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Inversion polymorphism in a few south Indian populations of *Drosophila ananassae*.

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Introduction

The inversions were first detected in *Drosophila melanogaster* through the suppression of crossing-over by inversion heterozygotes (Sturtevant, 1926). Since flies with different karyotypes produced by inversions are externally indistinguishable, many investigators including Dobzhansky believed that the inversion karyotypes are adaptively neutral (White, 1977). This assumption is proved to be wrong, since many investigations demonstrated that inversion polymorphism in *Drosophila* are subject to natural selection and is an adaptive trait (Ayala *et al.*, 1974). The degree of inversion polymorphism varies in different species and also in different populations of the same species. Species like *D. pseudoobscura* (Dobzhansky and Sturtevant, 1938), *D. persimilis* (Mohn and Spiess, 1963), *D. subobscura* (Sperlich, 1961), *D. willistoni* (Prevosti, 1964), *D. ananassae* (Kikkawa,1938), *D. melanogaster* (Barnes, 1983), *D. robusta* (Carson and Stalker, 1947), *D. pavani* (Brncic, 1957), *D. paramelanica* (Stalker, 1960), *D. euronotus* (Stalker, 1963), *D. nasuta* (Ranganath and Krishnamurthy, 1978), *D. immigrans* (Toyofuku,1957), D. *nebulosa* (Pavan, 1946) possess large stores of inversions. These species have been termed as "champion species" by White (1977). On the other hand species such as *D. simulans*, *D. virilis*, and *D. novamexicana* do not seem to possess inversions in their natural populations (Aulard *et al*., 2002; Singh, 2008; White, 1977).

The most convincing evidence for the selective control of inversion frequencies comes from observations on inversion frequencies in geographic populations of different *Drosophila* species which showed seasonal, geographic, altitudinal, and latitudinal variations. In certain species, north-south clines in inversion frequencies (increase towards equator) have been reported (Krimbas and Powell, 1992). Dobzhansky *et al.* (1950), and Da Cunha and Dobzhansky (1954) have found a good correspondence between the mean number of heterozygous inversions and an index expressing environmental heterogeneity in natural populations of *D. willistoni*. Superiority of inversion heterokaryotypes over homokaryotypes has been demonstrated by Dobzhansky (1970). This led Dobzhansky and coworkers (1950) to suggest that chromosomal polymorphism is a device to cope with the diversities of environments.

Drosophila ananassae is one such species which exhibits high level of inversion polymorphism. It is a cosmopolitan domestic species having a unique status among *Drosophila*. Due to certain peculiarities such as male crossing over, high mutability, and high level of chromosomal polymorphism, it has been used for many genetic studies. This species harbors large numbers of inversions. Further it carries three well knit coextensive inversions, namely, 2LA on the left arm of the 2^{nd} chromosome, 3LA on the left arm of the 3^{rd} chromosome, and 3RA of the right arm of the 3^{rd} chromosome. The extent of genetic polymorphism in various populations of *Drosophila ananassae* carrying these inversions has been studied; the adaptive significance of them has also been studied (Futch, 1966; Rajeswari and Krishnamurthy, 1969; Reddy and Krishnamurthy, 1974, Singh and Chatterjee, 1988; Singh and Som, 2001). Therefore, in the present study inversion frequencies have been analysed in a few south Indian populations of *D. ananassae*.

Materials and Methods

D. ananassae flies collected from Dharwad, Bellur, Manglore, and Mysore following the procedure described by Hegde *et al* (1999) were used for the present study. After the flies were brought to the laboratory, the females were individually placed in glass vials (2.5 cm × 8.5 cm) containing wheat cream agar medium, and males were used for identification. These flies were then maintained in the vivarium at constant temperature of 22 ± 1°C and relative humidity of 70%. When larvae appeared, eight third instar larvae from each isofemale line were used for analysis of inversion frequency following the procedure of Jayaramu (2009).

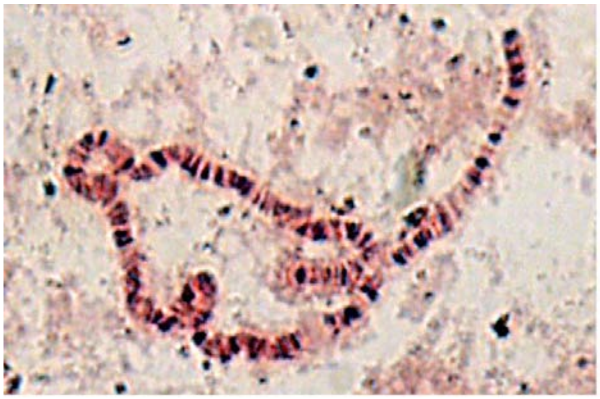
Results and Discussion

One of the most important aspects of evolutionary biology is the study of how natural selection modifies the genetic structure of populations. For this to happen, populations must encompass some degree of chromosomal or genetic variation or other kinds of modifications in the gene pool. Analysis of inversion polymorphism is one of the strategies to know the extent of genetic variation between populations. In the present study inversion polymorphism has been studied in four different geographical populations of *Drosophila ananassae*. A comparison of percentage of inversions (Table 1) of the four different populations (Mysore, Mangalore, Bellur, and Dharwad) showed that the inversion frequencies varied significantly between different populations. The same inversion was found to be present in different frequencies in different populations. For example, the frequency of 2LA inversion in Dharwad population was 20 percent, while in Mangalore population it was 36.7 percent. It was noticed that in all the population studied, 3LA inversion was most frequent, while 2LA+3LA was least. The difference in the percentage of inversions in different populations suggests that the frequency of each of the three paracentric inversions was not the same in all the populations studied. This agrees with earlier studies of inversion frequency in different species of *Drosophila* (Brncic and Koref-Santibanez, 1964; Singh, 1991; Sperlich, 1966; Spiess and Langer, 1961).

The earlier studies on inversion polymorphism in *D. ananassae* (Da Cunha, 1960; Krimbas and Powell, 1992; Singh, 1998) have demonstrated that most of the inversions are distributed either on second or third chromosomes. Two hypotheses have been proposed to account for the concentration of inversions on single chromosomes, the co-adaptation hypothesis and mechanical hypothesis. Although the present study does not provide evidence in favor of any of these hypotheses, it can be said that inversion polymorphism is a means of reducing recombination in a chromosomal segment. Consequently, frequency dependent selection has been

Table 1. Inversion frequency (%) in different geographic populations of *D. ananassae*

	Inversion frequency (%)				
Strains	N	2LA	3LA	2LA+3LA	Inversion free (Monomorphic)
Dharwad	38	20.0	50.0	20.0	10.0
Mangalore	42	36.7	53.3	6.7	3.3
Mysore	40	33.3	43.4	10.0	13.3
Bellur	32	16.7	40.0	26.7	16.6



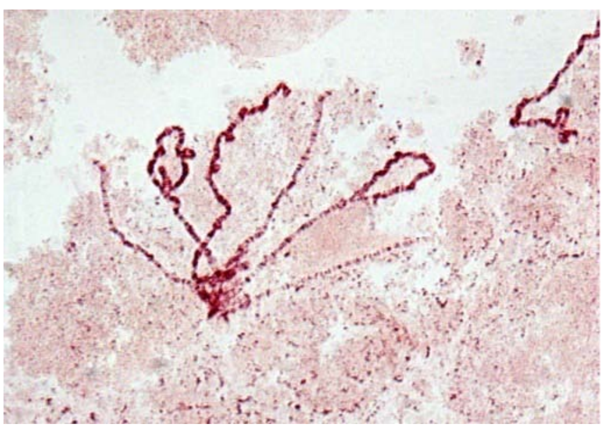


Figure 1 (Top). 2LA inversion of *D. ananassae.*

Figure 2 (Middle). 3LA inversion of *D. ananassae.*

Figure 3 (Bottom). 2LA+ 3LA inversion of *D. ananassae.*

reported to influence second and third chromosome inversions in *D. ananassae* (Kojima and Tobari, 1969). In the present study the persistence of inversion polymorphism in these populations could be explained by an advantage of inversion heterozygotes over corresponding homozygotes. The author in the present study has noticed more heterokaryotypes than homokaryotypes. This confirms the fact that the inversion polymorphism is adaptive and balanced due to higher Darwinian fitness on inversion heterozygotes (Dobzhansky, 1951).

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Drosophilids of Male Mahadeshwar hills of Chamarajanagar District Karnataka State, India.

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Introduction

The term "Biodiversity" encompasses different ecosystems, species, genes, and their relative abundance. The most succinct definition of biodiversity is the structural and functional variety of life forms such as genetic, population, species, community, and ecological levels. Biodiversity is a buzz word, which is attracting the researchers to understand the diversity of biological systems. Insects are supposed to be the major contributors and comprises 80% of faunal constellation. Genus *Drosophila* is one such group of insects, which has attracted the attention of biologists in terms of biodiversity. A better understanding of how different species are affected by current climates and why they sometimes respond differently to climate change is necessary for predicting future effects of climate change (Weather head, 2005). In view of this the chapter deals with the survey of Drosophilids fauna distributed in south Karnataka, India during 2010, 2011, and 2012 at variable altitudes and to record the impact of seasonal stress on Drosophilid composition.

Materials and Methods

Chamarajanagar District, Male Mahadeshwar Hills is situated about 215 km from Bangalore and is a sacred place, with its famous Shiva temple. Amidst dense forest, the temple attracts not only the pilgrims but also nature lovers. The foot of the hill (658 m) was surrounded by mango orchards along with trees such as *Acacia concinna*, *Zizipus jujube*, *Vitex negundo*, and *Phyllanthus* species; the middle region (809 m) *Andrographis serpellifolia*, *Bridalia* species, *Tectona grandis*, *Tamarindus indica*; the top hill (912 m) *Vitex negundo* and other small shrubs.

Collection procedure of Drosophila *flies*

Both bottle trapping and net sweeping methods were used. For bottle trapping, milk bottles of 250 ml capacity containing smashed ripe bananas sprayed with yeast were tied to the twigs underneath to small bushes and trees. Five bottles were kept at each altitude. The following day the mouth of the bottle was plugged with cotton and brought to the laboratory. These flies that were collected in the bottles were transferred to the fresh bottles containing cream of wheat agar medium as food. Net sweeping was also done for collecting the flies using banana rotting fruits with equal