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Hidden Wings of Jalna: Diversity and Ecological Significance of Moths (Lepidoptera: Heterocera) from Jalna District, Maharashtra, India

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Abstract: ***Moths constitute an important component of terrestrial ecosystems and serve as pollinators, herbivores, decomposers, and bioindicators of environmental health. Despite their ecological importance, moth diversity in many inland districts of Maharashtra remains poorly documented. The present study was conducted to assess the biodiversity of moths in Jalna district, Maharashtra, India, during the period from June 2024 to February 2025. Sampling was carried out using light trap methods and opportunistic photographic documentation across agricultural fields, grasslands, urban gardens, and semi-natural habitats. A total of 72 species belonging to 58 genera and 14 families were recorded during the study. Family Erebidae was dominant with 19 species followed by Crambidae (12 species), Geometridae (10 species), Noctuidae (9 species), and Sphingidae (6 species). Seasonal abundance was highest during monsoon and post-monsoon months due to favourable humidity and vegetation availability. The study highlights the importance of Jalna district as a potential habitat for diverse moth fauna and emphasizes the necessity for long-term biodiversity monitoring and habitat conservation. The findings contribute baseline information for future ecological and taxonomic studies in the Marathwada region of Maharashtra.***

Keywords: Bioindicators, terrestrial ecosystems, pollinators, herbivores, biodiversity & Moths

1. Introduction

Lepidoptera is one of the most widespread and widely recognized insect orders globally (Powell. et. al., 2009). Moths are one of the most diverse groups of insects belonging to the order Lepidoptera and suborder Heterocera. Globally, moth diversity greatly exceeds butterfly diversity, and moths play significant ecological roles as pollinators, prey organisms, nutrient recyclers, and indicators of habitat quality. They contribute substantially to ecosystem functioning and food web stability (Kalawate, 2018). They perform essential ecosystem services and show promise as indicators of forest health (Kitching *et al.,* 2000).

They are often used as indicators of biodiversity and habitat quality, contributing significantly to ecosystems as pollinating agents, food sources in the food webs, and through the saproxylic habit of many larvae (Schmidt *et al.,* 2006)

According to Merckx & Slade (2014), moths are indicator species and used to monitor the environmental conditions, including habitat fragmentation, pesticides exposure, climate fluctuations. India possesses rich lepidopteran diversity due to varied climatic and ecological conditions. Several studies have documented moth diversity from biodiversity hotspots such as the Western Ghats, Himalayan regions, and northeastern India; however, comparatively fewer studies are available from central and inland Maharashtra regions.

Order Lepidoptera includes both butterflies and moths, in which moths are nocturnal and butterflies are diurnal (Anil and Parthsarathy, 2017). Lepidoptera is most diversified order, comprising 1,57,424 species worldwide (Van Nieukerken *et al.,* 2011; Sajjad, 2019). World has recorded over 1,65,000 moth species (Khan and Perveen, 2015). In India approximately 12000 species of moths are found belonging to 40 families (Chandra, 2007). The study of moth diversity is important as they play a major role in pollination, nutrient recycling and environmental indications (Shubhalaxmi, 2018). Amongst lepidopterans, butterflies are most studied globally rather than nocturnal moths (Shubhalaxmi, 2018). The semi-arid area of Maharashtra like Baramati have higher temperature and less rainfall, but this region shows significant diversity of moth because of their agricultural fields, scrublands, and fragmented habitat (Sharvari *et al.,* 2024). Similar to this, a variety of moth aggregated that are anthropogenic and seasonal variations may be found in Vidarbha regions which is notable by dry deciduous forests, reservoirs, urban environment and agro-ecosystems.

Recent investigations from Maharashtra have reported considerable moth diversity from different ecosystems. Studies from Gondia documented 58 species under 10 families, whereas Wardha district reported significant diversity from agricultural and semi-urban habitats. Similar observations from Sindhudurg wetlands also emphasized the ecological importance of moth assemblages in wetland ecosystems.

Moths are increasingly recognized as useful bioindicators because they respond rapidly to habitat disturbance, climate change, pesticide exposure, and urbanization. Artificial illumination, agricultural intensification, and habitat fragmentation are major threats affecting moth populations worldwide.

Jalna district of Maharashtra forms part of the semi-arid Marathwada region characterized by agricultural landscapes, scrub vegetation, seasonal wetlands, and mixed rural habitats. Despite its ecological significance, no comprehensive documentation of moth diversity has been conducted from this region. Therefore, the present study was undertaken to investigate the biodiversity, distribution, and seasonal

occurrence of moths in Jalna district and to generate baseline faunal data for future ecological studies and conservation planning.

2. Materials and Methods

Study Area
The present investigation was conducted in Jalna district, Maharashtra, India. Geographically, Jalna district lies between 19°01′ to 21°03′ N latitude and 75°04′ to 76°04′ E longitude. The region experiences tropical semi-arid climatic conditions with hot summers, moderate monsoon rainfall, and mild winters. Major habitats surveyed included: Agricultural fields, Grasslands, Urban gardens, Roadside vegetation, Wetland margins, Semi-natural scrub forests. The dominant vegetation consisted of neem (*Azadirachta indica*), babul (*Acacia nilotica*), lantana (*Lantana camara*), grasses, crop plants, and seasonal flowering herbs.

Duration of Study
Field surveys were conducted from June 2024 to February 2025 covering monsoon, post-monsoon, and winter seasons.

Collection and Documentation
Moths were surveyed using light trapping methods with mercury vapor lamps and LED light sources installed against white cloth sheets during evening and night hours between 7:00 PM and 11:30 PM. Opportunistic photographic observations were also performed using digital cameras and mobile photography. Specimens were identified based on wing morphology, coloration, antennae structure, and available taxonomic literature. Identification guides and online repositories were consulted for confirmation.

Identification of moth
The available literature was used to identify the moths, including Barlow (1982), Holloway (1999), Holloway (1998), Holloway (2003), Holloway (2011), Moore (1880), Schintlmeiste and Pinratana (2007), Zolotuhin and Pinratana (2005), Kirti and Singh (2015), Kirti and Singh (2016), Kendrick (2002),

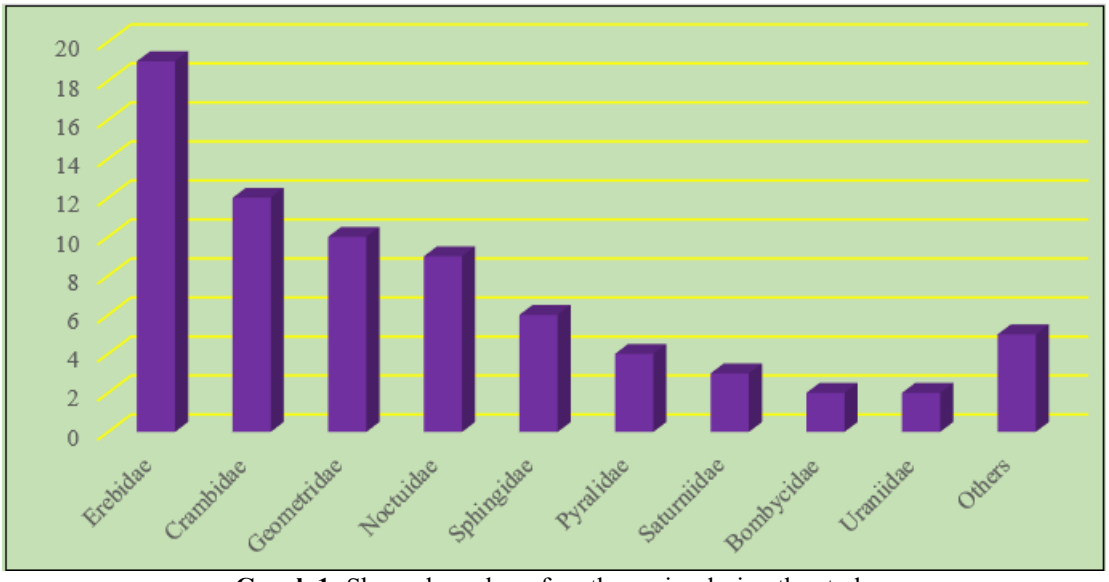
Data Analysis
Species richness, relative abundance, and family-wise distribution were calculated. Diversity observations were analyzed seasonally to determine variations in moth occurrence across different climatic periods.

3. Results

The present study recorded a total of 72 moth species belonging to 58 genera under 14 families from Jalna district. Family-wise distribution indicated dominance of Erebidae followed by Crambidae and Geometridae.

Table 1: Showed Family-wise Diversity of Moths

S. No.	Name of the Family	Number of Species
1	Erebidae	19
2	Crambidae	12
3	Geometridae	10
4	Noctuidae	9
5	Sphingidae	6
6	Pyralidae	4
7	Saturniidae	3
8	Bombycidae	2
9	Uraniidae	2
10	Others	5



Graph 1: Showed number of moth species during the study

The family Erebidae represented the highest species richness due to adaptability across diverse habitats including agricultural fields and urban vegetation. Similar dominance of Erebidae has been reported from Wardha and Sindhudurg regions of Maharashtra.

Seasonal Variation: Maximum moth abundance was recorded during monsoon and post-monsoon seasons between July and October. Increased humidity, vegetation growth, and flowering plants contributed to higher species occurrence during this period. Winter months exhibited comparatively lower abundance due to declining temperature and reduced vegetation cover.

Commonly Observed Species: Some frequently observed moth species during the study included: *Spodoptera litura*, *Achaea janata*, *Eudocima materna*, *Asota caricae*, *Utetheisa pulchella*, *Cnaphalocrocis medinalis*, *Agrius convolvuli*,

Hippotion celerio. Agricultural habitats showed high representation of noctuid and crambid moths due to crop availability and host plant abundance.

4. Discussion

The present study reveals considerable moth diversity in Jalna district despite increasing anthropogenic disturbances and agricultural intensification. The recorded diversity demonstrates the ecological importance of semi-arid habitats in supporting lepidopteran fauna. Dominance of family Erebidae observed in this study agrees with findings reported from Gondia, Odisha, and Sindhudurg regions where erebid moths constituted a major proportion of moth assemblages. The adaptability of erebid moths to varied environmental conditions and host plants may contribute to their dominance. Crambidae and Noctuidae were also well represented due to extensive agricultural activity in Jalna district. In other studies, Wardha's Karanja Ghadge, Wankhade et al. (2021b) recorded 64 species from 14 families and 31 subfamilies over February 2020 to January 2021, led by Erebidae (22 species). Many species belonging to these families are associated with crop ecosystems and grassland habitats. Agricultural landscapes provide abundant larval host plants which support moth populations throughout the growing season. Shubhalaxmi et al., (2011) reported 35 noctuid moths from the northern Western Ghats. Gurule & Nikam (2013) recorded 28 species of noctuid moths from Nashik, Dhule, Jalgaon, and Nandurbar districts of northern Maharashtra. Two-hundred-and-ninety-seven species of noctuid moths were reported by Mitra et al., (2019). Sivasakaran et al., (2017) listed the species in a checklist from Tamil Nadu, Western Ghats, India without photographs of the species. Rigorous studies are required to confirm the gaps areas of record of C. indica between Himalaya and the Western Ghats. Chandra (2008) reported 11 Noctuidae species from Jabalpur. Sivasankaran et al., (2011) reported 154 species of noctuid moths classified under 85 genera and 23 subfamilies from Tamil Nadu part of Western Ghats (Nilgiri Biosphere and Kodaikanal hills

Kalawate and Sharma (2017), Ahire and Khobragade (2021), in their research work also reported about the dominancy of moth species from family Erebidae from different regions such as North Maharashtra region, Amravati city Maharashtra, Pench National Park and Ahmednagar college campus, Ahmednagar, Maharashtra respectively. Chandrakar et al (2022). recorded 184, identified 163 moth species belonging to 10 families from Hinganghat taluka of district Wardha. Fernandes (2024), recorded 193 moth species with 61 species dominance of Erebidae family followed by Crambidae with 42 species from Verna village of Goa. Seasonal fluctuations observed during the present investigation correspond with climatic factors such as rainfall, humidity, and vegetation availability. Monsoon season enhances floral diversity and leaf biomass, thereby increasing larval feeding opportunities and adult nectar resources. Similar seasonal peaks during monsoon have been documented from Wardha and Gondia studies.

Moths are increasingly considered important bioindicators for assessing ecosystem health and habitat disturbance. Habitat fragmentation, excessive pesticide use, artificial night illumination, and urban expansion negatively affect moth diversity and abundance. Conservation of natural vegetation patches and reduction in indiscriminate pesticide application are therefore essential for sustaining moth populations. The present study provides preliminary baseline data for Jalna district; however, long-term monitoring and molecular taxonomic studies are required for comprehensive documentation. Future investigations should include seasonal quantitative sampling, host plant association studies, and ecological interaction analysis.

5. Conclusion

The present investigation documented rich moth biodiversity from Jalna district, Maharashtra, with 72 species under 14 families recorded during the study period. Family Erebidae was dominant followed by Crambidae and Geometridae. Seasonal abundance was highest during monsoon and post-monsoon months due to favourable climatic conditions and vegetation growth. The findings highlight the ecological importance of moths in semi-arid ecosystems and emphasize the necessity for biodiversity conservation in rapidly changing agricultural landscapes. The study provides valuable baseline information for future faunal surveys, ecological assessments, and conservation planning in the Marathwada region of Maharashtra.

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1-Spodoptera litura

2-Achaea janata

3-Eudocima materna

4 -Asota caricae

5-Utetheisa pulchella

6-Cnaphalocrocis medinalis

7-Agrius convolvuli

8-Hippotion Celerio

Plate 1: Showing the diversity of moth collected and preserved during the study