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INSECTS DIVERSITY IN AN AGROECOSYSTEM OF BHABAR REGION OF UTTRAKHAND

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ABSTRACT

Species diversity and abundance of insects associated in an agricultural ecosystem was studied in Bhabar region of district Nainital in Uttarakhand from March 2018 to February 2020. Data revealed a total of 148 insect species belonging to 47 families and nine orders (Lepidoptera, Coleoptera, Hemiptera, Orthoptera, Hymenoptera, Odonata, Diptera, Dictyoptera, and Phasmida), identified from 2007 specimens. These were classified into five functional trophic groups: phytophagous, predators, omnivores, saprophages and decomposers. The diversity indexes showed significance- Diversity (H′=1.778), Evenness (E=0.9689), and Margalef's Index (d=1.924). Diversity indices of insect orders showed Lepidoptera to be the most diverse (H′=1.994) with maximum species richness having high Margalef's index (d=2.607), and dipterans with highest evenness (E=0.9572). A total of 1331 individuals of insect pollinators/ visitors were observed, belonging to 99 species of 5 orders (Lepidoptera, Hymenoptera, Coleoptera, Hemiptera, and Diptera).

Key words: Insects, diversity, relative abundance, trophic guilds, diversity indexes, species richness, pollinators/ visitors, agroecosystem, Bhabar region, insect pollinators

Insects are the most dominating, diverse and comprise >75% of the known species of the animals (Westfall and Tennessen, 1996). The diversity of insect species is a function of the environmental condition (Yi et al., 2012). They inhabit all habitat types and play major roles in the function and stability of terrestrial and aquatic ecosystems (Godfray, 2002). Insects are important because of diversity, ecological role, and their influence on agriculture (Adetundan et al., 2005; Premalatha et al., 2011). Though the diversity of insect fauna associated in agroecosystems is well documented (Mokam et al., 2014; Banu et al., 2016; Atencio et al., 2018; Sayuthi et al., 2018; Emmanuel and Anuluwa, 2019), it is still difficult to study the interactions within the ecosystem. In addition, the effects of farming practices for better yield causes phytotoxicity and decline of favourable organisms such as predators, parasitoids, microorganisms and pollinators, particularly indiscriminate use of fertilizers and chemical insecticides (Luckman and Metcalf, 1978; Tilman et al., 2006). The insect fauna associated with agroecosystems include pests, predators, parasitoids, pollinators and non-economic importance species (Mitra et al., 2014; Mokam et al., 2014; Atencio et al., 2018; Ghani et al., 2019; Subedi and Subedi, 2019). Pollination is an essential process in maintaining a healthy and diverse ecosystem, and include a wide variety of organisms like birds, bats, other mammals and insects (Willmer et al., 1994). Various insect groups which are of prime significance in pollination of crops mainly of the orders Hymenoptera, Diptera, Coleoptera, Lepidoptera, Thysanoptera, Hemiptera and Neuroptera (Free, 1993; Kearns et al., 1998; Mitra et al., 2008; 2014). This study documents diversity and abundance of insects, trophic guilds, diversity indexes, and diversity of insect pollinators/ visitors in an agroecosystem of Bhabar region at village Chhoi near Ramnagar in district Nainital, Uttarakhand from March 2018 to February, 2020.

MATERIALS AND METHODS

Geographically, the village Chhoi is located in the subtropical zone (29°22′15.50″N, 79°08′ 47.20″ E, 348 masl) in the Bhabar region of Uttarakhand, situated in the foothills of central Himalaya. Three crops are grown in a year: July to October (paddy/ soybean), November to April (wheat/mustard) and seasonal vegetables (May-June), with shallow soil (5 cm). Sampling of insects was done at an interval of 30 days from March, 2018 to February, 2020, using "sweep sampling method", following Gadagkar et al. (1990) and hand picking (Jonathan, 1990). The net sweeps were made with nets made of thick cotton cloth (30 cm dia, with bag length of 60 cm). A randomly selected areas of each study sites was divided into a quadrate of 10x 10 m. Hand picking method was used for larger, ground living insects and insects living under the stones. Collected insects were identified with keys and available literature, after separated into orders and families, with voucher specimens preserved in the laboratory. The species which could not be identified were got identified from the Forest Research Institute, Dehradun. The trophic level in a food chain was assigned to these as phytophagous, predators, omnivores, saprophages and decomposers. Shannon's diversity index or Shannon-Wiener diversity (1963), evenness (Hill, 1973), and Margalef's species richness index (Margalef's, 1970) were calculated. Diversity and abundance of insect pollinators and their foraging activities were observed in the field from 08.00-17.00 hrs. The foraging behaviour of insect pollinators visiting flowering plants was also recorded.

RESULTS AND DISCUSSION

Table 1 shows the diversity and abundance of insects collected amounting to 2007 individuals belonging to 148 species, 47 families and 9 orders. Maximum number of species belonged to the order Lepidoptera (68) followed by Coleoptera (20), Hemiptera (18), Orthoptera (16), Hymenoptera (13), Odonata (13), Diptera (10), Dictyoptera (3), and Phasmida (1). Lepidoptera, Coleoptera, Hemiptera, Orthoptera, Hymenoptera, Odonata and Diptera, because of their high abundance and species richness, were the major constituents, while Dictyoptera and Phasmida were the minor ones. Species richness was higher in summer (81 species) and rainy season (82 species) than in winter (13 species). Species richness was significantly correlated with maximum temperature ($r=0.886$; $P<0.01$, $df=12$), minimum temperature ($r=0.853$; $P\leq0.01$, $df=12$), and with rainfall ($r=0.444$; $P<<0.05$, $df=12$). Maximum number of individuals belonged to the order Lepidoptera (838) followed by Hymenoptera (232), Coleoptera (215), Odonata (198), Orthoptera (187), Hemiptera (181), Diptera (139), Dictyoptera (16), and Phasmida (1). Higher number of insects were recorded during summer and rainy seasons and lower in winter season. Abundance of insects was significantly correlated with maximum temperature ($r=0.908$; $P\leq0.01$, $df=12$), minimum temperature ($r=0.851$; $P\leq0.01$, $df=12$), and rainfall ($r=0.338$; $P<<0.05$, $df=12$). In the present study, low and higher temperature and rainfall influenced the species richness and abundance of insects and are in accordance with the findings of Regniere et al. (2012), Abbas et al. (2014) and Garia et al. (2016, 2017).

Five trophic groups were identified: Phytophagous, predators, omnivores, saprophages and decomposers; of these phytophagous insects were numerically predominant (68% of all species and 72% of all individuals) followed by predators (22% of all species and 22% of all individuals), omnivores (6% of all species and 2% of all individuals), saprophages (3% of all species and 3% of all individuals), and decomposers (1% of all species and 1% of all individuals) recorded (Fig. 1). A total of 34 species of bioregulators (predators) were collected in the present study. Many ecologists have grouped insects into various functional trophic guilds to study the ecological interactions between insects, their hosts, their enemies and climate (Speight et al., 2008). Based on their feeding activities observed, Mokam et al. (2014) recognized three guilds, phytophagous (carpophagous and sap suckers), saprophagous, and carnivores (predators and parasitoids in insects collected from two agroecological zones, Cameroon). Globally, phytophagous insects have been reported to be predominant, representing upto 96.1% of individuals collected in different ecosystems (Gadakar et al., 1990; Dev et al., 2009; Chouangthavy et al., 2017; Atencio et al., 2018; Ghani and Maalik, 2019). Our results obtained in the present study show that phytophagous insects were dominant both in terms of species richnesss and abundance, and are very similar to those reported in different ecosystems.

The Shannon-Wiener Diversity Index (H′), Evenness (E), and Margalef's species richness Index (d) of insect fauna collected were computed and are presented in Table 2 and 3. Maximum Species Diversity Index (H') was 1.778, Evenness (E') was 0.9689, and Margalef's Species Richness Index (d) was 1.924. Table 3 shows the pooled relative abundance based on orders and their diversity indices. It is evident that Lepidopteran insects have the highest diversity index (H′=1.994), and species richness index (d=2.607), and Dipterans have highest Evenness (E=0.9449; highest value is 1). Insect diversity in conventional agroecosystems is usually low because farmers use a monoculture system, the use of artificial fertilizers and pesticides, and also the vegetation structure. As a result of these treatments, non-target insects including natural enemies die (Altieri and Letournean, 1982). However, maximum index recorded for terrestrial ecosystems is in the range of 5 and such high values have been reported from rainforests .

A total of 1331 individuals of insect pollinators belonging to 99 species, 5 orders, and 22 families were recorded (Table 1). Five insect orders found were Lepidoptera (Pieridae, Nymphalidae, Lycanidae, Papilionidae, Hesperiidae, Erabidae, Noctuidae, Zygaenidae, Sphingidae, Crambidae and

Table 1. Diversity of insect species and trophic components- Chhoi, Uttarakhand (March, 2018-February, 2020

S. No.	Taxonomic composition	Trophic level	2018-2019 Relative abundance (%)	2019-2020 Relative abundance (%)
	LEPIDOPTERA			
	Family: Pieridae			
1.	*Pieris brassicae* (L.)	P	2.32	2.18
2.	*Pieris canidia indica* (Spr.)	P	1.16	1.31
3.	*Pontia daplidice* (L.)	P	1.39	0.70
4.	*Eurema brigitta (*Cr.)	P	2.09	2.01
5.	*Leptosia nina* (F.)	P	0.58	0.87
6.	*Gonepteryx* sp.	P	0.58	0.17
7.	*Aporia agathon* (Gray)	P	0.93	0.87
8.	*Pareronia valeria* Cr.	P	1.16	1.31
9.	*Colias fieldi* Men.	P	0.93	0.87
10.	*Catopsilia pyranthe* (L.)	P	2.44	1.31
11.	*Catopsilia pomona* F.	P	1.74	0.70
12.	*Belenois aurota* F.	P	0.81	1.22
13.	*Cepora nerissa phryne* F.	P	0.93	1.05
	Unidentified sp.	P	0.93	0.96
	Family: Nymphalidae			
14.	*Kallima inachus* (Bois.)	P	0	0.17
15.	*Vanessa indica* Herb.	P	0.58	0.70
16.	*Symbrenthia* sp.	P	0.93	0.87
17.	*Aglais caschmiriensis* (Kollar)	P	1.16	1.31
18.	*Cynthia cardui* L.	P	0.58	0.52
19.	*Precis iphita* (Cr.)	P	0.70	0.70
20.	*Sephisa dichroa* (Kollar)	P	0.70	0.70
21.	*Precis lemonias lemonias* L.	P	2.67	2.62
22.	*Precis almana* (L.)	P	0.93	1.05
23.	*Precis orithya* (L.)	P	0.23	0.44
24.	*Neptis sankara* Kollar	P	0.58	0.70
25.	*Euthalia patala* Kollar	P	0.58	0.00
26.	*Symphaedra nais* (Forster)	P	0.23	0.35
27.	*Hypolimnas bolina* L.	P	0.12	0.17
28.	*Phalanta phalantha* (Drury)	P	0.70	0.44
29.	*Ariadne merione* (Cr.)	P	0.23	0.17
30.	*Ypthima* sp.	P	0.93	0.44
31.	*Danaus chryssippus* (L.)	P	0.93	1.40
32.	*Euploea core* (Cr.)	P	0.23	0.09
	Family: Lycaenidae			
33.	*Heliophorus* sp.	P	0.23	0
34.	*Heliophorus sena* Kollar	P	0.58	0
35.	*Talicada nyseus* (Guerin-Meneville)	P	0.58	0.87
36.	*Leptotes plinius* (F.)	P	0.23	0.44
37.	*Neopithecops zalmora* Butler	P	0.23	0.35
38.	*Zemeros flegyas* Cr.	P	0.23	0.35
39.	*Zizeeria* sp.	P	2.32	2.18
40.	*Catochrysops strabo* F.	P	0.23	0.44
41.	*Arhopala amantes* Hewitson	P	0.23	0.26
42.	*Acytolepis* sp.	P	0	0.17
	Unidentified sp.	P	0.23	0.35
	Family: Papilionidae			
43.	*Atrophaneura aristolochioae* F.	P	0.93	0.35

(contd.)

Table 1 (contd.)

44.	*Papilio polytes* L.	P	1.04	0.87
45.	*Graphium* sp.	P	0	0.09
46.	*Papilio demoleus* L.	P	0.46	0.44
47.	*Papilio clytia clytia* L..	P	0	0.09
	Unidentified sp.	P	2.2	1.48
	Family: Hesperiidae			
48.	*Telicota* sp.	P	0.12	0.09
49.	*Parnara guttata* Bremer & Grey	P	0.58	0.35
50.	*Polytremis eltola* Hewitson	P	0.12	0.09
	Family: Erabidae			
51.	*Amata* sp.	P	0.46	0.17
52.	*Eressa confinis* (Walker)	P	0	0.09
53.	*Erebus* sp.	P	0	0.09
54.	*Lithosiini* sp.	P	0	0.17
55.	*Cyana coccinea* Moore	P	0	0.70
56.	*Ceryx imaon* Cr.	P	0.58	0.52
	Family: Noctuidae			
57.	*Calyptra ophideroides* Guen.	P	0.58	0.00
58.	*Episteme adulatrix* Kollar	P	0	0.17
	Family: Eupterotidae			
59.	*Eupterote* sp.	P	0.12	0
	Family: Zygaenidae			
60.	*Campylotes histrionicus* Westwood	P	0.46	0.17
	Family: Sphingidae			
61.	*Daphnis nerii* (L.)	P	0.12	0.17
	Family: Crambidae			
	Unidentified sp.	P	0	0.17
	Family: Geometridae			
62.	*Anonychia grisea* Warren	P	0	0.09
	COLEOPTERA			
	Family: Scarabaeidae			
63.	*Metopodontus biplagiatus* Westwood	P	0	0.09
64.	*Gymnopleurus ruficornis* Mot.	D	0.58	0.70
65.	*Phyllophaga* sp.	P	0.23	0.44
66.	*Popillia japonica* Newman	P	0.12	0.17
67.	*Pseudolucanus cantor* Hope	P	0.70	0.61
68.	*Onthophagus* sp.	D	0.23	0.44
69.	*Rhomborrhina* sp.	Pre	0.12	0.00
	Family: Chrysomelidae			0.00
70.	*Sagra femorata* (Drury)	Pre	0.23	0.09
71.	*Aulacophora* sp.	P	0.70	0.70
72.	*Mimastra* sp.	P	0.23	0.09
73.	*Raphidopalpa foveicollis* (Lucas)	P	0.58	0.26
	Family: Coccinelidae			
74.	*Coccinella septempunctata* (L.)	Pre	2.90	4.37
75.	*Coccinella* sp.	Pre	1.39	1.75
76.	*Cheilomenes sexmaculata* (F.)	Pre	0	0.70
77.	*Oenopia kirbyi* (Mulsant)	Pre	0	0.44
78.	*Harmonia dimidiata* (F.)	Pre	0.23	1.05
	Family: Cerambycidae			
79.	*Synaphaeta* sp.	P	0	0.09
	Unidentified sp.	P	0	0.09
	Family: Meloidae			
80.	*Mylabris variabilis* (Pallas)	Pre	0.23	0.17
	Family: Tenebrionidae			
81.	*Mesomorphus* sp.	O	0	0.17

(contd.)

Table 1 (contd.)

	ORDER: HYMENOPTERA			
	Family: Apidae			
82.	*Apis cerana* F.	P	5.80	5.24
83.	*Apis dorsata* F	P	2.32	3.06
84.	*Bombus* spp.	P	0.70	0.61
	Family: Formicidae			
85.	*Lasius niger* (L.)	P	1.28	1.75
	Family: Sphecidae			
86.	*Sceliphron caucasicum* Dalla Torre	Pre	0.23	0
87.	*Sceliphron coromandelicum* Lepeletier	Pre	0.23	0
	Unidentified sp.	P	0.12	0
	Family: Vespidae			
88.	*Vespa* sp.	Pre	0.58	0.17
89.	*Vespa cincta* F.	Pre	0.23	0.17
90.	*Polistes* spp.	Pre	0.12	0.09
91.	*Delta dimidiatipenne* Saussure	P	0.12	0
92.	*Vespa basalis* Smith	O	0	0.09
	Family: Xylocopidae			
93.	*Xylocopa auripennis* Lepeletier	P	0.12	0.17
	ORTHOPTERA			
	Family: Acrididae			
94.	*Acridium melanocorne* L.	P	1.16	0.44
95.	*Paraconophyma scabra* (Walker)	P	2.55	1.40
96.	*Patanga japonica* Bolivar	P	0.93	0.87
97.	*Spathosternum p. prasiniferum* Walker	P	1.16	0.79
98.	*Ceracris fasciata* Brunner von Wattenwyl	P	2.09	1.75
99.	*Cyrtacanthacris tatarica* (L.)	P	0.58	0.61
100.	*Xenocatantops* sp.	P	0	0.09
101.	*Oedipoda* sp.	O	0.23	0.44
	Family: Gryllidae			
102.	*Gryllus* sp.	O	0.12	0.17
103.	*Teleogryllus testaceus* Walker	O	0.12	0.09
104.	*Gryllotalpa* sp.	O	0	0.17
	Family: Tettigonidae			
105.	*Letana linearis* Walker	O	0	0.09
106.	*Caedicia simplex* (Walker)	P	0.46	0.44
107.	*Elimaea* sp.	P	0.23	0.44
108.	*Neoconocephalus* sp.	P	0.23	0.17
	Unidentified sp.	O	0.58	0.52
	ODONATA			
	Family: Libellulidae			
109.	*Neurothemis* sp.	Pre	1.28	0.70
110.	*Orthetrum chrysis* (Burmeister)	Pre	1.80	1.05
111.	*Orthemis ferruginea* (F.)	Pre	1.39	0.79
112.	*Aethriamanta brevipennis* (Rambur)	Pre	0.58	0.87
113.	*Crocothemis servilia* (Drury)	Pre	0.93	0.87
114.	*Orthetrum pruinosum* (Burmeister)	Pre	1.16	0.70
115.	*Orthetrum taeniolatum* Schneider	Pre	1.28	0.70
116	*Libellula* sp.	Pre	0	0.09
	Family: Calopterygidae			
	Unidentified sp.	Pre	2.44	1.05
	Family: Chlorocyphidae			
117.	*Aristocypha fenestrella* Rambur	Pre	0.70	0.44
	Gomphidea			
118.	*Paragomphus lieantus* (Selys)	Pre	0.58	0.70

(contd.)

Table 1 (contd.)

	Family: Lestidae			
119.	*Lestes* sp.	Pre	0	0.17
	DIPTERA			
	Family: Muscidae			
120.	*Musca* sp.	S	1.28	2.18
	Family: Calliphoridae			
121.	*Lucilia* sp.	S	0	0.44
122.	*Calliphora* sp.	S	0.58	0.70
	Family: Sarcophagidae			
123.	*Sarcophaga* sp.	S	0	0.09
	Family: Asilidae			
124.	*Philodious javanus* Wied.	Pre	0.58	0.52
125.	*Stenopogan oldroydi* Josephs & Pauri	Pre	0.81	0.70
	Family: Tipulidae			
126.	*Tipula himalayensis* Brunetti	O	0.58	0.52
127.	*Tipula* sp.	O	0.70	0.70
	Family: Syrphidae			
128.	*Eristalis* sp.	Pre	0.70	1.05
129.	*Eristalis tenax* (L.)	Pre	0.58	0.87
	HEMIPTERA			
	Family: Reduviidae			
	Unidentified sp.	Pre	0.12	0.175
	Family: Fulgoridae			
130.	*Lycorma delicatula* (White)	P	0.23	0
	Family: Coreidae			0
131.	*Cletus punctiger* (Dallas)	P	0.58	0.52
	Unidentified sp.	P	0.23	0.44
	Family: Pentatomidae			
132.	*Nezara viridula* L.	P	0.58	0.87
133.	*Chinavia* sp.	P	0	0.17
134.	*Murgantia histrionic* Hahn	P	0.58	0.61
135.	*Dalpada* sp.	P	0.12	0.44
136.	*Lonicera* sp.	P	0	0.09
137.	*Halyomorpha halys* (Stal)	P	0	0.44
138.	*Bagrada hilaris* (Burmeister)	P	0	0.17
139.	*Eurydema pulchrum* (Westwood)	P	0	0.87
	Family: Alydidae			
140.	*Leptocorisa varicornis* F.	P	1.28	1.75
141.	*Leptocorisa* sp.	P	1.16	1.31
	Family: Largidae			
142.	*Physopelta gutta* (Brumeister)	P	0.93	1.05
143.	*Physopelta schlanbuschi* (F.)	P	0.58	0.87
	Family: Pyrrhocoridae			
144.	*Dysdercus cingulatus* (F.)	P	0.58	0.70
	Family: Cicadaidae			
145.	*Neotibicen pruinosus* (Say)	P	0	0.09
	DICTYOPTERA			
	Family: Mantidae			
146.	*Mantis* sp.	Pre	0.23	0.44
147.	*Acontista* sp.	Pre	0	0.17
	Family: Hymenopodidae			
148.	*Ephestiaslu intermedia* Werner	Pre	0.23	0.44
	ORDER: PHASMIDA			
	Unidentified sp.	Pre	0	0.09

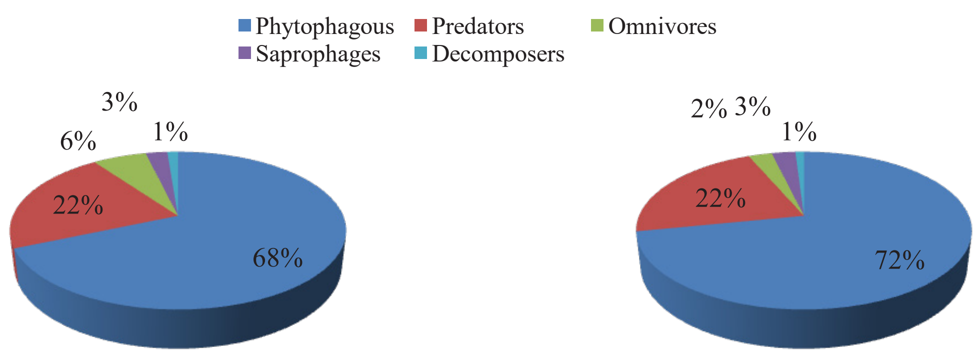
P- Phytophagous, Pre- Predators, O- Omnivores, S- Saprophages, D- Decomposers

Table 2. Species diversity and species richness of insect fauna- Chhoi, Uttarakhand (March, 2018-February, 2020)

Months	2018-2019			2019-2020			2018-2020		
	Shannon index (H')	Evenness (E')	Margalef (d)	Shannon index (H')	Evenness (E')	Margalef (d)	Shannon index (H')	Evenness (E')	Margalef (d)
March	1.478	0.5482	1.924	1.594	0.6152	1.789	1.549	0.5881	1.683
April	1.61	0.6252	1.818	1.778	0.7398	1.683	1.654	0.6537	1.597
May	1.581	0.6941	1.55	1.537	0.6643	1.465	1.523	0.655	1.398
June	1.642	0.6457	1.739	1.693	0.6037	1.847	1.65	0.5784	1.82
July	1.45	0.609	1.471	1.456	0.6126	1.385	1.318	0.5337	1.362
August	1.48	0.6276	1.504	1.548	0.6719	1.412	1.439	0.6026	1.385
September	1.39	0.5733	1.674	1.368	0.5612	1.586	1.302	0.5255	1.46
October	1.417	0.5894	1.731	1.542	0.6679	1.484	1.518	0.6519	1.403
November	0.4506	0.7846	0.5581	0.5004	0.8247	0.4343	0.5402	0.8582	0.3899
December	0	0	0	0	1	0	0	1	0
January	0	0	0	0.6616	0.9689	0.4809	0.6555	0.963	0.417
February	0	1	0	0	1	0	0	1	0

Table 3. Relative abundance, species diversity and species richness of insect orders- Chhoi, Uttarakhand (March, 2018-February, 2020)

Order	Relative abundance (%)	Shannon Index (H')	Evenness (E')	Margalef (d)
Lepidoptera	41.98	1.994	0.6121	2.607
Coleoptera	12.35	1.566	0.7977	1.669
Hemiptera	11.11	1.826	0.7758	2.422
Orthoptera	9.88	1.024	0.928	0.7213
Hymenoptera	8.02	1.439	0.8432	1.559
Odonata	8.02	1.179	0.65	1.559
Diptera	6.17	1.748	0.9572	2.171
Dictyoptera	1.85	0.6365	0.9449	0.9102
Phasmatodea	0.62	0	1	0
Total	100.0			



A. Species B. Individuals

Fig. 1. The guild structure of insect fauna

Geometridae). Hymenoptera (Apidae, Formicidae, Vespidae, Xylocopidae), Coleoptera (Chrysomelidae, Coccinellidae, Meloidae), Hemiptera (Fulgoridae, Coreidae and Meloidae), Diptera (Syrphidae). Lepidoptera with 832 individuals (62.5%) was the most abundant followed by Hymenoptera with 227 individuals (17.1%). Family Pieridae (25.0%) was the most abundant of all families. Insect pollinators of all five orders were found active throughout the day, but peak foraging activity was different. Lepidopterans were only nectar foragers and active during afternoon but less active in the morning. All hymenopterans were both pollen and nectar forager, and active during day time. Foraging activities of coleopterans and hemipterans remained relatively constant throughout the day. Insect pollinators are of prime significance in pollination of different agricultural, medicinal herbal and horticultural crops mainly belong to insect orders: Hymenoptera, Lepidoptera, Coleoptera, Diptera, Thysanoptera, Hemiptera and Neuroptera (Sihag, 1988; Free, 1993; Mitra et al., 2008; Bhowmik et al., 2014; Subedi and Subedi, 2019; Singh and Mall, 2020). Thus, the present study concludes from 2007 individuals that these belong to 148 species, 47 families and 9 orders. Phytophagous were the most dominant trophic group. Significant diversity (H′=1.778) and evenness (E=0.9689) were observed; and Margalef's Index was 1.924). Pollinators belonged to the orders Lepidoptera, Coleoptera, Hymenoptera, Diptera and Hemiptera.

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