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Entomofaunal Inventory of Shakambhari Hills of Sikar Region, Rajasthan

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Abstract

The Shakambhari Hills in the Sikar region of Rajasthan host a rich and diverse entomofauna, yet have remained largely unexplored in terms of systematic entomological studies. This study presents a comprehensive inventory of insect species recorded from three distinct locations Kalakhet, Sakarai, and Bhagova by conducting random field surveys between 2021 and 2024. A total of 8,631 individuals belonging to 148 genera across 10 orders and 61 families were identified. Coleoptera was the most diverse and abundant order, followed by Lepidoptera and Hymenoptera. Presence of large number of insects from this region clearly indicates this region to comprise of tremendous diversity of insects and quite rich in flora which serve as host plants. These findings highlight the ecological significance of the Shakambhari Hills and underscore the need for conservation and further ecological research.

Keywords: Insects, diversity, abundance, hills, variations.

INTRODUCTION

The Shakambhari Hills, located in the semi-arid region of Sikar, Rajasthan, are part of the Aravalli range and are known for their unique topography and vegetation. The availability of diverse life forms in an environment is influenced by the presence of flora and fauna and vice versa. Many different types of environments are habitats for insects (Sharma *et al.,* 2021). According to Harper and Hawksworth (1994), insects make up a sizable amount of terrestrial species richness and biomass and are essential to the health of ecosystems. The insect ecology is being disrupted by human disruption of the agro-environment and fluctuations in the global climate (Swami & Lekha, 2020). The severity of environmental fluctuations is exacerbated by pollution, urbanization, and habitat erosion. Insects not only contribute to essential processes like pollination, decomposition, and nutrient cycling but also serve as bioindicators of ecosystem health (M. Ahmad & Dar, 2020). Despite their ecological importance, systematic surveys of insect biodiversity in this area have been limited. Insects, being integral to ecological processes such as pollination, decomposition, and food web dynamics, require thorough documentation, especially in understudied habitats. This study aims to bridge this gap by conducting a quantitative and qualitative inventory of insect species across three selected sites within the Shakambhari Hills.

MATERIALS AND METHODS

Study Areas

The study was conducted at Shakambhari Hills in Sikar district, situated in the northeastern region of the state of Rajasthan between 27.640° E and 75.390° N. Sampling was conducted in three locations within the Shakambhari Hills:

- Kalakhet
- Sakrai
- Bhagowa

These areas were selected based on differences in vegetation type, human activity, and elevation to provide a representative overview of regional insect diversity. Survey was conducted 3 days of week from 2021 to 2024. Sites in each area were chosen using a stratified random sampling technique based on factors such as size, longitude, vegetation, etc.

Sampling and Identification

Field sampling was carried out using a combination of sweep nets, light traps, pitfall traps, and hand collection. Insects were photographed on spot. Specimens were preserved, mounted, and identified

using standard entomological keys and verified through available literature and expert consultation.

Statistical Analysis:

In ecological communities, species diversity, abundance, and spatial and temporal dispersion are crucial. Shannon-Wiener diversity index, Simpson index of dominance, Pielou`s evenness index and Margalef's diversity index were used for data analysis.
In MS Excel, collected data was analyzed using Past 4.03 software.

RESULTS

The present study has recorded 148 species of insects belonging to 61 families and 10 orders (Table 4.1). Coleoptera is most abundant order with 3373 individuals followed by Lepidoptera (3136), Hymenoptera (883), Orthoptera (431), Diptera (328), Odonata (211), Hemiptera (136), Mantodea (98), Systellommatophora (20) and Thysanoptera (15). Species diversity and density of insects indicate a good diversity of plants in an area. Climate change, forest degradation, habitat loss, unavailability of hosts and nectar plant species are among major reasons for a decline in insect population. This leads to loss of plants species that depend on the insects for pollination.

Among the three areas, maximum species were observed at Kalakhet (3708) followed by Bhagova (2937) and Sakrai (1986). These variations may correspond to differences in vegetation cover, microclimatic conditions and human interference.

Taxonomic Composition

The most dominant orders in terms of diversity and abundance were:

- Coleoptera: 54 species, 3,373 individuals
- Lepidoptera: 55 species, 3136 individuals
- Hymenoptera: 16 species, 883 individuals

Notable species with the highest recorded abundance include:

- *Spilarctia lutea* (Arctiidae): 163 individuals
- *Sitophilus oryzae* (Curculionidae): 140 individuals
- *Catharsius sagax* (Scarabaeidae): 133 individuals
- *Tathorhynchus exsiccate* (Erebidae): 130 individuals
- *Dineutus unidentatus* (Gyrinidae): 127 individuals
- *Melanoplus bivittatus* (Acrididae): 127 individuals

Table 1: Insect composition in three study areas of Shakambhari hills

S. No.	Order	Family	Scientific Name	Kalakhet	Sakrai	Bhagowa	Total no. of individuals
1	Coleoptera	Anobiidae	*Lasioderma serricorne*	42	20	32	94
2		Bruchidae	*Callosobruchus chinensis*	20	15	10	45
3		Carabidae	*Carabus orientalis*	62	15	22	99
4			*Anthia sexmaculata*	58	25	43	126
5		Cerambycidae	*Metopides nivosus*	35	25	30	90
6			*Derobrachus geminatus*	20	10	15	45
7		Chrysomelidae	*Aspidimorpha miliaris*	66	10	50	126
8			*Calligrapha bicolorata*	10	4	7	21
9			*Coptocephala gebleri*	14	5	11	30
10		Coccinellidae	*Cheilomenes sexmaculata*	28	21	18	67
11			*Coccinella septempunctata*	13	0	19	32
12		Curculionidae	*Sitophilus oryzae*	57	39	44	140
13		Dermestidae	*Trogoderma granarium*	27	22	18	67
14		Dysticidae	*Cybister tripunctatus var-asiaticus*	38	22	30	90
15		Elateridae	*Lanelater sps.*	15	13	14	42
16		Gyrinidae	*Dineutus unidentatus*	58	30	39	127
17		Hydrophilidae	*Hydrous indicus*	22	10	27	59
18			*Hydrous olivaceous*	23	13	25	61
19			*Hydrophilus ovatus*	18	6	23	47
20			*Hydrophilus triangularis*	40	20	40	100
21		Meloidae/Cantharidae	*Epicauta orchea*	30	28	30	88
22			*Mylabris pustulata*	18	6	18	42
23			*Cyaneolytta violacea*	57	30	37	124
24		Melolonthidae	*Holotrichia consanguinea*	14	12	16	42

S. No.	Order	Family	Scientific Name	Kalakhet	Sakrai	Bhagowa	Total no. of individuals
25		Oedemeridae	*Oxycopis thoracica*	20	18	25	63
26		Scarabaeidae	*Anomala vitis*	20	14	13	47
27			*Gymnopleurus cyaneus*	2	9	5	16
28			*Gymnopleurus miliaris*	32	10	21	63
29			*Gymnopleurus parvus*	10	4	5	19
30			*Heliocopris gigas*	8	4	5	17
31			*Catharsius platypus*	12	5	10	27
32			*Catharsius sagax*	61	30	42	133
33			*Copris repertus*	21	15	31	67
34			*Copris numa*	30	0	17	47
35			*Copris furciceps*	31	15	19	65
36			*Copris andrewesi*	25	15	8	48
37			*Heteronychus arator*	20	13	16	49
38			*Onthophagus catta*	22	10	12	44
39			*Onthophagus gulo*	5	5	20	30
40			*Onthophagus oculatus*	25	18	22	65
41			*Onthophagus crassicolis*	38	15	24	77
42			*Onthophagus seniculus*	42	18	14	74
43			*Onitis siva*	41	15	38	94
44			*Onitis falcatus*	53	0	42	95
45			*Onitis brahma*	10	5	12	27
46			*Phylllophaga rubinosa*	16	9	14	39
47			*Sisyphus longipes*	12	4	9	25
48			*Adoretus sp.*	54	12	23	89
49		Silphidae	*Silpha sp.*	15	7	10	32
50		Silvanidae	*Oryzaephilus surinamensis*	28	15	15	58
51		Tenebrionidae	*Tribolium castaneum*	27	5	5	37
52			*Pimelia inexpectata*	17	8	14	39
53			*Pimelia indica*	14	1	10	25
54			*Gonocephalum depressum*	29	8	21	58
55	Diptera	Culicidae	*Aedes albopictus*	10	5	8	23
56		Drosophilidae	*Drosophilla melangogaster*	35	28	32	95
57		Muscidae	*Musca domestica*	30	26	32	88
58		Sarcophagidae	*Sarcophaga sp.*	25	22	35	82
59		Syrphidae	*Syrphus spp.*	9	16	15	40
60	Hemiptera	Dinidoridae	*Coridius ianus*	13	6	11	30
61		Pentatomidae	*Chinavia hilaris*	14	8	9	31
62		Pyrrhocoridae	*Dysdercus cingulatus*	13	10	11	34
63		Reduviidae	*Acanthaspis siva*	14	13	14	41
64	Hymenoptera	Apidae	*Amegilla violacea*	47	22	33	102
65			*Apis cerana*	23	8	19	50
66			*Apis dorsata*	20	13	0	33
67			*Apis florae*	37	23	25	85
68			*Ceratina sexmaculata*	38	18	33	89
69			*Ceratina smaragdula*	22	0	16	38
70			*Trigona laeviceps*	23	12	15	50
71			*Xylocopa fenestrate*	34	10	23	67
72			*Xylocopa latipes*	27	0	22	49
73		Halictidae	*Halictus spp.*	20	10	18	48
74			*Nomia latreille*	12	5	17	34
75		Megachilidae	*Coelioxys capitatus*	27	15	7	49
76			*Megachile disjuncta*	24	10	14	48

S. No.	Order	Family	Scientific Name	Kalakhet	Sakrai	Bhagowa	Total no. of individuals
77		Scoliidae	*Campsomeriella annulata*	12	8	32	52
78			*Scolid binotata*	22	8	16	46
79		Vespidae	*Vespa orientalis*	21	12	10	43
80	Lepidoptera	Acrolophidae	*Acrolophus heppneri*	40	14	24	78
81		Arctiidae	*Spilarctia lutea*	58	50	55	163
82		Bombycidae	*Ocinara bifurcula,*	55	5	50	110
83		Bostrychidae	*Rhizopertha dominica*	2	19	20	41
84		Crambidae	*Maruca vitrata*	33	0	23	56
85			*Noorda blitealis*	43	16	35	94
86			*Omiodes indicata*	29	21	44	94
87		Erebidae	*Achaea janata*	0	10	4	14
88			*Amata cyssea*	20	10	29	59
89			*Cerynea trogobasis*	37	21	24	82
90			*Eudocima maternal*	30	10	14	54
91			*Euproctis chrysorrhoea*	19	13	16	48
92			*Euproctis fraterna*	45	20	14	79
93			*Lymantria dispar*	14	8	10	32
94			*Olepa ricini*	11	5	8	24
95			*Orgyia postica*	34	19	22	75
96			*Pandesma qvenavadi*	22	18	12	52
97			*Phytometra formsalis*	49	15	23	87
98			*Anomis fulvida*	12	3	13	28
99			*Trigonodes hyppasia*	15	9	15	39
100			*Utetheisa lotrix*	17	10	23	50
101			*Achaea serva*	33	33	31	97
102			*Eudocima phalonia*	22	20	35	77
103			*Tathorhynchus exsiccate*	50	35	45	130
104		Gelechiidae	*Sitotroga cerealella*	20	11	20	51
105		Geometridae	*Idaea subsericeata*	31	20	21	72
106			*Macaria abydata*	30	21	27	78
107			*Orthonama obstipata*	51	22	39	112
108			*Pelagodes falsaria*	34	20	29	83
109			*Scopula inductata*	16	10	14	40
110			*Synchlora bistriaria*	13	7	13	33
111			*Traminda mundissima*	22	19	25	66
112		Limacodidae	*Aergina hilaris*	13	8	12	33
113		Lycaenidae	*Tarucus balkanicus*	16	14	13	43
114		Noctuidae	*Aegocera venulia*	16	8	14	38
115			*Apamea remissa*	32	13	19	64
116			*Chasmina candida*	17	5	13	35
117			*Chrysodeixis acuta*	8	5	2	15
118			*Chrysodeixis chalcites*	29	14	18	61
119			*Digama hearseyana*	23	13	17	53
120			*Helicoverpa armigera*	14	6	11	31
121			*Maliattha signifera*	23	19	17	59
122		Nymphalidae	*Danaus chrysippus*	38	17	35	90
123			*Hypolimnas misippus*	22	7	18	47
124		Papilionidae	*Papilio demolius*	10	0	6	16
125		Peridae	*Catopsilia crocale*	13	0	8	21
126			*Pieris brassicae*	10	5	8	23
127		Pterophoridae	*Sphenarches anisodactylus*	20	14	12	46
128		Pyralidae	*Hypsopygia olinalis*	30	15	17	62

S. No.	Order	Family	Scientific Name	Kalakhet	Sakrai	Bhagowa	Total no. of individuals
129		Sphingidae	*Agrius convolvuli*	8	5	15	28
130			*Daphnis nerii*	5	4	4	13
131			*Hippotion celerio*	28	10	8	46
132			*Hippotion rosetta*	5	0	6	11
133			*Macroglossum stellatarum*	30	18	9	57
134		Tineidae	*Tineola bisselliella*	14	16	16	46
135	Mantodea	Mantidae	*Sphodromantis viridis*	18	20	22	60
136		Eremiaphilidae	*Tarachodes sps.*	14	11	13	38
137	Odonata	Libellulidae	*Bradinopyga geminata*	18	20	17	55
138			*Branchythemis contaminata*	19	10	17	46
139			*Pantala flavescens*	12	9	13	34
140			*Crocothemis servilia*	14	18	10	42
141		Coenagrionidae	*Ceriagrion coromendalinum*	11	10	13	34
142	Orthoptera	Acrididae	*Melanoplus bivittatus*	45	40	42	127
143		Phalangopsidae	*Meloimorpha japonica*	20	15	13	48
144		Pyrgomorphidae	*Atractomorpha crenulata*	35	28	30	93
145			*Poekilocerus pictus*	46	40	43	129
146		Tettigoniidae	*Macopoda elongata*	13	11	10	34
147	Systellommatophora	Veronicellidae	*Laevicaulis alte*	8	7	5	20
148	Thysanoptera	Thripidae	*Thrips hawaiiensis*	7	1	7	15
	Total			3708	1986	2937	8631

Table 2: Insect diversity indices across three study areas of Shakambhari hills

	Kalakhet	Sakrai	Bhagowa
Taxa (S)	147	139	147
Individuals	3708	1986	2937
Dominance (D)	0.008978	0.009767	0.008966
Shannon (H)	4.836	4.768	4.838
Evenness (e^H/S)	0.8571	0.8466	0.8588
Margalef	17.77	18.17	18.28

Among all insect orders observed, Lepidoptera is most diverse followed by Coleoptera, Hymenoptera, Orthoptera, Diptera, Odonata, Hemiptera and Mantodea respectively. Systellommatophora and Thysanoptera are low in diversity. Coleoptera is most diverse in Bhagowa area and Mantodea is least diverse in Sakrai area.

DISCUSSION

Our results reveal pronounced spatial variation in insect diversity across the Shakambhari Hills. Kalakhet emerged as the most diverse site, with the highest abundance (3708 individuals), lowest dominance (D = 0.008978), and highest Shannon diversity index (H′ = 4.836), indicating a well-balanced and species-rich community. Bhagowa exhibited similarly high diversity (Shannon H′ = 4.838), despite marginally elevated dominance (D = 0.008966). In contrast, Sakrai had the lowest abundance (1,986), highest dominance (D = 0.009767), and lowest Shannon index (H′ = 4.768), though its Margalef index (18.17) was at par with Bhagowa, suggesting rich species richness but reduced evenness. The area-specific data provide valuable insights into habitat preferences and microhabitat variation. Kalakhet, with the highest diversity, may offer more stable microclimates or less disturbance. These patterns reflect the broader ecological principle that habitat quality and connectivity are crucial drivers of insect diversity.

The Aravalli Hill Range, as a semi-arid zone with diverse vegetation types and microhabitats, supports a wide array of insect species, including Lepidoptera, Hymenoptera, Diptera, and Orthoptera (D. Ahmad *et al.,* 2021; Jangid *et al.,* 2017).

The dominance of Coleopterans in our study aligns with global trends in insect diversity and their adaptability to diverse habitats. The high representation of Lepidoptera and Hymenoptera further points to the ecological richness of the area. The notable presence of both agricultural pests (e.g., *Helicoverpa armigera*) and pollinators (e.g., *Apis* spp., *Amegilla violacea*)

underscores the ecological and economic significance of the region's insect fauna.

Habitat heterogeneity and area play critical roles in promoting insect community richness and abundance. In shrub ecotones, true bug diversity was strongly linked with greater habitat area, floral richness, and structural quality elements likely more prevalent in Kalakhet and Bhagowa. Beyond local features, landscape composition influences species richness at both habitat and landscape scales. In fragmented settings like Sakrai, such turnover may occur, but local diversity remains compromised due to dominance by a few resilient taxa.

Lepidopterans, particularly moths and butterflies, have been widely studied in different hill ranges of India due to their ecological importance and sensitivity to environmental changes. Ahmad et al. (2021) recorded significant moth diversity in the Aravalli Hill Range, highlighting species richness across altitudinal gradients. Similarly, Bhagat (2020) and Sharma (2011) documented notable butterfly species diversity in Mukundara Hills and Aravalli Range respectively, emphasizing the influence of vegetation type and habitat structure on their distribution. Comparative studies from other regions, such as the Western Ghats (Mathew *et al.,* 2018) and Mandi Hills (Kaundil & Mattu, 2017), further support these findings.

The diversity of other insect orders such as Hymenoptera and Diptera in Rajasthan reflects varied ecological roles and adaptations. Bishnoi and Dang (2019) along with Hooda and Jain (2020) reported a rich diversity of bees and wasps in Kota, which are essential pollinators in agroecosystems. Similarly, studies on mosquito diversity in Jodhpur (Sharma *et al.,* 2021) and aquatic insects in Lake Pichhola, Udaipur (Naz *et al.,* 2021) demonstrate how aquatic and semi-aquatic habitats also serve as vital refugia for Dipteran species, influencing public health and biodiversity alike.

Insect diversity in Rajasthan's agroecosystems also reveals interesting patterns influenced by seasonal cropping systems and habitat management. Swami and Lekha (2020) studied insect faunal diversity in Rabi agroecosystems using light traps and found a high turnover rate of insect fauna, emphasizing the need for regular monitoring. Similarly, Dhakad *et al.,* (2014) reported diverse Orthopteran fauna in sugarcane fields of Udaipur, with species composition influenced by cultivation practices and climate.

The influence of habitat fragmentation on insect diversity and distribution is another pressing issue. According to Haddad *et al.,* (2015), fragmentation leads to reduced species richness, disrupted ecological networks, and long-term declines in population viability. This aligns with our observations Kalakhet and Bhagowa presumably benefit from better habitat integrity, whereas Sakrai may be more fragmented or degraded. This is particularly relevant in regions like the Aravalli Hills, where increasing urbanization and deforestation pose a significant threat to insect habitats (Forest Survey of India, 2006; Tak & Srivastava, 2015). Studies suggest that species richness and ecological indices such as Shannon-Wiener and Simpson's Index can be effective tools for assessing the impact of such fragmentation (Harper & Hawksworth, 1994; Pielou, 1966; Shannon & Wiener, 1949).

Meta-analyses indicate that herbivore insect abundance and species richness decline significantly with habitat fragmentation, especially in smaller, isolated patches, and specialist species are the most vulnerable. In the context of our findings, Sakrai's elevated dominance and lower evenness may indicate the loss of specialist taxa, skewing community composition toward generalist or dominant species.

CONCLUSION

The Shakambhari Hills reveal a rich entomological diversity and display clear gradients in insect diversity among different areas with Kalakhet and Bhagowa supporting richer, more evenly distributed communities compared to Sakrai. These patterns are consistent with broader ecological principles linking habitat area, quality, connectivity, and fragmentation to insect diversity. Protecting and restoring habitat integrity, mitigating fragmentation, and promoting structural complexity are essential strategies for conserving insect biodiversity in this region.

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