Preface

The fruit fly *Drosophila* is one of the most intensively studied organisms in biology that serves as a model system for investigations of many developmental, cellular processes, disease(s), adaptation, diversity and evolution; whose underlying fundamental principles are comparable to higher eukaryotes, including man (Reviewed in Devineni *et al.* 2013). Genus *Drosophila*, with its cosmopolitan nature and complexities in species compositions is an excellent model for studying the eco-distributional pattern of various species (Carson 1965). Systematic study concerning variations in the species compositions and the patterns of distribution of various members of the genus *Drosophila* in different geographical regions of the earth will enable understand the principles underlying adaptive radiation and certain mechanisms involved in speciation (Muniyappa 1981).

Significant progress has been made in the field of taxonomy and systematics of the family Drosophilidae (Diptera) in India. However, vast area of great ecological interest still either awaits exploration or is poorly explored. Particularly, very little is known regarding *Drosophila* fauna of North-Eastern region of the Indian subcontinent. This region with its diverse climatic conditions, variable altitudes, deep valleys, luxuriant flora, running streams and moist surroundings makes one of the richest repositories of biodiversity in the world. It provides an ideal location for the colonization of several *Drosophila* species (Singh and Gupta 1977, Dwivedi and Gupta 1979, Gupta and Singh 1979, Dwivedi *et al.* 1979, 1980, Singh 1987; Yenisetti *et al.* 2002; Achumi *et al.* 2011, 2013).

Nagaland is one of the sub-Himalayan hilly states blessed with tremendous floral and faunal diversity, but very little work has been done to understand *Drosophila* diversity. Singh (1987) conducted a pioneering preliminary survey on Drosophilids of Dimapur, Medziphema and Kohima of Nagaland. A preliminary report on Drosophilids of Mokokchung town was published by Yenisetti *et al.* (2002). But for these maiden attempts no systematic comprehensive study has been done on Drosophilids of Nagaland. As most parts of Nagaland are unexplored virgin areas, it is possible that new *Drosophila* species can be identified from this region. In the present work chapter I focuses on the occurrence and distribution of *Drosophila* species of Nagaland.
The ecological and biological diversity of an ecosystem determines the presence or absence of a species in an ecological niche. Apart from physical and biotic factors, the topography and season also affect animal distribution. As elevation is one of the important aspects of topography, it is important to look at animal distribution from that perspective. Efforts have been made to collect *Drosophila* at different altitudes, but these data were not considered with an ecological perspective (Reddy and Krishnamurthy 1977). According to Reddy and Krishnamurthy (1977), physical and biotic factors are the sole determinants of animal distribution. This idea logically denotes that elevation and season have no influence on animal distribution. In the present study, goal was to determine if elevation affects distribution.

According to Gause’s competitive exclusion theory, two related species competing for the same resources cannot co-exist together in the same ecological niche (Gause 1934). However, laboratory experiments questioned the validity of this principle (Ayala 1969). The presence of taxonomically or phylogenetically related species in an ecological niche indicates their coexistence, and absence of such related species infers competitive exclusion (Guruprasad *et al.* 2010). Present study sought to understand whether taxonomically or phylogenetically related *Drosophila* species coexist in nature (*Achumi et al.* 2013). Current study was undertaken to understand the altitudinal and seasonal variation of *Drosophila* species on Mount Japfu (15 km from Kohima town, the capital of Nagaland state), which has a peak altitude of about 3015.6 meter (*Achumi et al.* 2013). Observations of this study constitute Chapter II.

A new species, *Drosophila hegdii* was discovered from Lumami, Nagaland state in this study (*Achumi et al.* 2011). Chapter III describes this new species and explores its molecular phylogeny with the help of “DNA barcoding.”

In every organism or a population there is a continued interaction between the genotype and the environment to attain a better homeostatic stability. This stability is achieved by several ways and one is by initiating change in the karyotype (*Slavica et al.* 2006). Chromosomal rearrangements are sources of genetic variation. Chromosomal rearrangements have been implicated in adaptation and speciation in a wide variety of taxa.
This can be understood by looking into the chromosomal polymorphism mainly due to inversions in their natural populations. Dobzhansky and Pavan (1950) suggested that the chromosomal polymorphism is a device to cope with the diversity of environments. Swanson (1974) demonstrated that paracentric inversions due to their high adaptive value in heterozygous condition have been positively selected in animals. Present study aims at understanding the significance of multiple cosmopolitan inversions in *D. ananassae* in adapting to various climatic and geographical factors. Chapter IV focuses on inversion polymorphism and its adaptive significance in Nagaland populations of *Drosophila ananassae*.

In nutshell current study provides an insight into the species diversities and pattern of distribution of the members of the *Drosophila* in Nagaland; explains whether taxonomically or phylogenetically related *Drosophila* species coexist in nature; deciphers the molecular phylogeny of a new species- *Drosophila hegdii* from Nagaland and further reveals the adaptive significance of genomic rearrangements in *Drosophila ananassae* populations of Nagaland, a sub-Himalayan hilly state of north-east India.