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SEASONAL DIVERSITY AND DOMINANCE PATTERNS OF EARWIGS (INSECTA: DERMAPTERA) IN JHARGRAM, WEST BENGAL: A QUANTITATIVE APPROACH

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ABSTRACT

This study examines seasonal variation in earwig diversity in Jhargram, West Bengal, based on 167 specimens collected across pre-monsoon, monsoon, and post-monsoon periods. Six species were recorded *Euborellia annandalei* (Burr, 1906), *Euborellia annulipes* (Lucas, 1847), *Euborelli acompressa* (Borelli, 1907), *Nala lividipes* (Dufour, 1829), *Diplatys sinuatus* Hincks, 1955, and *Marava arachidis* (Yersin, 1860) under four families Anisolabididae, Labiduridae, Diplatidae, and Spongiphoridae. Diversity was assessed using the Shannon-Wiener Diversity Index (H′), species evenness with the Evenness Index (J′), and dominance using the Berger-Parker Index (d). Diversity peaked during the monsoon, while the highest evenness occurred pre-monsoon. Post-monsoon exhibited moderate diversity and the lowest dominance. Among all the species, *E.annandalei* was the most abundant, occurring during the monsoon and post-monsoon periods. *M. arachidis* was consistently present across all seasons, with the highest number recorded during the pre-monsoon period. *D. sinuatus* was observed exclusively during the monsoon season, making it the least frequently encountered species. These findings reveal significant seasonal shifts in species composition and dominance, offering insights into the ecological dynamics of earwig populations in Jhargram, West Bengal.

KEYWORDS: Seasonal Diversity, Dominance, Earwigs, Jhargram, West Bengal

Earwigs are a diverse group of insects known for their characteristic forceps present at the end of their abdomen (Kamimura, 2023). They are found worldwide, inhabiting diverse environments ranging from forests and grasslands to agricultural fields and hiding themselves inside the moist, dam cracks and crevices during day time (Deepak and Ghosh, 2018). These nocturnal insects play essential ecological roles such as predators, scavengers, and also act as the prey on the basis of their feeding habit (Günther and Herter, 1974, Renz and Kevan, 1991). Despite their ecological significance, studies on the seasonal variation and community structure of earwig populations remain limited, especially in the West Bengal, India.

Understanding the diversity and abundance of earwig species is critical for elucidating their ecological roles and responses to environmental changes. Insects, including earwigs, exhibit pronounced seasonal variations driven by climatic factors such as temperature, humidity, and rainfall. So that our study focuses on assessing the seasonal variation in earwig populations in Jhargram by collecting specimens during pre-monsoon, monsoon, and post-monsoon.

Jhargram, a district located in the western part of West Bengal, India, is characterized by a tropical climate with distinct pre-monsoon, monsoon, and post-monsoon seasons. The region's unique climatic conditions and diverse habitats such as mix of forested patches, agricultural fields, and human habitation, provide an ideal environment for studying earwig biodiversity.

A total of 147 specimens representing six species *viz.*, *Euborellia annandalei* (Burr, 1906), *Euborellia annulipes* (Lucas, 1847), *Euborellia compressa* (Borelli, 1907), *Nala lividipes* (Dufour, 1829), *Diplatys sinuatus* Hincks, 1955, and *Marava arachidis* (Yersin, 1860) (Figure: 1) were recorded. To quantitatively analyze community structure, three biodiversity indices were employed: the Shannon-Wiener Diversity Index (H′) to measure species diversity, the Evenness Index (J′) to assess distribution equity among species, and the Berger-Parker Index of Dominance (D) to determine the dominance of the most abundant species. This research provides insights into the community dynamics and ecological patterns of earwigs in response to seasonal climatic changes.

MATERIALS AND METHODS

Study Area and Data Collection

A total of 167 earwig specimens were collected from various habitats in different season from Jhargram (22.455000, 86.997400), West Bengal and preserved in 70% alcohol.

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Identification

Collected samples were identified on the basis of Srivastava volumes (1988, 2003, and 2013) and other literatures. Genitalia were removed for final confirmation.

Data Analysis

Species-wise abundance data for each season were recorded and tabulated. The diversity and dominance of earwigs were quantitatively analyzed using following three biodiversity indices:

1. Shannon-Wiener Diversity Index (H′) - To measure species diversity

$H' = - \Sigma [(pi) * \ln(pi)]$

Where, H' is the Shannon-Wiener diversity index,

Pi is the proportion of individuals belonging to the ‘i’-th species relative to the total number of individuals.

2. Evenness Index (J′)- To assess distribution equity among species means how evenly individuals are distributed among the recorded species.

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

Where, S is the total number of species in the community,

3. Berger-Parker Index of Dominance (D)- To quantitatively analyze community structure.

$D = N_{max}/ N$

Where, N_{max} = Number of individuals in the most abundant species,

N = Total number of individuals in the sample

RESULTS AND DISCUSSION

A total of 167 specimens of earwigs were collected from Jhargram, West Bengal, during three distinct seasonal periods: monsoon (July 2023), post-monsoon (September 2023), and pre-monsoon (March 2024). These specimens belonged to six species, distributed across four genera and four families: Anisolabididae, Labiduridae, Diplatidae, and Spongiphoridae (Figure 1, Table 1).

The earwig fauna collected from Jhargram, West Bengal, during the study period comprised a total of 167 individuals, representing six species, four genera, and four families: Anisolabididae, Labiduridae, Diplatidae, and Spongiphoridae. Among these, the family Anisolabididae was the most diverse, contributing three species of the genus *Euborellia* Burr, 1910. The most dominant species overall was *E. annandalei*, with a total of 52 specimens (31.1% of total catch), primarily observed during the monsoon (30 individuals) and post-monsoon (22 individuals) seasons, and absent during the pre-monsoon period. *E. annulipes* was the second most abundant species within the family, recorded across all three seasons, 9 individuals in monsoon, 11 in post-monsoon, and 10 in pre-monsoon, indicating its broad ecological tolerance. *E. compressa* was also collected in all seasons, with a total of 24 individuals: 7 during monsoon, 9 during post-monsoon, and 8 during pre-monsoon (Figure 1, Table 1)

The family Labiduridae was represented by a single species, *N. lividipes*, which accounted for 31 specimens in total. It showed a peak in abundance during the post-monsoon period (14 individuals), followed by monsoon (11 individuals) and pre-monsoon (6 individuals), suggesting its preference for moist, post-rainfall habitats. The family Diplatidae was represented by only one species, *D. sinuatus*, which was exclusively recorded during the monsoon season, with five individuals collected. This species showed strong seasonal specificity, being absent in both post- and pre-monsoon periods. The family Spongiphoridae was represented by *M. arachidis*, a relatively stable and seasonally consistent species. It was recorded during all three seasons with a total of 25 individuals: 6 in monsoon, 8 in post-monsoon, and 11 in pre-monsoon, showing highest abundance during the pre-monsoon period (Figure 1, Table 1).

Overall, species composition and abundance data revealed clear seasonal variation. *E. annandalei* emerged as the dominant species during monsoon and post-monsoon periods, while *M. arachidis* showed its peak during the pre-monsoon period (Table 5). The presence of certain species in all seasons *viz.*, *E. annulipes*, *E. compressa*, *N. lividipes*, *M. arachidis* highlights their adaptability to varying environmental conditions. In contrast, the restricted occurrence of *D. sinuatus* in the monsoon suggests its dependence on specific microhabitat conditions prevalent during the rainy season.

The monsoon season (July, 2023) recorded the highest number of specimens (68 individuals) and six identified species (Table 2). The Shannon diversity index was 1.563, indicating moderately high diversity (Table 2). However, the Berger-Parker dominance index was also highest (0.441), revealing a notable dominance of *E. annandalei*, which comprised nearly half of the sample (30 individuals) (Table 2). The evenness value of 0.872 suggests some imbalance in species distribution, likely due to favorable monsoon conditions that supported the proliferation of dominant species (Table 2).

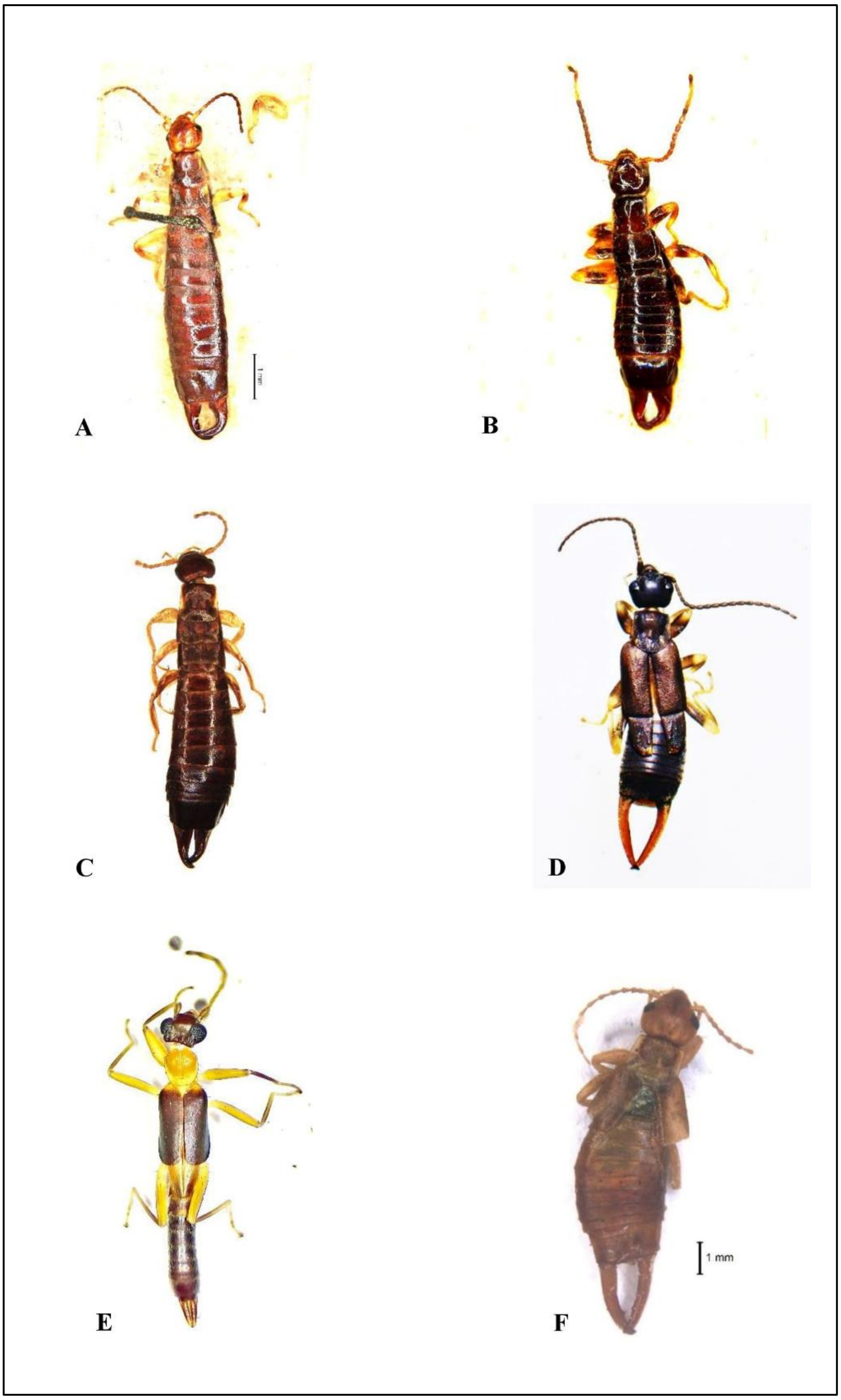

Figure 1: Dorsal habitus of (A) *Euborellia annandalei* (Burr, 1906), male; (B) *Euborellia annulipes* (Lucas, 1847), male; (C) *Euborellia compressa* (Borelli, 1907), male; (D) *Nala lividipes* (Dufour, 1829), male; (E) *Diplatys sinuatus* Hincks, 1955, male; (F) *Marava arachidis* (Yersin, 1860), male

In the post-monsoon season (September, 2023), a total of 64 specimens representing five species were collected (Table 3). The Shannon index slightly decreased to 1.529, indicating a minor reduction in diversity compared to the monsoon (Table 3). Interestingly, evenness increased to 0.950, and dominance (d) decreased to 0.344, indicating a more equitable distribution of individuals across species (Table 3). This shift suggests that the ecological pressure from changing humidity, vegetation cover, and resource availability during the post-monsoon phase may have reduced the competitive advantage of dominant species, allowing subordinate species to flourish.

Table 1: List of earwigs collected in different seasons from Jhargram, West Bengal

Sl. No.	Family	Species	Collection made on different seasons		
			Monsoon	Post-Monsoon	Pre-Monsoon
1.	Anisolabididae	*Euborellia annandalei* (Burr, 1906)	30	22	-
2.		*Euborellia annulipes* (Lucas, 1847)	9	11	10
3.		*Euborellia compressa* (Borelli, 1907)	7	9	8
4.	Labiduridae	*Nala lividipes* (Dufour, 1829)	11	14	6
5.	Diplatidae	*Diplatys sinuatus* Hincks, 1955,	5	-	-
6.	Spongiphoridae	*Marava arachidis* (Yersin, 1860)	6	8	11
Total			68	64	35

Table 2: Diversity indices of earwig specimens collected during monsoon period

Species	Exs.	Shannon Index (H′) H' = - Σ [(pi) * ln(pi)]			Evenness (J') J' = H'/ln(S)			Berger-Parker Index (D): D = N_{max}/ N		
		pi	Piln(pi)	H'	No. of Species (S)	ln(S)	J'	N_{max}	N	D
E. annandalei	30	0.4412	-0.3627	1.5629	6	1.7918	0.8724	30	68	0.4412
E. annulipes	9	0.1324	-0.2656							
E. compressa	7	0.1029	-0.2356							
N. lividipes	11	0.1618	-0.2936							
D. sinuatus	5	0.0735	-0.1943							
M. arachidis	6	0.0882	-0.2112							

Table 3: Diversity indices of earwig specimens collected during post-monsoon period

Species	Exs.	Shannon Index (H′) H' = - Σ [(pi) * ln(pi)]			Evenness (J') J' = H'/ln(S)			Berger-Parker Index (D): D = N_{max}/ N		
		pi	Piln(pi)	H'	No. of Species (S)	ln(S)	J'	N_{max}	N	D
E. annandalei	22	0.3438	-0.3663	1.5294	5	1.6094	0.9503	22	64	0.3438
E. annulipes	11	0.1719	-0.2996							
E. compressa	9	0.1406	-0.2742							
N. lividipes	14	0.2188	-0.3294							
M. arachidis	8	0.1250	-0.2599							

Table 4: Diversity indices of earwig specimens collected during pre-monsoon period

Species	Exs.	Shannon Index (H′) H' = - Σ [(pi) * ln(pi)]			Evenness (J') J' = H'/ln(S)			Berger-Parker Index (D): D = N_{max}/ N		
		pi	Piln(pi)	H'	No. of Species (S)	ln(S)	J'	N_{max}	N	D
E. annulipes	10	0.2857	-0.3582	1.350	4	1.3863	0.9738	11	35	0.3143
E. compressa	8	0.2286	-0.3300							
N. lividipes	6	0.1714	-0.2981							
M. arachidis	11	0.3143	-0.3635							

Table 5: Comparison of Diversity and Dominance Indices of earwig species across seasons in Jhargram, West Bengal

Season	No. of Indivisuals	No. of Species	Shannon-Wiener Diversity Index (H′)	Evenness Index (J′)	Berger-Parker Index of Dominance (d)	Dominant Species
Monsoon (July, 2023)	68	6	1.5629	0.8724	0.4412	*E. annandalei* (44%)
Post-Monsoon (September, 2023)	64	5	1.5294	0.9503	0.3438	*E. anandalei* (34%)
Pre-Monsoon (March, 2024)	35	4	1.350	0.9738	0.3143	*M. arachidis* (31%)

In the pre-monsoon season (March, 2024), the total number of specimens was lower (35 individuals), and species richness was slightly reduced, with four species recorded (Table 4). Despite this, the Shannon diversity index remained relatively high at 1.350, and the evenness peaked at 0.974, indicating a very balanced species distribution (Table 4). The Berger-Parker index was the lowest at 0.314, highlighting the absence of a dominant species during this period (Table 4). These findings imply that pre-monsoon environmental conditions characterized by rising temperatures and decreasing moisture may have limited the abundance of all species relatively evenly, resulting in a more balanced community structure.

CONCLUSION

This study provides clear evidence that seasonal variations significantly affect the diversity, dominance, and evenness of earwig communities in the studied region. By analyzing specimens collected during the pre-monsoon (March 2024), monsoon (July 2023), and post-monsoon (September 2023) periods, it was observed that monsoon conditions promote the highest species diversity and abundance (H' = 1.563) (Table 5). However, this period also exhibited the highest species dominance (d = 0.441) and lowest evenness (E = 0.872) (Table 5), largely due to the prevalence of *E. annandalei* (Table 5). In contrast, the pre-monsoon (H' = 1.350, E = 0.974, d = 0.314) and post-monsoon (H' = 1.529, E = 0.950, d = 0.344) periods demonstrated more equitable community structures, despite lower overall abundance (Table 5).

These findings highlight how environmental conditions such as moisture, temperature, and resource availability drive shifts in earwig community dynamics. The data suggest that species richness peaks in the monsoon, but community balance improves during transitional seasons, which may promote long-term ecological stability by reducing competitive exclusion.

From a conservation and pest management perspective, this seasonal understanding is valuable. Species like *E. annandalei*, which dominate during the monsoon, may act as indicators of habitat suitability or ecological disturbance, while evenly distributed communities during the pre- and post-monsoon periods may reflect more stable or recovering ecosystems. These patterns can inform timing strategies for surveys, monitoring ecosystem health, and implementing integrated pest management (IPM) programs, especially in agricultural landscapes where earwigs play dual roles as pests and beneficial predators.

In conclusion, multi-seasonal monitoring and diversity index-based analysis offer essential tools for understanding insect biodiversity and should be integrated into long-term ecological and agricultural planning.

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