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RESEARCH ARTICLE

BIODIVERSITY OF DROSOPHILA IN THREE DIFFERENT REGIONS OF KARAPUZHA DAM,WAYNAD DISTRICT, KERALA (WESTERN GHATS)

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ABSTRACT

Pre-monsoon studies were conducted to study the variation in *Drosophila* population in Karapuzha dam backwaters, Waynad, Kerala. A total of 825 *Drosophila* flies belonging to eight species of three subgenus namely, Sophophora, *Drosophila* and Scaptodrosophila were collected. Subgenus Sophophora was predominant with six species and Subgenus *Drosophila* and Scaptodrosophila was least represented with one species each. The diversity of *Drosophila* community was assessed by using Simpson, Berger-Parker and Shannon-Wiener indices. Simpson index was low at 0.1704 in the region adjacent to lake when compared to other regions, which indicates high diversity. This can be attributed to the moist environment and vegetation near the lake. Cluster analysis and Occurance constancy method was used to analyze the species occurrence. The distribution pattern of *Drosophila* was uneven in space and time.

INTRODUCTION

Drosophila, commonly known as fruit fly is an excellent model organism. It belongs to family *Drosophilidae*. Since the time of Morgan, *Drosophila* is being used as a model organism. *Drosophila* has answered many questions of the scientific community in the field of **genetics and inheritance, embryonic development, learning, behavior, and aging.** The family *Drosophilidae* has 3,500 described species (Bachli, 1998). However, taxonomical studies on *Drosophila* are poorly concentrated in India because of lack of expertise and opportunities.

Karapuzha dam is one of the biggest earth dam in India located in Pakkam, Waynad district. It is located 763 m (2,503 ft) above the sea level. The region receives an annual rainfall of 3,000 to 4,000 mm with a minimum temperature of 18° C and maximum of 29° C (in last five years). Waynad is rich in flora and fauna being a part of Western Ghats that are older than the Himalayas. The fauna of Waynad includes Coffee (Coffea arabica), which is a major agriculture crop here, Tea (Camellia sinensis), Rosewood (*Dalbergia sissoo*), Eucalyptus (Eucalyptus globus), Arecanut (Areca catechu), Teak (*Tectona grandis*), *Artocarpus hirsutus*, *Artocarpus odoratissimus* and *Erythrina caffra*. The forest types of Waynad include South Indian Moist Deciduous forests, West coast semi-evergreen forests and plantations of teak and Eucalyptus. The major tree species are *Tectona grandis*, *Terminalia* sp, *Dalbergia latifolia*, *Anogeissus latifolia*, *Grewia tiliaefolia*, *Adina cordifoli*, *Cirmamum zeylanicum*, *Pterocarpus marsupium*, *Vateria indica*, *Largerstroemia lanceolata*, *Artocarpus hirsute*, *Macranga peltata*. It is known that temperature and rainfall affects viability, fertility and developmental time that influences the rate of population growth (Torres and Madi-Ravazzi, 2006). Flowering and fruit bearing plants provide site for oviposition and feeding, because of which vegetation plays an important role in density of *Drosophila.* In an attempt to undertake taxonomical studies in the Waynad region of Western Ghats, the present study was conducted during the premonsoon season.

MATERIALS AND METHODS

Drosophila collection was made using sweeping method in the month of February in Karapuzha dam backwaters, Waynad district (Western Ghats) to assess the biodiversity of *Drosophila* fauna. Collection was made in three different

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regions around the backwaters of the dam. Various fruits were fermented such as, *Vitas vanifera* (grapes), Orange (*Citrus sinensis*), *Carica papaya* (Papaya), *Citrus auranthium* (Lemon), Watermelon (*Citrullus lanatus*), Apple (*Malus domentica*), Chikku (*Manilkara zapota*), Chakota (*Citrus maxima*) were mixed well and spread under shade (preferably near water source), With a net fly were swept into the bottles in the morning as well as in the evening for the next two consecutive days. The flies in bottles (with standard wheat cream agar 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. Females were put for isofemale line culture and their male progeny was used 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).

The Simpson index (D) that measures the probability of two individuals that are randomly selected from a sample that belong to the same species, was calculated using the formula:

$D=\Sigma n\ (n-1)/N\ (N-1)$ Where, n = the total number of organisms of a particular species and N = the total number of organisms of all populations.

Shannon-Wiener index measures the value of species as a function of their frequency in the community and was calculated using the formula: $H' = -\Sigma$ ln pi where pi is the proportion of individuals found in species i.

Berger- Parker index (1/d) which shows the relative abundance was calculated using the formula: $1/d=N/N_{Max}$. Where, N = Number of individuals of all species and N_{max} = Number of individuals in the most common species.

Statistical Analysis

In order to corroborate the species occurrence qualitatively, the Occurrence Constancy Method (Dajoz, 1983) was used. The constancy value (*c*) was obtained by dividing the number of collections in which one species occurred by the total number of collections totally made, and then multiplying the result by 100. Species with index $c \geq 50$ were considered constants. Accessory species were those with $25 \leq c < 50$. Accidental species had $c < 25$. Species that occurred in only one area were considered exclusive. Cluster analysis was performed as described by Mateus *et al*. 2006. Squared Euclidean distance was chosen to measure the similarity between different species and Ward's method was followed to unite clusters. Cluster analysis was carried out using SPSS version 20.0 (IBM corp. Released 2011. IBM SPSS Statistics for windows, Version 20.0. Armonk, NY: IBM Corp)

RESULTS

The distribution pattern of *Drosophila* in different regions of Karapuzha dam backwaters is shown in Table 1. A total of 825 flies were analyzed belonging to eight different species, with the highest number of flies collected near the lake. The number of flies decreased drastically at a slight elevation point where only 185 flies were recorded belonging to five different species. *Drosophila parabipectinata, Drosophila bipectinata, Drosophila malerkotliana, Drosophila nigra* were found to be common in all three regions suggesting they are the dominant species.

The Constancy value (c) of all species with absolute (A) and relative (r) abundance are presented in Table 2. Constant species represented a majority of the total collected population. *Drosophila ananassae* was considered as accessory species and was found only near the lake.

The value of Simpson, Shannon-Wiener and Berger-Parker indices that indicate the abundance, richness and diversity of *Drosophila* flies are shown in Table 3. Flies collected near the lake showed a Simpson index of 0.1704, Shannon-Wiener index of 1.8970 and Berger Parker index of 0.2768. The top region showed a Simpson index of 0.3509, Shannon-Wiener index of 1.2260 and Berger Parker index of 0.4757. The Forest region showed a Simpson index of 0.2832, Shannon-Wiener index of 1.4170 and Berger Parker index of 0.3619.

In the Cluster analysis (Figure 1), less abundant species occupied the first cluster and most abundant species occupy the bottom of the cluster. First cluster has *D. ananassae, D. kikkawai, D. anomelani, D. bipectinata, D. malerkotliana* belonging to Subgenus Sophophora, *D. nasuta* belonging to Subgenus *Drosophila* and *D. nigra* of Subgenus Scaptodrosophila. Second cluster is predominated by constant and most abundant species *Drosophila parabipectinata.*

DISCUSSION

In the present study, *Drosophila* population density showed significant variation from region to region as shown in Figure 2. The number of flies recorded near the lake were 383 which comprised of all the eight species that were recorded. It is evident that *Drosophila* density is highest near lake. Variations of dominant species in different regions are shown in Figure 3.

Lower values of the Simpson index indicate higher diversity, and value of 1 indicates no diversity. Reverse is true for Berger Parker and Shannon Wiener index (Ludwig and Reynold, 1988; Mateus *et al*., 2006). Lower values of the Shannon index near the lake indicate more diversity when compared to other two regions. The Shannon index increases as both the richness and the evenness of the community increases. It is evident that *Drosophila* density is highest near the lake because of moist environment and also due to rich vegetation that was present, which includes many flowering plants. Since the premonsoon conditions are not favorable for *Drosophila* population (Guruprasad *et al*., 2009), the density of flies recorded can be expected to be low. Premonsoon season in Waynad is relatively dry and has an average rainfall of 25mm, which directly influences the population density of *Drosophila.* From the eco-distributional pattern of *drosophila*, it is evident that the distribution pattern of *Drosophila* is uneven in space and time.

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Tables and figures

Table 1 Biodiversity of different regions of Karapuzha Dam backwaters, Waynad district, Kerala during post monsoon season

S/N	Species	Near Lake	Top	Forest	Total number
	Subgenus Sophophora				
1	*D. ananassae*	54	-	-	54
2	*D. parabipectinata*	106	88	93	287
3	*D. bipectinata*	81	16	24	121
4	*D. kikkawai*	31	9	-	40
5	*D. malerkotliana*	44	63	36	143
6	*D anomelani*	23	-	8	31
	Total	339	176	161	676
	Subgenus Drosophila				
7	*D. nasuta*	32	-	91	123
	Total	32	-	91	123
	Subgenus Scaptodrosophila				
8	*D. nigra*	12	9	5	26
	Total	12	9	5	26
	Grand total	383	185	257	825

Table 2 Absolute (A) relative (r) and constancy values (c) of species collected at different regions in backwaters of Karapuzha dam backwaters.

		Lake		Top		Forest		
S/N	Species	A	r	A	r	A	r	c
	Subgenus: Sophophora							
1	*D. ananassae*	54	0.141	-	0.000	-	-	33.33
2	*D. parabipectinata*	106	0.277	88	0.476	93	0.362	100
3	*D. bipectinata*	81	0.211	16	0.086	24	0.093	100
4	*D. kikkawai*	31	0.081	9	0.049	-	-	66.66
5	*D. malerkotliana*	44	0.115	63	0.341	36	0.140	100
6	*D anomelani*	23	0.060	-	-	8	0.031	66.66
	Total	339		176		161		
	Subgenus: Drosophila							
7	*D. nasuta*	32	0.084	-	-	91	0.354	66.66
	Total	32		0		91		
	Subgenus: Scaptodrosophila							
8	*D. nigra*	12	0.031	9	0.049	5	0.019	100
	Total	12		9		5		
	Grand total	383		185		257		

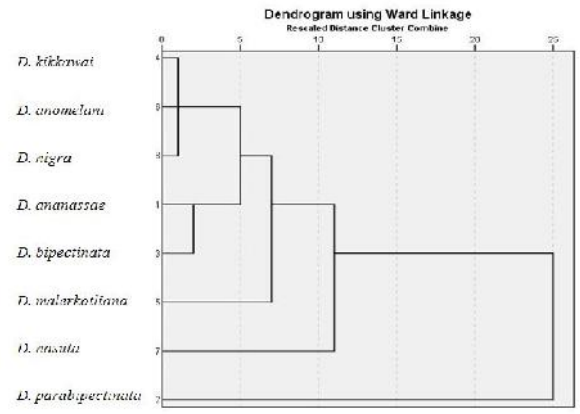

Figure 1 The Cluster analysis of *Drosophila* species found in Karapuzha dam (Dendrogram using Ward's method).

Table 3 Simpson index (D), Shannon-Wiener index (H), and Berger-Parker (1/d) index of *Drosophila* in three regions of Karapuzha dam backwaters.

Diversity indices	Lake	Top	Forest
Simpson index (D)	0.1704	0.3509	0.2832
Shannon-Wiener index (H)	1.897	1.226	1.417
Berger-Parker index (1/d)	0.2768	0.4757	0.3619

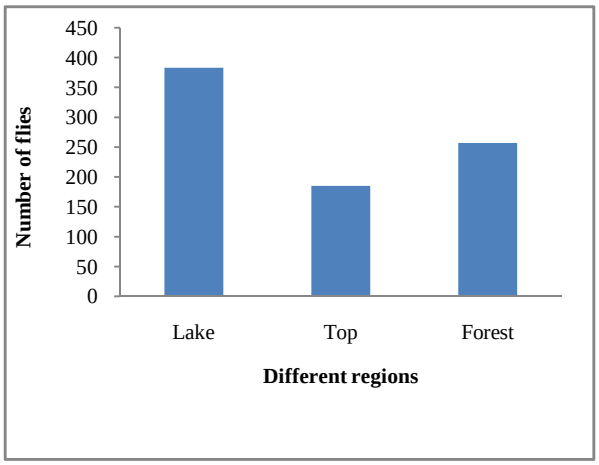

Figure 2 Variation in population of *Drosophila* species in backwaters of Karapuzha dam backwaters.

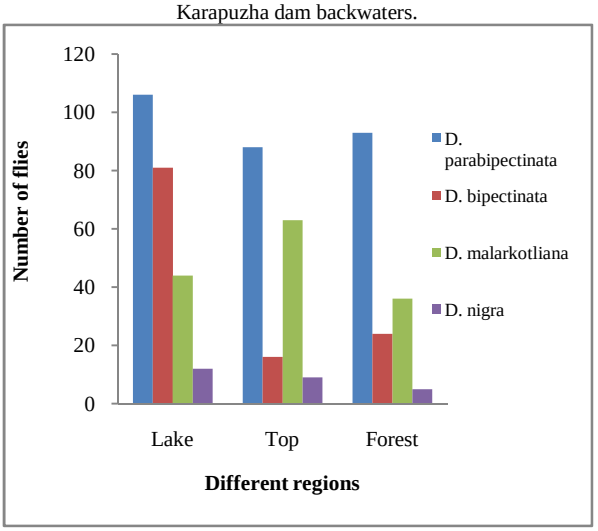

Figure 3 Variation in *Drosophila* population of the constant species(c) in backwaters of karapuzha dam, Waynad, Kerala.

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