International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 12-04-2026, Accepted: 13-05-2026, Published: 28-05-2026
Volume 11, Issue 2, 2026, Page No. 321-329

A report on the seasonal diversity and distribution of insect fauna in Chintamani Kar Bird Sanctuary, West Bengal, India

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Abstract
A preliminary survey was conducted on the seasonal diversity and distribution of insect fauna in the Chintamani Kar Bird Sanctuary, West Bengal, India. The survey was carried out during for one year from May,2025 to April, 2026 field visits representing different climatic seasons. A total of 87 species belonging to 12 insect orders and 49 families were recorded during the present investigation. The highest abundance of insects was recorded during summer with 899 (R.A.= 55.76%) individuals followed by monsoon with 586(R.A.= 36.35%) individuals and winter with 127 (R.A.= 7.87%) individuals. Hemiptera was the dominant order in terms of species richness, while Libellulidae, Formicidae, Papilionidae, and Nymphalidae were among the most represented families. Diversity indices revealed higher species diversity during monsoon season with Shannon diversity index (H') of 3.395 and Simpson index (1-D) of 0.961. Environmental variables such as rainfall, humidity, and temperature showed positive relationships with species occurrence and abundance. Heat map analysis also demonstrated distinct seasonal occurrence patterns among insect species. The present study provides baseline information on the insect diversity of Chintamani Kar Bird Sanctuary and highlights the ecological importance of seasonal variation in maintaining insect biodiversity.

Keywords: Insect diversity, their seasonal distribution, biodiversity indices, Chintamani Kar Bird Sanctuary

Introduction

Insects represent one of the most diverse groups of organisms on Earth and play a vital role in maintaining ecological balance through pollination, nutrient cycling, decomposition, biological control, and food web interactions (Triplehorn & Johnson, 2005) [8]. They are considered important ecological indicators because their abundance and diversity are strongly influenced by climatic and environmental changes (Price *et al.,* 2011) [5]. Seasonal fluctuations in temperature, rainfall, and humidity often affect insect emergence, reproductive success, feeding behavior, and habitat utilization (Wolda, 1988) [9].

India is recognized as one of the mega-diverse countries of the world and supports enormous insect diversity due to its varied climatic conditions and habitat heterogeneity. West Bengal, particularly its forested and semi-natural habitats, harbours a rich diversity of insect fauna. However, several regions remain poorly documented with respect to insect diversity and seasonal occurrence patterns.

Chintamoni Kar Bird Sanctuary, located in South 24 Parganas district of West Bengal, is an ecologically significant protected area characterized by dense vegetation, shrubs, trees, wetlands, and rich floral diversity. Although the sanctuary is mainly known for avifaunal diversity, its insect diversity remains insufficiently explored. Since insects are highly sensitive to habitat structure and environmental changes, documenting their diversity is important for understanding ecosystem stability and conservation value.

Several researchers have emphasized the significance of insect diversity studies in forest ecosystems because insects serve as pollinators, predators, decomposers, herbivores, and prey for higher trophic levels (Dhaliwal *et al.,* 2010) [3]. Seasonal diversity assessments also help in understanding species turnover, habitat preference, and ecological interactions.

Therefore, the present study was conducted to document the seasonal diversity and distribution of insect fauna in Chintamoni Kar Bird Sanctuary during three seasonal surveys representing summer, monsoon, and winter conditions. The study also aimed to analyse order-wise and family-wise diversity patterns, seasonal abundance, and ecological diversity indices. Moreover, the present investigation serves as baseline documentation for future ecological and conservation studies in the sanctuary. Further long-term monitoring involving detailed seasonal surveys and habitat-based analyses would help in understanding population dynamics, ecological interactions, and the conservation status of insect fauna in the region.

Materials and Methods

Study Area

The present study was conducted in the Chintamoni Kar Bird Sanctuary, located in West Bengal, India (Latitude 22°25'44.4"N and Longitude 88°24'06.7"E), to assess the seasonal diversity and distribution of insect fauna. The sanctuary is characterized by dense vegetation, moist deciduous forest patches, shrubs, aquatic habitats, and diverse floral resources that support a wide range of insect communities. Sampling was carried out during three major seasons, namely summer, monsoon, and winter, to evaluate variations in species richness, abundance, and diversity indices. The region experiences tropical climatic conditions with marked seasonal variations in temperature, humidity, and rainfall, which significantly influence insect population dynamics.

Collection and Identification of Insects

Field surveys were conducted for one year at different seasons between May,2025 to April, 2026 during the study period through direct visual observations in different habitats of the sanctuary, including forest trails, flowering vegetation, shrubs, grasslands, and wetland margins. Insects were not physically collected during the study. Instead, photographic documentation was carried out using a DSLR camera to record insect species in their natural habitats. Close-up photographs were captured carefully to ensure visibility of important morphological characters required for identification.

The photographed insects were identified up to species level with the help of standard taxonomic keys, published literature, and online faunal databases. Identification was primarily based on external morphological features such as wing patterns, body coloration, antennae, body segmentation, and leg morphology visible in the photographs. The classification and nomenclature of insects followed standard entomological taxonomy.

Diversity Analysis

Different ecological diversity indices were calculated to evaluate seasonal variations in insect diversity. The indices included Shannon–Wiener diversity index (H'), Simpson diversity index (1-D), species richness, Margalef richness index, Menhinick richness index, Berger–Parker dominance index, and evenness index (J'). These indices are widely used for assessing biodiversity and ecological stability in insect communities (Shannon & Weaver, 1949; Simpson, 1949; Margalef, 1958) [4, 6, 7].

Species richness and abundance data were used to compare diversity among seasons. The total number of individuals and species recorded in each season were also analysed during the present study.

Seasonal Distribution, Statistical and Graphical Analysis

The collected data were organized using microsoft excel and r-software and represented through tables, bar diagrams, heat maps, and correlation graphs. The occurrence of each species during summer, monsoon, and winter seasons and the relationships between species count and environmental variables such as temperature, humidity, and rainfall were analysed graphically using Microsoft excel and r-software. Lastly a heat map was also generated to visualize the occurrence of species across different seasons was also analysed using r-software during the present study.

Results and Discussion

Overall Species Composition

The present investigation recorded a total of 87 insect species belonging to 12 orders and 49 families from Chintamani Kar Bird Sanctuary during the three seasonal surveys. The recorded orders included Coleoptera, Diptera, Lepidoptera, Hemiptera, Hymenoptera, Orthoptera, Odonata, Neuroptera, Dermaptera, Psocoptera, Thysanoptera, and Araneae. The occurrence of such diverse insect groups reflects the ecological richness and habitat heterogeneity of the sanctuary (Table 1,2; Fig. 1-7).

The sanctuary provides a favorable environment consisting of moist vegetation, flowering plants, shaded forest patches, wetlands, and leaf litter habitats that support different insect communities. Similar observations were reported in forest ecosystems where habitat complexity positively influences insect diversity and abundance (Price *et al*., 2011) [5].

Order-wise Distribution of Insects

The order-wise distribution of insects is presented in Table 1 and Fig. 1. Hemiptera was the dominant order with 18 recorded species, followed by Diptera and Lepidoptera with 17 species each. Odonata contributed 10 species, while Hymenoptera and Orthoptera contributed 11 and 9 species respectively (Table 1,2 & Fig.1-2).

The dominance of Hemiptera may be related to the abundance of vegetation and host plants in the sanctuary. Herbivorous hemipteran insects such as aphids, planthoppers, leafhoppers, and shield bugs are commonly associated with diverse plant communities (Dhaliwal *et al.,* 2010) [3].

Dipteran insects showed high abundance particularly during summer and monsoon seasons. Species such as Musca domestica, Aedes sp., Condylostylus sp., and Lucilia cuprina were commonly encountered. Moist environmental conditions and organic matter accumulation during monsoon favor breeding and larval development of dipteran insects.

Lepidopteran diversity was also considerable during the study. Butterflies belonging to families Papilionidae, Pieridae, Nymphalidae, and Erebidae were frequently recorded. Butterfly diversity is often positively associated with nectar availability, host plants, and sunlight exposure (Bonebrake *et al*., 2010) [2].

Odonates such as Neurothemis tullia, Orthetrum glaucum, Urothemis signata, and Lyriothemis sp. were mainly observed during monsoon, probably because rainfall creates suitable aquatic habitats for larval development.

Family-wise Distribution Pattern

The family-wise distribution of insect species is represented in Table 5 and Fig. 2. Libellulidae emerged as one of the dominant families during monsoon season, while Formicidae and Papilionidae showed greater abundance during summer (Table 1,2 & Fig.1-2).

Formicidae members such as *Oecophylla smaragdina, Tetraponera rufonigra,* and *Ochetellus glaber* were frequently observed in tree trunks, foliage, and forest trails. Ants are considered important bioindicators because they respond rapidly to environmental disturbances and habitat changes (Andersen, 1997) [1].

Papilionidae butterflies including *Pachliopta hector*, *Papilio demoleus, Papilio helenus*, and *Papilio polytes* were predominantly observed during summer. Their occurrence indicates the availability of flowering plants and larval host species within the sanctuary.

The family Tettigoniidae under Orthoptera showed higher representation during monsoon season. Moist conditions and dense undergrowth provide suitable habitats for katydids and related orthopteran insects.

Table 1: Distribution of insect species surveyed at Chintamani Kar Bird Sanctuary at different seasons

Sl. no.	Scientific name	Order	Family	Found in Season			Distribution in India	IUCN status
				Summer	Monsoon	Winter		
1	*Aulacophora femoralis*	Coleoptera	Chrysomelidae	+	+	-	Meghalaya	Not Evaluated
2	*Aedes* sp.	Diptera	Culicidae	+	+	-	All states	Not Evaluated
3	*Aethriamanta brevipennis*	Odonata	Libellulidae	-	+	-	Kashmir, rajasthan, uttarakhand West bengal	Least Concern
4	*Amata cyssea*	Lepidoptera	Erebidae	-	-	+	Tamil Nadu, West Bengal, odisha	Not Evaluated
5	*Aphis nerii*	Hemiptera	Aphididae	+	-	-	Himalaya, plains, Western ghat	Not Evaluated
6	*Apis cerana indica*	Hymenoptera	Apidae	-	-	+	Himalaya, plains, Western ghat, Tamilnadu	Not Evaluated
7	*Apis mellifera*	Hymenoptera	Apidae	-	-	+	Punjab, Hariyana, Himachal, Uttarakhand, JK, uttarpradesh	Not Evaluated
8	*Archips* sp.	Lepidoptera	Tortricidae	-	+	--	Himalaya, Northeat, Wester ghat	Not Evaluated
9	*Ariadne merione*	Lepidoptera	Nymphalidae	+	-	-	Tamilnadu, Karnataka, Andhra pradedh	Not Evaluated
10	*Atractomorpha* sp.	Orthoptera	Pyrgomorphidae	+	-	-	All ststes	Not Evaluated
11	*Augochlora pura*	Hymenoptera	Halictidae	-	-	+	Bihar, Chhattishgarh, Maharashtra, Tamil nadu	Not Evaluated
12	*Aulacaspis tubercularis*	Hemiptera	Diaspididae	-	-	+	Uttarpradesh, Tamilnadu, Karnataka	Not Evaluated
13	*Bactrocera dorsalis*	Diptera	Tephritidae	+	-	-	Maharashtra, Karnataka, Tamilnadu, Punjab	Not Evaluated
14	*Belippa horrida*	Hemiptera	Membracidae	-	+	-	West Bengal, Assam, Karnataka, Tamil nadu	Not Evaluated
15	*Cerastipsocus venosus*	Psocoptera	Psocidae	-	-	+	Uttarakhand, Uttarpradesh, Bihar, West Bengal, Tamil nadu	Not Evaluated
16	*Ceriagrion coromandelianum*	Odonata	Coenagrionidae	+	-	-	Himalaya, Kanyakumari	Least Concern
17	*Ceryx diptera*	Lepidoptera	Erebidae	+	-	-	Himalayan region	Not Evaluated
18	*Chrysomya megacephala*	Diptera	Calliphoridae	+	-	+	Tamil nadu, West Bengal, Karnatak, Maharashtra	Not Evaluated
19	*Chrysoperla carnea*	Neuroptera	Chrysopidae	-	-	+	Panjab, Hariyana, UP, Maharashtra	Not Evaluated
20	*Coccinella nigrita*	Coleoptera	Coccinellidae	-	+	-	Panjab, Hariyana, UP, Maharashtra, Karnataka, Tamilnadu	Not Evaluated
21	*Coelophora bissellata*	Coleoptera	Coccinellidae	+	-	-	Himachal Pradesh, Manipur, Meghalaya, Punjab, Sikkim, UP	Not Evaluated
22	*Condylostylus* sp.	Diptera	Dolichopodidae	+	+	-	Tropical and Subtropical india	Not Evaluated
23	*Conocephalus melaenus*	Orthoptera	Tettigoniidae	-	+	-	Panjab, Hariyana, UP,	Not Evaluated
24	*Conocephalus spinosus*	Orthoptera	Tettigoniidae	-	+	-	Panjab, Hariyana, UP, Karnataka	Not Evaluated
25	*Coptosoma scutellatum*	Hemiptera	Plataspidae	+	-	-	Assam, Arunachal Pradesh	Not Evaluated
26	*Coridius janus*	Hemiptera	Dinidoridae	-	+	-	Assam, Arunachal Pradesh, Karnatak	Not Evaluated
27	*Culex* sp.	Diptera	Culicidae	+	-	-	All states	Not Evaluated
28	*Dalpada oculata*	Hemiptera	Pentatomidae	-	+	-	Northeast Indai, Western ghat	Not Evaluated
29	*Danaus chrysippus*	Lepidoptera	Nymphalidae	+	-	-	Jammu and Kashmir, Andaman and Nicobar, West Bengal Tamil nadu	Least Concern
30	*Disladispa armigera*	Coleoptera	Chrysomelidae	-	+	-	South and north east India	Not Evaluated
31	*Drosophila melanogaster*	Diptera	Drosophilidae	+	-	+	West India, South India, Central India	Not Evaluated
32	*Edwardsiana rosae*	Hemiptera	Cicadellidae	-	-	+	Panjab, Hriyana, Maharashtra, Karnatak	Not Evaluated
33	*Elimaea signata*	Orthoptera	Tettigoniidae	-	+	-	Arunachal Pradesh, Karnatak, Assam	Not Evaluated
34	*Erionota torus*	Lepidoptera	Hesperiidae	+	-	-	All states	Not Evaluated
35	*Eristalinus megacephalus*	Diptera	Syrphidae	+	-	-	South and northeast India, Tamilnadu, Karnataka	Not Evaluated
36	*Eriosoma lanigerum*	Hemiptera	Aphidae	+	-	-	Himalaya, Kanyakumari, West land	Not Evaluated
37	*Eucriotettix spinilobus*	Orthoptera	Tetrigidae	-	+	-	Panjab, Hriyana, Maharashtra	Not Evaluated
38	*Eurema hecabe*	Lepidoptera	Pieridae	-	+	-	Panjab, Hriyana, Maharashtra, Karnatak, Assam	Least Concern
39	*Euscyrtus concinnus*	Orthoptera	Gryllidae	-	+	-	Panjab, Hriyana, Maharashtra	Not Evaluated
40	*Gryllus* sp.	Orthoptera	Gryllidae	+	-	-	All states	Not Evaluated
41	*Gyponana* sp.	Hemiptera	Cicadellidae	-	+	-	Tropical and subtropical India	Not Evaluated
42	*Hexacentrus japonicus*	Orthoptera	Tettigoniidae	-	+	-	Assam, West Bengal, Arunachal Pradesh, Sikkim, Uttara Khand	Not Evaluated
43	*Issus coleoptratus*	Hemiptera	Issidae	-	+	-	Himalya, Mussoorie, Sikkim,	Not Evaluated

							Kerala, Karnataka	
44	*Junonia iphita*	Lepidoptera	Nymphalidae	+	-	-	South and north east india	Not Evaluated
45	*Kolla bataviae*	Hemiptera	Cicadellidae	-	-	+	Bengal, Arunachal Pradesh, Sikkim	Not Evaluated
46	*Lasius niger*	Hymenoptera	Formicidae	-	-	+	Bihar, Odisha, Assam, West Bengal	Not Evaluated
47	*Leptocoris vicinus*	Hemiptera	Rhopalidae	-	-	+	Bihar, Odisha, Assam	Not Evaluated
48	*Leptocorisa acuta*	Hemiptera	Alydidae	-	-	+	Bihar, Odisha, Assam, Karantak, Punjab	Not Evaluated
49	*Leptocorisa oratorius*	Hemiptera	Alydidae	-	-	+	Bihar, Odisha, Assam, Uttarpradesh	Not Evaluated
50	*Leptosia nina*	Lepidoptera	Pieridae	+	-	-	Bihar, Odisha, Assam	Not Evaluated
51	*Lixus concavus*	Coleoptera	Curculionidae	-	+	-	Ladakh, Himachal Pradesh, Punjab, Hriyana	Not Evaluated
52	*Lucilia cuprina*	Diptera	Calliphoridae	-	+	-	Ladakh, Himachal Pradesh, Punjab, Hriyana, Maharashtra	Not Evaluated
53	*Lycostomus praeustus*	Coleoptera	Lycidae	+	-	-	Himalaya, Norteast, Western ghat	Not Evaluated
54	*Lyriothemis* sp.	Odonata	Libellulidae	-	+	-	Himalaya, Norteast, Western ghat, Assam, Karnatak	Not Evaluated
55	*Melanitis phedima*	Lepidoptera	Nymphalidae	-	-	+	Ladakh, Himachal Pradesh, Punjab, Hriyana Mussoorie, Sikkim	Not Evaluated
56	*Musca domestica*	Diptera	Muscidae	+	+	+	All states	Not Evaluated
57	*Myrmarachne elongata*	Araneae	Salticidae	+	-	-	Himachal Pradesh, Punjab, Hriyana, Kerala, Odisha	Not Evaluated
58	*Neurothemis tullia*	Odonata	Libellulidae	-	+	-	Andaman and Nicobar, Karnataka, Kerala, Pradesh, Punjab, Hriyana	Least Concern
59	*Ochetellus glaber*	Hymenoptera	Formicidae	+	-	-	Maharashtra, Karnataka Pradesh, Punjab, Hriyana	Not Evaluated
60	*Ocypus olens*	Coleoptera	Staphylinidae	+	-	-	Ladakh, Himachal Pradesh, Punjab, Hriyana	Not Evaluated
61	*Oecophylla smaragdina*	Hymenoptera	Formicidae	+	+	+	Andaman and Nicobar, Ladakh, Himachal Pradesh, Punjab, Hriyana	Not Evaluated
62	*Ophiomyia phaseoli*	Diptera	Agromyzidae	-	-	+	AndharaPradesh, Uttarpradesh, Punjab, Hriyana	Not Evaluated
63	*Orthetrum glaucum*	Odonata	Libellulidae	-	+	-	Ladakh, Himachal Pradesh, Punjab, Hriyana, Kerala	Not Evaluated
64	*Pachliopta hector*	Lepidoptera	Papilionidae	+	-	-	Andaman and Nicobar, Ladakh, Himachal Pradesh, Punjab, Hriyana, Telangana	Least Concern
65	*Papilio demoleus*	Lepidoptera	Papilionidae	+	-	-	Bihar, West Bengal, UP Punjab, Hariyana, Karnatak, Kerala	Not Evaluated
66	*Papilio helenus*	Lepidoptera	Papilionidae	+	-	-	Tamil nadu, Bihar, West Bengal, UP Punjab, Hariyana, Karnatak, Kerala	Not Evaluated
67	*Papilio polytes*	Lepidoptera	Papilionidae	+	-	-	Ladakh, Himachal Pradesh, Punjab, Hriyana, Kerala, Andaman and Nicobar	Not Evaluated
68	*Paratettix* sp.	Orthoptera	Tetrigidae	-	+	-	Ladakh, Himachal Pradesh, Punjab, Hriyana, Kerala	Not Evaluated
69	*Phimenes flavopictus*	Hymenoptera	Vespidae	+	-	-	Ladakh, Himachal Pradesh, Punjab, Hriyana, Kerala, Arunachal Pradesh, Uttarakhand	Not Evaluated
70	*Pieris brassicae*	Lepidoptera	Pieridae	-	+	-	Ladakh, Himachal Pradesh, Bihar, Punjab, Hriyana, Kerala	Not Evaluated
71	*Planococcus citri*	Hemiptera	Pseudococcidae	+	-	-	Ladakh, Himachal Pradesh, Tamilnadu, Telangana, Punjab, Hriyana, Kerala	Not Evaluated
72	*Podontia lutea*	Coleoptera	Chrysomelidae	-	+	-	Southern india, western ghat	Not Evaluated
73	*Polistes carnifex*	Hymenoptera	Vespidae	-	+	-	Ladakh, Himachal Pradesh, Punjab, Hriyana, Kerala	Not Evaluated
74	*Polyrhachis rastellata*	Hymenoptera	Formicidae	+	-	-	Eastern ghat, North Est india	Not Evaluated
75	*Ricania speculum*	Hemiptera	Ricaniidae	+	-	-	Ladakh, Himachal Pradesh, Punjab, Hriyana, Kerala, Tamilnadu, Karnatak	Not Evaluated
76	*Sarcophaga carnaria*	Diptera	Sarcophagidae	+	-	-	Himachal Pradesh, Punjab, Hriyana, Kerala, Uttarpradesh	Not Evaluated
77	*Scolia clypeata*	Hymenoptera	Scoliidae	+	-	-	Assam, Meghalaya, Odisha, Karnataka	Not Evaluated
78	*Scarabaeus sacer*	Coleoptera	Scarabaeidae	+	-	-	Jammu and Kashmir	Not Evaluated
79	*Sepedon sphegea*	Diptera	Sciomyzidae	+	-	-	Eastern ghat, North est india	Not Evaluated
80	*Statherotis discana*	Lepidoptera	Tortricidae	-	+	-	Eastern ghat, North est india	Not Evaluated
81	*Sympetrum fonscolombii*	Odonata	Libellulidae	+	-	-	Himachal Pradesh, Punjab, Hriyana, Kerala, Uttarpradesh	Least Concern

82	*Sympetrum striolatum*	Odonata	Libellulidae	+	-	-	Himachal Pradesh, Punjab, Uttarpradesh	Not Evaluated
83	*Sympetrum valgatum*	Odonata	Libellulidae	+	-	-	Himachal Pradesh, Kerala, Uttarpradesh	Not Evaluated
84	*Syntomoides imaon*	Lepidoptera	Erebidae	+	-	+	Sikkim, Khasi hills, Kerala, West Bengal	Not Evaluated
85	*Tetraponera rufonigra*	Hymenoptera	Formicidae	+	-	-	Himachal Pradesh, Kerala, Uttarpradesh	Not Evaluated
86	Thrips	Thysanoptera	Thripidae	+	-	-	All states	Not Evaluated
87	*Urolabida histrionica*	Dermaptera	Anisolabididae	+	-	-	Jharkhand, West Bengal, Karnatak, Tamilnadu, Kerala	
88	*Urothemis signata*	Odonata	Libellulidae	-	+	-	Himachal Pradesh, Punjab, Hriyana, Kerala, Uttarpradesh	Least Concern

Table 2: Number of insect species surveyed at Chintamani Kar Bird Sanctuary in each season

Sl. No.	Species	No of individuals		
		Summer	Monsoon	Winter
1	*Aulacophora femoralis*	50	22	-
2	*Aedes* sp.	18	20	-
3	*Aethriamanta brevipennis*	-	18	-
4	*Amata cyssea*	-	8	-
5	*Aphis nerii*	30	-	-
6	*Apis cerana indica*	-	-	15
7	*Apis mellifera*	-	-	9
8	*Archips* sp.	-	8	-
9	*Ariadne merione*	5	-	-
10	*Atractomorpha* sp.	6	-	6
11	*Augochlora pura*	-	-	3
12	*Aulacaspis tubercularis*	-	-	6
13	*Bactrocera dorsalis*	15	-	-
14	*Belippa horrida*	-	6	-
15	*Cerastipsocus venosus*	-	-	2
16	*Ceriagrion coromandelianum*	5	-	-
17	*Ceryx diptera*	10	-	-
18	*Chrysomya megacephala*	25	-	14
19	*Chrysoperla carnea*	-	-	11
20	*Coccinella nigrita*	-	15	-
21	*Coelophora bissellata*	10	-	-
22	*Condylostylus* sp.	15	20	-
23	*Conocephalus melaenus*	-	17	-
24	*Conocephalus*	-	*14*	-
25	*Coptosoma scutellatum*	200	-	-
26	*Coridius janus*	-	12	-
27	*Culex* sp.	20	-	-
28	*Dalpada oculata*	-	16	-
29	*Danaus chrysippus*	10	-	-
30	*Disladispa armigera*	-	19	-
31	*Drosophila melanogaster*	23	-	5
32	*Edwardsiana rosae*	-	-	13
33	*Elimaea signata*	-	11	-
34	*Erionota torus*	2	-	-
35	*Eristalinus megacephalus*	17	-	-
36	*Eriosoma lanigerum*	*22*	-	-
37	*Eucriotettix spinilobus*	-	13	-
38	*Eurema hecabe*	-	48	-
39	*Euscyrtus concinnus*	-	21	-
40	*Gryllus* sp.	10	-	-
41	*Gyponana* sp.	-	10	-
42	*Hexacentrus japonicus*	-	12	-
43	*Issus coleoptratus*	-	5	-
44	*Junonia iphita*	6	-	-
45	*Kolla bataviae*	-	-	12
46	*Lasius niger*	4	-	-
47	*Leptocoris vicinus*	-	-	2
48	*Leptocorisa acuta*	-	-	7
49	*Leptocorisa oratorius*	-	-	*1*
50	*Leptosia nina*	9	-	-
51	*Lixus concavus*	-	14	-
52	*Lucilia cuprina*	-	23	-
53	*Lycostomus praeustus*	8	-	-
54	*Lyriothemis* sp.	-	12	-
55	*Melanitis phedima*	-	-	3
56	*Musca domestica*	17	28	10
57	*Myrmarachne elongata*	4	-	-
58	*Neurothemis tullia*	-	26	-
59	*Ochetellus glaber*	60	-	-
60	*Ocypus olens*	*20*	-	-
61	*Oecophylla smaragdina*	50	24	8
62	*Ophiomyia phaseoli*	-	5	-
63	*Orthetrum glaucum*	-	20	-
64	*Pachliopta hector*	10	-	-
65	*Papilio demoleus*	15	-	-
66	*Papilio helenus*	20	-	-
67	*Papilio polytes*	14	-	-
68	*Paratettix* sp.	-	9	-
69	*Phimenes flavopictus*	4	-	-
70	*Pieris brassicae*	-	52	-
71	*Planococcus citri*	50	-	-
72	*Podontia lutea*	-	18	-
73	*Polistes carnifex*	-	7	-
74	*Polyrhachis rastellata*	16	-	-
75	*Ricania speculum*	1	-	-
76	*Sarcophaga carnaria*	16	-	-
77	*Scarabaeus sacer*	*2*	-	-
78	*Scolia clypeata*	10	-	-
79	*Sepedon sphegea*	12	-	-
80	*Statherotis discana*	-	6	-
81	*Sympetrum fonscolombii*	10	-	-
82	*Sympetrum striolatum*	2	-	-
83	*Sympetrum valgatum*	1	-	-
84	*Tetraponera rufonigra*	19	-	-
85	Thrips	16	-	-
86	*Urothemis signata*	-	19	-
87	*Urolabida histrionica*	10	8	-
	TOTAL	899	586	127

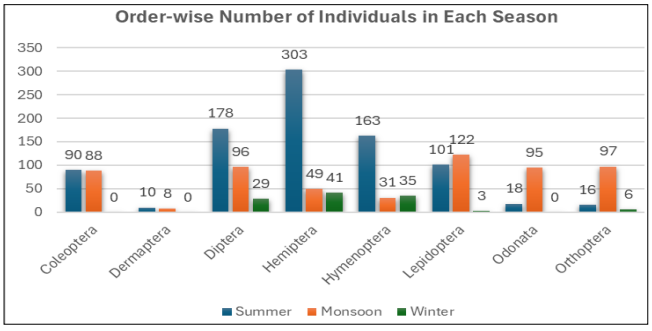

Fig 1: Number of insects based on insect order observed at different seasons during the present study period

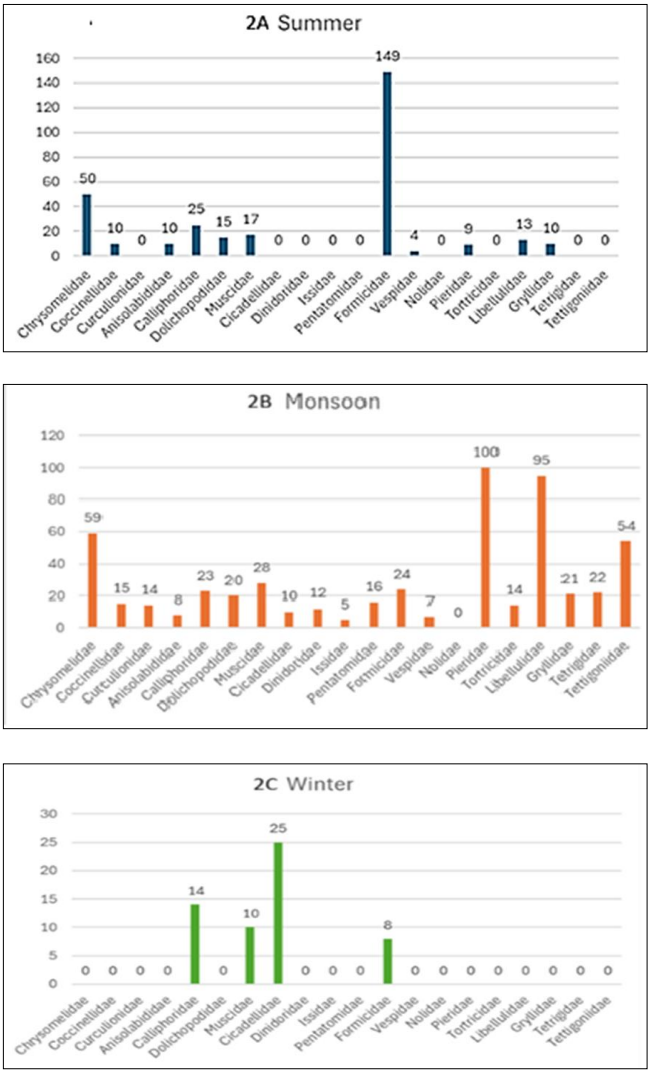

Fig 2 (A, B, C): Total number of insect species based on their family observed at different seasons during the present study period

Seasonal Variation in Species Diversity

The insect fauna exhibited significant seasonal variation in both abundance and species richness. The highest abundance was recorded during Summer with 899 individuals, followed Monsoon with 586 individuals, whereas Winter recorded the lowest abundance with 127 individuals (Table 1-2, Fig: 1- 5).

Species richness was also highest during summer with 46 species, followed by monsoon with 35 species and winter with 17 species. Higher species richness during summer may be associated with increased temperature, greater floral diversity, and active breeding conditions. Seasonal climatic conditions strongly influence insect metabolism, feeding activity, dispersal, and reproductive success (Wolda, 1988) [9].

The comparatively lower diversity during winter may be attributed to reduced temperature and lower availability of food resources. Many insects remain inactive or undergo diapause during colder periods, leading to reduced population density.

Seasonal Abundance of Insect Orders

Order-wise abundance analysis showed that Hemiptera contributed the highest number of individuals during summer due to the dominance of phytophagous species such as *Coptosoma scutellatum* and *Planococcus citri* (Table 6). Lepidopterans and odonates showed increased abundance during monsoon because of suitable climatic conditions and greater host plant availability.

Winter season recorded lower abundance overall, although certain species such as Apis cerana indica, Apis mellifera, and *Chrysoperla carnea* were observed during this period. Pollinator species remain ecologically important during winter because they contribute to pollination activities in flowering plants (Table 6).

Musca domestica and *Oecophylla smaragdina* were among the few species recorded throughout all three seasons, indicating their ecological adaptability and tolerance to environmental fluctuations (Table 6).

Relationship Between Environmental Factors and Species Diversity

The relationship between species counts and environmental variables such as temperature, humidity, and rainfall is represented in Fig. 3, Fig. 4, and Fig. 5 respectively. The graphical analysis suggested that species richness and abundance increased with higher humidity and rainfall.

Monsoon season created favourable conditions for insect breeding, larval survival, and vegetation growth, which ultimately enhanced insect diversity. Temperature also influenced insect activity patterns because many insects are ectothermic organisms whose metabolism depends on environmental temperature.

The heat map analysis (Fig. 6) clearly demonstrated distinct seasonal occurrence patterns among insect species. Some insects showed restricted seasonal distribution while others remained present across multiple seasons.

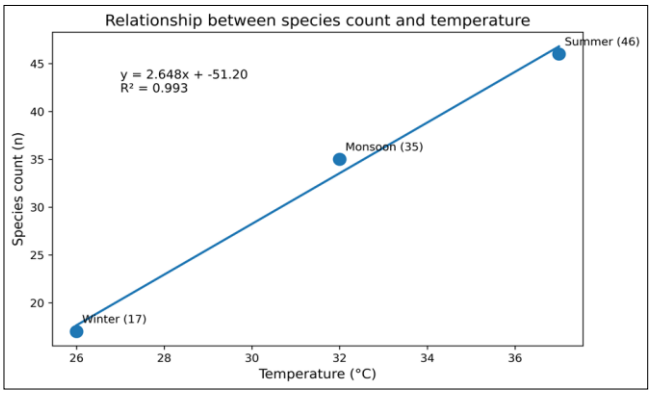

Fig 3: Relationship between species count and temperature recorded during the present study period

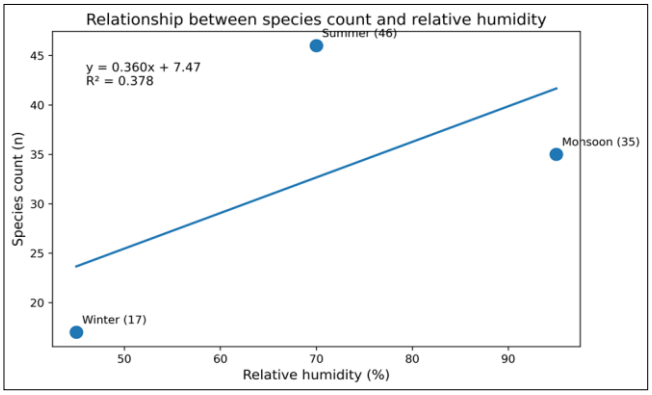

Fig 4: Relationship between species count and humidity recorded during the present study period

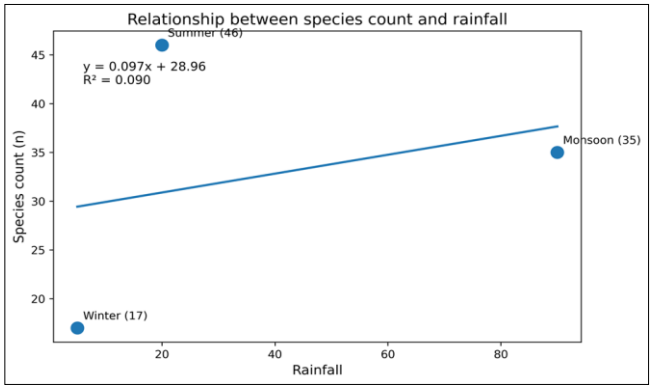

Fig 5: Relationship between species count and rainfall recorded during the present study period

Diversity Indices

The diversity indices calculated during the present study demonstrated considerable seasonal variation in species diversity (Table 7). The Shannon diversity index (H') was highest during monsoon (3.395), followed by summer (3.242), whereas winter recorded the lowest value (2.647). Higher Shannon diversity during monsoon indicates greater species heterogeneity and more balanced species distribution.

Simpson diversity index (1-D) was also highest during monsoon (0.961), suggesting lower dominance and greater ecological stability during this season. Similar findings have been reported in tropical habitats where rainfall and humidity promote insect emergence and population growth (Wolda, 1988) [9].

Evenness index (J') values were comparatively high during monsoon (0.955) and winter (0.934), indicating relatively uniform distribution of individuals among species. Berger–Parker dominance index was highest during summer (0.222), suggesting that a few species dominated the insect community during this season.

Margalef and Menhinick richness indices revealed comparatively higher richness during summer and monsoon seasons. The presence of diverse vegetation, flowering plants, and suitable microhabitats may contribute to increased richness.

Table 3: Diversity indices of the insect fauna at Chintamani Kar Bird Sanctuary at different seasons

Diversity Index	Summer	Monsoon	Winter
Total Individuals (N)	899	586	127
Species Richness (S)	46	35	17
Shannon Index (H')	3.242	3.395	2.647
Simpson Index (1-D)	0.927	0.961	0.921
Evenness (J')	0.847	0.955	0.934
Margalef Richness (D)	6.616	5.335	3.303
Menhinick Richness (D_{Mn})	1.534	1.446	1.509
Berger–Parker Dominance (d)	0.222	0.089	0.118

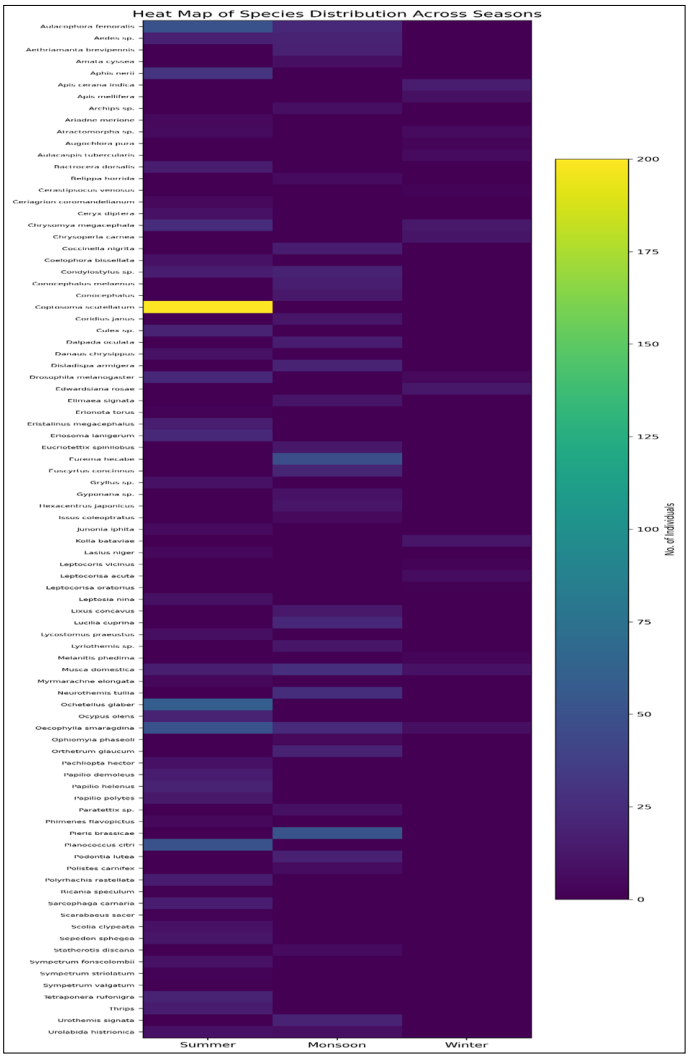

Fig 6: Heat map of the insect species distribution at different seasons surveyed during the present study period

Conclusion

The present study provides a preliminary account of the seasonal diversity and distribution of insect fauna in Chintamani Kar Bird Sanctuary, West Bengal. A total of 87 insect species belonging to 12 orders and 49 families were documented during the three seasonal surveys representing summer, monsoon, and winter.

The study revealed considerable seasonal variation in species richness, abundance, and diversity indices. Summer season recorded the highest abundance of individuals, whereas monsoon season showed the highest diversity index values, indicating a more stable and evenly distributed insect community. Hemiptera emerged as the dominant order, while families such as Libellulidae, Papilionidae, Formicidae, and Nymphalidae were highly representedCRIPT.

Environmental factors including temperature, humidity, and rainfall strongly influenced insect occurrence and abundance. The study also demonstrated that Chintamani Kar Bird Sanctuary supports ecologically important insect groups including pollinators, predators, decomposers, and herbivores.

The recorded insect diversity highlights the ecological importance of Chintamani Kar Bird Sanctuary as a suitable habitat for diverse insect communities. Insects play important ecological roles including pollination, nutrient recycling, decomposition, biological control, and maintenance of food webs.

Butterflies and bees contribute significantly to pollination, while dragonflies act as natural predators of mosquitoes and other small insects. Ants and beetles contribute to decomposition and nutrient cycling within forest ecosystems.

However, increasing anthropogenic disturbances, habitat fragmentation, pollution, pesticide use, and climate change may negatively affect insect diversity in future years. Therefore, long-term biodiversity monitoring and habitat conservation strategies are necessary for maintaining ecological stability and preserving insect fauna within the sanctuary.

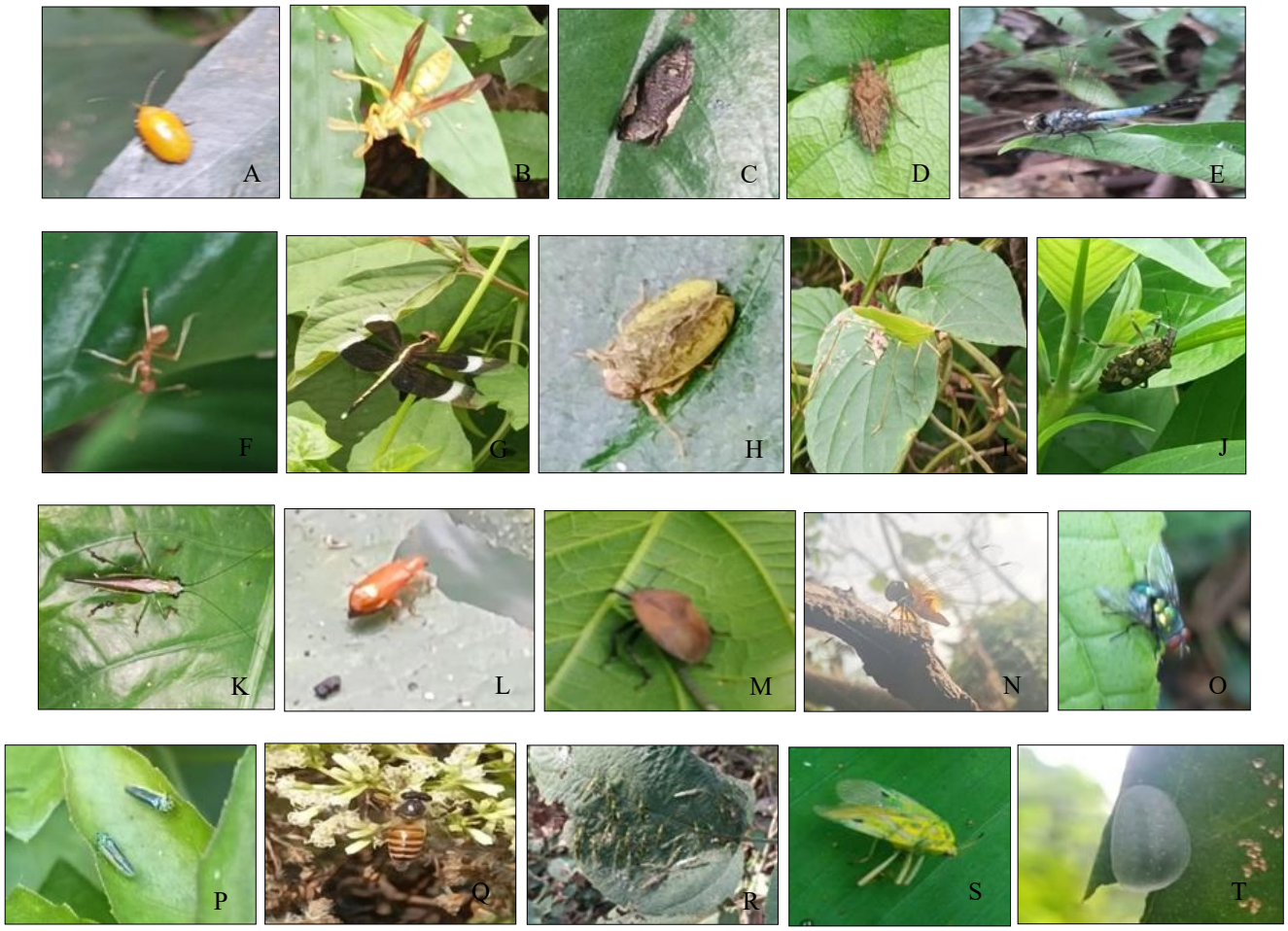

Fig 7: a. *Podontia lutia* b. *Polistes carnifex c. Statherotis discana* d. *Paratettix sp* e. *Orthetrum glauccum* f. *Oecophylla sp* g. *Neurothemis tullia h. Issus coleoptratus* i. *Elimaea signata* j. *Dalpada oculate* k. *Conocephalus spinosus* l. *Aulacophora fermoralis* m. *Coridius janus* n. *Aethriamanta brevipennis* o. *Lucilia cuprina* p. *Kolla bataviae* q. *Apis cerana indica* r. *leptocorisa acuta* s. *Urolabida histrionica* t. *Belippa horrida*

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