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Altitudinal species variation in Drosophilids of Canary Hill, Hazaribag, Jharkhand, India

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Abstract- India possesses diversified physio-geographical and topological conditions which affect the geographical distribution of animals including *Drosophila* with reference to variation in elevation, latitude and longitude of geographical areas. To explore the species richness of family Drosophilidae in relation to altitudinal changes, a survey conducted at Canary hill of Hazaribag reveals a collection of 754 species of *Drosophila* representing two genera (Genus *Drosophila* & *Zaprionus*) of family Drosophilidae. Also, the survey conducted at two different elevations of Canary Hill reveals the detection of ten different species along with remarkable variation in species distribution as indicated by species diversityassessment using different indices. The study indicated decreasing trend in species diversity by showing Simpson index of 0.18, Shannon-Wiener index 1.88 and Berger – Parker index 4.11at the base of hill as compare to the diversity index at 50 meter indicating Simpson index 0.24, Shannon-Wiener index 1.66 and Berger- Parker index 2.80 respectively.

Key words: *Drosophila*, Altitude, Diversity indices, Canary hill

INTRODUCTION

Drosophila has been used as a model organism for research for almost a century and thousands of scientists around the world work on it. It has richly contributed to our understanding of the pattern of eco-distribution, biodiversity,[1] and altitudinal variation.[2,3] The *Drosophila* species are observed in any ecosystem, from considerable altitudes to sea level, and in equatorial as well as in temperate zones.[4] The Drosophilidaefamily is composed by 65 genera and more than 3500 described species that occur all over the world.[5] The early studies on *Drosophila* in India were mainly with taxonomy. From 1970 onwards studies in other fields have also been initiated such as biodiversity. Significant progress has been made in the field of taxonomy and biodiversity of family Drosophilidae in South India. However, there are a few areas of South India, especially South Karnataka, which are not explored to analyse the fauna of *Drosophila species*. Similarly, other areas of India specially Jharkhand and Bihar are native in this regard. A very meager study has been done in this two states.[6] To bridge this large gap, the present study has been undertaken in Canary hill of Hazaribag District, Jharkhand, India to document the distribution status *Drosophila* fauna.

Canary hill of Hazaribag is situated at latitude 24°0'50"N & 85°23'39"E and has subtropical climate. The height of hill is 70m or 230 feet from the base regions and is situated around 2019 feet above the sea level. The climate is pleasant and has thick vegetation of deciduous

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nature. During summers (March to May) the average temperature ranges between 23-35°C. Winter is very cool with maximum temperature of about 12°C and minimum touches to about 3-4°C. During January, sometimes ice formations are seen at night and temperature can drop down to freezing level. The hills station has an average rainfall during monsoons (June to September).

It has been spotted as place of tourist visit which is markedby well-laid out park andis blessed with three small lakes. Earlier, it was a good habitat for the many wild animals like wolves, tigers and hyenas till 80's,but growing anthropogenic activities and residential construction at and around has destroyed the wild habitat. Despite of Canary hill being protected by the forest department, Govt. of Jharkhand, the environmental conditions stillfavors theoccurrence of large verities of *Drosophila* species. Perhaps this background prompted the author to undertake the present studies.

MATERIALS & METHODS

Drosophilids field collection were undertaken between 20-23August 2016 at two regions. One at the base of the hill and another at altitudes of 50 m from the base of the Canary hill (24°0'50"N, 85°23'39"E using Net-sweeping and Trap-bait method.

In net sweeping method, species were collected by sweeping over the thick vegetation by collecting net. The swept flies were then transferred to the bottles containing 70% of ethyl alcohol and some live specimens were brought in to the lab for rearing. Bait trapping method was also adopted for collection. In this technique, culturing bottles containing smashed banana were hanged on the branches of trees in shady areas. Following day, bottles with attracted flies were collected usually in the morning or evening by plugging the bottles with cotton and later on transferring them to culture bottles containing *Drosophila* culture medium for identification.

Collected species were sorted out under binocular and species were identified on the basis of taxonomic description with respect to quantities of character such as body length, wing indices, arista branches, gena width, orbital ratio and genital structure, following the method different researchers[7-14] wherever appropriate and online identification tool like Biocis, JDD & Fly base.

The abundance, richness and diversity relationship of collected flies were assessed by Simpson (D), Shannon-Wiener (H) and Berger-Parker (1/d) indices.[15]

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

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

where,

n = total number of organisms of a particular species

N = total number of organisms of all population.

Shannon-Wiener measures the value of species as a function of their frequency in the community and was calculated using the formula:

$$H' = -\sum \mathbf{pi\ ln\ pi}$$

p_i= the proportion of individuals belonging to the i^{th} species in the dataset of interest.

Berger- Parker index (1/d) which shows the relative abundance was calculated using the formula:

$$\frac{1}{d} = \frac{N}{N_{max}}$$

Where,

N = number of individuals of all species

N_{max} = number of individuals in the most common species.

RESULTS & DISCUSSION

A total of 754 flies were captured belonging to ten different species of which seven species belonged to Subgenus *Sophophora*, two species to Subgenus *Drosophila* and one species to genus *Zaprionu*s. Table 1

D. malerkotliana was found to be most abundant species in the collection. Variation in species types & number was seen with respect to altitude. It has highest number of flies at basal zone. *D. malerkotilana* and *D.melanogaster* were common at both base as well as at altitudes of 50 meter. Respective diversities were assessed through various indices. (Table-2) and analyzed graphically (Fig.-1). Assessment revealed comparatively low Simpson index(0.18) and more Shannon (1.88) and Berger – Parker index (4.11) at ground level as compare to biodiversity indices at high altitude (50 m) with high Simpson index (0.24) and less Shannon –Weiner & Berger –Parker as 1.66 & 2.80 respectively.

The overall result shows that *Drosophila* community is affected by the altitudinal variation as previously reported.[16-19] According to this, as altitude increases there are decrease in number of *Drosophila* species. Out of 754 individuals collected, the base of the hill comprises 522

and 50 m comprises 232 species of *Drosophila* flies. The *Sophophora* comprises more number of flies among which *D. malerkotilana*, *and D.melanogaster* species are the common and abundant species found in both regions.

Higher density of *Drosophila* in lower altitudes can be attributed to the type of forest, where fertile top soil is eroded due to heavy rain and deposited in hill resulting in dense vegetation, providing a suitable environment with thick vegetation at lower altitudes. Diverse species of flowering and fruit bearing flora provide resources for feeding and ovi-positioning.[20] Thus, from the present eco-distributional and population analysis of *Drosophila* at Canary hill, it is clear that the distributional pattern of a species or related group of species is uneven in space. *D. malerkotliana* and *D.melanogaster*e merged as champion species, as they are registered in more in number in both altitudes. *D. biarmipes* are completely absent at higher altitude. Further, more study is still requiredto present a wide spectrum of *Drosophila* diversity at Canary hill of Hazaribag.

Table 1- Distribution of *Drosophila* at two different altitudes in, Canary hill, Hazaribag district, Jharkhand, India.

Sl. No.	Genus	Subgenus	Species	Base	50m from base	Total no.
1.	*Drosophila*	*Drosophila*	*D. nasuta*	14	06	20
2.			*D. immigrans*	16	06	22
3.		*Sophophora*	*D. malerkotliana*	127	83	210
4.			*D. jambulina*	09	01	10
5.			*D. takahashii*	87	25	112
6.			*D. melanogaster*	120	69	189
7.			*D. ananassae*	25	05	30
8.			*D. biarmipes*	01	00	01
9.			*D. trilutea*	95	25	120
10.	*Zaprionus*		*Z. indianus*	28	12	40
			Total	**522**	**232**	**754**

Table 2- Diversity index of *Drosophila* population collected at different altitudes in Canary hill

Sl. No.	Formula	Base	50 m
1.	Simpson index (D) = Σ n(n-1)/N(N-1)	0.18	0.24
2.	Shannon-Wiener H' = - Σ pi ln pi	1.88	1.66
3.	Berger- Parker index (1/d) 1/d=N/N_{max}	4.11	2.80

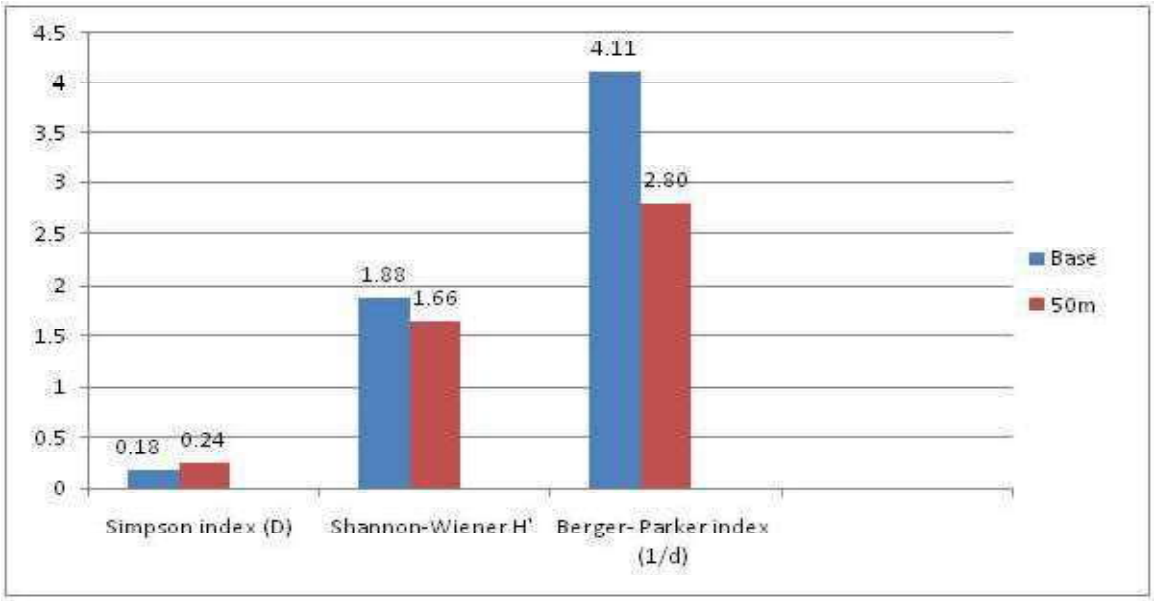

Fig. 1- Graphical representation of Diversity index of *Drosophila* population collected at different altitudes in Canary hill.

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