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Impact of corn meal and wild yeast media on *Drosophila* diversity in the Assam-Meghalaya rolling terrain

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Abstract. The distribution and diversity of Drosophila species across six sites in the rolling terrain between Assam and Meghalaya, employing trap-bait and net sweeping methods throughout the year. Using corn meal and *Musa balbisiana* (Wild yeast mediated) as culture media, flies were collected and analyzed for abundance, richness, and diversity using Simpson, Shannon-Wiener, and Berger-Parker indices. In Baridua, *Drosophila melanogaster* was predominant with 968 individuals on corn meal and a richer community of 2,536 on *Musa balbisiana*. Tura had 844 individuals on corn meal dominated by *D. melanogaster*, *D. elegans*, *D. repleta* and *D. sechellia while*, *Musa balbisiana* recorded 851 individuals with *D. melanogaster* being dominant, alongside *D. suzukii*, *D. sechellia*, *D. busckii* and *D. pseudoobscura*. Kharkutta showed 717 individuals on corn meal predominantly *D. melanogaster* and *D. subobscura* while 949 individuals recorded in *Musa balbisiana* dominated by *D. melanogaster*, *D. nasuta*, *D. pseudoobscura*, *D. subobscura* and *D. immigrans*. Rangjuli recorded 902 individuals on corn meal with *D. melanogaster*, *D. yakuba* and *D. repleta* as dominant species while 1,746 individuals recorded on *Musa balbisiana* with *D. melanogaster*, *D. suzukii*, D. *simulans* and *D. repleta being* dominant. Dudhnoi had 825 individuals on corn meal with *D. melanogaster as* dominant, along with *D. suzukii*, *D. busckii*, while 2,104 individuals recorded on *Musa balbisiana* dominated by *D. melanogaster*, *D. mauritiana*, *D. immigrans*. Langpih showed 566 individuals on corn meal with *D. melanogaster*, *D. mauritiana* and *D. immigrans* being dominant while 834 individuals recorded on *Musa balbisiana* dominated by *D. melanogaster*, *D. immigrans*, *D. bipectinata*, *D. repleta* and *D. suzukii*. It has been found that wild yeast media significantly increased *Drosophila* diversity compared to corn meal. Future research should explore species genetic analysis, seasonal variations, climate change effects, genetic diversity, habitat influences, human activity impacts, and ecological interactions for effective conservation strategies.

Keywords: Assam-Meghalaya, diversity, *Drosophila*, Shannon-Wiener, abundance, wild yeast

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Introduction

The fruit fly *Drosophila* has been an invaluable contributor to our understanding of genetics, inheritance, variation, and speciation and understanding the factors influencing *Drosophila* species distribution has broader implications for both ecological and evolutionary studies, Known for their cosmopolitan nature and intricate species compositions, Drosophilidae emerges as an exemplary model for the study of eco-distributional patterns (Carson

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& Wasserman, 1965). While significant attempts have been made in the taxonomy of the family Drosophilidae at global level (Bachli, 1998), the northeastern region of India remains a relatively unexplored territory. Assam and Meghalaya with its rich biodiversity, diverse climatic conditions, and varying altitudes, presents a promising arena for investigating the taxonomy and ecological dynamics of *Drosophila* species (Singh & Gupta, 1977; Dwivedi & Gupta, 1979; Gupta & Singh, 1979; Singh & Gupta, 1980; Singh & Chatterjee, 1987; Achumi *et al.*, 2013; Rabha *et al.*, 2024).The familial Drosophilidae encompasses over 3,500 species globally, with approximately 200 species reported from various parts of India (Bachli, 1998). The potential discovery of new *Drosophila* species in this biodiversity hotspot is a tantalizing prospect (Yenisetti *et al.*, 2002). In fact, the Drosophilid is considered as a hotspot of biodiversity in different regions. Thus, the Indo Himalayan region offers a suitable habitat for a wider range of distribution of *drosophila* diversity (Khali *et al.*, 2022). The ecological intricacies associated with *Drosophila* in the rolling terrain are least attended in terms of its diversity either at temporal or spatial ones (Magurran, 2011). Since most studies have consisted of collected trips only in the favourable season(s). *Drosophila* assemblage in three different habitats of Northwestern Ghats of Karnataka (India) highlighted the dominance of *Drosophila bipectinata*, *Drosophila malerkotliana* and *Drosophila eugracilis* was established under different variables (Srinath *et al.*, 2023).

The exploration of *Drosophila* species diversity in the northeastern region of India has significant contributions (Fartyal *et al.*, 2014) presenting at least 150 species from the genus *Drosophila*. Comprehensive review underlines that the species diversity of the genus *Drosophila* is intricately linked to genetic diversity, providing a foundation for understanding the evolutionary processes within this genus (Singh, 2015; Filippopoulou & Konstantinides, 2024). However, details regarding these occurrences are limited, emphasizing the need for more in-depth research both at temporal and spatial area (Singh, 2015). The genus's sensitivity to environmental variations, particularly in natural population size, suggests a need for a more nuanced understanding of the ecological factors influencing *Drosophila* dynamics (Achumi *et al.*, 2013; Srinath & Shivanna, 2014).

The general configuration of the landscape, its geology, climate, and other natural features define the terrain and based on the similarities in terrain properties, geomorphology, geological and morphometric properties, soil types, etc. into different units (Saha *et al.*, 2019) and so the Assam and Meghalaya in India, characterized by its softly contoured land, featuring a series of gentle ups and downs that influences on the diversity of Drosophilidae. Since the foothills are the transitional eco-sensitive zone with low relief hills between the plains and topographically high mountains (Borpujari & Bora, 2021)

Banana mash is the ideal media for *Drosophila* attraction, while the *Musa balbisiana* has been found to be worth as culture media added with wild yeast (Rabha *et al.*, 2024) due to its nutritional richness (Sarma *et al.*, 2022). A notable gap exists in the *Drosophila* diversity for Assam and Meghalaya therefore an attempt has been made to evaluate *Drosophila* species richness and abundance using corn meal and wild yeast media.

Materials and methods

The study area is confined to certain selected sites in the Assam-Meghalaya foothill belt bordering the Kamrup and Goalpara districts of Assam, India (Figs. 1, 2). The border is bounded by Kamrup Metropolitan District, the Brahmaputra River, Darrang District, and Meghalaya State. The foothill zone, which covers 778.27 km2, is the northward projection of Garo hills and Khasi-Jaintia hills. The study covers 206 km west to east, with an elevation ranging from 42 to 1124 meters. Geographically, the Assam-Meghalaya foothill belt bordering the Kamrup district lies between geo-coordinates 91˚0'3.338'' E and 91˚46'22.82'' E longitude and 26˚0'4.432'' N and 26˚13'46.372'' N latitude. The study selected six sites: Baridua, Tura, Kharkutta, Rangjuli, Dudhnoi, and Langpih (Table 1).

Preparation of culture media and collection of flies

Two different culture media, labelled A and B, were prepared for *Drosophila* collection conducted 2019–2021 in pre- monsoon (March to May), monsoon (June to. September), the post-monsoon (October to November), winter (December to February) (Borthakur, 1986).

Culture Media Preparation

Culture Medium A: 100 g of corn meal was boiled with 50 ml of water. After cooling, it was mixed with 4 g of commercial yeast powder (CY). The mixture was then added with 5% propionic acid in 1% sodium bicarbonate (V/V) as an additive, following the standard *Drosophila* culture procedure (Rabha *et al*., 2024).

Culture Medium B: Prepared similar to that of A, but with some differences. Ripen banana (*Musa balbisiana*) was blended, and 20 g of locally prepared wild yeast (WY) named as Bakhar in place of CY (Rabha *et al*., 2024). The mixture was wrapped with aluminum foil and left for 24 hours.

Collection Methods

Two collection methods were employed in tandem: the trap-bait method and the net sweeping method. *Drosophila* collection was made using the sweeping method throughout the year in four different seasons. The net sweeping method involved spreading the culture media under a shaded area (1m²). Sweeping was performed after 24 hours, over the spread culture media with precautions to prevent the entry of rainwater over the same. The net was used for sweeping into the bottles in the morning as well as in the evening for the next two consecutive days. Flies were collected using traps (I and II) made in 500 ml plastic bottles. A minute-hole was made that allowed drosophilid flies to enter but prevented entry by larger insects. The traps I and II baited hung in the understory vegetation. The two traps were used at each site: two of them being on the right side of the trail, approximately three meters away from each other, the third being about three meters away on the left side of the trail.

The flies in bottles (Corn and banana media) were taken for laboratory and analyzed. Males were separated and their taxonomical markers like, body color, genitalia, sex comb and bristle pattern and were used as criteria for classification. The abundance, richness and diversity relationship of flies collected were assessed by Simpson (D), Shannon-Wiener (H) and Berger-Parker (1/d) indices (Mateus *et al*., 2006).

Drosophila Collection

Drosophila collection was done during specific times: between 7 am to 1 pm and 5 pm to 11 pm during the study period (Since January 2019 until December 2021). The collected flies were etherized and transferred into the two mentioned culture media separately. Observations were made under a microscope.

Record of Abiotic parameters

During the study period, abiotic parameters like Temperature, Relative Humidity (RH), rainfall, and day length were systematically recorded using specialized instruments. The precision of these measurements was guaranteed through specific methods:

Temperature Measurements

Temperature data were obtained using a maximum and minimum thermometer. This device allowed for the accurate recording of both the highest and lowest temperatures experienced during the observation period.

Table 1: Features of different study sites in the Rolling Terrain of Assam and Meghalaya Border, India (MSL-Mean Sea level in meter)

Site no	Collection spots	MSL	Specifications of study site (s)	GPS Coordinates
I	Baridua(Meghalaya)	230	Baridua (USTM), influenced with lush green landscapes and diverse flora and fauna, provides an ecologically rich setting in the area.	26.1013^{0}N 91.8477^{0}E
II	Tura (Meghalaya)	300	Tura, (West Garo Hills district), Meghalaya, India, encompasses diverse habitats with hills, forests, and riverine landscapes, contributing to a rich ecological tapestry.	25.5141^{0}N 90.2032^{0}E
III	Kharkutta(Meghalaya)	220	Kharkutta, a reserve forest (North Garo Hills district) with landscapes and subtropical forests eco region.	25.9055^{0}N 90.9176^{0}E
IV	Rangjuli(Assam)	60	Rangjuli (Goalpara district) characterized by the ecological features like riverine landscapes, alluvial plains with diverse vegetation of subtropical climate.	25.9689^{0}N 90.9355^{0}E
V	Dudhnoi(Assam)	40	Dudhnoi (Goalpara district) is part of the Brahmaputra Valley, with riverine landscapes and alluvial plains.	25.9861^{0}N 90.7866^{0}E
VI	Langpih(Assam)	120	Langpih located in the Assam-Meghalaya border characterized by subtropical vegetation with riverine landscapes with habitat diversity. Also, influenced by human activities like agriculture and settlements.	25.6887^{0}N 91.2300^{0}E

Fig. 1. Satellite map of study sites

Relative Humidity (RH) Measurements

Relative Humidity readings were taken using dry and wet bulb thermometers in conjunction with an RH chart. This method provided a comprehensive understanding of the moisture content in the air, contributing to a thorough assessment of environmental conditions.

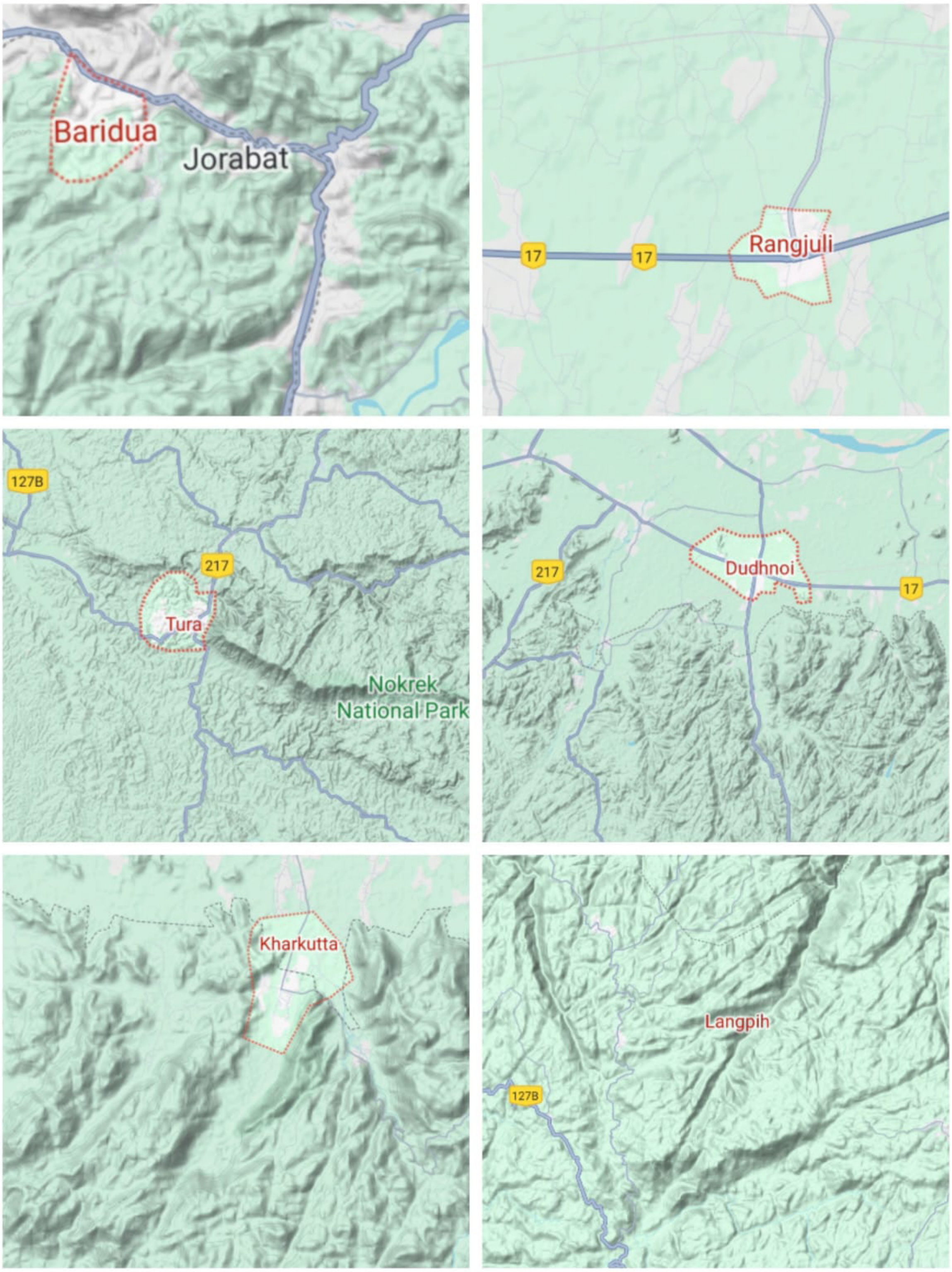

Fig. 2. Terrain map of the study sites

Rainfall Measurements

Rainfall data were collected using a rain gauge. This instrument facilitated the precise measurement of the amount of rainfall, ensuring an accurate representation of the precipitation levels experienced in the study area.

Day Length Records: Records of day length were conducted using a Sunshine recorder. This device helped record the duration of sunlight exposure during each day, contributing valuable information about the photoperiod and the variation in day length throughout the research period.

Identification of Males and Females

Identifying the sex of adult flies involves a meticulous examination of their anatomy. Key features assist in this differentiation (Carrillo, 2022).

Male Flies: In males, the last two segments of the abdomen exhibit a darker shade, featuring thick black bands. The abdomen has a distinctive shape with a rounded bottom. Additionally, male flies possess sex combs on their forelegs, just before the joint, characterized by thick black lines. This feature is absent in females.

Female Flies: The abdomen is a prominent criterion for differentiation in females, adult females are notably larger than males. The last two segments of the female abdomen typically display one darker band at the bottom and a lighter band above it.

Abdominal Shape

The shape of the abdomen serves as another distinguishing factor. The female's abdomen is pointed, while the male's abdomen has a rounded bottom.

Species Identification

1. *D. melanogaster* (Subgenus Sophophora Sturtevant): Primary clasper only present; Epandrium trapezoidal in shape (Meigen, 1830).

2. *D. immigrans* (Subgenus *Drosophila* Fallen): Tips of longitudinal veins black, male foreleg first tarsomere with a dense cluster of fine Hair (Sturtevent, 1921).

3. *D. busckii* (Subgenus *Drosophila* Sturtevant): Yellowish in color pre apical setae absent on second and third tibiae (Coquillet, 1901).

4. *D. nasuta* (Subgenus *Drosophila* Fallen): Male frons whitish pruinose abdominal pattern reduced in both male and female (Lamb, 1914).

5. *D. repleta* (Subgenus *Drosophila* Fallen): Third and fourth longitudinal veins divergent; Discal and second basal cells united; Anterior reclinate inserted posterior to proclinate orbital (Wollaston, 1858).

6. *D. ananassae* (Subgenus Sophophora Sturtevant): In male foreleg, several transverse rows of blackish brown bristles on the ventral surface of the first and second tarsal segment (Doleschall, 1858).

7. *D. bipectinata* (Subgenus Sophophora Sturtevant): Sex comb on first tarsomere in two rows; Single setae present on second tarsomere (Duda, 1923).

8. *D. kikkawai* (Subgenus Sophophora Sturtevant): Abdominal tergites with dark posterior bands in both males and females. Setae absent from posterior margins of abdominal tergites (Burla, 1954).

9. *D. suzukii* (Subgenus Sophophora Sturtevant): Sex comb with four stout bristles in the inner distal surface of first tarsal segment and few black bristles on the inner distal surface of second tarsal segment (Prasad & Paika,1964).

10. *D. pseudoobscura* (Subgenus Sophophora): Darker body color and adult flies are typically small (Woodworth 1901).

11. *D. sechellia* (Subgenus Sophophora): Reduced wing size with pigmentation in thorax and abdomen (Mayr, 1942).

12. *D. yakuba* (Subgenus Sophophora): Body colour is typical fruit fly appearance with a tan to brownish color (Morgan, 1910).

13. *D. elegans* (Subgenus *Drosophila*): Apical black patches, sex combs in transverse rows on the first 3 tarsal segments (Bock & Wheeler, 1972).

14. *D. mauritana* (Subgenus Sophophora): Small sized fly and tan to brownish colour (Seguy, 1928).

15. *D. subobscura* (Subgenus Sophophora): Variable body colour with shades of tan to brown (Woodworth, 1916).

16. *D. simulans* (Subgenus Sophophora): Closely similar to *drosophila melanogaster* in size, shape, color, shape and venation, chaetotaxy and in the presence of tarsal comb in male (Sturtevant, 1919).

Statistical analysis

A varied array of statistical parameters and diversity indices were systematically utilized by using PAST (Version 4) Tool to investigate the variability and correlation among species and culture media. The statistical analysis ANOVA, followed by Tukey's Pairwise Correlation, Mann-Whitney Pairwise Correlation, Diversity Indices, Correlation Similarity, and PCA (Principal Component Analysis) was carried out.

Results

Specifications of selected study sites were mentioned in Table 1. Records of the abiotic parameters of the six different study site area depicted in the Table 2. *Drosophila* species were recorded both from the trap and bait method across six diverse study sites(s) presented in the Table 3. Each exposed to different environmental conditions and trapped in two different culture media. Baridua site presented the highest number of *Drosophila melanogaster* against *Musa balbisiana* culture at 2055 inclusive of 960 males 1095 females followed by Cornmeal media at 777 (267+510) Table 3. The same site also presented a diversity of 9 species in both the category of culture media (Corn meal 968 and *Musa balbisiana* media 2536). The observations accounted a total number of 16 species in all the six different sites (Fig. 3). The least number of *Drosophila* individuals were 1400 noted in site VI (Langpih), but with six species, while the site V (Dudhnoi) presented 2929 individuals but with 5 different species against both the culture media.

The observations also presented a distinct female oriented content count in site I, in all the culture media. While the Site II to VI, the males outnumbered the females only in Corn meal media, interestingly the *Musa balbisiana* culture media attracted more females in these sites too (Table 3). Season wise count presented higher number of individuals during the monsoon period, whereas the species diversity was recorded both in the Monsoon and post monsoon period. Effect of altitude presented for the site I at 230 MSL with both the numbers and species diversity, while the MSL showed least diversity at Dudhnoi.

Table 2: Records of abiotic parameters of the study sites during the study period

Site no	Site(s)	Abiotic Parameters	Seasons: PM- Pre-Monsoon, M- Monsoon, PS- Post Monsoon & W- Winter			
			PM	M	PS	W
I	Baridua	Temperature (^{0}C)	20-25	25-34	26-30	17-22
		RH (Relative Humidity) (%)	68-75	80-83	75-80	60-70
		Rainfall (mm)	115-211	250-310	215-243	20-30
		Day length (h)	11-13	12-14	10-12	9-11
II	Tura	Temperature (^{0}C)	22-26	24-32	22-30	12-18
		RH (Relative Humidity) (%)	61-64	72-75	75-77	56-60
		Rainfall (mm)	125-215	220-280	230-270	25-45
		Day length (h)	10-12	11-14	10-12	9-11
III	Kharkutta	Temperature (^{0}C)	20-24	25-32	21-25	12-19
		RH (Relative Humidity) (%)	58-62	73-78	68-71	58-60
		Rainfall (mm)	90-160	210-290	180-250	20-40
		Day length (h)	11-12	11-15	10-11	9-10
IV	Rangjuli	Temperature (^{0}C)	21-25	25-36	21-29	15-19
		RH (Relative Humidity) (%)	57-62	72-77	67-69	60-65
		Rainfall (mm)	120-210	230-310	150-210	20-60
		Day length (h)	10-12	11-13	10-12	9-10
V	Dudhnoi	Temperature (^{0}C)	21-25	25-36	21-29	15-19
		RH (Relative Humidity) (%)	60-64	73-78	68-72	56-67
		Rainfall (mm)	120-230	220-320	180-220	20-55
		Day length (h)	10-12	11-13	10-11	9-11
VI	Langpih	Temperature (^{0}C)	25-32	25-32	22-28	11-19
		RH (Relative Humidity) (%)	56-60	72-77	63-75	52-58
		Rainfall (mm)	110-210	240-310	220-230	20-45
		Day length (h)	10-11	12-14	10-11	9-11

Table 3: Number of species and Individuals recorded indifferent site(s) and two different culture media in all seasons. Sites; I- Baridua, II- Tura, III- Kharkutta, IV- Rangjuli, V- Dudhnoi & VI- Langpih

Sites	Culture media	Sex	PM	M	PS	W	Species (♂+♀)	Total
I	Corn Meal (CY)	♂	59	97	105	95	*D. melanogaster* (267+510=777), *D.pseudoobscura* (48+49=97), *D. suzukii* (12+15=27), *D. subobscura* (12+23=35) & *D. busckii* (17+15=32)	968
		♀	110	192	193	117		
	Musa balbisiana (WY)	♂	174	431	339	196	*D.melanogaster* (960+1095=2055), *D. ananassae* (38+40=78), *D. pseudoobscura* (52+64=116), *D. mauritana* (33+118=151), *D. bipectinata* (32+45=77) & *D. kikkawai* (25+34=59)	2,536
		♀	218	497	535	146		
II	Corn Meal (CY)	♂	71	133	164	86	*D. melanogaster* (436+352=788), *D. elegans* (11+16=27), *D. repleta* (4+12=16) & *D. sechelia* (3+10=13)	844
		♀	52	112	149	77		
	Musa balbisiana (WY)	♂	72	146	108	75	*D. melanogaster* (367+414=781), *D. suzukii* (13+10=23), *D. sechelia*(8+10=18), *D. busckii* (7+8= 15) & *D. pseudoobscura* (6+8=14)	851
		♀	88	158	116	88		
III	Corn Meal (CY)	♂	72	116	126	62	*D. melanogaster* (366+323=689) & *D. subobscura* (10+18=28)	717
		♀	63	109	118	51		
	Musa balbisiana (WY)	♂	103	106	163	81	*D. melanogaster* (422+452=874), *D. nasuta* (13+16=29), *D. pseudoobscura* (7+10=17), *D. subobscura* (6+10=16) & *D. immigrans* (5+8= 13)	949
		♀	114	115	179	88		
IV	Corn Meal (CY)	♂	60	136	165	112	*D. melanogaster* (458+418=876), *D. yakuba* (8+6=14) & *D. repleta* (7+5= 12)	902
		♀	52	128	144	105		
	Musa balbisiana (WY)	♂	137	387	212	113	*D. melanogaster* (814+855=1,669), *D. suzukii* (15+18=33), *D. simulans* (13+15=28) & *D. repleta* (7+9=16)	1,746
		♀	149	402	223	123		
V	Corn Meal (CY)	♂	69	111	185	75	*D. melanogaster* (406+370=776), *D. suzukii* (23+9=32) & *D. busckii* (11+6= 17)	825
		♀	57	104	171	53		
	Musa balbisiana (WY)	♂	158	438	314	113	*D. melanogaster* (995+1,059=2,054), *D. yakuba* (15+13=28) & *D. simulans* (13+9=22)	2,104
		♀	169	454	329	129		
VI	Corn Meal (CY)	♂	52	82	109	57	*D. melanogaster* (278+251=529), *D. mauritana* (17+7=24) & *D. immigrans* (5+8=13)	566
		♀	44	74	103	45		
	Musa balbisiana (WY)	♂	83	139	114	62	*D. melanogaster* (361+392=753), *D .immigrans* (13+16=29), *D. bipectinata* (10+12=22), *D. repleta* (8+9=17) & *D. suzukii* (6+7=13)	834
		♀	92	146	123	75		

(CY- Commercial Yeast; WY- Wild Yeast (*Bakhor);* PM- Pre Monsoon, M- Monsoon, PS- Post monsoon & W- Winter). ♂- Male & ♀- Female.

Furthermore, the RH at 72-77% allowed to count higher numbers and diversity. Moreover, the highest day length also influenced the higher presence of individuals in Baridua (12-14 hr) and Kharkutta (11-15 hr). Impact of seasonality on the abundance of *Drosophila* in different seasons and different sites have been presented in the Table 4. It was observed that wild yeast mediated *Musa balbisiana* media attracted higher numbers of *Drosophila* individuals, Precisely the *Drosophila melanogaster*. In total there are 16 different species recorded in both Corn meal and *Musa balbisiana* culture media (Fig. 3).

Statistical analysis

Table 5 offers a detailed view with 24 observations for each of the four seasons: pre-monsoon, monsoon, post-monsoon, and winter. It provides insights into the cumulative total number of individuals, which are 2318 for pre-monsoon, 4813 for monsoon, 4487 for post-monsoon, and 2224 for winter. These numbers give a comprehensive perspective on the thermal load experienced throughout each season. The variance and standard deviation values further enhance the analysis, revealing the variability within the population data. Notably, the pre-monsoon season shows higher variability with a variance of 8863.06, while the monsoon season exhibits the highest standard deviation at 286.97.

Table 4: Seasonal variation of Drosophila species with two different types of yeast mediated culture media in six different sites of a Rolling terrain of Assam & Meghalaya. (Y- Yeast or bakhar, C- Commercial; W- Wild , PM- Pre Monsoon, M- Monsoon, PS- Post monsoon & W- Winter, N- Nil, Sn- Species number; 1. *D. melanogaster,* 2. *D. immigrans*, 3. *D. busckii*, 4. *D. nasuta*, 5. *D. repleta*, 6. *D. ananassae*, 7. *D. bipectinata*, 8. *D. kikkawai*, 9. *D. suzukii*, 10. *D. pseudoobscura*, 11. *D. sechellia*, 12. *D. yakuba*, 13. *D. elegans*, 14. *D. mauritana*, 15. *D. subobscura* & 16. *D. simulans*)

Sn	Y	Site -I				Site-II				Site-III				Site-IV				Site-V				Site-VI			
		PM	M	PS	W	PM	M	PS	W	PM	M	PS	W	PM	M	PS	W	PM	M	PS	W	PM	M	PS	W
1	C	162	244	236	135	117	213	301	157	130	219	232	108	108	252	301	215	117	203	338	118	87	144	204	94
	W	328	814	618	295	162	299	203	117	182	214	336	142	273	771	423	202	318	872	628	236	157	264	211	121
2	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	6	7	N
	W	N	N	N	N	N	N	N	N	N	7	6	N	N	N	N	N	N	N	N	N	N	16	13	N
3	C	N	32	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	17	N	N	N	N	N
	W	N	N	N	N	N	15	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	29	N	N	N
5	C	1	6	9	N	N	12	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	N	N	N	N	N	N	N	N	N	16	N	N	N	N	N	N	N	N	N	N	N	4	13	N
6	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	N	78	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	N	N	77	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	18	1	3	N
8	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	59	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9	C	7	13	7	N	N	N	N	N	N	N	N	N	N	N	N	N	9	12	1	10	N	N	N	N
	W	N	N	N	N	13	10	N	N	N	N	N	N	13	2	N	18	N	N	N	N	N	N	N	13
10	C	N	N	55	42	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	N	36	80	N	N	N	14	N	N	N	N	17	N	N	N	N	N	N	N	N	N	N	N	N
11	C	N	N	N	N	6	7	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	5	N	7	6	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12	C	N	N	N	N	N	N	N	N	N	N	N	N	N	4	8	2	N	N	N	N	N	N	N	N
	W	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	20	8	N	N	N	N	N
13	C	N	N	N	N	N	25	2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	9	6	1	8
	W	5	N	99	47	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15	C	N	N	N	35	N	N	N	N	5	6	12	5	N	N	N	N	N	N	N	N	N	N	N	N
	W	N	N	N	N	N	N	N	N	6	N	N	10	N	N	N	N	N	N	N	N	N	N	N	N
16	C	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
	W	N	N	N	N	N	N	N	N	N	N	N	N	N	N	12	16	9	N	7	6	N	N	N	N

The ANOVA results (Table 6), demonstrates that a substantial portion of the overall variability is attributable to differences between the groups. The Between Groups analysis showed a significant difference, highlighting important distinctions. The Within Groups analysis, although not significant, provided valuable context on the variability within the groups. Components of Variance analysis offered a deeper understanding of the sources contributing to variance. Levene's test for homogeneity of variance from means detected a significant difference, underlining the importance of considering variance in the analysis. Additionally, the Welch F test for unequal variances provided further clarity. These findings collectively contribute to a comprehensive understanding of the data's variability and support the conclusion regarding the equality of means among the studied groups.

Tukey's Pairwise Correlation

In the Tukey's Pairwise Correlation (Table 7), the strikingly high correlation coefficient of 0.9996 in the Pre-Monsoon vs. Post-Monsoon intersection is indicative of a remarkably harmonious transition between these two periods. This could imply that climatic conditions, such as temperature and precipitation patterns, exhibit a seamless shift from pre-monsoon to post-monsoon, possibly reflecting a climatic continuum. Conversely, the comparatively low coefficient of 0.03873 in the Monsoon vs. winter intersection points towards marked dissimilarities. Such divergence could be attributed to the distinct nature of Pre-monsoon weather compared to winter conditions. The meager coefficient is 0.02994 in the Monsoon vs. winter intersection suggests a less pronounced connection between these two seasons. This implies that the transition from monsoon to post-monsoon introduces distinct meteorological characteristics, possibly involving shifts in rainfall patterns or atmospheric dynamics. The Post-Monsoon vs. winter intersection, featuring a coefficient of 0.07081, further accentuates the notion of discernible differences between these seasons.

Table 5: Summary statistics *Drosophila* abundance and *Drosophila* diversity

Parameters	PM	M	PS	W
N	12	12	12	12
Min	96	156	212	102
Max	392	928	874	342
Sum	2318	4813	4487	2224
Mean	193.17	401.08	373.92	185.33
Std. error	27.18	82.84	56.78	19.68
Variance	8863.06	82351.36	38687.72	4645.52
Stand. Dev	94.14	286.97	196.69	68.16
Median	164.50	274.50	311.00	166.00
25 percentile	123.75	222.00	238.75	130.25
75 percentile	268.75	667.75	415.25	231.25
Skewness	1.14	1.29	1.88	1.01
Kurtosis	0.28	-0.18	3.30	1.17
Geom. Mean	175.38	331.55	339.63	174.83
Coeff. var	48.74	71.55	52.60	36.78

Table 6: Result of one Way ANOVA

Test for equal means	Sum of sqrs	df	Mean square	F	p (same)
Between groups:	476433	3	158811	4.721	0.00609
Within groups:	1.48E+06	44	33636.9	Permutation p (n=99999)	
Total:	1.96E+06	47	0.00518		
Components of variance (only for random effects):					
Var (group):	10431.2	Var	33636.9	ICC:	0.236706
omega2:	0.1887				
Levene´s test for homogeneity of variance, from means	p (same):	0.0005488			
Levene´s test, from medians	p (same):	0.1925			
Welch F test in the case of unequal variances: F=4.908, df=22.48, p=0.009049					

Mann-Whitney Pairwise correlation

The Mann-Whitney matrix (Table 7) reveals intricate ecological relationships among the four seasons: pre-monsoon, monsoon, post-monsoon, and winter presented low similarity coefficient of 0.01657 between pre-monsoon and monsoon underscores the substantial differences, likely influenced by distinct precipitation patterns, temperature regimes, or vegetation dynamics. Conversely, the relatively high coefficient of 0.5067 between monsoon and post-monsoon suggests a noteworthy ecological resemblance, signifying shared environmental characteristics. The minimal similarity coefficient of 0.000894 between post-monsoon and winter signals pronounced dissimilarity, hinting at marked shifts in environmental parameters between these seasons.

Diversity Indices

The diversity indices (Table 8) provide a detailed characterization of the ecological community across four distinct seasons. The consistent taxonomic richness of 12 observed taxa suggests a stable and diverse community composition. Fluctuations in individual abundance are evident, with the monsoon season exhibiting the highest abundance (4813 individuals) and winter the lowest (2224 individuals). Dominance indices suggest a relatively even distribution of individuals among different taxa, fostering a balanced community structure. High values for Simpson_1-D, Shannon_H, and Evenness_e^H/S across all seasons indicate a diverse and evenly distributed community. Winter stands out with the highest diversity and evenness, emphasizing its ecological richness. Richness indices, such as Menhinick and Margalef, highlight varying degrees of richness, with winter consistently exhibiting the highest values. Evenness indices (Equitability J) suggest equitable distributions of individuals among taxa, and Fisher alpha values imply winter hosts higher diversity, including rare species. The Berger-Parker index underscores low dominance and even distribution. The constant Chao-1 value of 12 indicates that the observed taxa likely represent the true species richness.

Correlation Similarity

The Correlation Similarities of (Table 9) of BARIDUA-CY, BARIDUA-WY, TURA-CY, TURA-WY, KHARKUTTA-CY, KHARKUTTA-WY, RANGJULI-CY, RANGJULI-WY, DUDHNOI-CY, DUDHNOI-WY, LANGPIH-CY, and LANGPIH-WY contains a correlation coefficient, offering insights into the strength and direction of the associations between the corresponding locations. Starting with perfect correlations on the diagonal (1.0), these values represent the self-correlation of each location. Moving to inter-location correlations, high positive correlations are evident, such as between BARIDUA-CY and BARIDUA-WY (0.930) or TURA-CY and TURA-WY (0.885), indicating a consistent positive relationship between these paired locations. The matrix also reveals varying degrees of positive correlations among other locations. For example, RANGJULI-CY exhibits strong positive associations with several locations, ranging from 0.589 to 0.955. In contrast, the correlation values for KHARKUTTA-WY and RANGJULI-WY are relatively lower, suggesting weaker positive relationships between these pairs of locations. The matrix lacks instances of high negative correlations, as all values are positive or close to zero. The positive correlations imply that when one location experiences an increase, the correlated location is likely to witness a simultaneous increase, and vice versa.

PCA (Principal Component Analysis)

The Principal Component Analysis (PCA, Fig. 4) indicate key insights into the structure of the dataset. The PC1 (PM) dominates with an eigenvalue of 3.63682, explaining a substantial 90.921% of the total variance. This suggests that PC1 captures the primary underlying patterns and trends within the data. The PC2 (M) with smaller eigenvalue (0.193909), is still significant as it contributes an additional 4.8477% to the overall variance.

Table. 7: Result of Tukey's Pairwise & Mann-Whitney Pairwise

Test		PM	M	PS	W
Tukeys pairwise	PM		0.03873	0.08918	0.9996
	M	3.927		0.9834	0.02994
	PS	3.414	0.5131		0.07081
	W	0.148	4.075	3.562	
Mann Whitney	PM		0.01657	0.00355	0.8398
	M	0.01657		0.5067	0.005098
	PS	0.00355	0.5067		0.000894
	W	0.8398	0.005098	0.000894	

Table 8: Record of Diversity Indices in four different seasons (PM- Pre Monsoon, M- Monsoon, PS- Post Monsoon and W- Winter)

Indices	PM	M	PS	W
Taxa_S	12	12	12	12
Individuals	2318	4813	4487	2224
Dominance_D	0.10	0.12	0.10	0.09
Simpson_1-D	0.90	0.88	0.90	0.91
Shannon_H	2.39	2.28	2.38	2.43
Evenness_e^H/S	0.91	0.82	0.90	0.94
Brillouin	2.37	2.27	2.37	2.41
Menhinick	0.25	0.17	0.18	0.25
Margalef	1.42	1.30	1.31	1.43
Equitability_J	0.96	0.92	0.96	0.98
Fisher_alpha	1.66	1.48	1.50	1.67
Berger-Parker	0.17	0.19	0.19	0.15
Chao-1	12	12	12	12

Table 9: Correlation similarity of CY and WY in study sites.

Sites	BARIDUA-CY	BARIDUA-WY	TURA-CY	TURA-WY	KHARKUTTA-CY	KHARKUTTA-WY	RANGJULI-CY	RANGJULI-WY	DUDHNOI-CY	DUDHNOI-WY	LANGPIH-CY	LANGPIH-WY
BARIDUA-CY	1											
BARIDUA-WY	0.930	1										
TURA-CY	0.960	0.885	1									
TURA-WY	0.815	0.904	0.655	1								
KHARKUTTA-CY	0.909	0.979	0.922	0.800	1							
KHARKUTTA-WY	0.628	0.660	0.809	0.278	0.798	1						
RANGJULI-CY	0.955	0.781	0.940	0.634	0.776	0.589	1					
RANGJULI-WY	0.720	0.854	0.546	0.988	0.740	0.196	0.509	1				
DUDHNOI-CY	0.844	0.804	0.959	0.484	0.895	0.941	0.825	0.378	1			
DUDHNOI-WY	0.840	0.961	0.730	0.979	0.893	0.450	0.645	0.964	0.608	1		
LANGPIH-CY	0.905	0.868	0.984	0.590	0.934	0.898	0.870	0.487	0.991	0.696	1	
LANGPIH-WY	0.801	0.957	0.712	0.949	0.906	0.503	0.586	0.942	0.622	0.992	0.700	1

PC2 provides complementary insights by capturing orthogonal variability to PC1. Moving on, PC3 (PS) (eigenvalue = 0.110479, 2.762% variance) and PC4 (W) (eigenvalue = 0.0587884, 1.4697% variance) continue to contribute to understanding the dataset's complexity, albeit with diminishing eigenvalues.

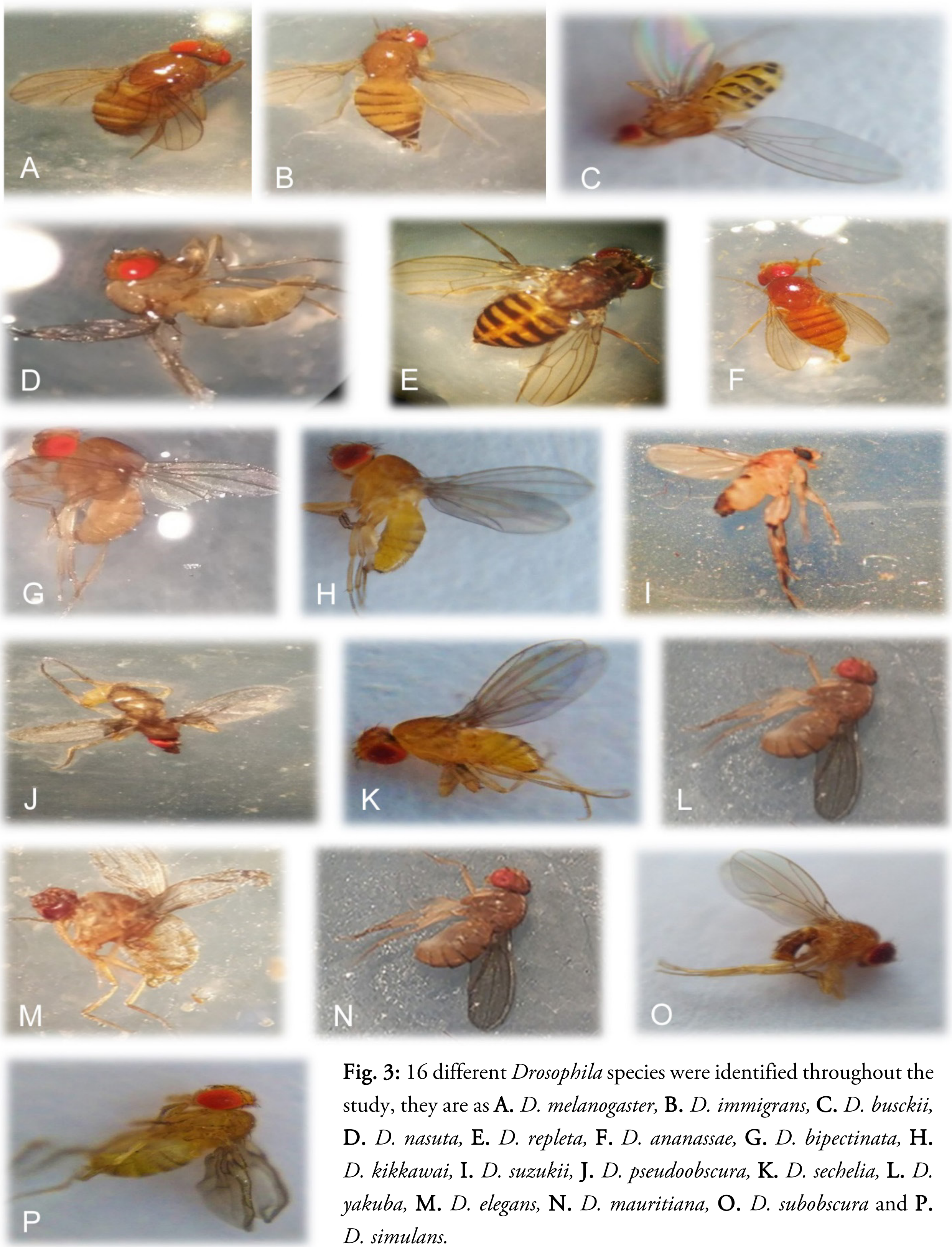

Fig. 3: 16 different *Drosophila* species were identified throughout the study, they are as **A.** *D. melanogaster,* **B.** *D. immigrans,* **C.** *D. busckii,* **D.** *D. nasuta,* **E.** *D. repleta,* **F.** *D. ananassae,* **G.** *D. bipectinata,* **H.** *D. kikkawai,* **I.** *D. suzukii,* **J.** *D. pseudoobscura,* **K.** *D. sechelia,* **L.** *D. yakuba,* **M.** *D. elegans,* **N.** *D. mauritiana,* **O.** *D. subobscura* and **P.** *D. simulans.*

Discussion

The occurrence and adaptability of *Drosophila melanogaster* across various study sites underscore its ability to thrive in diverse ecological conditions, with variations in species composition and abundance reflecting the influence of geographical factors and substrate availability (Coulson & Coulson, 1995; Dillon *et al*., 2010). The complex interplay of physical and chemical factors within the species' tolerance range shapes the existence, abundance, and distribution of Drosophilidae in ecosystems. This ecological dynamic is further exemplified in the North-Eastern region of India, particularly along the Assam-Meghalaya border, where a rich habitat supports a diverse *Drosophila* population influenced by a spectrum of ecological factors (Achumi *et al*., 2013; Khali *et al*., 2022). This study pioneers in projecting *Drosophila* abundance and diversity against two designated culture media, corn meal, and *Musa balbisiana*, in a rolling terrain context (Borpujari & Bora, 2021).

Collection data from various altitudes within this terrain reveals intriguing patterns, with the highest density observed at 230 meters in Baridua and the lowest at 120 meters in Langpih. Contrary to expectations, the data challenges the notion of 800 meters altitude providing optimal conditions for *Drosophila* abundance in certain forest areas (Ponnanna & Krishna, 2013). Insights from similar studies in Karnataka state further support the notion that altitudes ranging from 40 to 300 meters above sea level might be ideal for *Drosophila* distribution (Souza *et al*., 2019). Moreover, the study delves into the impact of elevation on the *Drosophila* community, observing a decrease in distributional density with increasing elevation (Wakahama, 1962; Guruprasad *et al*., 2011). Seasonal patterns, particularly during the monsoon period, also influence *Drosophila* abundance, with lower altitudes exhibiting greater density possibly due to increased floral diversity. However, as altitude increases, areas rich in specific flora species diminish, affecting *Drosophila* abundance differently. Further analysis is warranted to unravel the intricate relationship between elevation, flora diversity, and *Drosophila* distribution. Tukey's pairwise analysis sheds light on seamless shifts in climatic conditions from pre-monsoon to post-monsoon, reflecting a climatic continuum that impacts *Drosophila* populations. These shifts may be attributed to variations in temperature, precipitation, or atmospheric phenomena between pre-monsoon and winter conditions, highlighting the intricate ecological dynamics shaping *Drosophila* diversity and distribution in the region. Climate change and urbanization are causing alterations in distribution patterns of *D. repleta* (Ramniwas *et al*., 2024).

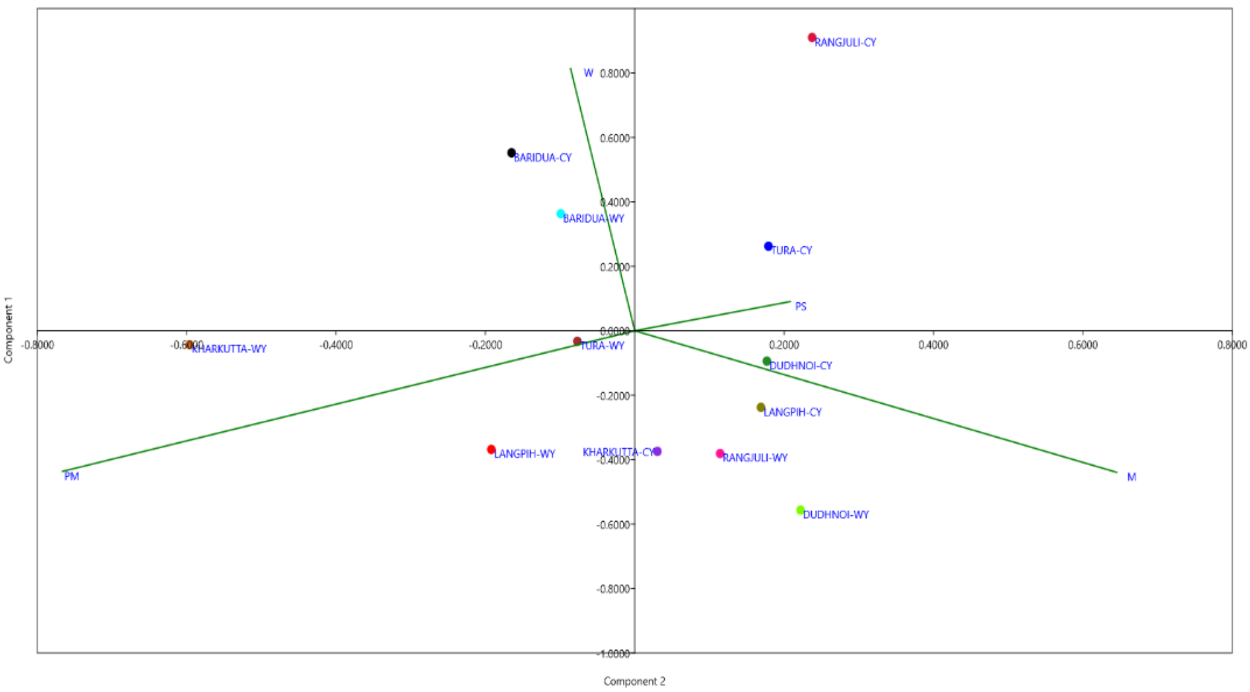

Fig. 4: PCA Analysis: Eigen values and Variance of PC 1- 3.63682 (Var 90.921%), PC2- 0.193909 (Var 4.8477), PC3- 0.110479(Var 2.762) and PC4- 0.0587884 (Var 1.4697).

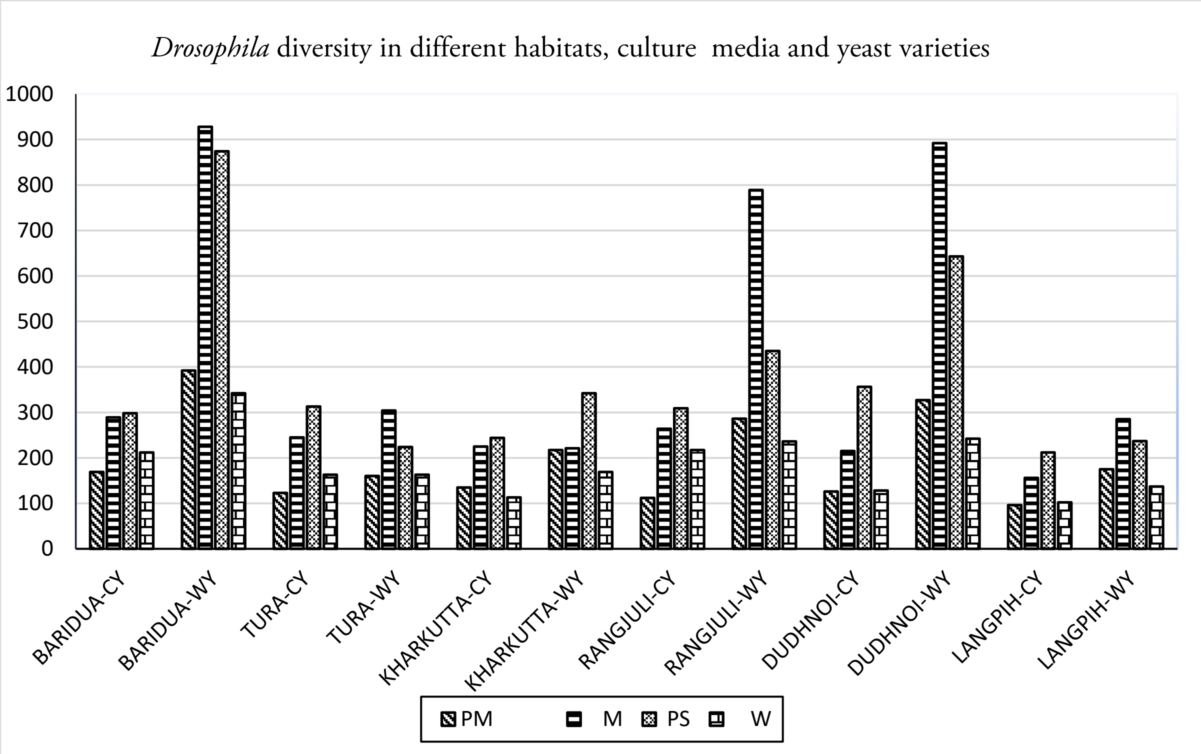

Fig. 5: *Drosophila* diversity charts with two different Yeast mediated culture media

The investigation reveals the ecological impact on the distribution of *Drosophila* species, particularly noting the optimal altitude (230 meters above sea level) in Baridua as providing a congenial climatic atmosphere for *Drosophila* diversity (Borpujari & Bora, 2021). The dominance of *D. melanogaster* in Baridua, especially against *Musa balbisiana* culture, suggests a strong association with specific environmental conditions, possibly indicating an ecological niche favoring this species (Table 4). The study also observes higher diversity in *Musa balbisiana* culture media with wild type yeast, correlating with the presence of *D. ananassae*, *D. pseudoobscura*, and *D. suzukii* (Borpujari & Bora, 2021). This prompts further investigation into the intricate interactions and adaptations of these species within the shared microenvironment. Notably, the consistent prevalence of *D. melanogaster* across different study sites may indicate a broader ecological versatility in various localizations, such as the rolling terrain of the Assam-Meghalaya borders, allowing this species to thrive in diverse habitats (Achumi *et al.*, 2013; Khali *et al.*, 2022). Moreover, the impact of *Musa balbisiana* with its rich nutrients has been highlighted previously (Rabha *et al.*, 2024; Hoang *et al.*, 2015). However, variations in male-female distributions and the presence of other species like *D. suzukii* and *D. busckii* suggest potential factors influencing reproductive strategies and competitive interactions (Borpujari & Bora, 2021). The prevalence of *D. melanogaster* in diverse environments may indicate its role as an indicator species, responsive to changes in habitat conditions, with potential implications for ecosystem health and the impact of environmental changes on insect communities (Coulson & Coulson, 1995; Dillon *et al.*, 2010). The presence of other *Drosophila* species, especially those not conventionally associated with laboratory studies, raises questions about the ecological dynamics and adaptive strategies of these species. Further investigation into the roles of *D. suzukii* and *D. busckii* in specific environments may provide insights into their ecological functions and potential interactions with *D. melanogaster* (Borpujari & Bora, 2021). Overall, *D. melanogaster* demonstrates adaptability and prevalence across all study sites, emphasizing the need for continued analysis of ecological factors influencing *Drosophila* species diversity.

Interestingly, *D. elegans* were recorded only in site II (Tura) against corn meal culture media at an altitude of 300 meters above sea level during the monsoon and post-monsoon periods. However, their absence in other areas or seasons could not be explained. Similarly, the species *D. nasuta* was only recorded in *Musa balbisiana* media in the pre-monsoon period of Site VI (Langpih), and *D. ananassae* in the pre-monsoon period against *Musa balbisiana*, Site I (Baridua) respectively. *D. bipectinata*, *D. kikkawai*, and *D. simulans* are the only species recorded exclusively in wild yeast-mediated culture media *Musa balbisiana* (Table 4). Unexpected dominance of *D. bipectinata*, *D. kikkawai*, and *D. simulans in* wild yeast media suggests a need for further investigation into habitat preferences.

Table 5 provides a comprehensive overview of the distribution and characteristics of each variable, aiding in understanding the central tendency, variability, and shape of the data distribution. One-way ANOVA analysis (Table 6) suggests significant differences in means between groups, supported by Levene's test and Welch F test indicating heterogeneity of variances among groups. Further investigation into specific groups contributing to these differences is warranted, along with post-hoc tests to identify significantly differing group means. Tukey's pairwise comparisons (Table 7) reveal significant differences in means between PM and M, as well as M and W, offering valuable insights into pairwise relationships among variables (Guruprasad *et al.*, 2011). Mann-Whitney pairwise comparisons (also in Table 7) highlight significant differences between PM and M, PM and PS, M and W, and PS and W distributions. However, no significant differences are found between PM and W, as well as M and PS distributions, providing insights into non-parametric distinctions in distribution shapes and positions among variables. The low coefficient of 0.02994 in the Monsoon vs. Post-Monsoon intersection suggests a less pronounced connection between these seasons, possibly indicating distinct meteorological characteristics during the transition from monsoon to post-monsoon, reflected in the post-monsoon and winter season data (Table 7; McCoy, 1990). Temperature, rainfall, relative humidity, and day length play significant roles in extending suitable habitats for distribution, as indicated by Tukey's pairwise Correlation and Mann Whitney Pairwise correlation (Table 7; Connahs *et al.*, 2011). The minimal similarity coefficient of 0.000894 between post-monsoon and winter indicates pronounced dissimilarity, hinting at marked shifts in environmental parameters between these seasons (Table 7; Prigent *et al.*, 2013). The higher numbers of *Drosophila*, particularly *D. melanogaster*, during the Monsoon period align with previous studies (Guruprasad *et al.*, 2011), and the geographical locations' influence, such as landscape variations, supports these findings (McCoy, 1990). The significant pattern of abundance in *Drosophila* species distribution may be attributed to the heterogeneity of rolling terrain across study sites, with species richness showing a decline in abundance at Site VI, correlated with altitude variations (Tables 3 & 8). Different patterns of population dynamics, influenced by rainfall and solar intensity, may have contributed to higher Drosophilid abundance (Connahs *et al.*, 2011; Prigent *et al.*, 2013).

The diversity indices presented in Table 8 offer a comprehensive and detailed view of the ecological community within each variable. These indices not only highlight the richness of species but also provide insights into the balance and diversity of the ecosystem. By capturing various dimensions such as species richness, evenness, and abundance, these indices paint a nuanced picture of the ecological dynamics at play. For instance, measures like the Shannon-Wiener index and Simpson's diversity index delve into the species richness and evenness, shedding light on the distribution of different species within the community. The abundance-based indices like Margalef's richness index complement this by providing a quantitative assessment of species abundance and how evenly distributed they are. Moreover, these diversity indices are instrumental in assessing the health and resilience of ecosystems. A higher diversity often indicates a more resilient ecosystem capable of withstanding disturbances and maintaining stability over time. Conversely, a decline in diversity may signal ecological imbalances or stressors affecting the ecosystem's health. In the Table 9, the correlation matrix serves as a powerful analytical tool for understanding the relationships between different geographical locations. It goes beyond simple pairwise comparisons by quantifying the strength and direction of associations among locations. By analyzing this matrix, researchers can uncover underlying patterns, identify regional dependencies, and explore interactions between geographical entities. The correlations depicted in Table 9 offer valuable insights into the degree of similarity or dissimilarity between locations. Locations with higher correlations share more similar patterns in ecological dynamics, suggesting common environmental influences or shared species compositions. On the other hand, lower correlations indicate divergent trends, possibly driven by unique environmental factors or localized ecological processes. Both Table 8 and Table 9 provide crucial information for understanding ecological communities and geographical interactions. They serve as valuable resources for researchers studying biodiversity, ecosystem dynamics, and regional environmental dependencies.

The intriguing observation of a higher abundance of female individuals within Banana culture supplemented with wild yeast, possibly influenced by food odors such as Cis Vaccenyl acetate (CVA), as discussed in previous studies (Lebreton *et al.*, 2015; Rabha *et al.*, 2024), underscores the complexity of ecological interactions in

Drosophila populations. This intriguing finding, made across six diverse localities, also reveals the assemblage of 16 distinct *Drosophila* species, diverging from findings in other ecological contexts (Srinath *et al.*, 2023), hinting at nuanced ecological zonation's. Moving forward, comprehensive research should explore multiple avenues to deepen our understanding of *Drosophila* dynamics. Firstly, delving into the genetic adaptations of these species to diverse environments, as suggested by Rabha *et al.* (2024), can unveil molecular mechanisms governing their ecological versatility and competitive edge. Secondly, investigating reproductive strategies, especially concerning observed variations in male-female distributions, as highlighted by Lebreton *et al.* (2015), can provide insights into mate choice, sexual selection, and reproductive success patterns. Thirdly, understanding broader community dynamics, including interspecific interactions and ecological niches occupied by different species, contributes to a holistic ecological framework, aligning with the findings of Srinath *et al.* (2023). Finally, long-term monitoring studies spanning multiple seasons and years, supported by McCoy (1990) and Prigent *et al.* (2013), can uncover temporal variations in *Drosophila* species composition, illuminating the dynamic responses of insect communities to environmental changes. Through these avenues, incorporating insights from past research and building upon them, we can gain deeper insights into the intricate ecological dynamics, adaptation strategies, and ecological roles of *Drosophila* populations within diverse ecosystems.

Conclusion

Our investigation into the distribution and diversity of *Drosophila* species across six distinct study sites has provided valuable insights into the ecological dynamics of these model organisms. The prevalence of *D. melanogaster* across various habitats underscores its adaptability and suggests its potential role as an indicator species responsive to environmental variations. The observed variations in species composition and abundance highlight the intricate interplay between geographical factors and substrate availability. The dominance of *D. melanogaster* in Baridua points to a potential ecological niche favoring this species in certain microenvironments. The higher diversity observed in *Musa Balbisiana* in Baridua, with the presence of additional species, suggests the importance of plant-microbe interactions and the potential for ecological coexistence among different Drosophila species. The implications of our findings extend beyond the scope of this study, emphasizing the need for continued research into the ecological roles of *Drosophila* species and their responses to changing environments. Furthermore, the presence of other species, such as *D. suzukii* and *D. busckii*, raises intriguing questions about their ecological functions and interactions within this rolling ecological terrain of Assam Meghalaya boarder. Future research should focus on genetic analysis of species to understand ecological adaptability.

This study sets the stage for future investigations, encouraging a more comprehensive understanding of the genetic, ecological, and reproductive factors shaping *Drosophila* communities, contributes valuable insights to the broader field of ecological and evolutionary studies, providing a foundation for future endeavors aimed at unraveling the complexities of *Drosophila* populations in response to environmental changes.

Author's Contributions

Dhirendra K Sharma contributed to the conceptualization, project administration, and supervision of the work; **Aparajita Rabha** performed the investigation by implementation of methodology, formal analysis, and draft preparation; **Chittaranjan Baruah** contributed to supervision, final review and edit of the manuscript. **Arup Nama Das** performed a formal analysis of the statistics section of the paper.

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Data Availability Statement

All data supporting the findings of this study are available within the paper.

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Ethics Approval

Insects were used in this study. All applicable international, national, and institutional guide lines for the care and use of animals were followed. This article does not contain any studies with human participants performed by any of the authors.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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تاثیر پودر ذرت و مخمر وحشی بر تنوع مگس *Drosophila* در زمین‌های ناهموار بین آسام تا مگالایا

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دریافت: ۱۴۰۲/۰۸/۱۳ | پذیرش: ۱۴۰۳/۰۱/۳۰ | دبیر تخصصی: بهرام ناصری

چکیده

توزیع و تنوع گونه‌های مگس سرکه جنس *Drosophila* در شش مکان در زمین های ناهموار حدفاصل آسام و مگالایا، با استفاده از روش‌های تله طعمه‌ای و تور در طول سال بررسی شد. از پودر ذرت و *Musa balbisiana* (با واسطه مخمر وحشی) به عنوان محیط کشت استفاده شد، مگس‌های جمع آوری شده، از نظر فراوانی، غنا و تنوع با استفاده از شاخص‌های سیمپسون، شانون-وینر و برگر-پارکر مورد تجزیه و تحلیل قرار گرفتند. در منطقه Baridua، مگس سرکهِ *D. melanogaster* با ۹۶۸ فرد روی پودر ذرت و با جمعیت بیشتر از ۲۵۳۶ روی *Musa balbisiana*، گونه غالب بود. در منطقه تورا، ۸۴۴ مگس در پودر ذرت بود که به گونه‌های *D. melanogaster*، *D. elegans*، *D. repleta* و *D. sechellia* تعلق داشتند در حالی که روی تله دیگر (*Musa balbisiana*)، تعداد۸۵۱ مگس ثبت شدند که به گونه *D. melanogaster* تعلق داشته و مابقی متعلق به گونه‌های *D. suzukii*، *D. sechellia*، *D. busckii* و *D. pseudoobscura* بودتد. در مکان Kharkutta ۷۱۷ مگس در تله پودر ذرت مشاهده شدند که عمدتا گونه های *D. melanogaster* و *D. subobscura* بودند در حالی که ۹۴۹ مگس در *Musa balbisiana* ثبت شدند که بیشترین جمعیت به ترتیب مربوط به *D.melanogaster*ِ، *D. nasuta*، *D.pseudoobscura*، *D. subobscura* و *D. immigrans* بود. در مکانRangjuli، تعداد۹۰۲ مگس روی پودر ذرت شمارش شدند که به گونه های *D. melanogaster*، *D. yakuba* و *D. repleta* تعلق داشتند، در حالی که ۱۷۴۶ فرد روی *Musa balbisiana* با گونه‌های غالب *D. melanogaster*، *D.suzukii*، *D.simulans* و *D.repletebeing* ثبت شدند. در مکان Dudhnoi ۸۲۵ مگس در پودر ذرت با جمعیت غالب از *D. melanogasteras* ، همراه با *D. suzukii*، *D. busckii*، ثبت شدند، در حالی که ۲،۱۰۴ افراد ثبت شده در *Musa balbisiana* با گونه‌های *D. melanogaster*، *D. mauritiana*، *D. imigrans* بود. در مکان Langpih ۵۶۶ مگس را در کنجاله ذرت از گونه‌های *D. melanogaster*، *D. mauritiana* و *D. imigrans*غالب بودند نشان داد در حالی که ۸۳۴ مگس در *Musa balbisiana* با گونه‌های غالب *D. melanogaster*، *D. imigrans*، *D. bipectinata*، *D.replete* و *D.suzuki* ثبت شدند. این بررسی نشان داد که محیط مخمر وحشی به طور قابل توجهی تنوع مگس سرکه را در مقایسه با پودر ذرت افزایش می‌دهد. تحقیقات آینده باید تجزیه و تحلیل ژنتیکی گونه ها، تغییرات فصلی، اثرات تغییر آب و هوا، تنوع ژنتیکی، تاثیرات زیستگاه، اثرات فعالیت‌های انسانی، و تعاملات زیست محیطی را برای استراتژی‌های موثر حفاظتی بررسی کند.

کلمات کلیدی: آسام-مگالایا،تنوع، مگس سرکه، مخمروحشی، شانون وینر، فراوانی

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