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Research Article

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Diversity and abundance of insects in cropland of Himalayan Tarai region of Ramnagar, Uttarakhand

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ABSTRACT

Species richness, species and trophic diversity and abundance of insects were studied in a cropland of Himalayan Tarai region of Ramnagar, Uttarakhand from March, 2017 to February, 2018. A total of 28 species belonging to 4 insect orders, 28 and 9 families were collected. Herbivores, predators and scavengers constituted the insect community of which herbivores were most preponderant. The sweep net method was used to explore the diversity of insects. On the basis of total number of recorded species, Lepidoptera was the most dominant order contributing 22 species followed by Odonota, Coleopter, and Hymenoptera (2 species each), respectively. Among the different species of the order, Lepidoptera was most dominant order which constituted 79.0 % of the total collected species. Shannon diversity index ($\bar{H}$) was (2.033) followed by Evenness (0.6101) and Margalef's index (4.342), respectively. A maximum number of individuals of the butterflies was recorded during the summer season. This work also focuses on identifying the major pollinators in different crops. These efforts work towards the goal of insect diversity conservation in this particular site. So far, no inclusive work on insect fauna in the cropland of the Himalayan Tarai region of Ramnagar which is an important area of Uttarakhand state has been done.
Keywords: Insect diversity, Cropland, Sawal Deh, Ramnagar.

INTRODUCTION

Insects comprise more than 75 % of all described animal species and about 7,51,000 known species of insects which is about three-fourths of all species of animals on the planet. Earlier conducted studies demonstrated that not only the number of pollinators influences the pollination service but also the pollinator diversity has a significant effect in increasing the chance of pollination (Tscharntke and Brandl, 2004). The structure of the agricultural landscape due to rigorous cultivation exerts a major impact on the standing crop and richness of the fauna of ecosystems (Ryszkowski, 1985). Composition, abundance, and diversity of species in different crops have been the object of rigorous studies (Ryszkowski *et al*., 1993; Grutzmacher and Link, 2000).

Insects are the main components of biodiversity and are indicators of environmental degradation (Schowalter, 2000). In general, organic farming is reported to increase arthropod diversity in agricultural landscapes (Bengtsson *et al*., 2005; Hole *et al*., 2005; Smukler *et al*., 2010). Most agro-ecosystems tend to be highly disturbed and common practices like tillage, planting, application of fertilizers and pesticides, irrigation, and harvest can cause changes in average environmental conditions that change the functioning of the ecosystem (Altieri *et al*., 2005). However, the major factor responsible for the loss of insect populations during the last few decades is the widespread use of organic pesticides (ZSI 2012). Ecosystems depend heavily on insect activity and insects play crucial roles in ecosystem function, nutrient recycling, pollinating plants, dispersing seeds, maintaining soil structure and fertility, controlling populations of other organisms, provide a major food source for other organisms.

The present investigation is aimed at understanding certain structural and functional aspects of a cropland community in the Himalayan Tarai region of Ramnagar. The main objectives of the investigation were to determine species richness, species, trophic level diversity, and abundance in a cropland ecosystem from March 2017 to February 2018.

MATERIALS AND METHODS

Study Area: The study site was 1 ha of cropland. Ramnagar, known as Corbett city is a popular tourist place and municipal board in the Nainital district of Uttarakhand. It is located at 29.40^0 N 79.12^0 E and has an average elevation of 345 meters (1,132 feet) and the state of Uttarakhand is situated between $28^0\ 53^0\ 24^0$-$31^0\ 27^0\ 50^0$ N and $77^0\ 34^0\ 27^0$-$81^0\ 02^0\ 22^0$ E. It is located

approximately 65 Km from Nainital, Uttarakhand. Ramnagar is located at the foothills of the Himalayas on the bank of river Kosi. The town is well known for being the gateway to Corbett National Park and draws lots of tourist attention because of its geographical location. Ramnagar is located in the centre was selected to represent agro-ecosystem in mixed crop zone. A survey was made to select the crop fields of sugarcane, wheat, soybean, maize, paddy and mustard in Ramnagar, Uttarakhand (Fig.1).

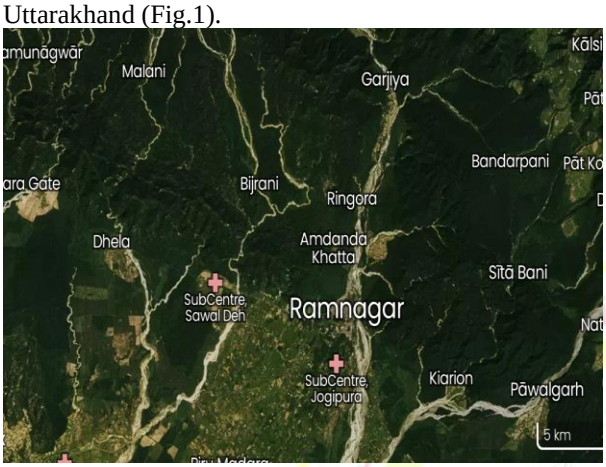

Fig. 1. Study area

Sampling Site: The study site was Sawal Deh village which is located in the Ramnagar region. It is situated 7 Km away from sub-district headquarter Ramnagar. Paddy, wheat, mustard, soybean, and maize are agricultural commodities grown in this village (Fig.2).

Fig.2. Sampling sites (Sawal Deh)

A sampling of Insects: The study was conducted from March 2017 to February 2018, in the selected field. The samples were collected from soil, ground surface plants surface, and air. The insects were collected by sweep sampling method (Gadagkar *et al*., 1990). Collection is done each month by using standard protocols. The dead insects were transferred into boxes for temporary storage. The sacrificed insects were then properly pinned by steel pins and kept for proper drying.

Data Analysis:

I. Shannon-Wiener diversity Index

The species diversity was calculated using Shannon Wiener Index ($\bar{H}$)

$$\bar{H}(S) = -\sum_{i=1}^{s} pi \log pi$$

Where pi = fraction of total population made up of species I,

s = total number of species encountered

i = proportion of species

II. Evenness Index

It was calculated as per Hill, i.e,

E = H/ In S

Where S = total number of species

H = Index of species

III. Margalef's Index

Species richness was calculated using Margalef's Index

Margalef's Index = (S-1)/ In N

Where S = total number of species

N = total number of individuals in the sample

In = natural logarithm

RESULTS AND DISCUSSION

During the study period a total of 28 species belonging to 9 families and the 4 orders were recorded from Sawal Deh, Ramnagar, Uttarakhand (Table 1, Fig.3). Based on number of species collected, 86 % were herbivores, 11 % predators, 3 % scavengers; based on a number of individuals, 93.63 % were herbivores, 5.58 % predators, and 0.79 % scavengers (Table 4, Fig. 5). Ryszkowski *et al*., (1993) have also reported that herbivores were the dominant insect group in comparison to other trophic levels in agro-ecosystems.

Percent contribution of a relative number of individuals and species of different families of insects recorded from the study area (Table 2, Fig.5). Similarly, the percent contribution of relative number of individuals and species of different orders of insects (Table 3, Fig. 4 & 5). Order Lepidoptera, Pieridae, and Nymphalidae were the most dominant family which constituted 29.48 % and 25.10 % of the total collected insects. Diversity indices showed that the Shannon-Wiener diversity index was (2.033) followed Evenness was (0.6101) and Margalef's index was (4.342) in Table 3.

Insect diversity varies with seasons. They are abundant for a few months and are rare or absent during extreme summer or winter seasons. During the present study, which is very similar to the findings of Ghani and Malik, (2020) have reported 15 species belonging to 9 families and 896 individuals of insect from District Sialkot, Pakistan. Atmowidi *et al*., (2007) observed 19 species belonging to 11 families and 5,955 individuals from Bogor, Indonesia. Tewari *et al*., (2006) have reported 45 species belonging to 9 insect orders from the Kumaun region, Uttaranchal. Dev *et al*., (2009) have reported 88 species belonging to 9 insect orders and 33 families from Kumaun region, Uttarakhand. There is evidence that

ecological influences on diversification rates are important drivers of study. The present findings concluded that the mustard flowers are highly attractive to a multitude of insect species, especially those belonging from Hymenoptera and Lepidoptera. Our results indicate a diversity and abundance of insects, especially bees, play a significant role in the fruit set of mustard. It has been predicted probably for the very first time in the crops of Sawal Deh.

Fig.3. Insects Photo Plate

Table 1. Taxonomic composition and number of individuals of different species of insects were collected in the study area.

S. No	Taxonomic Composition	No. of Individuals	% of Individuals
	Order: Lepidoptera, Family: Pieridae		
1.	*Pieris canidia* Sparrman	12	2.390
2.	*Catopsilia pyracantha* Linnaeus	20	3.984
3.	*Catopsilia pomona* Fabricius	10	1.992
4.	*Eurema brigitta* Cramer	57	11.355
5.	*Pieris brassicae* Linnaeus	42	8.367
6.	*Pareronia valeria* Cramer	4	0.797
7.	*Cepora nerissa* Fabricius	3	0.598
	Family: Nymphalidae		
8.	*Vanessa caschmirensis* Kollar	1	0.199
9.	*Cynthia cardui* Linnaeus	4	0.797
10.	*Junonia lemonias* Linnaeus	50	9.960
11.	*Junonia almana* Linnaeus	6	1.195
12.	*Junonia orithya* Linnaeus	1	0.199
13.	*Junonia pita iphita* Cramer	4	0.797
14.	*Euploea core core* Cramer	50	9.960
15.	*Danaus chrysippus* Linnaeus	9	1.793
16.	*Parantica sita* Stoll	1	0.199
	Family: Papilionidae		
17.	*Graphium doson axionides*	60	11.952
18.	*Papilio demoleus* Linnaeus	30	5.976
19.	*Papilio polytes* Linnaeus	4	0.797
20.	*Aporia agathon*	3	0.598
	Family: Lycaenidae		
21.	*Zizeeria* sp.	50	9.960
22.	*Talicada nyseus* Guerin-Meneville	13	2.590
	Order- Coleoptera, Family: Scarabaeidae		
23.	*Sisyphus hirtus* Wiedemann	4	0.797
	Family: Coccinellidae		
24.	*Coccinella septempunctata* Linnaeus	20	3.984
	Order- Hymenoptera, Family: Apidae		
25.	*Apis cerana* Indica	30	5.976
26.	*Bombus* sp.	6	1.195
	Order: Odonata, Family: Libellulidae		
27.	*Orthetrum chrysis* Selys	5	0.996
	Family: Calopterygidae		
28.	*Calopteryx maculate*	3	0.598
	Total	502	100.0

Table 2. Percent contribution of the relative number of individuals and species of different families of insects recorded from the study area

Family	No. of species	% of species	No. of Individuals	% of Individuals
Pieridae	7	25.00	148	29.48
Nymphalidae	9	32.14	126	25.10
Papilionidae	4	14.29	97	19.32
Lycanidae	2	7.14	63	12.55
Scarabaeidae	1	3.57	4	0.80
Coccinellidae	1	3.57	20	3.98
Apidae	2	7.14	36	7.17
Libellulidae	1	3.57	5	1.00
Calopterygidae	1	3.57	3	0.60
Total	28	100.00	502	100.00

Table 3. Percent contribution of the relative number of individuals and species of different orders of insects recorded from the study area

Order	No. of species	% of species	No. of Individuals	% of Individuals
Lepidoptera	22	79.0	434	86.5
Coleoptera	2	7.0	24	4.8
Hymenoptera	2	7.0	36	7.2
Odonata	2	7.0	8	1.5
Total	28	100	502	100

Table 4. Trophic level composition in terms of number of individuals and their percent contribution to the total number of individuals in the cropland

S. No.	Trophic level	No. of species	% of species	No. of individuals	% of individuals
1	Herbivores	24	86	470	93.63
2	Predators	3	11	28	5.58
3	Scavengers	1	3	4	0.79
		28	100	502	100

Table 5. Diversity indices of insect in a crop of Sawal Deh

	2017-2018
No. of species	28
No. of individuals	502
Abundance	502
Shanon-Weiner Index	2.033
Evenness	0.6101
Margalef	4.342

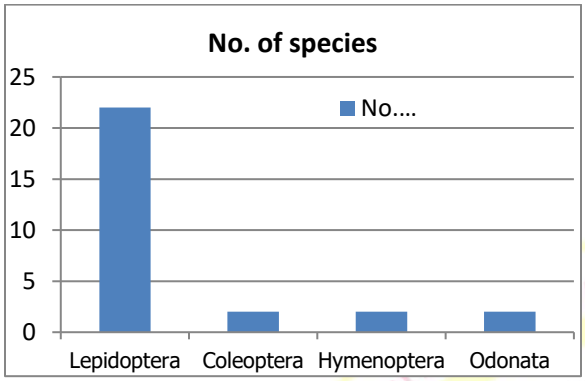

Fig. 4. Distribution of species (2017-2018)

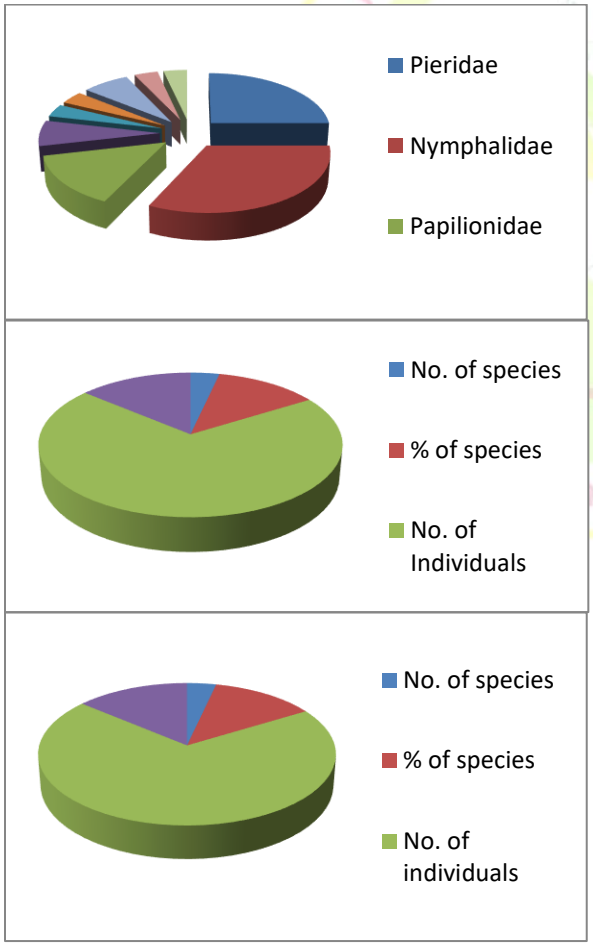

Fig. 5. The Guild structure of the insect community

CONCLUSION

From the present study it was concluded that the population of insects is affected by environmental factors and minimizing wild animals' conflict in study area. The diversity index, species richness, and evenness of insects in Sawal Deh, moderate diversity was observed. Enhancement of pollinator insects as part of crop management should be considered by the farmers and the use of chemicals should be minimized for maintaining the biodiversity of insects. Overuse of pesticides and fertilizers cause landscape degradation and eventually leads to loss of natural habitat of insects. But to control the insect pest farmers are supposed to use insecticides which also affect the beneficial insects. So, farmers should use the insecticides rationally or could use biological control methods. In that case, this work may be extended further in some other way.

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