



RESEARCH ARTICLE

STUDY AND UPDATED CHECKLIST OF MOTHS (LEPIDOPTERA: HETEROCERA) IN  
SELECTED AREAS OF DELHI, INDIA

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ABSTRACT

The present study deals with the inventory of moths in selected areas of Delhi carried out from 2014 to 2015. During the study 11 species are new reports to the moth fauna of Delhi. After the present study, the moth fauna of Delhi comprises a total of 73 species belonging to 67 genera and 9 families. Of these, species richness of family Noctuidae was found to be the highest followed by Erebidae, Geometridae, Crambidae, Sphingidae.

Key words:

Moths, Delhi,  
Human settlements,  
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INTRODUCTION

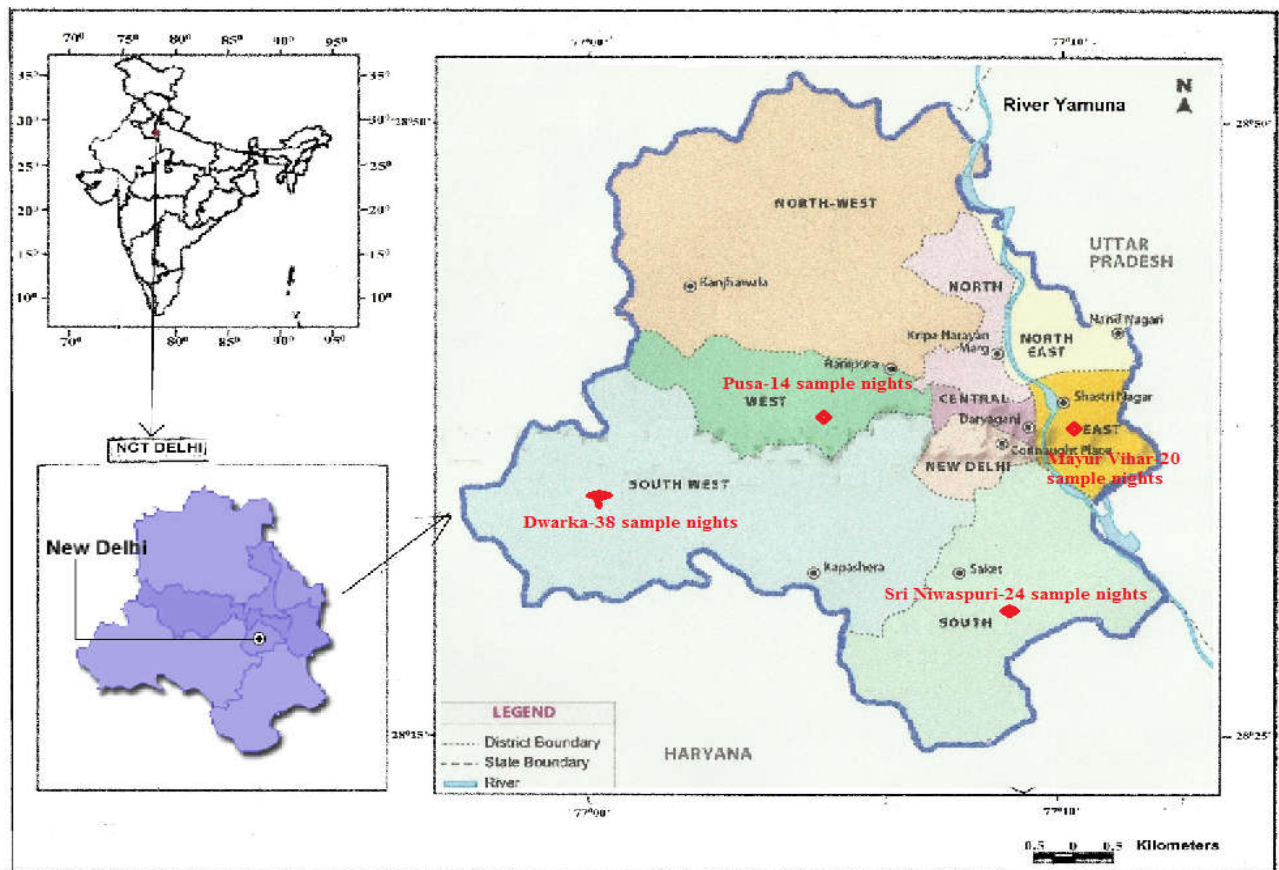
Moths (Lepidoptera: Heterocera) are one of the most diverse groups among the insects (Soggard, 2009). There are about 1, 27,000 species of moths from all over the world (Alfred et al., 1998). Among these, over 5000 species are reported from India (Bell and Scott, 1937; Cotes and Swinhoe, 1887-1889; Hampson, 1892, 1894, 1895, 1896; Chandra, 2007; Gurule and Nikam, 2013; Smetacek, 2011; Uniyal et al., 2013; Sondhi and Sondhi, 2016) and 73 species from Delhi (Ghosh and Varshney, 1997; Paul et al., 2016; Raviskar, 2016). Moths play different ecological roles throughout their life cycle; their larvae being herbivores are insect pests of crops and vegetables (Scriber and Feeny, 1979), their adults act as food sources of other animals and some as night pollinators (Holt, 2002; Elanchezhian et al., 2014; Hahn and Bruhl, 2016). They are also indicators of the environmental health of any ecosystem (Bachanda, 2014). Hence, inventory of moths and their role in any urban green space is very important. Delhi represents one of the unique urban habitats in the world that is located (28°40' N to 28°67' N; 77°14' E to 77°22' E) on the bank of river Yamuna and surrounded by Aravalli hills.

It is bound by the state of Haryana on the northern, western and southern sides and Uttar Pradesh on the eastern side. Study of land use and land cover change of Delhi (Mukhopadhyay et al., 2013) shows that between 1989 and 2011, urban or built up area of this region has increased from 25.17% to 45.18%, dense vegetation has decreased from 31.73% to 22.47% and sparse vegetation has reduced from 37.40% to 29.37%. This clearly indicates rapid rate of urbanization in this region during the last two decades and most serious effect of this urbanization is the drastic increase in the built up area that includes human settlements or residential areas. But interestingly green space and biotic interactions in urban residential areas are vital as these are directly related to ecological health of these residential areas. Understanding biotic interactions in these areas also helps to find out species which can adapt successfully to the changes due to urbanization. Keeping this in mind the present study was undertaken to document moths in selected areas of Delhi from April 2014 to December, 2015.

MATERIALS AND METHODS

The present study is further extension of the previous work carried out by Paul et al., 2016 from April 2014 to December 2015. Moths were collected in different seasons following opportunistic search and light trap collection in selected residential areas of Delhi viz., Dwarka, Sri Niwasपुरi, Mayur

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Original source of map: [www.delhi.gov.in/](http://www.delhi.gov.in/)

Vihar and Pusa (Sri Niwas Puri-24 sample nights; Mayur Vihar-20 sample nights; Dwarka -38 sample nights and Pusa-14 sample nights). Sampling was carried out twice in a month in each area. During opportunistic search all the possible microhabitats i.e. tree bark, leaves, bushes, herbs/grasses, shrubs, ceiling/wall/floor of houses, grounds and under street light posts were searched at evening hours (6-9 pm). Light trap was also set during the same time period using a 160W mercury vapour bulb over a 3x3m<sup>2</sup> white cloth sheet which was hung between two vertical poles. The moths sitting on the white cloth were picked into the killing bottles containing chloroform (CHCl<sub>3</sub>). Later they were stretched properly using entomological pins and have been kept properly in the insect box for later identification. Wing measurements were done in millimeters by measuring the length of the distance between the two forewing tips. Identification was done using manuals of Bell and Scott (Bell and Scott, 1937) and Hampson (Hampson, 1892, 1894, 1895, 1896).

## RESULTS AND DISCUSSION

In present study 11 new species of moths belonging to 10 genera and 4 families were recorded and are added to the existing moth fauna of Delhi (Table 1). Among these, species richness was found to be the highest for the family Noctuidae (26 spp.) followed by Erebidae (16 spp.), Geometridae (11 spp.), Crambidae (8 spp.), Sphingidae (8 spp.), Eupterotidae, Lasiocampidae, Pyralidae and Zyganidae each having 1 spp. (Figure 1). After the present study, the moth fauna of Delhi comprises a total of 73 species, 67 genera and 9 families. Polyphagous nature of Noctuidae Sivasankaran *et al.* (2011). members may account for their higher species richness (Paul *et al.*, 2016). (Sivasankaran *et al.*, 2011) account for their higher species richness. The study also revealed that for the seasonal

data of the moths, the highest diversity was found during pre-monsoon (Sanyal *et al.*, 2013) or summer season (April-May) followed by monsoon and post monsoon or winter. Winter season witnesses the least number of the moth species, reason being they are poikilotherms; hence they might continue in their pupa stages and wait for the rise in temperature and photoperiod for their population outbreak as adult (Lees, 2016). Hence, maximum number is seen in the summer season. We expect many more species from the area in future through systematic surveys covering all the seasons of the year and that will no doubt help to understand overall species diversity as well as seasonal variations in moth abundance in this region and underlying biotic interactions. We could only get *Chiasmia fidoniata*, *Euproctis lunata*, *Trigonodes hyppasia* and *Dichagyris flammatrix* listed by Ghosh and Varshney in 1997. In our twenty one months (April 2014-December 2015) survey, we did not get the other species reported by them till date so it can be concluded that these species are becoming rare due to anthropogenic pressure in the city. Area wise distribution of moths depicts that Dwarka has the highest diversity among all the four locations, followed by the agricultural patches of Pusa, residential and commercial areas of Mayur Vihar and Sri Niwas Puri, respectively. Reason for such a trend can be the low urban and anthropogenic interference at Dwarka site which was initially an undisturbed area followed by agricultural patches and few upcoming human settlements. Najafgarh canal also flows through this area which helps in the holistic development of the biodiversity of this location. Pusa is an academic and research institute where there are small pockets of agricultural farmlands for the research purpose. The presence of comparatively moderate species diversity (26 spp.) at this site despite of the frequent use of herbicides, insecticides and pesticides.

Table 1. Checklist of moth fauna of Delhi

S.No.	Genus	Common Name	Wingspan (in mm)	Season	Locality	Microhabitats
Superfamily :Bombycoidea						
Family: Eupterotidae						
1.	<i>Eupterote fabia</i> (Cramer, 1779)	Monkey moth	84	Monsoon	Dwarka	House ceiling
Family :Sphingidae						
2.	<i>Acherontia styx</i> Westwood, 1848	Death's-headHawk moth	104	Summer	Dwarka campus	<i>Cynodon dactylon</i>
3.	<i>Agrius convovuli convovuli</i> (Linnaeus, 1758)	-			Ghosh and Varshney's report	
4.	<i>Clanis phalaris</i> (Cramer, 1777)	-	115	Summer	Dwarka campus, New Delhi	House wall
5.	<i>Hippotion celerio</i> (Linnaeus, 1758)	Vine /silver striped Hawk Moth	78	Summer	Dwarka campus, New Delhi	Bark of Aurocaria sp
6.	<i>Psilogramma menephron</i> (Cramer, 1780)*	Privet Hawk Moth	90	Summer/ Monsoon	Dwarka	<i>Cynodon dactylon</i>
7.	<i>Psilogramma sp.</i> Rothschild & Jordan, 1903	-	86	Summer	Janakpuri, New Delhi	<i>Cynodon dactylon</i>
8.	<i>Theretra oldenlandiae</i> (Fabricius, 1775)	Impatiens Hawk Moth	70	summer	Dwarka campus, New Delhi	<i>Petunia sp.</i>
9.	<i>Theretra silhetensis</i> (Walker, 1856)*	Brown-Banded Hunter	57	Summer/Monsoon	Dwarka	Flood lights of Campus
Superfamily :Geometroidea						
Family :Geometridae						
10.	<i>Chiasmia frugaliata</i> Guenee, 1858*	-----	27-28	Winter end -Summer beginning period Monsoon end -winter beginning period	Dwarka, Pusa	Light trap
11.	<i>Chiasmia fidoniata</i> (Guenee, 1858)				Ghosh and Varshney's report	
12.	<i>Chiasmia sp.</i>				Rashtrapati Bhawan	
13.	<i>Cleora acaciaria</i> (Boisduval, 1833)	-	30	Winter end -Summer beginning period Monsoon end -winter beginning period	Dwarka, New Delhi	Light trap
14.	<i>Cleora cornaria</i> Guenee, 1885	-	35	Winter end -Summer beginning period Monsoon end -winter beginning period	Dwarka, New Delhi	Light trap
15.	<i>Istrugia disputaria</i> (Guenee, 1858)				Ghosh and Varshney's report	
16.	<i>Pelagodes veraria</i> Guenee, 1858				Rashtrapati Bhawan	
17.	<i>Rhometra sacraria</i> Linnaeus, 1767*	-----	25-27	Winter end -Summer beginning period Monsoon end -winter beginning period	Dwarka, Sri Niwaspuri, Pusa	Light trap
18.	<i>Scopula sp.</i> Schrank, 1802				Rashtrapati Bhawan	
19.	<i>Thalassodes quadraria</i> (Guenee, 1857)				Rashtrapati Bhawan	
20.	<i>Traminda mundissima</i> (Walker, 1861)				Rashtrapati Bhawan	
Family: Lasiocampidae						
21.	<i>Trabala vishnou</i> (Lefebvre, 1827)		50	Monsoon	Dwarka campus, New Delhi	<i>Cynodon dactylon</i>
Superfamily: Noctuoidea						
Family :Erebidae						
22.	<i>Achaea janata</i> (Linnaeus, 1758)	Castor semi looper	60	Summer	Mahavir enclave, New Delhi	Light trap
23.	<i>Amata cyssea</i> Stoll, 1782	Handmaiden moth	28-30	Summer	Dwarka, Pusa	House wall
24.	<i>Anomis flava</i> (Fabricius, 1775)	<i>White pupillied scallop moth</i>			Rashtrapati Bhawan	
25.	<i>Argina astrea</i> (Drury, 1773)				Ghosh and Varshney's report	
26.	<i>Asota ficus</i> Fabricius, 1775	-----	49	Monsoon	Kashmere Gate, Pusa, Delhi	Light trap
27.	<i>Cretonotos gangis</i> (Linnaeus, 1763)	Tiger moth	40	Monsoon	Dwarka campus, New Delhi, Rashtrapati Bhawan.Pusa	<i>Cynodon dactylon</i>
28.	<i>Dysgonia crameri</i> (Moore, 1885)*	-----	39	Summer/Monsoon	Dwarka, Mayur Vihar, Pusa	Light trap
29.	<i>Dysgonia torrida</i> (Guenee, 1852)	Jigsaw moth	41	Summer	Dwarka, Mayur Vihar, Sri Niwaspuri, Pusa	Light trap, <i>Cynodon dactylon</i>

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30.	<i>Eublemma anachoresis</i> (Wallengren,1863)					Rashtrapati Bhawan	
31.	<i>Euproctis lunata</i> Walker,1855					Ghosh and Varshney's report	
32.	<i>Hypena</i> sp.	Snout moth				Rashtrapati Bhawan	
33.	<i>Lymantria</i> sp. Hubner,1819	Tussock moth	25	Monsoon		Dwarka campus, New Delhi	Light trap
34.	<i>Ophiusa triphaenoides</i> (Walker,1858)	-	53	Summer		Dwarka campus, New Delhi	Light trap
35.	<i>Spirama helicina</i> (Hubner,1831)	Owlet moth				Rashtrapati Bhawan	
36.	<i>Spirama retorta</i> (Clerk,1764)	Indian owlet moth	60	Monsoon		Dwarka campus, New Delhi	<i>Cynodon dactylon</i>
37.	<i>Trigonodes hyppasia</i> (Cramer,1779)	Semi looper					
38.	<i>Utethesia pulchella</i> (Linnaeus ,1758)	Crimson Speckled	31	Winter end –summer beginning		Mahavir enclave, New Delhi,Pusa	leaf of <i>Acacia</i> sp.,Light trap
<b>Family :Noctuidae</b>							
39.	<i>Acontia lucida</i> (Hufnagel,1766)	Pale shoulder	27	Summer		Kashmere Gate, Delhi	Light trap
40.	<i>Agrotis ipsilon</i> (Hufnagel,1766)	Dark sword grass/black armyworm	47	Summer/Monsoon		Dwarka campus, New Delhi,Pusa	Light trap
41.	<i>Attatha ino</i> (Drury,1782)*		33-34	Summer		Dwarka, Mayur Vihar, Pusa	Light trap
42.	<i>Autographa nigrisigna</i> (Walker,1857)*	Beet worm	36	Summer		Dwarka, Pusa	Light trap
43.	<i>Chrysodeixis acuta</i> (Doubleday, 1843)*	Trumbridge Wells Gem	35	Summer/Monsoon		Dwarka campus, New Delhi, Pusa	Light trap
44.	<i>Chrysodeixis chalcites</i> (Esper,1789)	Tomato looper/Golden twin spot moth	35	Summer /Monsoon		Dwarka, Mayur Vihar, Sri niwaspuri, Pusa	Light trap, House wall
45.	<i>Chrysodeixis eriosoma</i> (Doubleday, 1843)*	Green garden looper	34	Summer/ Monsoon		Dwarka, Mayur Vihar, Pusa	Light trap
46.	<i>Ctenoplusia albostrata</i> (Bremer & Grey, 1853)*	-----	31	Summer		Dwarka, Pusa	Light trap
47.	<i>Digama hearseyana</i> Moore ,1859	-----	34	Monsoon		Dwarka, New Delhi, Pusa	Light trap
48.	<i>Dichagyris flammata</i> (Schiffenmuller,1775)	The black collar moth				Ghosh and Varshney's report	
49.	<i>Erythroplusia pyropia</i> Butler,1879					Rashtrapati Bhawan	
50.	<i>Earias insulana</i> (Boisduval,1833)	Cotton spotted bollworm				Ghosh and Varshney's report	
51.	<i>Helicoverpa armigera</i> (Hubner,1809)	Cotton bollworm	35	Summer/Monsoon		Dwarka, Mayur Vihar, Sri Niwaspuri, Pusa	Light trap, <i>Tridax procumbens</i>
52.	<i>Helicoverpa assulta</i> (Guenée, 1852)	Oriental tobacco budworm	34	Summer		Dwarka campus, New Delhi, Pusa	Light trap
53.	<i>Helicoverpa peltigera</i> Denis & Schiffenmuller, 1775	Native bud worm	34	Summer/Monsoon		Dwarka, New Delhi	Light trap
54.	<i>Metachrostis badia</i> Swinhoe ,1886					Ghosh and Varshney's report	
55.	<i>Mythimna loreyi</i> (Duponchel,1827)	Maize caterpillar	34	Summer		Dwarka, Mayur Vihar, Sri Niwaspuri, Pusa	Light trap
56.	<i>Mythimna separata</i> Walker,1865	Oriental armyworm	45	Summer		Dwarka, Mayur Vihar, Sri Niwaspuri, Pusa	Light trap
57.	<i>Oraesia emarginata</i> (Fabricius,1794)	Fruit piercer				Rashtrapati Bhawan	
58.	<i>Pandesma</i> sp.	-----	37	Monsoon		Dwarka campu, New Delhi	Light trap
59.	<i>Spodoptera exigua</i> (Hubner,1808)	Beet armyworm	30	Summer/Monsoon/winter		Dwarka, Mayur Vihar, Sri Niwaspuri, Pusa	Light trap

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60.	<i>Spodoptera litura</i> (Fabricius,1775)	Oriental leaf worm moth	35	Summer/Monsoon/winter	Dwarka, Mayur Vihar, Sri Niwaspuri, Pusa	Light trap
61.	<i>Thysanoplusia daubei</i> Boisduval, 1840*	-----	21-22	Summer	Dwarka, Sri Niwas Puri, Pusa	Light trap
62.	<i>Thysanoplusia orichalcea</i> (Fabricius,1775)	Golden Plusia	38-39	Summer	Dwarka, Mayur Vihar, Sri Niwaspuri, Pusa	Light trap, <i>Cynodon dactylon</i>
63.	<i>Xestia sp.</i> ( Hübner, 1790)	-----	-	Summer	Dwarka campus, New Delhi	<i>Cynodon dactylon</i>
<b>Superfamily :Pyraloidea</b>						
<b>Family :Crambidae</b>						
64.	<i>Botyodes diniasalis</i> (Walker,1859)	Grass moth			Rashtrapati Bhawan	
65.	<i>Cnaphalocrocis medinalis</i> (Guenee,1854)	Rice leaf roller			Rashtrapati Bhawan	
66.	<i>Cnaphalocrocis sp.</i> Lederer, 1863	Rice borer	37	Winter	Dwarka campus, New Delhi	Light trap
67.	<i>Diphania indica</i> (Saunders,1851)	Cucumber moth	27	Summer-Monsoon-Winter	Dwarka, Mayur Vihar, Sri Niwaspuri, Rashtrapati Bhawan, Pusa	Light trap, House Wall
68.	<i>Gadessa nilusalis</i> (Walker,1859)	Grass moth			Rashtrapati Bhawan	
69.	<i>Maruca vitrata</i> (Fabricius ,1787)	Bean pod moth	15	Summer-Monsoon-Winter	Dwarka, Mayur Vihar, Rashtrapati Bhawan, Sri niwaspuri, Pusa	Light trap, <i>Cynodon dactylon</i>
70.	<i>Sameodes cancellalis</i> (Zeller,1852)	Grass moth			Rashtrapati Bhawan	
71.	<i>Spoladea recurvalis</i> (Fabricius, 1775)	Beet webworm moth	22	Monsoon	Mahavir enclave, New Delhi; Rashtrapati Bhawan	Light trap
<b>Family :Pyralidae</b>						
72.	<i>Pristarthria akbarella</i> (Ragonot, 1888)					Ghosh and Varshney's report
<b>Superfamily :Zygaenoidea</b>						
<b>Family :Zygaenidae</b>						
73.	<i>Campylotes histrionicus</i> Westwood,1840					Ghosh and Varshney's report

\*New reports

Summer: March -June-, Monsoon: July- September, Winter:Mid October -February

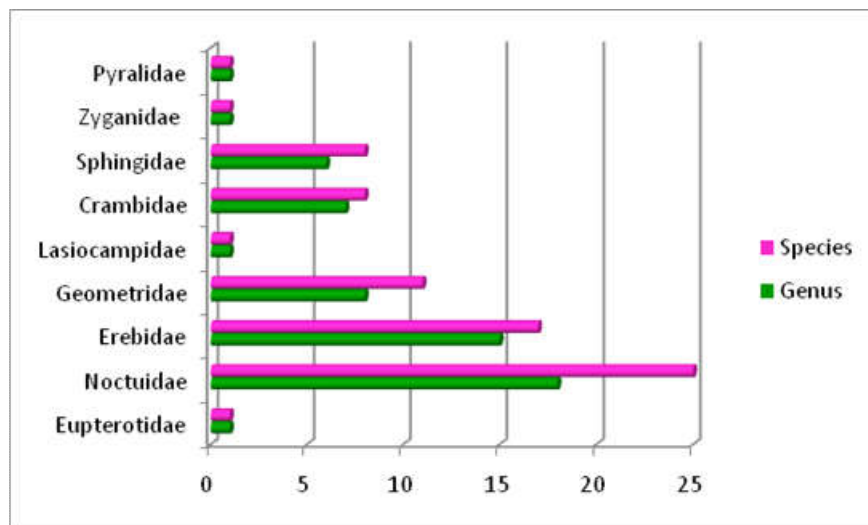


Fig.1. Family wise distribution of the moth diversity in Delhi

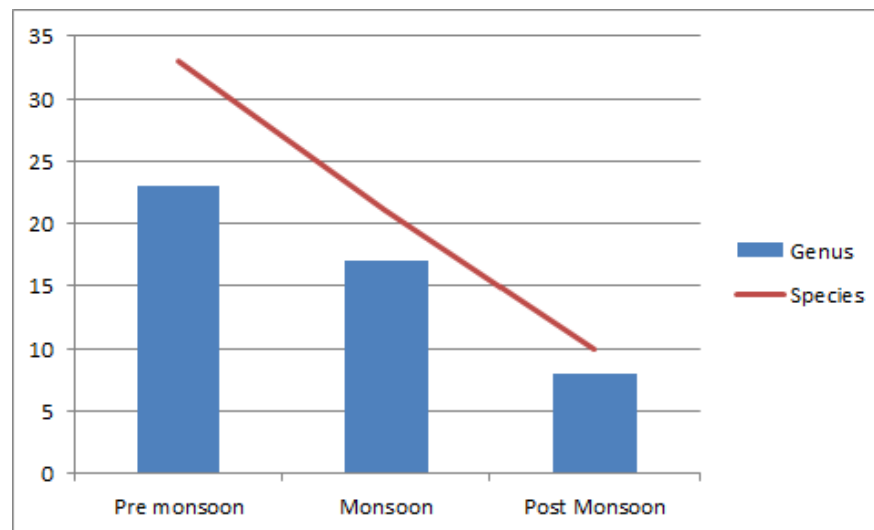


Fig.2. Seasonal distribution of the moths in Delhi

Table 2. Istration of moths in Delhi at different sampling sites

Location	Family	Genus	Species
Dwarka	7	31	41
Pusa	4	19	26
Mayur Vihar	3	9	13
Srinivasपुरi	4	9	12

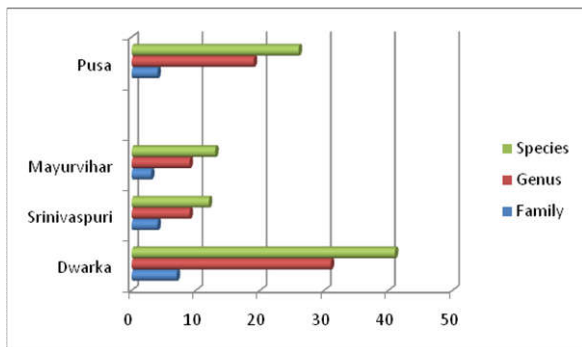
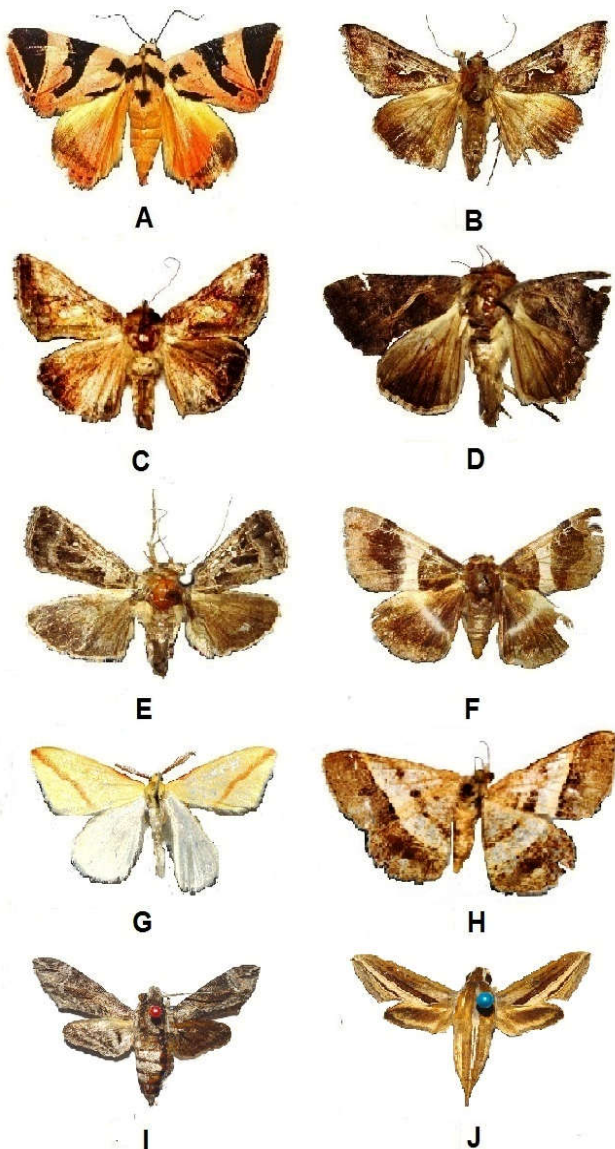


Fig. 3. Moth diversity in Delhi at different sampling sites



A-E –Noctuidae: (A) *Attatha ino*; (B) *Autographa nigrisigna*; (C) *Chrysodeixis eriosoma*; (D) *Ctenoplusia albostrigata*; (E) *Thysanoplusia daubei*; F-Erebidae (F) *Dysgonia crameri*; G-H-Geometridae: (G) *Rhodometra sacraria*; (H) *Chiasmia frugaliata*; I-J-Sphingidae: (I) *Psilogramma menephron*; (J) *Theretra silhetensis*

Fig. 4. Moths of Delhi in selected Human Settlements

The Mayur Vihar and Srinivas Puri being highly urbanized locations with high artificial light pollution (Macgregor *et al.*, 2015) show low biodiversity of the moths. The reason can be of unequal sampling nights as well for different locations. Delhi being the urbanized capital city of the world reporting 73 species of moths is commendable on its biodiversity part.

### Conclusion

Delhi is a fast growing city which has to strike a balance between natural biodiversity and upcoming infrastructures which is a challenging. This paper is a checklist for moths and also provides a raw sketch regarding the species diversity along different land use types and seasonality of moths occurrence which further encourages to take up the challenge of finding out the moth pollination network in the city along with their native host plant relationship. Being a Heterocera researcher, it is highly recommended for the future investigators to carry out similar studies at other land use types as well spending longer duration of moth traps to narrow down the gap areas. Likewise not only mercury vapour bulbs but also ultra violet bulbs and bait traps can be used to acquire a comprehensive catalogue of the moths of Delhi which will also include micro moths. Sampling timings and short of logistics were drawbacks to the study.

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