (Table 1 and fig 1 and 2).

iii). Relative Contribution of Various Genera Regarding to Relative Contribution of Various Genera: The result shows that, three genera were recorded with two single while other were with single species Daphnis with highest number of species (2 species) showing maximum contribution of 25.38% each. This is followed by Acherontia, Hippotion, Dryocampa, pollanisus, Traminda, Scopula & Atteva each with single species and contributes to only 7.69% each (Table 1, fig. 3).

Table 1: Subfamily Wise Distribution and List of Moth Genera and Identified Species Recorded from Study Area.

Sr. No.	No. of Species	Family	Subfamily	Genus
1	*Agrius convolvli*	Sphingidae	Sphinginae	Agarius
2	*Averontia lachesis*	Sphingidae	Sphinginae	Averontia
3	*Daphnis nerii*	Sphingidae	Macroglossinae	Daphnis
4	*Hippotion velox*	Sphingidae	Macroglossinae	Hippotion
5	*Dryocampa rubicunda*	Saturniidae	Ceratocampinae	Dryocampa
6	*Pollanisus apicalis*	Zygaenidae	Procridnae	Pollanisus
7	*Ophiusa algira*	Erebidae	Noctuoidea	Ophiusa
8	*Maxates sp.*	Geometridae	Geometrinae	Maxates
9	*Traminda mundissima*	Geometridae	Sterrhinae	Tramina
10	*Scopula imitoria*	Geometridae	Sterrhinae	Scopula
11	*Ailanthus webworm (Atteva avrea)*	Attevidae	Attevinae	Atteva

Table 2: Percentage of Species Distribution in Different Subfamily

Sr. No.	Genera	Species Richness	Percentage
1	Sphingidae	02	18.18%
2	Macroglossinae	02	18.18%
3	Ceratocampinae	01	9.09%
4	Procridnae	01	9.09%
5	Noctuoidea	01	9.09%
6	Geometridae	01	9.09%
7	Sterrhinae	02	18.18%
8	Attevinae	01	9.09%
9	Total	01	100%

Table 3: Species Number and its Percentage under Each Genus.

Sr. No.	Genera	Species Richness	Percentage
1	Agaris	02	15.38%
2	Averontia	01	7.69%
3	Daphanis	02	15.38%
4	Hippotion	01	7.69%
5	Drocampa	01	7.69%
6	Pollanisus	01	7.69%
7	Ophiusa	01	7.69%
8	Maxates	01	7.69%
9	Traminda	01	7.69%
10	Scopula	01	7.69%
11	Atteva	01	7.69%
	Total	13	100%

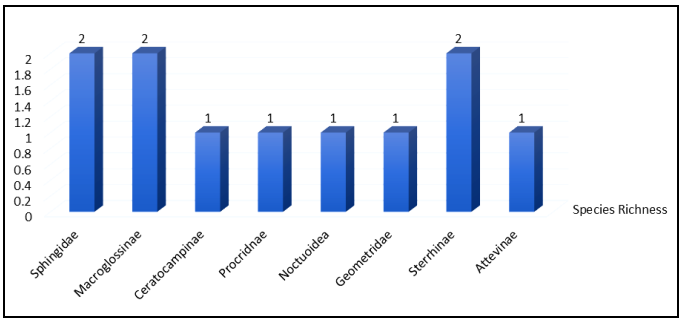

Fig 1: Species Richness in Subfamily

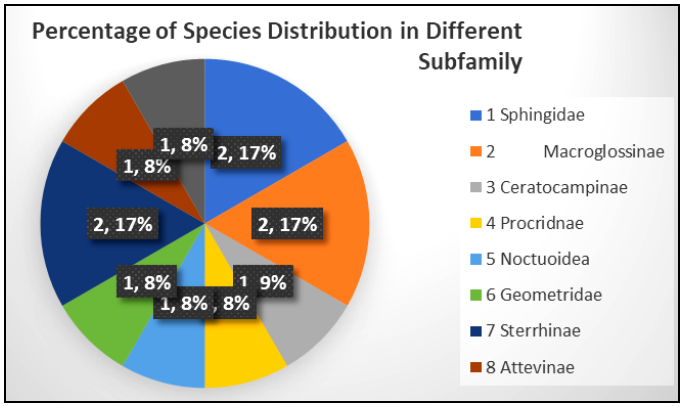

Fig 2: Percentage of Species Distribution in Different Subfamily

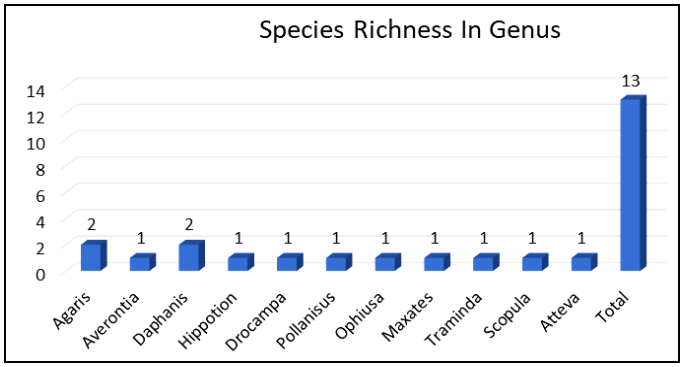

Fig 3: Species Richness in Genus

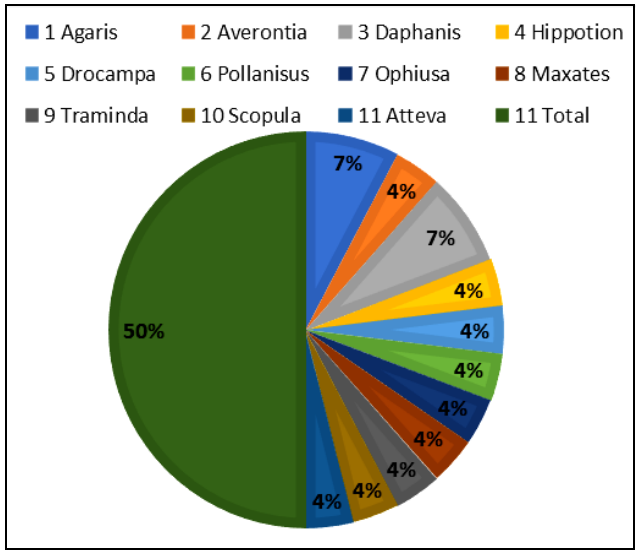

Fig 4: Species Number and its Percentage under Each Genus

Agrius convolvli

Traminda mundissi

Scopula imitoria


Averontio lachesis


Dryocampa rubicunda


Ophiusa algira


Hippotion velox


Maxates Sp.


Atteva avrea


Daphnis nerii


Pollanisus apicalis

Fig 5: Photographs of all collected 11 moth species from Khamgaon city as shown follows:

Discussion

A comprehensive survey was made from June 2023 to August 2023 in and around Khamgaon study area regarding various habitats to study the diversity and distribution of moths. This topic tries to cover all of moth diversity and its composition in respective area for comparison of study sites. The diversity of living organism classified in the level of organization such as order, family, genus and species.

Diversity of Moth Fauna: This study was mainly carried out to elucidate the biodiversity of moth fauna that has not been studied previously. It was observed that number of moth species belonging to family Sphingidae, was found more than other families viz., Saturniidae, Zygaenidae, Erebidae, Geometridae & Atticates. The represented by 11 species of moths belonging to 06 families have been listed in this order (Table. 1). Of these 06 families the family Sphingidae was found to be dominant family which was represented by 04 species. This family was followed by Saturniidae 01 species, followed by Zygaenidae, Erebidae, Attevidae, (1 species each) and Geometridae (3 species).

Similar studies were carried out at 16 sites in Southern Korea to determine the patterns of diversity for moths in this area. A total of 975 moth species were recognized in the 6 month collection periods (May to Oct) between 2001 and 2007. Species diversity and seasonal abundance of fruit piercing moth was carried out from different localities in Tamil Nadu. They observed five species of fruit piercing moth belonging to two genera (Ramkumar 2010) [37]. Comprehensible surveys of moth diversity have been done in Hawaii (Zimmerman 1948) [41] and on larger continental islands such as Australia (Common 1990) New Zealand (Hudson 1928), and Borneo (Holloway 1976) [30]. There have also been a few studies on smaller islands (Holloway 1977) [31], but for most islands in French Polynesia, there is little more than a superficial examination (Paulin 1998) [36] of the moth fauna since the Bishop Museum's entomological expeditions in the 1930's (Adamson 1939) [40]. It thus implies that further work undertaken in greater depth and covering large areas may reveal a rich biodiversity of moth fauna.

Moths are easily affected by slightest disturbances in climate and also by pollution. A sudden variance in the abundance or decline in moth population is often a clear indicator of climate upheaval or increased levels of pollutants in environment

Conclusions

From the present study, it is concluded that, there is diversity in these habitats in terms of species richness, abundance and composition. This difference was due to effect of anthropogenic activities and changing habitat environment occurring frequently in and around the study area. Major and most noticeable factor is anthropogenic activities; today these are most responsible than climatic factors for eliminating the moths from their original nesting site. In addition, these findings suggest that biotic factors and abiotic factors were important determinant of moth assemblage. Moth species richness generally increased with the increase in the

vegetation than open area. This study may provide new information on moth assemblages in a studied region with respect to disturbance, microhabitat condition and environmental features. In this study, we have attempted to study the diversity of moths from khamgaon city, Buldana region. This work adds to the inventory of moths of this region which could be utilized for future studies.

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