



Seasonal fluctuations in composition and abundance of insect diversity in the East Gojjam Zone, Ethiopia

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Abstract

Insects are abundant and most diverse groups of animals, which are integral components of earth's ecosystems. Taxonomic and ecological studies of insects are crucial for understanding biodiversity, ecosystem functions, and the role these organisms play in soil health, nutrient cycling, and overall environmental stability. This study examined the insect community's abundance and composition in three areas of East Gojjam, Ethiopia, during the dry and wet seasons, from March to August 2021. Various species of insects were collected and identified using standardized sampling techniques; including sweep net, pitfall trap, and yellow pan trap to ensure a representative capture of different insect groups. After being conserved, the specimens were then identified using a morphological key to the lowest taxonomic level. Thirteen orders and fifty-four families were identified from the 461 insects that were gathered. The rainy season had the highest insect species abundance (57.27%), while the order Isoptera had the most individuals (18.65%) across all collections from all seasons. In the wet season, the Aphidae and Rhinotermitidae families were found to have the highest prevalence and widest distribution, with 55 (20.8%) and 34 (17.25%) individuals, respectively. Researchers recorded the highest species richness (29), Shannon-wiener diversity index ($H=2.87$), and Margalef's index ($D=5.94$) during the wet season. All seasons and locations had the lowest insect communities, while the dry season had the highest. Based on these findings, conservation and monitoring efforts should be prioritized the dry season, when insect diversity and abundance are lower, to help sustain vulnerable species and maintain ecological balance.

Keywords: *Abundance, Diversity, Season, Species richness, Insect*

1. Introduction

Insects are the most successful and dominant group of creatures on earth. They contribute significantly to total biodiversity and include more than half of all known animal species (Stork, 2018;

Tihelka *et al.*, 2021). They affect agriculture, human health, natural resources, and the environment due to their diversity (Braak *et al.*, 2018; Mensah *et al.*, 2018). Insects are essential organic matter decomposers and pollinators, which propel the creation of agricultural crops.

Furthermore, by biologically controlling pests and serving as bio-indicators of good streams and soils, they offer significant ecosystem services that go beyond pollination. On the other hand, very few insects pose a serious threat to metropolitan areas and agricultural crops. They disperse illnesses that can jeopardize the health of people, plants, and animals. Every year, millions of people die from diseases spread by insects (WHO, 2020). Global biodiversity, food security, and human livelihoods are all at risk due to invasive insect species' ability to harm crops and disrupt the delicate balance of healthy ecosystems (Early *et al.*, 2016).

The biodiversity of insects is related to environmental factors, food, and their physical condition (Yi *et al.*, 2011). Rainfall, moisture, and sunshine are crucial factors that are closely linked to the seasonal patterns of insects. In natural settings, these factors impact the number and variety of insects (Okrikata and Yusuf, 2016; Jenber and Wili, 2021). The diversity of floral species, diet, the pervasive chemical contamination of ecosystems, and the biology and abundance of vertebrate predators that rely on insects, like birds, are other factors that have been shown to be responsible for insect seasonality (Jenber and Wili, 2021; Raven and Wagner, 2021; Sanchez-Bayo and Wyckhuys, 2019).

The various factors described above leads to a rapid decline in both the amount and the variety of insect species and contribute to the occurrence of insect seasonality, which has a direct or indirect impact on insect diversity.

East Gojjam is dominated by mixed crop-livestock agricultural activities. However, improper use of land management practices including intensive farming,

overgrazing, and the widespread use of agrochemicals such as pesticides and herbicides pose significant threats to insect diversity in the region (Teferi *et al.*, 2013; Wale and Yami, 2019). Since insects are essential to preserving ecological diversity and stability, their removal may have a negative impact on ecosystems (Sanchez-Bayo and Wyckhuys, 2019). Insect fundamentals like species richness, variety, and abundance have not received much attention in the region. The richness of many species in the region is unknown, which leads to a lack of understanding in the taxonomic and ecological aspects of insects. Therefore, the purpose of this study is to assess the seasonal diversity and abundance of insects in Ethiopia's Eastern Gojjam while providing baseline data for further investigation and tracking of seasonal fluctuations in insect diversity.

2. Materials and Procedures

2.1. An explanation of the research area

The Goncha-Siso Enesie, Gozamin, and Machakel districts in Ethiopia's Eastern Gojjam Zone were the sites of this study in 2021 (Fig 1). The zone has an elevation range of 1500–3400 meter above sea level, and is roughly situated between latitudes 10°30' and 11°30' N and longitudes 37°30' and 38°30' E. The average annual rainfall in the area is between 900 and 2,200 mm, and the mean minimum and maximum temperatures fall between 11 and 22°C (CSA, 2013). The region experiences two distinct rainy seasons, with an average of about 1150 mm of rainfall each year. While showers are expected to occur all year long, the long rainy season starts in June and lasts until September. December and January are the coldest months, and May and June are the hottest. Abbay

Gorge's elevation is 785 meters above sea level, whereas the Çhoke Mountains' highest point is 4093 meters above sea level (Dagne and Worku, 2019). Most of East Gojjam's geography is made up of plain and mountainous areas, which make up 48% and 40% of the region's total area, respectively. According to Yirga *et al.* (2012), 80.73% of the Zone's total area is classified as Dega (high land) and Weyna dega (middle land).

East Gojjam Zone is characterized by diverse vegetation, including large trees, grasses, and herbaceous plants. During the insect collection process, various plant species were also systematically collected from diverse habitats within the study area to capture a broad spectrum of the local flora. The collections were carried out in parallel with insect sampling to ensure synchronized documentation of ecological association. These plants were taken to the Debre Markos University Botanical Science Laboratory for documentation and identification. Plant specimens were identified by using the observation of morphological features, and the use of identification key (Judd *et al.*, 2009). Major plant species recorded in each study areas include:

Acacia abyssinica Hochst. *Arundo donax* L. *Cyperus longus* L., *Eucalyptus globulus* Labill, *Brucea antidysenterica* J. F. Mill., *Rosa abyssinica* Lindley, *Scadollus mulliflorus* (Martyn) Raf. *Rhubus studneri* Schweinf., *Cynodon dactylon* (L.) Pers., *Argemone mexicana* L., *Stephania abyssinica* Walp. *Saccharum officinarum* L., *Hypericum revolutum* Vahl., *Salix subserata* Willd., *Phytolacca dodecandra* L'Herit., *Croton macrostachyus* Del. *Phoenix reclinata* Jacq., *Albizia shimperiana* Oliv., *Croton macrostachyus* Del., *Carissa spinarum* L., *Sida schimperiana* Hochst., *Dovyalis abyssinica* Warb., *Verbascum sinaiticum* Benth.,

Maytenus arbutifolia, *Buddleja polystachya* Fresen., *Vernonia amygdalina* Del., *Ficus sur* Forssk., *Urtica simensis* Steudel, *Calpurnia aurea* (Ait.), *Solanum anguivi* L., and *Rumex nervosus* Vahl.

Additionally, the local community used these districts as farmlands and grasslands for the production of crops, primarily *Eragrostis tef* (Zucc.) trotter, *Zea mays* L., and *Allium cepa* L. Traditional rain-fed agriculture, typically without fertilizer or lime, and tiny households were the hallmarks of the farming system used on the cleared area.

2.2.Sampling site selection

From 18 districts of East Gojjam Zone, three of them (four sites in each District) were selected purposely based on habitat heterogeneity of insects such as farmland (all-year round farming), grassland community, mixed crop-grassland, and open fields. These districts and the study sites were Goncha-Siso Enesie (Bahiregiorgis, Altabel, Genete-mariam and Weyible), Gozamin (Chemoga, Chinboard, Enerata, and Yekora), and Machakel (Debrekelemo, Lejet, Comed, and Amanuel). Therefore, a total of 12 sites were incorporated for this study.

2.3.Insect sampling

Seasonal-based data (dry and wet) were carried out from March 2021 to August 2021. Insect samplings were done biweekly using a sweeping net, pitfall trap, and yellow pan trap. The distance between two pans was 50meters (Westphal *et al.*, 2008). Graound animals were caught via pitfall trap method. At regular intervals, ten pitfall traps were positioned. The pitfall traps were placed in the ground with their holes at the surface level and measured 15 cm in diameter by 25 cm in depth. They contained roughly 200 milliliters of an aqueous solution containing 10% formalin (Inayat *et al.*, 2010). After being labeled and stored in a

jar with 10% chloroform, the captured insects were brought to the Debre Markos University Insectary for identification. Using a standard identification key, the

insects were morphologically classified into order and family levels (Triplehorn and Johnson, 2005).

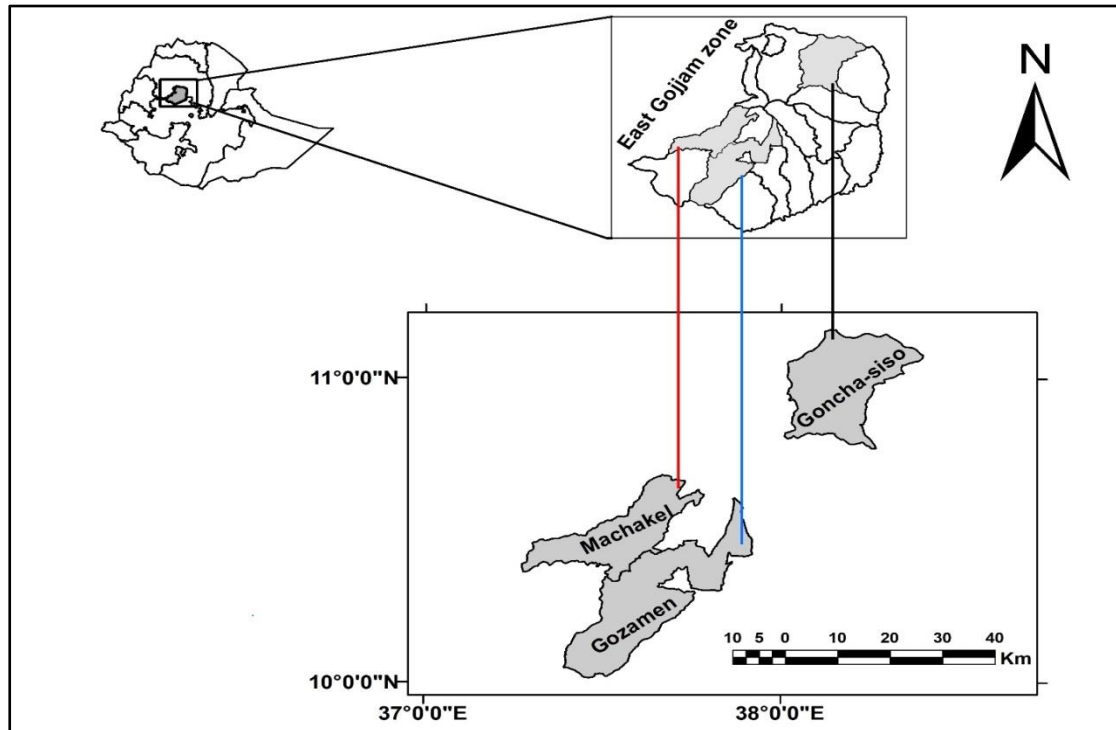


Fig 1 Map showing the study districts in East Gojjam, Ethiopia

2.4.Data analysis

Descriptive statistics was used for calculating and presenting the relative abundance of the collected insect assemblages. Besides, Shannon-Weaver (H') and evenness were employed to analyze the insect diversity and richness in different habitat categories.

The Shannon-weaver index (H') was used to calculate the variety of insects. Strong (2016):

$$H' = - \sum_{i=1}^S p_i (\ln p_i)$$

Where $P_i = n_i/N$ is the percentage of i th species in the total sample, and $\ln$ is the natural logarithm of p_i . A species that has a higher H' value is more diversified than one that has a lower H' value.

The formula for calculating evenness (j) is $J = H'/\ln S$, where $\ln S = H_{\max}$ (Shannon and Weaver, 1949). H' -is the Shainnon-

Wiener diversity index, $\ln S$ -is the natural logarithm of species richness (total number of species), and S is the number of families or species in a community.

For a large J value, the calculation's evenness would be greater. This indicates that the distribution of insects with higher J values is more uniform.

The formula from Simpson (1949) was used to determine species richness (D).

$$D = \sum \frac{n_i(n_i-1)}{N(N-1)}$$

Where n_i denotes the total number of creatures in each species and N is the total number of insects in all species.

Simpsons' index, which is computed as $D = \sum (P_i^2)$, where P_i is the fraction of families in the sample (community), was used to evaluate the variety of the community. This offered dominance

metric, where increased diversity was indicated by lower values.

Margalef's richness index (MRI) was used to determine the richness of insect orders. Where $-S$ was the total number of insects of a particular order, and $N.MRI = S-1/\ln$ was the total number of insects of all individuals. A Margalef's richness index values below 2 indicate low richness; values 2 - 5 to moderate richness; while exceeding 5 reflect high richness. Family abundance was calculated as the ratio of the total number of members of a family (assumed across all study plots) to the total number of sample units in which that family was found. Using the following formula, frequency was determined as the proportion of quadrats with a family present:

$$\text{Frequency (\%)} = \frac{\text{Number of quadrants wh}}{\text{Total number}}$$

To interpret distribution patterns, families were classified into three categories based on their frequency values. Families with >

50% frequency are widely distributed, between 25% and 50% are moderately distributed, and <25% are sparsely distributed (Curtis and McIntosh, 1950).

The degree of similarity between insects in different habitats was evaluated using Jaccard's index (CJ). CJ is equal to $j/(a+b-j)$, where j is the total number of families in both places, a and b are the numbers of families in sites A and B, respectively. For two sites that are absolutely different from one another, the Jaccard's index is zero. 1 means there is no difference between the two sites.

3. Findings

3.1. Number of insects collected in East Gojjam Zone 2021

461 insect species were gathered in both the rainy and dry seasons during the study period. The highest percentage of insects (57.27%) was gathered from the various study locations during the rainy season (Fig 2).

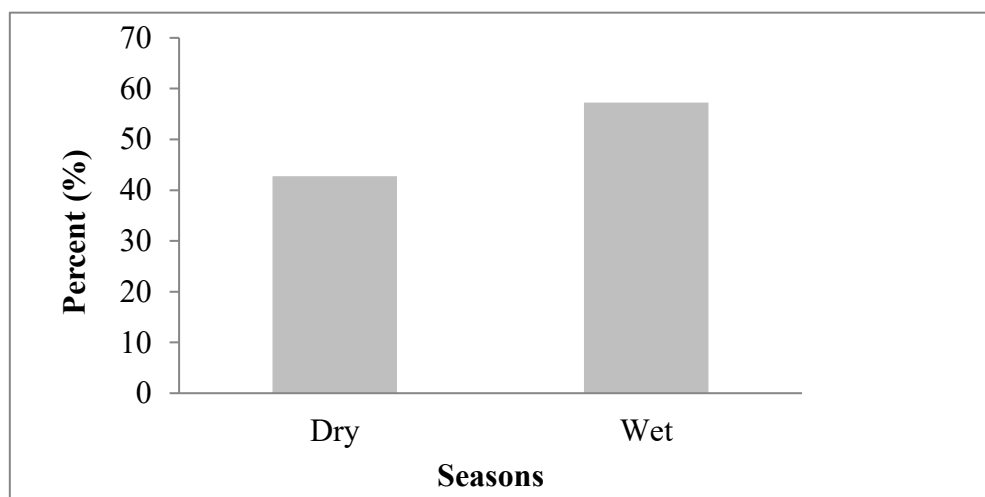


Fig 2 Percentage of insect species collected in dry and wet seasons in East Gojjam Zone in 2021.

3.2. Insects' diversity and abundance in East Gojjam Zone in 2021

The rainy season had the largest insect abundance (264) and species richness (17), whereas the dry season had the lowest

abundance (12) and species richness (197). Insect species dominance was lower and diversity was somewhat higher ($D=0.05$) in the dry season ecosystem. However, the wet and dry seasons are not so different from one another. Margalef's index

($D=3.76$) and Shannon-Wiener diversity index ($H=0.36$) were higher during the wet

season compared to the dry season (Table 1).

Table 1. compares the diversity of insects in the East Gojjam Zone during the dry and wet seasons in 2021.

Seasons	Species richness	Abundance	H'	MRI	Evenness	Simpson's index
Dry season	12	197	0.32	2.75	0.13	0.05
Wet season	17	264	0.36	3.76	0.12	0.08

* MRI stands for Margalef's index; H' for Shannon-Wiener index.

3.3. Insect species richness and diversity in the East Gojjam Zone by season in 2021

The rainy season had the largest abundance ($N=131$) and a higher species richness (29) than the dry season due to the large number of insect species. Margalef's

index ($MRT=5.94$) and the Shannon-Wiener diversity index ($H=2.87$) are highest during the wet season (Table 2). Wet seasons at various locations showed the highest (0.99) homogeneity or pattern of distribution of species with other species in a sampled site.

Table 2. Diversity indices for insect families collected during wet and dry seasons of East Gojjam Zone in 2021

Districts	Seasons	S	N	H'	d	J'
Goncha-Siso Enesie	Dry	18	63	2.36	4.10	0.81
	Wet	20	89	2.29	4.47	0.99
Gozamin	Dry	21	79	2.38	4.57	0.78
	Wet	29	131	2.80	5.94	0.82
Machakel	Dry	17	55	2.14	3.95	0.75
	Wet	21	44	2.87	5.35	0.94

S stands for species richness, H' for Shannon-Wiener index, J' for Pielou's evenness index, d for Margalef's index, and N for the number of individuals.

3.4. Species composition of insects in East Gojjam Zone in 2021

Out of the 461 insects that were gathered, 13 orders and 54 families were found in the three districts of the East Gojjam Zone that were chosen. Insect species in the order Hymenoptera (24.36%) were most abundant during the dry season. Insects in the order Homoptera were most dominant (20.8%) during the wet season. However, insect species in the orders Isoptera (18.65%) and Hymenoptera (18.2%) were recorded as dominant groups in all collection sites during the dry and wet seasons. Insect species in the orders Mantoda (0.43%), Phasmatoda (0.22%), and Neuroptera (0.22%) were the least during the wet season (Table 3).

3.5. Incidence of insect families at different sites of East Gojjam Zone, in 2021

Among 54 insect families, families such as Isoptera (Termitidae with 15.5% in wet season), and Homoptera (Aphidae with 20.8% in wet season) showed relatively wide distribution, while most Hymenoptera families like Apidae (8.12% in dry season) and Formicidae (5.07% in dry season) had low to moderate frequencies, indicating sparse to moderate distribution. Several families in orders such as Diptera and Odonata orders generally showed low frequencies (<5%),

reflecting sparse distribution across the sampling plots during both seasons (Table 4).

3.6. Insect similarities between seasons in East Gojjam Zone in 2021

Similarities between insects were noted throughout the research area at various times of year. During the dry season, insects were found to be the most similar. Insects were less similar in the rainy season (Figure 3).

Table 3. Seasonal insect species composition in East Gojjam Zone in 2021

Insect order	Dry season			Wet season		
	Insect numbers	(%) abundance	Relative	Insect numbers	(%) abundance	Relative
Hymenoptera	48	24.36		36	13.63	
Lepidoptera	22	11.17		31	11.74	
Orthoptera	15	7.61		27	10.22	
Isoptera	45	22.84		41	15.53	
Blattoda	3	1.52		5	1.89	
Mantoda	-	-		2	0.75	
Diptera	23	11.67		28	10.60	
Odonata	12	6.09		16	6.06	
Coleoptera	14	7.10		13	4.92	
Homoptera	10	5.07		55	20.83	
Hemiptera	5	2.53		8	3.03	
Neuroptera	-	-		1	0.37	
Phasmatoda	-	-		1	0.37	
Total	197	99.96		264	99.94	

Table 4. Insect family frequencies gathered during the dry and rainy seasons in the East Gojjam Zone in 2021

Orders	Family	Representative genera	Dry season	Wet season
			Frequency (%)	Frequency (%)
Hymenoptera	Apidae	<i>Apis</i>	16(8.12)	6(2.27)
	Formicidae	<i>Formica</i>	10(5.07)	10(3.78)
	Pompiliidae	<i>Anoplus</i>	2(1.01)	1(0.37)
	Sphecidae	<i>Ammophila</i>	6(3.04)	3(1.13)
	Scolidae	<i>Scolia</i>	4(2.03)	4(1.51)
	Halicitidae	<i>Halictus</i>	1(0.50)	3(0.37)
	Vespidae	<i>Vespula</i>	-	2(0.75)
	Colletidae	<i>Colletes</i>	3(1.52)	-
	Andrenidae	<i>Andrena</i>	1(0.50)	-
	Ichneumidae	<i>Ichneumon</i>	1(0.50)	4(1.51)
	Argidae	<i>Arge</i>	4(2.03)	2(0.75)
	Tiphiidae	<i>Tiphia</i>	-	1(0.37)
	Pieridae	<i>Pieris</i>	9(4.56)	14(5.30)

Lepidoptera	Lycaenidae	<i>Lycaena</i>	4(2.03)	6(2.27)
	Nymphalida	<i>Danaus</i>	8(4.06)	2(0.75)
	Papilionidae	<i>Papilio</i>	-	9(3.40)
	Riodinidae	<i>Calephelis</i>	1(0.50)	-
	Carabidae	<i>Carabus</i>	3(1.52)	2(0.75)
Coleoptera	Tenebrionidae	<i>Tenebrio</i>	2(1.01)	1(0.37)
	Scarabaeidae	<i>Scarabaeus</i>	3(1.52)	6(2.27)
	Chrysomelidae	<i>Chrisolina</i>	1(0.50)	2(0.75)
	Gyrinidae	<i>Gyrinus</i>	2(1.01)	-
	Hydrophilidae	<i>Hydrophilus</i>	1(0.50)	-
	Conccinelidae	<i>Coccinella</i>	-	1(0.37)
	Dysticidae	<i>Dytiscus</i>	1(0.50)	-
	Lycidae	<i>Lycus</i>	-	1(0.37)
	Trachypachidae	<i>Trachypachus</i>	1(0.50)	-
	Acrididae	<i>Schistocerca</i>	10(5.07)	16(6.06)
Orthoptera	Gryllidae	<i>Gryllus</i>	1(0.50)	4(1.51)
	Tettigoniidae	<i>Tettigonia</i>	3(1.52)	4(1.51)
Odonata	Copiphoridae	<i>Copiphora</i>	-	3(1.13)
	Acrididae conica	<i>Acrida</i>	1(0.50)	-
	Aeshnidae	<i>Aeshna</i>	10(5.07)	12(4.54)
	Gamphidae	<i>Gamphus</i>	-	4(1.51)
Diptera	Calopterygidae	<i>Calopteryx</i>	2(1.01)	-
	Mucidae	<i>Musca</i>	16(8.12)	9(3.40)
	Tachnidae	<i>Tachina</i>	2(1.01)	3(1.13)
	Syrphidae	<i>Syrphus</i>	-	8(3.03)
	Coelopidae	<i>Coelopa</i>	-	3(1.13)
	Spharoceridae	<i>Spharocera</i>	-	3(1.13)
	Hippoboscidae	<i>Hippobosca</i>	-	1(0.37)
	Acroceridae	<i>Acrocera</i>	4(2.03)	-
	Hesperinidae	<i>Hesperinus</i>	1(0.50)	-
	Sepsidae	<i>Sepsis</i>	-	1(0.37)
Isoptera	Termitidae	<i>Macrotermes</i>	11(5.58)	41(15.5)
	Rhinotermitidae	<i>Coptotermes</i>	34(17.2)	-
Blattoda	Blattidae	<i>Periplaneta</i>	-	3(1.13)
	Blattellidae	<i>Blattella</i>	3(1.52)	2(0.75)
Homoptera	Aphidae	<i>Aphis</i>	10(5.07)	55(20.8)
Hemiptera	Reduviidae	<i>Reduvius</i>	5(2.53)	4(1.51)
	Pentatomidae	<i>Pentatoma</i>	-	4(1.51)
Mantoda	Mantidae	<i>Mantis</i>	-	2(0.75)
Phasmatoda	Phasmidae	<i>Phasma</i>	-	1(0.37)
Neuroptera	Chrysopidae	Chrysoperia	-	1(0.37)

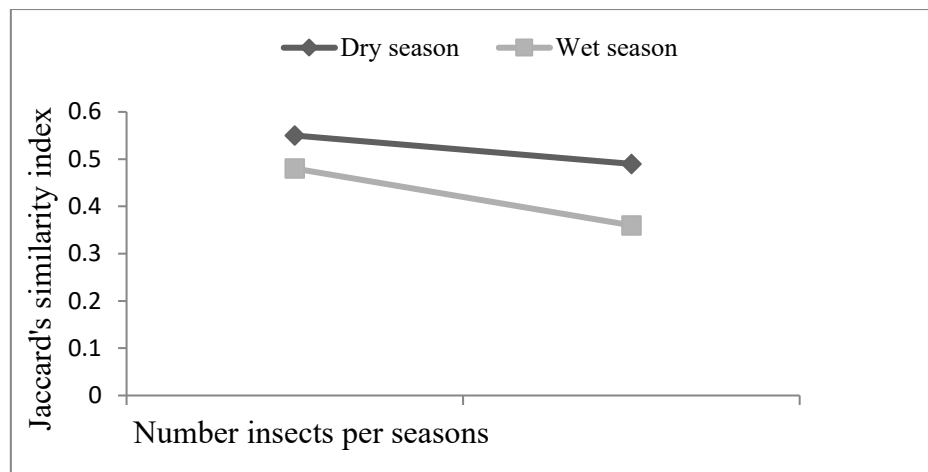


Figure 3. Jaccard's index of seasonal similarity among seasons in East Gojjam Zone in 2021.

The distribution of insects is highly similar when the values are high.

4. Discussion

Even though the studied areas were home to a large number of insect species, sampling in this study concentrated on major species, and 461 species from all sites during the dry and wet seasons, belonging to 13 orders and 54 families, were identified. Insect variety and abundance are higher during the wet season than during the dry season, as evidenced by the fact that the majority of specimens ($n=264$, 57.27%) were collected at this time. The seasonal variations in insect numbers may be influenced by climatic factors like rain, temperature, and humidity, which impact insect reproduction, growth, and survival (Amarasekare and Coutinho, 2014). Because it encourages the growth of vegetation and increases the number of leaves and shoots that provide food and shelter for herbivore insects, pollinators, and their natural enemies, rainfall in particular is important. These results are consistent with prior research highlighting the dependence of insect diversity on climatic factors like rainfall and

temperature (Yi *et al.*, 2011; Okrikata and Yusuf, 2016).

The findings highlight the strong dependency of insect diversity on favourable environmental conditions and resource availability. Dense vegetation also supports insect populations by offering shade and appropriate oviposition places. This association underscores the critical link between insect populations and floral resources, as noted by Ahrne *et al.* (2009) and Hulsmann *et al.* (2015). Insect population maintenance also depends on the quantity and quality of food sources (Sjodin *et al.*, 2008; Ballantyne *et al.*, 2015). Conversely, dry season is characterized by reduced availability, quality, and quantity of food resources, which increases insect mortality and triggers survival strategies such as migration, diapause, aestivation, and hibernation. Although diapause, aestivation, and hibernation are all forms of dormancy, they differ in their triggering factors: diapause is hormonally induced and often seasonal, aestivation is triggered by hot and dry conditions, and hibernation is triggered by cold temperature. Many insects also adapt by entering dormancy or

migrating, temporarily lowering observable populations. These adaptations enable them to endure unfavourable conditions but lead to a noticeable decline in their overall numbers during this period. Habitat fragmentation can come from human actions like the use of pesticides and the clearance of land for farming or grazing, which reduces the continuity of suitable habitats and lowers insect species richness, diversity, and abundance. This notion was strongly supported by Haddad *et al.* (2015) and Hallmann *et al.* (2017), who emphasized that habitat fragmentation reduces insect diversity and species richness by isolating populations and decreasing the availability of suitable niches.

The studied area's ecological richness is highlighted by the maximum Shannon-Wiener diversity index ($H=2.87$) and Margalef's index ($d=5.94$) during the wet season. By creating more resources and habitats, more rainfall promotes the growth of green vegetation, which in turn increases insect diversity and abundance. This is the reason why the Margraf index indicates that a greater number of insect species were responsible for both the comparatively high species richness ($S=29$) and the maximum abundance ($N=131$). The decreased evenness ($J=0.82$), however, may be the result of heavy rainfall destroying many of their food reserves. For a number of causes, including as resource availability for adult and larval host plants, behavioral traits, and interactions with other species, insect species richness and diversity may rise during the wet season. However, the relative lack of diversity during the dry season outweighs the challenges posed by harsher conditions such as reduced moisture and food scarcity ($H=2.14$). Likewise, the low evenness ($J=0.75$) may be due to the dominance of some insect

species such as Termitidae, Muscidae, Apidae, and Formicidae which contributed about 50% of the total numbers recorded.

There were distinct seasonal trends in the quantity of insect specimens and species composition, and these varied from season to season. During the wet season, the survey collected the greatest number of insects and species composition. Thirteen orders were gathered in all. Nevertheless, the biggest numbers of insect species, however, were found in the orders Isoptera and Hymenoptera. There were twelve families of insect pollinators in the order Hymenoptera, with the Apidae family predominating at each study site. The Scarabaeidae and Mucidae families were the most significant, while the orders of insects that were the second and third most diverse and rich were the Coleoptera and Diptera, respectively. Insect orders such as Mantoda, Phasmatoda, and Neuroptera were collected during the wet season only. This implies that the wet season is rich in insect species compared with the dry season.

The study identified 54 insect families, with Aphidae being the most frequently occurring, followed by Termitidae. The dominance of these families during the wet season might be due to favourable environmental conditions such as abundant vegetation and moisture in the area. Some families such as Pieridae, Formicidae, Acrididae, and Aeshnidae frequently occurred in both seasons from all surveyed areas. The common incidence of these insect families across different seasons might be due to the availability of a host plant that provides essential nutrients and protective shelters. Despite seasonal weather differences, these plants may also be essential for the survival, reproduction, and spread of these insects all year long. This shows different insects in these

families were responding to the dry and wet season's variation in different ways either declining or increasing their numbers.

Families such as Mucidae, Apidae, and Termitidae were more commonly found during the dry season in all the study sites. However, families such as Halictidae, Chrysomelidae, Ichneumonidae, Andrenidae, Hydrophilidae, Dysticidae, Hesperinidae, Trachypachidae, Gryllidae, Riodinidae, and Acrididae-conica were recorded the least in the dry season. Likewise, families such as Pompilidae, Chrysopidae, Tenebrionidae, Hippoboscidae, Concinidae, Tiphiidae, Sepsidae, Phasmidae, Lycidae and were recorded the least in the wet season. Insect populations may vary seasonally within different seasons as a result of environmental conditions that impact their abundance, life cycle, and abundance. For instance, warmer temperatures and high humidity during the wet season often accelerate insect development, survival, reproduction, and increased activity, leading to higher abundance. Conversely, lower humidity during the dry season increases water stress, and reduces insect abundance. The study by Bale *et al.* (2002) emphasises the sensitivity of insect populations to temperature fluctuations which influence their seasonal distribution patterns. Despite differences in species composition due to seasonal fluctuations, a high degree of similarity in insect communities was observed across districts and seasons, suggesting that many insect species are broadly distributed and share common habitats and ecological niches. The seasonal variation in insect populations is intricately linked to environmental factors (Gullan and Cranston, 2010). These factors directly influence insect physiology, resource availability, and lifecycle strategies, driving fluctuations in their abundance and distribution across seasons.

In order to preserve insect diversity and the ecosystem services they offer in East Gojjam, Ethiopia, it is critical to comprehend and manage environmental changes, as this study on these interactions highlights.

5. Conclusion

These findings show that seasonal environmental conditions have a major impact on the diversity, species richness, and abundance of insects in Ethiopia's East Gojjam Zone. Given the lowest insect diversity observed during the dry season, conservation strategies should prioritize this period to support vulnerable populations and sustain ecological functions. Insect community stability and the preservation of vital ecosystem functions like pollination and nutrient cycling may be maintained by promoting habitat and lowering human demands during the dry season. Therefore, in order to improve insect population resilience and protect ecological integrity, we advise focused conservation measures during the dry season.

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6. References

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