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Species diversity status of family Drosophilidae at Hazaribag, Jharkhand, India

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Abstract
Species of family Drosophiladae has world-wide distribution. More than 3800 species of family Drosophilidae are reported globally and included about 300 from India representing 25 genera. Hazaribag is a small town situated at 2000 feet above the sea level and its 45% of areas is covered with dense deciduous forests. A preliminary collection were made at various places of Hazaribag district in the different areas during August 2016 which has reveals 20 different types of species belonging to four genera and five subgenera. *Drosophila malerkotliana* was found to be the most abundant species (19.889%) followed by *Drosophila melanogaster* (16.97%) and *Drosophila trilutea (14.20 %)*. The other 17 species have relative abundance. Among the genera, genus Drosophila is champion comprises 90.92% of which 81.40% belongs to subgenus Sophophora indicating their well adaptive ability in these ecological areas. The various diversity indices calculated like D (Simpson index), the *H'* (Shannon diversity index) and *1/d* (Berger – Parker index) have values 0.11, 2.49 and 5.03, respectively showing species diversity at Hazaribag.

Keywords: *Drosophila,* diversity indices, species diversity

1. Introduction
The species of family Drosophilidae is a relatively large family of dipteran flies of worldwide distribution consisting of 76 genera with more than 3800 described species from the entire world (Wheeler, 1981, 1986; Bächli *et al*., 2004) [16, 2]. It was W.E. Castle (1906) [3] who first reported the potential use of *Drosophila melanogaster* in understanding genetics. In about eleven decades since then, *Drosophila* still stood as a premium experimental organism almost in all the fields of animal and medical sciences. As a matter of fact, it would not be an exaggeration to say that though initially established as model for genetic and evolutionary studies, *Drosophila* still continues to be an organism of innovation and surprises in all field of bio research. It is thus regarded as better experimental model over other species like *C. elegans, Zebra fishes, Bacteria and mice*.

Together with the development of genetics, developmental and evolutionary biology, systematic studies taxonomic studies in the genera of the family *Drosophilida*e in India are meagerly explored as compared to other parts of the world. *Drosophila* species distributed in various ecosystems. In India this pattern of eco distribution, clinal and altitudinal variations and their bio diversity have been well studied in (Gupta & Mahato, 2015; Guru Prasad *et al*., 2010; Guru Prasad and Hegde, 2006;) [5, 7, 8, 9] and about more than 300 species are known to occur (Naskar *et al*. 2014,; Fartyal, 2012; & Gupta, 2005;) [13, 4, 6]. However, in Bihar fragmentary studies have been done and so far only one new record D*rososphila quadrilineata* from Bhagalpur and a common species *Drosophila ananassae* from Gaya is reported (Rahman & Singh, 1969) [14]. Neighboring Jharkhand state being rich in forest is entirely naïve for such studies.

Thus, despite of great efforts by the Drosophila workers only a considerable data has been procured but in view of great size of the country, the available records are meager and no way furnish a complete picture of family Drosophilidae in India.

The district of Hazaribag is situated in the north eastern part of North Chotanagpur Division and is a part of Chotanagpur plateau. The area is full of several plateaus, mountains and valleys. There are three natural divisions of this district - Medium Plateau, Lower Plateau and Damodar Valley. The district headquarter is a part of medium plateau, which is situated at the height of about 2,000 ft (610 m) from the sea level. Except the western part of the medium plateau, the whole area is surrounded by the lower plateau. The height of lower plateau is about 1,300 ft above the sea level. Damodar Valley is in the southern part of this district where Ramgarh town is situated which is about 1,000 ft below the districts head quarter.

About 45% area of this district is covered by forest which is full of medicinal plants and trees. Due to negligence and lack of awareness they are on the verge of extinct. Leopards, bears, jackals and foxes etc. freely move in these forests. In the winter season several migratory birds visit these forests areas. Surroundings of Hazaribag have rich natural resource of several ores like mica and Coal as the main minerals. These minerals are very important from industrial point of view. China clay and limestone are also found in this district.

Being rich in these natural resources, the Hazaribag in recent years is immensely exploited by the name of urbanization & industrialization leading to ecological loss and ultimately the insect fauna apart from other wild animals. This situation leads the author to survey the *Drosophila* biodiversity status at Hazaribag which was earlier known as a place of thousand gardens.

2. Materials and methods

Drosophila flies were collected using Net-sweeping and Trap-bait method from different localities of Hazaribag district in August 2016. The study area includes different habitats such as domestic places, fruit markets, agriculture fields and forests.

In net sweeping method, the places of collection were spread with various rotten fruits such as *Musca paradisca* (banana), *Vitas vanifera* (grapes) etc., one day before to attract flies. After a day of spreading, the flies were collected by sweeping using fine net. The flies were then transferred to the bottles containing *Drosophila* culture medium and brought to laboratory for identification. Bottle trapping method was also followed for collection.

In this technique, culture bottles containing smashed banana with live yeast were tied to twigs of bushes under shaded areas. On following day, bottles with attracted flies were collected by plugging the bottles.

Captured flies were preserved in tubes containing 70% ethanol for taxonomical identification. For the analysis of male terminalia of cryptic species, flies were boiled 10% potassium hydroxide (KOH), stained in acid fuchsine and dissected in glycerol (Bächli *et al.*, 2004) [2].

The individuals were further identified through external morphology, identification keys, and comparisons the details with the literature. While describing the quantities of character such as body length, method of Maither, 1955 [11] was considered. The other description regarding wing indices, arista branches, gena width, orbital ratio, genital structure etc., the method of Hsu, 1949 [10] was adopted.

The abundance, richness and diversity relationship of collected flies were assessed by Simpson (D), Shannon-Wiener (H) and Berger-Parker (1/d) indices (Mateus *et al*., 2006). The **Simpson index (D)** measures the probability of two individuals, randomly selected from a sample that belong to the same species and was calculated using the formula:

$$D=n(n-1)/N(N-1)$$

where, n = total number of organisms of a particular species and N = total number of organisms of all population.

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

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

Pi = 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:

$$1/d=N/N_{max}$$

Where, N = number of individuals of all species and N_{max} = number of individuals in the most common species.

3. Results and discussion

A total of 1443 flies were collected and preserved during Aug 2016. After identification 20 different types of Drosophila species were confirmed. These species taxonomically positioned into four genera (*Drosophila*, *Scaptodrosophila*, *Zaprionus and Amiota*) and five subgenera (*Drosophila*, *Sophophora*, *Dorsilopha*, *Anaprionus*, Zaprionus) as represented in Table 1. *Drosophila. malerkotliana* was found to be the most abundant species (19.89%), followed by *Drosophila melanogaster* (16.98%) and *Drosophila trilutea (14.21 %)*. The other 17 species have relative abundance.

Among the genera, genus *Drosophila* is champion exhibiting the occurrence of 90.92% while within the genus the subgenus *Sophophora* shows the presence of 81.40%. The species of these subgenus thus seems to be well adapted to this region.

Different biodiversity indices were calculated like Simpson index (D) the Shannon diversity index (*H'*) and Berger - Parker index (*1/d*) whose values are indicated as 0.11, 2.49 and 5.03, respectively. From this it is understood that despite of three more abundant species - *D. malerkotliana*, *D. melanogester*, and *D. trilutea* it also marked by the presence of other species. It thus revealed that the lower the Simpson index (0.11) the area is more diversified with a value of D_{BP} = 5.03. It also revealed that this area have many rare species as indicated by Shannon index (2.49) which lies in between 1.5 - 3.5 proposed for a real community.

Table 1: List of species of Family *Drosophilidae* and their numbers

S/N	Genus	Subgenus	Species	Number
1	Drosophila	Drosophila	D. albomicans	27
2			D. annulipes	14
3			D. immigrans	30
4			D. nasuta	95
5			D penispina	17
6		Sophophora	D. ananassae	84
7			D.biarmipes	26
8			D. bipectinata	65
9			D. eugracilis	34
10			D. kikkawai	53
11			D. malerkotliana	287
12			D. melanogaster	245
13			D. takahashii	65
14			D. trilutea	205
15			D. jambulina	4
16		Dorsilopha	D. busckii	61
17	Scaptodrosophila		D. bryani	7
18	Zaprionus	Anaprionus	Z. multistriatus	16
19		Zaprionus	Z.indianus	103
20	Amiota		Amiota species	5

Table 2: Diversity index of *Drosophilidae* population collected at different places of Hazaribag

1	Simpson index (D) = Σ n(n-1)/N(N-1)	0.11
2	Shannon-Wiener H' = - Σ pi ln pi	2.4882
3	Berger- Parker index (1/d) 1/d=N/Nmax	5.02787

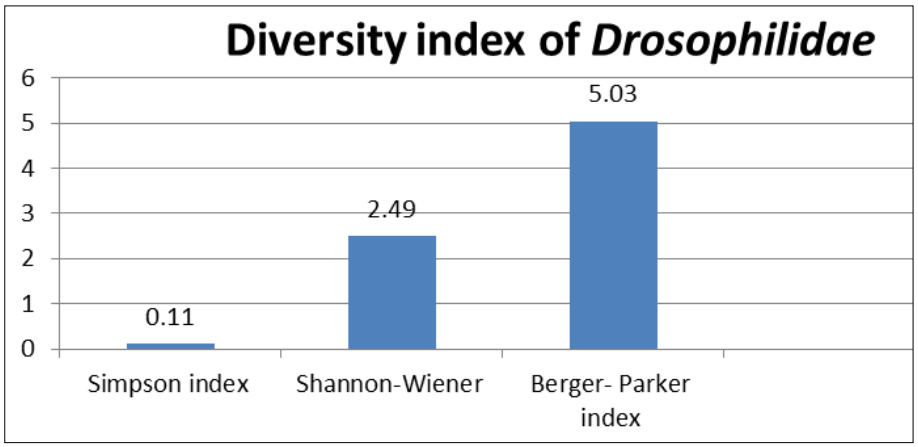

Fig 1: Diversity index

Table 3: No & Percentage of Flies Distribution (genus & subgenus wise)

S.No.	Genus	Subgenus	No. and % of flies in Hazaribag	
1	Drosophila		1312	90.92%
		Drosophila	183	13.95%
		Sophophora	1068	81.40%
		Dorsilopha	61	4.65%
2	Scaptodrosophila		7	0.48%
3	Zaprionus		119	8.25%
		Anaprionus	16	13.45%
		Zaprionus	103	86.55%
4	Amiota		5	0.35%
		Total	1443	100

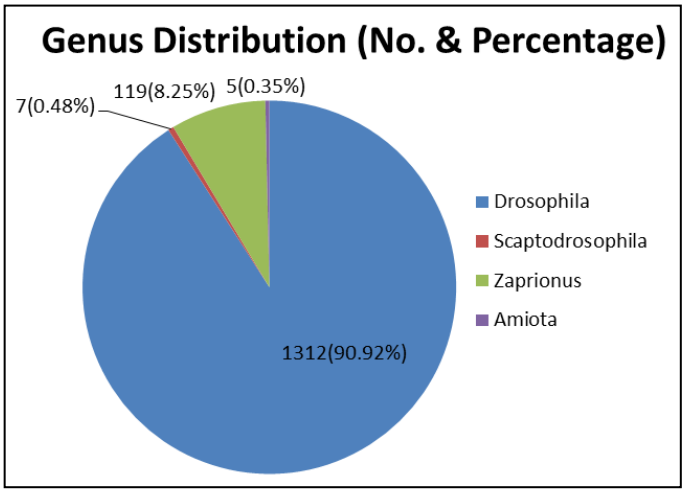

Fig 2: Distribution of genus

From the above fact and analysis it seems that undoubtedly Hazaribag definitely represent a real community and further explorations may add some new species and new records as many of these areas are still awaited for survey. Despite of great ecological loss in the recent year Jharkhand government marked many protected forest areas where survey is still going on.

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