Curriculum Vitae

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Languages Known : English, Hindi, Bengali, Sanskrit

Academic Qualifications:

- **Ph. D. (Environment Management)** in 2019 from Guru Gobind Singh Indraprastha University on the topic "Studies on Biotic Interactions of Lepidoptera in Urban Landscapes of NCT Delhi".
- M.Sc. (Zoology, Specialization in Fish Biology) in 2008 from Miranda House, University of Delhi, India. Secured (75.8%)
- B.Sc. (Zoology Hons.) in 2006 from Maitreyi College, University of Delhi, India. Secured (73.6%)
- B.Ed. in 2009 from C.I.E, University of Delhi, India. Secured (74.5%)
- Qualified CSIR NET (Lectureship) in 2008. Roll No. 302378.

Professional Experience:

- Aug 2013-Aug 2018: Senior Research Fellow for Ph.D. at GGS Indraprastha University. Over 5 years of research experience in the field of Ecology.
- 2009-2012: Assistant Professor (Ad-Hoc) at Shivaji College and Sri Venkateswara College, University of Delhi, Delhi, India. 3 years of teaching experience at the under graduate level.
- Took practical classes for IGNOU (LSE-08) as a guest lecturer from 08.10.2009-15.10.2009 at Department of Zoology, Maitreyi College, Delhi University.

Fellowships/Scholarships Received:

- Junior Research Fellowship awarded by Guru Gobind Singh Indraprastha University (Sep2013-Oct 2015).
- Senior Research Fellowship awarded by Guru Gobind Singh Indraprastha University (Nov2015-Sep 2017).
- Indraprastha Research Fellowship awarded by Guru Gobind Singh Indraprastha University (Oct 2017-Apr 2019).

Areas of Interest:

Ecology, Biodiversity, Entomology, Evolution and Systematics, Chordata, Non-Chordata, Embryology

Techniques Known:

Light microscopy, Pollen culture, Curation of insect specimens, Statistical analysis of data using the software SPSS, MS office, Research Methodology.

Research Publications:

- Paul, M. (2021). Impact of urbanization on moth (Insecta: Lepidoptera: Heterocera) diversity across different urban landscapes of Delhi, India. Acta Ecologica Sinica,41(3):204-209.
- Paul, M. & Sultana, A. (2020). Studies on butterfly (Insecta: Lepidoptera) diversity across different urban landscapes of Delhi, India. Current Science, 118(5):819-827.
- Paul, M. (2020). Larval Host Plants of Selected Lepidoptera (Moths: Heterocera and Butterflies: Rhophalocera) of Urban Delhi. Indian Forester, 146(11):1065-1071.
- Paul, M., Singh, R. & Das, S.K. (2020). Preliminary investigation on moths (Lepidoptera: Heterocera) as pollinators in urban settlements of Delhi. International Journal of Ecology and Development,35(3):91-98.
- Paul, M., Das, S.K., Singh, R. & Pathania, P.C. (2017). Study and Updated Checklist of Moths (Lepidoptera: Heterocera) in Selected Areas of Delhi, India. International Journal of Current Research,9(8):56208-56214.
- Paul, M., Das, S.K., Singh, R. & Shashank, P.R. (2016). Moth (Lepidoptera: Heterocera) Fauna of Delhi with Notes on Their Role as Potential Agricultural Pests. Journal of Entomology and Zoology Studies,4(2):435-438.

Non – Research Publications:

- Short science fiction “Kiku, the caterpillar” published in the popular science magazine ‘Science Reporter’ by NISCAIR, 2021,58(03):40-41.
- Short science fiction “The girl and the glowing tree” published in the popular science magazine ‘Science Reporter’ by NISCAIR, 2021,58(06):48-50.

Conference Proceedings:

Climate Change, Resource Conservation and Sustainability Strategies: A Study on Faunal Diversity of Guru Gobind Singh Indraprastha University Campus, Dwarka, New Delhi. Shubhi Malik, Mandeep Kaur, Manish Joshi and Monalisa Paul at Guru Gobind Singh Indraprastha University, Vol 1, No 1, 2017.ISBN:978-93-84871-086.

National/ International Conferences Attended

- Oral presentation on “Impact of Urban Green Spaces on the Biodiversity of Butterflies in the City of Delhi’’ at the International Conference on Green Infrastructure: Nature based Solutions for Sustainable and Resilient Cities held at Orvieto, Italy,4th -7th April,2017.
- Oral presentation (Best Oral Presenter) on “Preliminary Checklist of Moths of Delhi and their role as Potential Agricultural Pests’’ at the International Conference on Science Emerging Scenario and Future Challenges (SESFC-2016) held at Dharamshala, Himachal Pradesh, 11th - 12th June,2016.

Workshops Attended:

- Participated and contributed as a Rapporteur in the conference on “International Conference on Environment’’ on 3rd -4th November 2017 organized by National Green Tribunal (NGT) at Mavalankar Hall, Constitution Club of India, New Delhi, India.
- Participated in the workshop “Young Ecologists Talk & Interact’’ on 17th -20th January 2016 at Amity University, Delhi NCR, India.

Acta Ecologica Sinica 41 (2021) 204–209

Contents lists available at ScienceDirect

Acta Ecologica Sinica

journal homepage: www.elsevier.com/locate/chnaes

Impact of urbanization on moth (Insecta: Lepidoptera: Heterocera) diversity across different urban landscapes of Delhi, India

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ARTICLE INFO

Article history:
Received 16 December 2020
Received in revised form 25 January 2021
Accepted 25 January 2021

Available online 13 February 2021

Keywords:
Biodiversity
Delhi
India
Lepidoptera
Moths
Urbanization

ABSTRACT

The present study deals with the diversity of moths along with the contrasting six selected landscapes and three seasons in Delhi, India for the years 2015–16 and 2016–17. Among the 51 species of moths recorded, relative abundance of family Noctuidae (61%) was found to be the highest followed by Erebidae (21.6%) and Crambidae (13%). Species diversity was found to be the highest during pre-monsoon season, whereas among the study sites Dwarka not only had the highest relative abundance of moth species (26%) but also the highest biodiversity indexes. Prior to this study in Delhi, only documentation of this faunal group, mostly in the form of occasional observations or reporting or compilation of checklists were done which have their own significance. The findings of this study indicate the significance of the urban green areas in the city to support a wide array of moths.

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Studies on butterfly (Insecta: Lepidoptera) diversity across different urban landscapes of Delhi, India

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The present study deals with the diversity of butterflies along with the contrasting six selected land-use types and three major seasons in Delhi for the years 2015–16 and 2016–17. Among the 40 species of butterflies recorded, family Nymphalidae (13 spp.) showed the highest species diversity. Species richness was found to be the highest during monsoon season, whereas among the six different study sites, Aravalli Biodiversity Park, New Delhi had the highest biodiversity index. Earlier studies have been confined up to species listing and documentation, whereas mathematical interpretations through biodiversity indices concerning increasing urbanization were neglected. The findings of this study indicate the significance of green patches within urban infrastructure in the cities to support a wide array of butterflies.

Keywords: Biodiversity, butterflies, green areas, landscape, urban.

URBAN expansion is threatening biodiversity globally by destroying the natural and seminatural habitats and increasing the levels of anthropogenic disturbance[1]. Urbanization in cities has generated many fragmented and concrete lands at a rapid pace, while very few places have been recreated as green areas for the conservation of biodiversity of local flora and fauna. Butterflies being poikilotherms respond to such environmental changes sharply with a decline in their population diversity and hence are considered as an important section of biodiversity because they have considerable resonance with both the general public and decision-makers[2]. While greenery in urban areas may reduce the impact of urbanization on biodiversity, it is often over-managed and ends up in small, fragmented patches which may be isolated. Effective management strategies for different urban landscapes require proper understanding of the ecology and habitat requirements of all relevant taxa. Yet, little is known of how invertebrates and, in particular, lepidopteran assemblages utilize urban landscapes despite their common occurrence. They provide the best rapid indicators of habit quality being sensitive indicators of climatic change[3]. Longstaff and Müller[4] recorded 14 species of butterflies, which was a pioneering work on the Delhi butterflies. Later Jandu[5]; Donahue[6] and Ashton[7] contributed to the lepidopteran list. Sevastopulo[8] critically reviewed the earlier works of Delhi butterflies briefly. In 1997, an annotated list of 90 species of butterflies was recorded[9], whereas in 2004, 86 species of butterflies from all over Delhi were listed[10]. In recent years, 24 butterflies[11] from Guru Gobind Singh Indraprastha University campus, Dwarka, Delhi have been reported[11], whereas 2017 witnessed a total of 115 butterflies from all over Delhi region[12], which is a positive sign for the ecological health of the city.

Rapid urbanization in Delhi has directly or indirectly affected the biodiversity thriving in urban landscapes of the city. With encroachment of the Aravalli hills and ridge portions for the mushrooming anthropogenic needs, the total green cover of Delhi has been reduced to 299.77 sq.km (ref. 13). The urban population of Delhi has increased from 0.41 million in 2001 to 16.7 million in 2011, and urban area from 200.52 sq. km in 1951 to 1113.65 sq. km in 2011 (refs 14, 15). Study of land-use and land-cover change of Delhi in 2013 showed that between 1989 and 2011, the urban or built-up area of this region had increased from 25.17% to 45.18%, dense vegetation had decreased from 31.73% to 22.47% and sparse vegetation had reduced from 37.40% to 29.37% (ref. 16). This indicates the rapid rate of urbanization in this region during the last two decades, which includes drastic increase in human settlements. The negative effects of urbanization on species diversity have been

Figure 1. Location map of Delhi, India.

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Indian Forester, **146** (11) : 1065-1071, 2020
DOI: 10.36808/if/2020/v146i11/150248

ISSN: 0019-4816
eISSN: 2321-094X

Larval Host Plants of Selected Lepidoptera

(Moths: Heterocera and Butterflies: Rhophalocera) of Urban Delhi.

The study compiles the list of larval host plants of selected butterfly and moth species of Delhi. It is based on the direct field observations and secondary data records between February 2015 to March 2016 and April 2016 to March 2017. Data were collected in three distinct periods each year i.e. (a) Pre-monsoon (Mid-February to Mid-June: comprises spring and summer), (b) Monsoon (Mid-June to Mid-September), and (c) Post-monsoon (Mid-September to Mid-February: comprises autumn and winter). This study provides an overview of more than hundred native plants and agriculturally important crops of Delhi which are the food plants of the larval stages of 40 spp. butterflies and 29 spp. of moths respectively. This investigation can help in restoration of the native flora of Delhi which is being destroyed under the clutches of urbanization. Sustainable conservation for the larval host plants in the concerned areas provides a useful foundation for urban greenery.

Key words: Butterflies, Delhi, Host Plants, Larva, Moths

It is vital to conserve wild plants and their biotopes for generating 'green spaces' within the city and also crucial for preserving Lepidoptera diversity as urban greening is the need of the hour.

Introduction

Lepidoptera (scaled wing insects) is a holometabolous insect group comprises of four stages in their life cycle-egg, larva, pupa and adult. Out of them, the larval stage is the voraciously feeding stage (Kehimkar, 2013). They are selective in their host plants too (Nylin *et al*., 2014). Adult Lepidopterans have to look out not only for the nectar plants for nectaring but also have to choose for the host plants for egg laying so that when larvae hatch out of the eggs, they get their host plants to chew as foods (Borges *et al*., 2003; Gilbert, 1971; Baker and Baker, 1975). Food and mode of feeding are different in the larval and adult stages (Kunte, 2000). Larvae target the soft, tender and new leaves of the host plants as these are easier to chew in order to get the nutrition. In phytophagous insects, larval growth and longevity as well as fecundity of the adult are influenced by the nutritional value of the host plants (Bernays and Chapman, 1994).

This study deals with list of the larval host plants of selected butterfly (40 species) and moths (29 species) of Delhi. Moths being agricultural pests, this information will be very useful for further investigations in the area of insect pest management.

Delhi's urban area has grown from 200.52 km^2 in the 1951 to more than 658.34 km^2 in 2001 and the urban density has grown from 1,812 in 1921 to 19,473 persons per km^2 in 2001 (Mohan, 2003). Intensive development of agricultural land, expansion of suburbs and plantation of exotic species are all significant threats to the flora and fauna of a

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Received February 2020
Accepted October 2020

Preliminary investigation on moths (Lepidoptera: Heterocera) as pollinators in urban settlements of Delhi

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ABSTRACT

The present study was undertaken from January 2016 to June 2017 to find out ecological role of moths as pollinators in urban settlements of Delhi. From the study site, reference pollen slides of plants belonging to 12 angiosperm families were prepared at the time of anthesis. Moths were collected using light traps, of which 1033 individuals belonging to 33 spp. and four families were scanned for presence of pollen grains on their body parts and slides were prepared for those pollens. The study revealed the presence of pollen grains on 149 individuals belonging to six spp. of Noctuidae family for plants belonging to seven families taken. Also, that among moth spp. of the area, Thysanoplusia orichalcea was found to be the most frequent flower visitor followed by Acontia lucida and Chrysodeixis chalcites. Though, the present study was preliminary, the overall findings were highly encouraging as the study established possible role of moths in 'pollination network' for plants in urban settlements.

Keywords: *Moths, Noctuidae, pollen grains, Delhi.*

Journal of Economic Literature (JEL) Classification Number: Q570

1. INTRODUCTION

Pollination is one of the fundamental ecological processes and insects are the one of the major pollinating agents in terrestrial ecosystems throughout the world (Faegri and Van der Pijl 1979; Labandeira 2013; Borges et al. 2016). Among insects Lepidoptera are the potent pollinators after Hymenoptera and Diptera (Winfree et al. 2011). Though Lepidopterans perform an imperative functional role as pollinators throughout the day, butterflies mostly act as diurnal pollinators, whereas moths, in particular act as nocturnal pollinators (Philipp et al. 2006; Devoto et al. 2011; Willmer 2011;

Journal of Entomology and Zoology Studies 2016; 4(2): 435-438

Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(2): 435-438
© 2016 JEZS
Received: 29-01-2016
Accepted: 02-03-2016

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Moth (Lepidoptera: Heterocera) Fauna of Delhi with Notes on Their Role as Potential Agricultural Pests

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Abstract
The present study deals with moth inventory in Delhi carried out from 2014 to 2015. During the study 36 species of moths belonging to 31 genera and 7 families were added to the existing moth fauna of Delhi. After the present study, the moth fauna of Delhi comprises a total of 47 species belonging to 42 genera and 9 families. Among these, species richness was found to be highest for family Noctuidae (17 spp.) followed by Erebidae (11 spp.) and Sphingidae (6 spp.). The paper also provides information about moths acting as potential agricultural pests of common vegetables and crops of Delhi region based on secondary data.

Keywords: Agricultural pests, Delhi, Heterocera, Moth

1. Introduction
Insects being largest faunal group form a major component of the biodiversity of any area and hence, documentation of this group is indispensable to any scientific study and conservation