

Effect of temperature on diversity and abundance of Heterocera (Nocturnal *Lepidoptera*) in Jhalawar, Rajasthan, India

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Abstract

Lepidoptera order was found most abundant with 3410 specimens of 111 species. Family *Erebidae* of *Lepidoptera* was identified with maximum number of 33 species followed by *Noctuidae* (24 species), *Crambidae* (21 species), *Geometridae* (18 species), *Sphingidae* (3 species), *Pyralidae* (2 species). The field collection result showed that maximum species richness 51 (45.94%) was found between 25°C - 30°C range of night mean temperature and minimum species richness of nocturnal insects was found 3 (2.70%) between 10°C - 15°C lower range of night mean temperature. Abundance of all identified 18 family of nocturnal *Lepidoptera* was 3410. Five families with maximum abundance were *Erebidae* (939), *Noctuidae* (826), *Crambidae* (803), *Geometridae* (625) and *Pyralidae* (37) while five families with minimum abundance were *Sphingidae* (11), *Eutelidae* (7), *Tineidae* (6), *Thyrididae* (5) and *Saturnidae* (2). The field collection result showed that maximum abundance 1573 (46.12%) was found between 25°C - 30°C range of night mean temperature while minimum abundance of nocturnal insects was found between 54 (1.25%) between 10°C - 15°C upper range of night mean temperature.

Keywords: Temperature, Nocturnal *Lepidoptera*, diversity, abundance

Introduction

Lepidoptera including moths and butterflies, is the largest phytophagous order and among the top species-rich orders in class Insecta, this order comprises 166, 320 described species belonging to 143 families in 43 superfamilies distributed globally. In India, *Lepidoptera* are known by 13,199 species in 3,672 genera, 101 families and 31 superfamilies. Of which, 1,388 species are butterflies and the remaining 11,811 (90%) species are Heterocera (moths) (Singh *et al.*, 2025) ^[1]. Moths play important roles in many ecosystems as pollinators, herbivores, and prey for a wide range of species such as birds and bats (Vaughan N, 1997; Wickramasinghe LP, 2004) ^[2, 3]. Species richness and abundance per night were mainly influenced by night temperature, humidity and lamp type. With a limited sample size (10 nights) it was slightly better to concentrate sampling on the warmest summer nights, but with more sampling nights it was slightly better to sample during the warmest nights (Jonason *et al.*, 2014) ^[4]. Warming positively affects larval growth and survival due to higher metabolic rates (Bale *et al.* 2002; Jamieson *et al.* 2012) ^[5, 6]. For cold-blooded organisms, including insects, the relationships between ambient temperature and development, survival and reproduction scale up from daily or even hourly effects on individuals to seasonal patterns of phenology (Schwartz, 1998; Visser and Both, 2005) ^[7, 8]. The findings demonstrated that temperature strongly influenced the catches. Numbers of insects caught at streetlamps on cool nights decreased nearly to zero, and on warm nights they rose strongly, contributing to sharp peaks (Eisenbeis 2001a, 2001b) ^[9, 10].

Materials and Method

Jhalawar district of Rajasthan state was selected for this research work. The collection of nocturnal insects carried once in a week, from June, 2020 to May, 2021. Abundance of each species was also noted from 6pm to 6am. Nocturnal

insects are attracted to light, and most research papers have found that nocturnal insects are attracted to mercury vapour bulbs in the highest numbers. Light traps were constructed at home by using materials available in the local market. A circular hole of 8 cm diameter was made in the bottom of a 10-liter transparent plastic bucket or container. A plastic funnel bottom was cut to a size of 7 cm diameter and fixed over the hole in the bottom of the bucket or container. Four holes were made on the circumference of the bottom of the bucket to tie and hang the roaches using pieces of rope. The lid of the container was placed upside down and some holes were made on its circumference so that water does not accumulate in the container during the rainy season. The cotton soaked in ethyl acetate was placed inside the container under 6 to 8 layers of newspaper. A 180-watt mercury bulb is used about half a foot above the funnel to attract insect specimens. The used light trap was hanged 10 feet above ground level. The light trap was hung on a designated night each week from 0600 pm to 0600 am. Light sheets are also a successful method for capturing nocturnal insects with the most important advantage being that researchers can selectively collect specimens relevant to their research needs. The light sheet consists of a 6x8 feet white cotton sheet suspended from a parallel rod with a 1 feet long end spread on the ground so that the insect's specimens falling down can be easily picked. The insects were collected through the light sheet by manual picking or by using a small sweep net. A 180-Watt mercury vapour bulb was used as the light source along with a parallel rod to the light sheet. The ethyl acetate chemical was used to kill trapped insects' specimens. Cotton soaked with ethyl acetate kept below 6-8 layers of papers in the insect killing container. Large size insect's specimens were stretched on stretching board while small size specimens were fixed on the tip of triangle shaped hard papers by using DPX. At the time of shipping of specimen's boxes for the species identification the boxes were marked "Dead insects for

scientific study, no commercial value” and a complete return address given on the outside of each container. To estimate the effect of Temperature on nocturnal insect’s abundance mean value of temperature for sample collecting nights were obtained from <https://www.weatherapi.com/history/q/jhalawar>.

Result and Discussion

Diversity

Lepidoptera order was found most abundant with 3410 specimens of 111 species. Family *Erebidae* of *Lepidoptera* was identified with maximum number of 33 species followed by *Noctuidae* 24 species, *Crambidae* 21 species, *Geometridae* 18 species, *Sphingidae* 3 species, *Pyralidae* 2 species and single species of *Cossidae*, *Depressariidae*, *Eupterotidae*, *Gelechidae*, *Hyblaeidae*, *Nolidae*, *Saturniidae*, *Tineidae*, *Tortricidae*, *Uraniidae*, *Thyrididae*, *Utelidae* (Table-1).

Effect of temperature on Diversity

The field collection result showed that maximum species richness 51 (45.94%) was found between 25°C - 30°C range of night mean temperature followed by 26 (23.42%) between 30°C - 35°C range and 13 (11.71%) between 20°C - 25°C range of night mean temperature (table-2). Minimum species richness of nocturnal insects was found 3 (2.70%) between 10°C - 15°C lower range of night mean temperature (table-2). The result indicates that 25°C - 30°C night mean temperature was the optimum temperature for the activity of nocturnal insects. A positive correlation was found between nocturnal insect’s species richness and temperature up to the range of optimum temperature after that decreasing in was noticed.

Abundance

Abundance of all identified 18 family of nocturnal *Lepidoptera* was 3410. Five families with maximum abundance were *Erebidae* (939), *Noctuidae* (826), *Crambidae* (803), *Geometridae* (625) and *Pyralidae* (37) while five families with minimum abundance were *Sphingidae* (11), *Eutelidae* (7), *Tineidae* (6), *Thyrididae* (5) and *Saturnidae* (2). Present research identified five species with maximum abundance were *Paraponyx fluctuosalis* (323), *Helicoverpa armigera* (205), *Cleora injectaria* (155), *Syntomoides imaon* (152) and *Agrotis ipsilon* (113) (Table-1).

Effect of Temperature on Abundance

The field collection result showed that maximum abundance 1573 (46.12%) was found between 25°C - 30°C range of night mean temperature followed by 906 (26.56%) between 30°C - 35°C range and 463 (10.74%) between 20°C - 25°C range of night mean temperature (table-2). Minimum abundance of nocturnal insects was found between 54 (1.25%) between 10°C - 15°C upper range of night mean temperature (table-2). The result indicates that 25°C - 30°C night mean temperature was the optimum temperature for the activity of nocturnal insects. A positive correlation was found between nocturnal insect’s abundance and temperature up to the range of optimum temperature after that decreasing in abundance was noticed.

Table 1: Family wise Diversity and Abundance of Nocturnal *Lepidoptera*

Sl. No.	Name of Family	Diversity (species richness)	Abundance
1	<i>Erebidae</i>	31	939
2	<i>Noctuidae</i>	25	826
3	<i>Crambidae</i>	21	803
4	<i>Geometridae</i>	17	625
5	<i>Sphingidae</i>	3	11
6	<i>Pyralidae</i>	2	37
7	<i>Depressariidae</i>	1	23
8	<i>Cossidae</i>	1	22
9	<i>Gelechidae</i>	1	19
10	<i>Nolidae</i>	1	19
11	<i>Tortricidae</i>	1	19
12	<i>Uraniidae</i>	1	18
13	<i>Hyblidae</i>	1	17
14	<i>Eupterotidae</i>	1	12
15	<i>Eutelidae</i>	1	7
16	<i>Tineidae</i>	1	6
17	<i>Thyrididae</i>	1	5
18	<i>Saturnidae</i>	1	2

Table 2: Abundance and Diversity with temperature

Temperature (°C)	Abundance	Diversity
10.1 - 15.0	54	3
15.1 - 20.0	292	8
20.1 - 25.0	463	13
25.1 - 30.0	1573	51
30.1 - 35.0	906	26
35.1-40.0	122	8

Conclusion

A positive correlation was found between nocturnal insect’s species richness as well as abundance and temperature up to the range of optimum temperature (25°C - 30°C) after that decreasing in both species richness as well as abundance was noticed.

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