Physical Education, Health and Social Sciences

https://journal-of-social-education.org

E-ISSN: 2958-5996

P-ISSN: 2958-5988

Taxonomic Diversity, Habitat Associations, and Seasonal Variation of Beetles (Coleoptera) in Tehsil Darband, District Mansehra

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DOI: https://doi.org/10.63163/jpehss.v4i1.1683

Abstract

The present study investigated the taxonomic diversity, habitat associations, and seasonal variation of beetles (Coleoptera) in Tehsil Darband, District Mansehra, from July 2025 to March 2026. A total of 80 beetle specimens were collected from different habitats using pitfall traps, light traps, net sweeping, plant beating, and hand-picking. Specimens were preserved in 70% ethyl alcohol or by dry pinning and identified morphologically up to family and subfamily levels using standard taxonomic keys and published literature. Seven beetle families were recorded, namely Chrysomelidae, Coccinellidae, Meloidae, Geotrupidae, Cerambycidae, Scarabidae, and Carabidae, comprising 13 subfamilies. Chrysomelidae was the most abundant family with 26 individuals (32.5%), followed by Carabidae with 23 individuals (28.5%) and Scarabidae with 13 individuals (16.25%). Geotrupidae was the least abundant family, represented by one individual (1.25%). The agricultural habitat contributed the highest proportion of beetle captures (38.75%), followed by river-side habitats (32.5%), residential areas (17.5%), and woodland habitats (11.25%). Seasonal variation was pronounced, with the highest number of beetles recorded in July (31), followed by February (22) and September (20), whereas no specimens were recorded in December and January. The Shannon-Weiner diversity index was 1.59, while Shannon evenness was 0.82. The study indicates a moderately diverse beetle community in the study area and provides a reference dataset for future comparative studies.

Keywords: Beetles, Coleoptera, Taxonomic Diversity, Habitat Association, Seasonal Variation, Tehsil Darband, Mansehra

Introduction

Beetles belong to the order Coleoptera, which is the most diverse insect order and contains around 400,000 species worldwide (Chung, 2000). Beetles occur in nearly every major terrestrial environment, including trees and bark, flowers, leaves, soil near roots, plant tissues, galls, and dead or decaying material. Their feeding habits are diverse, with herbivorous, predatory, and scavenging groups represented within the order. Ground beetles of the family Carabidae are important predators of various insects and other arthropods, whereas dung beetles contribute to the decomposition of animal dung and associated ecological processes (Larsen, 2003; Pandey, 2017). Beetles are distributed across nearly all climatic regions, although the greatest diversity occurs in tropical areas (Bhumi, 2016). They occupy a wide range of habitats, including forests, grasslands, agricultural fields, river-side areas, gardens, and other vegetated environments (Mahar, 2024; Hussain, 2022). Their morphological characteristics, particularly the hardened forewings or elytra,

chewing mouthparts, antennae, and body structure, provide important features for taxonomic identification. Beetles perform important ecological functions. Dung beetles contribute to nutrient cycling, soil fertility, soil aeration, decomposition, and parasite suppression. Beetles also participate in pollination and may serve as herbivores, predators, scavengers, decomposers, and bioindicators of environmental conditions (Yadav, 2023; Andresen, 1999; Estrada, 1991) Despite their ecological importance, information concerning beetle diversity and habitat associations in selected areas of Tehsil Darband, District Mansehra, is limited. Therefore, the present study was conducted to document the beetle fauna and examine its distribution across different habitats and seasons.

Materials and Methods

Study period and study area

The study was conducted in Tehsil Darband, District Mansehra, from July 2025 to March 2026. The research area was divided into four sampling sites according to differences in habitat characteristics. These included agricultural fields, river-bank and stream-edge habitats, township residential areas, and woodland. The agricultural site was characterized by cultivated land containing wheat, maize, and barley. The river-side site contained moist soil and vegetation including carrot grass, *Cannabis sativa*, and wild shrubs. The residential site contained mulberry, chinaberry, and jujube, whereas the woodland site had moderate tree cover with *Dalbergia*, *Nilgari*, and jujube vegetation.

Collection of beetles

A total of 80 beetle specimens were collected during the study. Different collection methods were employed, including sweep nets, light traps, pitfall traps, hand-picking, plant beating, and other field collection procedures reported in the thesis. A total of 13 field visits were conducted during summer and winter. Specimens were identified using standard taxonomic keys and published literature. Photographs were taken using a camera with 60× magnification.

Preservation and labeling

Collected specimens were preserved in 70% ethyl alcohol to prevent decomposition. Larger specimens were preserved by dry pinning. Each specimen was labeled with relevant information including collection date, sample size, location, weather, time, habitat type, and collection method.

Identification

The collected beetles were identified on the basis of morphological characteristics using standard taxonomic keys and published literature. Identification was performed up to family and subfamily levels.

Data analysis

Beetle diversity was evaluated using the Shannon-Weiner diversity index, Simpson's diversity index, and Shannon evenness. The diversity of beetles was compared among study sites, habitats, and environmental conditions. The formulas reported in the thesis were:

Shannon-Weiner diversity index:

$H' = \sum [(pi) \times \ln(pi)]$

Simpson's diversity index:

$D = \sum (pi)^2$

Shannon evenness:

$E = H'/\ln(S)$

where *pi* represents the proportion of the total sample represented by each taxonomic group and *S* represents richness.

Results and Discussion

Taxonomic diversity

Morphological identification of the collected specimens revealed seven beetle families and 13 subfamilies. The recorded families were Chrysomelidae, Coccinellidae, Meloidae, Geotrupidae, Cerambycidae, Scarabidae, and Carabidae.

Chrysomelidae was represented by Galerucinae and Chrysomelinae. Coccinellidae included Epilachninae and Coccinellinae. Meloidae was represented by Meloinae, Geotrupidae by Geotrupinae, and Cerambycidae by Lamiinae. Scarabidae included Cetoniinae and Scarabaeinae, while Carabidae included Herpalinae, Nebriinae, Scaritinae, and Brachinini.

Family-wise abundance

A total of 80 beetle individuals were recorded. Chrysomelidae was the most abundant family, with 26 individuals representing 32.5% of the total collection. Carabidae was the second most abundant with 23 individuals (28.5%), followed by Scarabidae with 13 individuals (16.25%). Coccinellidae was represented by five individuals, Meloidae by five, Cerambycidae by four, and Geotrupidae by one individual. Geotrupidae therefore represented the least abundant family at 1.25%. The largest contribution came from Chrysomelidae, whereas Geotrupidae had the lowest representation.

Table 1. Family-wise abundance of beetles recorded from Tehsil Darband

Family	Number of individuals	Relative abundance
Chrysomelidae	26	32.5%
Carabidae	23	28.5%
Scarabidae	13	16.25%
Coccinellidae	5	10%
Meloidae	5	6.25%
Cerambycidae	4	5%
Geotrupidae	1	1.25%
Total	80	100%

Subfamily and habitat associations

Within Chrysomelidae, Chrysomelinae was represented by 18 specimens collected from carrot grass (*Parthenium hysterophorus*), while Galerucinae was represented by eight specimens collected from musk melon. Cetoniinae of Scarabidae accounted for 11 specimens and was associated with maize plants and pitfall traps. Carabidae were mainly collected from wheat fields and pitfall traps. Coccinellidae specimens were associated with ant colonies, carrot grass, and *Cannabis sativa*. Meloidae and Cerambycidae were associated with sponge gourd (*Luffa aegyptiaca*), whereas Geotrupidae and some Scarabidae were mainly attracted to light traps.

Table 2. Recorded subfamilies and their associated collection locations

Family	Subfamily	Sample size	Collection/association
Chrysomelidae	Galerucinae	8	Musk melon
Chrysomelidae	Chrysomelinae	18	Carrot grass
Coccinellidae	Epilachninae	3	Near ant colony
Coccinellidae	Coccinellinae	5	Carrot grass and *Cannabis*
Meloidae	Meloinae	5	Sponge gourd
Geotrupidae	Geotrupinae	1	Light trap
Cerambycidae	Lamiinae	4	Sponge gourd
Scarabidae	Cetoniinae	11	Maize plant and pitfall traps
Scarabidae	Scarabaeinae	2	Light trap
Carabidae	Herpalinae	3	Chinaberry tree
Carabidae	Nebriinae	7	Pitfall trap in wheat field
Carabidae	Scaritinae	12	Wheat field
Carabidae	Brachinini	1	Pitfall trap

Beetle abundance across habitats

The agricultural field had the highest proportion of beetle captures, accounting for 38.75% of the total collection. River-side habitats contributed 32.5%, residential areas 17.5%, and woodland habitats 11.25%. Carabidae were particularly abundant in agricultural fields, with 20 individuals, while Scarabidae contributed eight individuals. River-side habitats contained 18 Chrysomelidae and five Coccinellidae individuals. Woodland habitats contained five Meloidae, four Cerambycidae, and two Carabidae individuals.

Table 3. Distribution of beetle families across habitats

Family	Agricultural field	River side	Residential area	Woodland
Chrysomelidae	0	18	8	0
Coccinellidae	3	5	0	0
Meloidae	0	0	0	5
Geotrupidae	0	0	1	0
Cerambycidae	0	0	0	4
Scarabidae	8	2	3	0
Carabidae	20	1	0	2
Percentage of total	**38.75%**	**32.5%**	**17.5%**	**11.25%**

Seasonal variation

Strong seasonal variation in beetle abundance was observed. The highest number of specimens was recorded in July, with 31 individuals. September followed with 20 individuals, while February had 22 individuals. Three individuals were collected in August, two each in October and November, and no beetles were recorded during December and January. The results demonstrate marked seasonal fluctuation, with beetle abundance decreasing during the colder winter period and increasing again in February.

Table 4. Monthly abundance of beetles

Month	Number of beetles
July	31
August	3
September	20
October	2
November	2
December	0
January	0
February	22
Total	**80**

Diversity indices

The Shannon-Weiner diversity index was calculated as 1.59, indicating a moderately diverse beetle community. The study used seven families as the measure of richness. The reported Simpson's diversity calculation gave a value of D = 0.228, while the thesis reports 1-D = 0.0772 and interprets the result as indicating low dominance by a single family and good diversity. Shannon evenness was calculated as 0.82, indicating fair distribution of individuals within the community.

Table 5. Shannon-Weiner and Simpson's diversity index

Families	# individual	Pi	In(pi)
Chryosmoelidae	26	0.325	-1.124
Coccinellidae	7	0.875	-2.436
Meliodae	05	0.0625	-2.773
Geotropidae	1	0.0125	-4.382
Cerambycidae	04	0.04	-3.219
Scarabidae	13	0.1625	-1.817
Carabidae	23	0.2875	-1.247
S=7	Total= 80		

Conclusion and Recommendations

The present study documented 80 beetle specimens from selected habitats of Tehsil Darband, District Mansehra. The specimens represented seven beetle families and 13 subfamilies. Chrysomelidae was the dominant family, representing 32.5% of the total collection, while Geotrupidae was the least abundant at 1.25%. Beetle abundance varied considerably among habitats, with agricultural fields contributing the highest proportion of captures, followed by river-side, residential, and woodland habitats. Strong seasonal variation was also observed, with maximum abundance during July and no captures during December and January. The Shannon-Weiner diversity index of 1.59 reflected a moderately diverse beetle community, while Shannon evenness of 0.82 indicated fair distribution of individuals. The findings provide a reference dataset for future comparative studies of beetle diversity and habitat associations in the region.

Future studies should expand the geographical coverage and increase the number of sampling sites. Sampling throughout the year is recommended to better document seasonal variations in beetle diversity and abundance. The incorporation of molecular techniques, particularly DNA barcoding, is recommended to improve identification to species level. Reducing disturbance of pitfall traps may also improve the accuracy and representativeness of future collections.

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