Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(3): 88-90

Received: 10-03-2016
Accepted: 11-04-2016

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Drosophila – A Model Organism for Assessment of Biodiversity

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Abstract
A yearlong study was conducted to analyze the altitudinal variation in a population of *Drosophila* on Chamundi hill of Mysuru, Karnataka State, India. A total of 12,837 *Drosophila* flies belonging to 17 species of 3 subgenera were collected at altitudes of 680 m, 780 m, 880 m and 980 m. The subgenus Sophophora was predominant with 11 species and subgenus *Drosophila; Scaptodrosophila* was least represented with only a three species. Altitudinal changes in the population density and relative abundance of different species at different altitude. The distributional pattern of species or related group of species was uneven in space and time. *D. malerkotliana, D. nasuta* and *D. neonasuta* were found in all altitudes and can be considered as dominant species.

Keywords: Drosophila, Sophophora, Scaptodrosophila, D. malerkotliana, D. nasuta, variation, altitude

1. Introduction
Biodiversity among the living species in biosphere, from the simple to complex organisms is a common phenomenon. It is the richness in variety and variability of species of all living organisms in a given region. Biodiversity can be measured on many biological levels ranging from genetic diversity within a species to the variety of ecosystem on earth. India has great wealth of biological diversity in its forests, wetlands, marine and desert ecosystem and regarded as one of the 12 mega diverse countries in the world. The aquatic and land scape diversity contribute to the species diversity and richness. *Drosophila* a fruit fly, well known as "Cinderella of Genetics" is one amongst them. *Drosophila* is used as a model organism for addressing wide range of studies like basic genetics, population, behavior, evolutionary biology and molecular biology. *Drosophila* is most sought after experimental animal for its short life cycles, easy and inexpensive method of culturing, large progeny, availability of number of mutant stocks and genomes of few species. Having only four chromosomes in haploid set, giant chromosomes in larval salivary glands is an added advantage for studies of these flies in the life sciences.

The family *Drosophilidae* (Diptera) comprises more than 3,500 described species that occur in a number of ecosystems all over the world [1]. The *Drosophila* genus is the most abundant and comprises around 53% of the total species. Most of them are endemic, few are cosmopolitan in nature, and some are associated with human activity. Though studies of Indian *Drosophilidae* was started by Bezzi [2, 3] much of our knowledge of *Drosophila* in India was given by Dwivedi and Gupta [4]. Biodiversity of *Drosophila* with reference to India accounts for 140 species, whereas South India harbors 50 species [5]. *Drosophila* is highly sensitive to slight environmental changes that influence the natural population size and structure. It is known that changes in temperature and rainfall affect life cycle, developmental time and other factors that influence the rate of survival population growth [6]. The number of the individuals of a species in a locality is significantly influenced by the presence or absence of another species, especially those that are ecologically related [7, 8]. The ability to colonize multiple niches is an indication of the biological success of many species [6, 9, 14, 15]. Further distribution of *Drosophila* has not been viewed from the perspective of biodiversity from the past 10 years in Chamundi hill, Mysuru. To fill up this gap between these years of studies on the *Drosophila* fauna the authors have reviewed the altitude distribution of *Drosophila* fauna in same localities of Chamundi Hills which was studied 10 years back by the same author. The other dimension of present study is to co-relate the population diversity of *Drosophila* community with previous report which was reported by the same author. A study has been undertaken for a period of one year (2015-2016) at Chamundi Hills, Mysuru, to analyze the biodiversity of the *Drosophila* species which was earlier carried during the year 2005-2006 [10].

2. Materials and Methods

The assessment of *Drosophila* biodiversity is carried at different altitudes in same locality of Chamundi hill, Mysore (India) which was done almost 9-10 years back (2005-2006). The Chamundi hill is a small mountain (11'36' N Latitude and 76' 55' E) with scrubby forest spread all around was an uninhabited area some forty years ago with a small temple at the hill top. This hill has now become a famous tourist spot of Mysore (Karnataka, India) with a small township built at the top with a population of 3500 and experiences a high rate of floating population (tourists). Monthly collections of flies were made from wild locality at the altitudes of 680m, 780m, 880m, and 980m from February 2015 to January 2016. Collections have been made by using the regular banana bait and net sweeping methods. The flies collected from different parts were categorized, sexed and used for the analysis of diversity of the species. Categorization of the collected *Drosophila* flies was made respective to taxonomic groups by employing several keys [9, 12-14]. The data was subjected the Simpson index and Berger- Parker index to assess the biodiversity [10].

3. Results and Discussion

The study revealed that the pattern of the distribution of different species of *Drosophila* and their population size vary in time and space. The population was influenced by some macro environmental factors. The study indicated the dominance of the *melanogaster* species group over the *immigrans* and other groups. The results obtained in present investigation was more or less similar, but less in number of flies compare to the past investigation done during February 2005 to January 2006 [10] with the absence of some species such as *D. kikkawai, D. immigrans* belonging to subgenus *Drosophila* and *D. buskii* of subgenus Drosilopha which was found vey less in number during the previous study done by Guruprasad [10].

Observation and comparison of data of *Drosophila* community between and 2015-2016 showed in table 1. In present study (2014-2015) a total number of 12,837 individuals of *Drosophila* species was encountered out of which 4,235 (34%) belongs to 11 species of *Drosophila melanogaster* species group of subgenera Sophophora. The remaining 8,602 (65%) flies belong to other 2 subgenera such as *Drosophila*, Scaptodrosophila. During pervious collection 2005-2006 *Drosophila* community of Chamundi hill comprised of 17,605 flies of which 7,869 (44.64%) belonged to 13 species of *Drosophila melanogaster* species group [10]. The remaining 9,736 flies belonged to the other 3 subgenera. a) The distribution of different species of either *melanogaster* group or others was not uniform at different altitudes. b) It was observed the total number of individuals collected decreased with increasing altitude. In the present study only 11 species of the *melanogaster* species group was found with respect to 12 species of *Drosophila melanogaster* species group which was found during the previous collections in the Chamundi hill. c) Surprisingly, all flies of the species not found in all altitudes. d) There was less number of the flies encountered compared to the past survey which was made nine years back.

During previous survey (2005-2006) 17,605 *Drosophila* flies were collected at different altitudes of Chamundi Hills, Mysuru with 22 species of 4 subgenera. But in present survey only 12,263 *Drosophila* flies was collected with 17 species belonging to 3 subgenera. It was also noticed that the subgenus Sophophora was predominant in both the past and present collections. Surprisingly the subgenus *Drosilopha* which was found in less number during the year 2005-2006 was not encountered in any locality and altitude during present collections (20015-2016). *D. malerkotliana, D. nasuta and D. neonasuta* were found in all altitudes and can be considered as dominant species. The similar trend of the population density and relative density of past collection along with altitude was not observed in the present survey [10], but the population size was large during monsoon season [10].

According to constancy method during past collection (2005-2006) out of 22 total species 17 were regarded as constant species, 3 as accessory and 2 accident species. But in present survey of *Drosophila* flies (2014-2015) comprises 14 constant species, only 1 as accessory and 1 accident species. The absence of 3 species (subgenus: *Sophophora-D. kikkawai*; subgenus: *Drosophila-D. immigrans*; subgenus: *Drosilopha-D. buskii*) was major findings (table 1) of our present study. This study also shows that although several species co-exist in a given eco-system, all species do not enjoy equal opportunity to survive hence different species are represented in different densities in a given locality. Application of the Simpson (D) and Berger-Parker indices (1/d) to the collection data of the different altitudes of Chamundi hill demonstrates that 780m has higher biodiversity than other altitudes during 2015-2016 data was not showed, but this higher biodiversity was shifted to 780m to 680m according to the present data when comparing with past data is may due to more anthropologic activities at the base of the hill (680m) with number of commercial shops which can be seen now days. Thus from the present eco-distributional analysis of the *Drosophila* in Chamundi hill, Mysuru it is clear that the distributional pattern of a species or related group of the species is uneven in space and time and that *Drosophila* can serve as a model to study the biodiversity in any given area. The population of *Drosophila* was also depends on environmental factors such as rainfall and temperature. Although the total number of the flies reduced but the question is what factors could be attributed for the disappearance of three species which was found 10 years back [10].

4. Acknowledgments

The authors are extremely grateful to Prof D.G. Rao Principal, Regional Institute of Education (NCERT), Mysuru for his constant support and encouragement. The authors profusely thank Prof V.D. Bhat Dean of Studies and Prof G.V. Gopal Head, DESM Regional Institute of Education (NCERT), Mysuru for their support.

Table 1: The *Drosophila* species and their numbers collected from different altitude of Chamundi hill during 2015-2016

Species	680m	780m	880m	980m	Total
Subgenus Sophophora					
D.anomelani	13	25	11	15	64
D.coonorensis	0	7	0	9	16
D.gangotrii	11	0	12	8	31
D.jambulina	201	216	125	175	717
D.malerkotliana	295	575	350	241	1461
D.mysorenesis	61	77	70	50	258

D. punjabiensis	21	15	20	29	85
D.raja sakari	254	421	128	193	996
D. suzukii	10	8	5	0	23
D. takahasii	3	20	7	3	33
D. bipectinata	135	200	121	95	551
Total	1004	1564	849	818	4235
Subgenus Drosophila					
D. nasuta	1102	1573	1104	611	4390
D.neonasuta	434	699	512	431	2076
D.repleta	35	72	60	31	198
Total	1571	2344	1676	1073	6664
Subgenus					
Subgenus *Scaptodrosophila*					
D.brindavani	352	561	312	324	1549
D.nigra	90	81	48	11	230
D.mundagensis	56	52	31	20	159
Total	498	694	391	355	1938
Grand Total	3073	4602	2916	2246	12837
Mean Temperature in °c	30.5	29.9	27.08	22.7	26.1
Mean Rainfall in mm	54.21	56.13	62.07	62.1	59,4

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