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Distribution of Noctuid species (Lepidoptera, Noctuidae) in Conifer Forests of Himachal Pradesh, India

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Abstract

Owlet moths (Noctuidae) are eared in all areas of the world they have been physiologically surveyed. Noctuids are a prominent feature of terrestrial insect faunas and food webs, include innumerable species of economic importance, and display great heterogeneity in host plant specificity affecting their ecological roles and impact. The importance of a robust phylogenetic classification for ordering and understanding noctuid abundance is thus self-evident. Moths are sensitive to disturbances. This is particularly true with respect to endemic species most of them are habitat specialists. Due to continuous destruction of forests, habitats of lepidopteron have been severely affected in most of the tropical countries and now these species are slowly changing into hostile environs. In order to understand diverse ecological imbalances the community characterization was based on the richness and abundance of this family. Quantitative estimates of species diversity, evenness and richness in different locations were made using the data derived from the field surveys to maintain redundancy and resilience in the ecosystem. Relative abundance of Chirpine forest and Silver Fir was reported to have the greatest diversity, minimum diversity index is shown for Juniper, Kail and Deodar for consecutive three years. Species diversity was maximum in the year 2010; Species richness was maximum in the year 2011 and species evenness in 2011. Noctuid species are categorized into abundant, very common, common, frequent, occasional and rare, on the basis of their occurrence in different habitats. In the present study, 104 species of the family Noctuidae were collected from six different conifer forests of Himachal Pradesh located at 10 selected sites/localities spread over different elevations. An account of relative abundance of these species is given in this present paper.

Key Words: Noctuidae, relative abundance, conifer forest, species

Introduction

Insects are predominant biota on all continents and there is hardly any place on the earth, which is not invaded by these creatures. They are believed to have appeared on this planet in the Devonian period, some 200 million years ago and since then survived

the glacial periods and evolved into myriad forms. They are essentially terrestrial and are distributed through the permafrost line of the Arctic to the ice cap of the Antarctica, and through the mountain tops to the depths of caverns. They form the largest group among animals and plants in the world. It is commonly believed that 75-80 percent of the total animal species on this planet are insects (Kapoor, 1985; Ehrlich and Wilson, 1991; Varshney, 1998).

The Noctuidae forms the largest family of Lepidoptera with about 35,000 described species in more than 4,200 genera (Kitching and Rawlins, 1999). The real number of species is probably close to 50,000. It is traditionally divided into two large groups, the trifid and the quadrifid noctuids. The trifine Noctuidae is regarded as monophyletic, whereas the quadrifine Noctuidae is paraphyletic (perhaps polyphyletic). Most of the 32 subfamilies are monophyletic. In this huge and diverse family many noctuids can superficially be recognized by the generally robust body, and with a reniform and an orbicular marking most often present on each forewing. Many species-groups of Noctuidae have traditionally been considered difficult to identify, but during recent years a more up-to-date faunistic literature and new identification guides for the European fauna have been published alongside numerous articles.

The family Noctuidae is divided into numerous subfamilies, the latter fall broadly into two groups: the Trifinae and Quadrifinae. The former have vein M_2 of the hindwing weak or vestigial whereas in the Quadrifinae it is well developed. The Quadrifinae subfamilies are Herminiinae, Hypeninae, Catocalinae, Plusiinae, Stictopterinae, Eutellinae, Nolinae, Acontiinae, Cocytiinae, Rivulinae, Hypenodinae and Pantheinae. The Trifinae subfamilies are Noctuinae, Heliothinae, Hadeninae, Cucullinae, Acronictinae, Amphipyrinae, and Agaristinae (Holloway *et al.*, 1987). The family is best defined by the postspiracular position of the counter tympanal hood, the presence of an orbicular stigma within the forewing cell. As such, the family can be distinguished on the basis of the hindwing, where $S_c + R_1$ is separated from R_s and is connected with discal cell at the base (Kitching, 1984).

Lepidoptera are important herbivores, pollinators, and serve as food and hosts for multiple other organisms at higher trophic levels (Summerville and Crist, 2004; Summerville *et al.,* 2004). Lepidoptera is probably one of the most suitable groups for most quantitative comparisons between insect faunas to be valid, for the many reasons elaborated by Holloway (1980, 1984 and 1985), especially their abundance, species richness, response to vegetation and climate, their ease of sampling using light traps and relatively advanced taxonomy. Accordingly, it is being felt that much more remains to be done in their respect at regional, national and international levels. Being a megadiversity nation, the exploration of varied moth diversity is a need of the hour. The fundamental and applied importance of the Heterocera (moths) warrants all this in a systematic way.

Matherials and Methods

Various localities in Himachal Pradesh located at different altitude were surveyed during each year for the collection of Noctuid fauna. Forest Rest Houses of all localities

were chosen as an ideal site for setting up of temporary laboratory to execute the entire field work of setting light lure system, collection stretching, drying, labelling and storage of procured species of family Noctuidae of order Lepidoptera.A light lure system comprising of a 3 × 3 meters white sheet tied between a pair of vertical poles and sheet nicely illuminated by two mercury lamps of 160W each was used to attract the moths. The moths were immediately killed after their collection with ethyl acetate vapours in insect killing bottles followed by freezing treatment. In order to keep the scales intact on the body of the moths, they were removed from the bottles as soon as they were killed. Each specimen was pinned through the middle line of the thorax. Different types of pins were used for stretching the moths according to the size of specimens. This was preceded by spreading of both the wings on insect stretching boards, followed by their drying, either in the oven (45 °C) or in the improvised drying chambers. Followed by the tentative sorting in the field, each specimen was labelled, indicating the locality and date of collection. Resetting is done in the laboratory, by relaxing such specimens in the relaxing chambers (containing carboxylic acid and camphor in the ratio of 3:1), followed by drying in oven.

Methodology for analysing biodiversity

1. Regular marked trails in all conifer habitats were made during the night time, once every month. All moths species sighted were collected, identified and recorded. Identifications were confirmed from different national museums and literature. The sampling efforts in the four seasons were unequal and all moths collected over each of the month were pooled together for analysis, only relative estimates of the abundance was possible. Based on the relative abundance estimates, the moth were classified according to Rajasekhar (1992a, 1992b and 1995) as follows:

1. Abundant: >30%
2. Very Common: 20% - 30%
3. Common: 10% - 20%
4. Frequent: 5% - 10%
5. Occasional: 1% - 5%
6. Rare: < 1%.

The mean relative abundance values of all the counts in each habitat were calculated for the different species in the four seasons. Differences between the means across the habitats were tested to determine any habitat preference by the moths.

2. Trap counts were made to monitor moth populations during April to October. Two sites were selected at each habitat, such as fairly undisturbed conifer forest and disturbed conifer forests. Each of the sites was visited at least once per month and all the moths observed were recorded site-wise. Moths were also collected for identification.

Biodiversity analysis with Statistical tools:

Parameters of biological diversity; diversity indices, species richness, species dominance and evenness were calculated from the collected data..

Measurement of diversity

The type of diversity used here is E- diversity which is the diversity of species within a community or habitat. The diversity index was calculated by using the Shannon – Wiener diversity index (1949).

Diversity index = H = – H Pi In Pi
where Pi = S / N
S = number of individuals of one species
N = total number of all individuals in the sample
In = logarithm to base e

Measurement of species richness

Margalef's index was used as a simple measure of species richness (Margalef, 1958).

Margalef's index = (S – 1) / In N
S = total number of species
N = total number of individuals in the sample
In = natural logarithm

Measurement of evenness

For calculating the evenness of species, the Pielou's Evenness Index (e) was used (Pielou, 1966).

e = H / In S
H = Shannon – Wiener diversity index
S = total number of species in the sample

Results and Discussions

During the study, a total of 104 species were collected from six different conifer forest of Himachal Pradesh. The results showing maximum diversity index for Chir Pine, Chir Pine and Silver Fir for the years 2009, 2010 and 2011 respectively. The minimum diversity index is shown for Juniper, Kail and Deodar forests during the year 2009, 2010 and 2011 respectively (Table 1). Regarding species richness, maximum for Silver fir, Chir Pine and Silver Fir for the years 2009, 2010 and 2011 respectively and minimum species richness is shown for Juniper, Chilgoza and Deodar forests during the year 2009, 2010 and 2011 respectively(Table 2). Juniper, Chilgoza Pine and Silver Fir are showing maximum species evenness for the years 2009, 2010 and 2011 respectively and minimum species richness is shown for Kail, Silver Fir and Deodar forests during the year 2009, 2010 and 2011 respectively(Table 3). Dominance of species in different conifer forest during the three year study was shown differently (Table 4). In 2009, three species were found to be abundant in Juniper, Chilgoza and Kail forest. In 2010, two species were found to be abundant in Chilgoza and Kail forest. None of the species were found to be

abundant in number during 2011. The biodiversity (diversity index, species richness and evenness) of noctuid fauna in conifer forests is mainly due to the rich vegetation in this area as vegetation plays an important role for the existence of insect fauna in a community as it provides the main source of food etc. for insects. Conservation of the natural habitats is very essential for the existence of many species of lepidopterans. The survival of a large number of endemic species in a community or habitat warrants frequent monitoring of the ecological processes besides adoption of appropriate conservation strategies in order to safeguard its rich genetic diversity (Mathew and Rahmatullah, 1993). This work was an attempt to describe some aspects of biodiversity of noctuid moth fauna of Himachal Pradesh. A lot of further work is necessary in this regard and further collections are essential for getting a detailed periodic estimate of the faunal diversity of noctuid moths in this area.

Table 1 showing Shannon Winner diversity index (H) for three successive years.

FOREST	SW INDEX (Year 2009)	SW INDEX (Year 2010)	SW INDEX (Year 2011)
CHIR PINE	3.213075409	3.417430674	2.80412728
KAIL	2.364804261	2.326627562	2.54468181
DEODAR	2.642218477	2.762136041	2.381670577
CHILGOZA	2.33162447	2.437404571	2.600274472
SILVER FIR	3.09977098	2.771169641	3.409005984
JUNIPER	1.962817839	2.43446349	2.941676922

Table 2 showing Species Richness for three successive years.

FOREST	SPECIES RICHNESS (Year 2009)	SPECIES RICHNESS (Year 2010)	SPECIES RICHNESS (Year 2011)
CHIR PINE	3.32597	3.8306	2.7264
KAIL	2.571478	2.82843	2.7196
DEODAR	2.604729	3.20903	2.00806
CHILGOZA	2.457864	2.2577	2.3421
SILVER FIR	3.375	3.5301	4.07622
JUNIPER	1.944562	2.45677	3.6366

Table 3 showing Species Evenness for three successive years

FOREST	SPECIES EVENNESS (Year 2009)	SPECIES EVENNESS (Year 2010)	SPECIES EVENNESS (Year 2011)
CHIR PINE	2.6736389	2.544563	2.7264
KAIL	2.5038137	2.237715	2.7196
DEODAR	2.75999239	2.36893	2.00806
CHILGOZA	2.59273122	2.993098	2.3421
SILVER FIR	2.548325	2.197031	4.07622
JUNIPER	2.9514416	2.708425	2.27851655

Table 4: showing Species Dominance for three successive years.

FOREST	SPECIES DOMINANCE (Year 2009)	SPECIES DOMINANCE (Year 2010)	SPECIES DOMINANCE (Year 2011)
CHIR PINE	*Perigea capensis*	*Spodoptera litura*	*Trichoplusia orichalcia*
KAIL	*Bamra amblicala*	*Bamra amblicala*	*Bamra alblicala*
DEODAR	*Perigea capensis*	*Hypocala deflorata*	*Trichoplusia orichalcia*
CHILGOZA	*Luecania lauregi*	*Hypocala deflorata*	*Luecania loregi*
SILVER FIR	*Catoeala armandi*	*Sclerogenia jessica*	*Ochroplura herculea*
JUNIPER	*Hypocala deflorata*	*Polyphaenis confecta*	*Ochroplura vallesiaea*

Conclusions

This work was an attempt to describe some aspects of biodiversity of moth fauna of conifer forest in Himachal Pradesh. A lot of further work is necessary in this regard and further collections are essential for getting a detailed periodic estimate of the faunal diversity of moths in this area. Ultimately it is hoped that such work may lead to the development of standard monitoring procedures which could be of value in assessing the environmental stability of areas under cultivation for different crops and the prediction of the effect on the structure of moth populations of tropical forest destruction (Barlow and Woiwod, 1989).

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