POPULATION DYNAMICS

INTRODUCTION

The word "biodiversity" has exploded in Governmental and intergovernmental reports, news papers, meeting reports, and vocabulary of popular press during the last two decades. Growth in usage of this term has been dramatic in the scientific literature. There is long history of biological diversity in variety of contexts. Biodiversity can be considered synonymous with biological diversity for practical purpose as defined by Norse et. al. (1986). This is reinforced by the official definition in the convention on “Biological Diversity” signed by 156 countries and European community at the United Nations Conference on the Environment and Development i.e. The Earth Summit in 1992 at Rio de Janeiro in Brazil. "Biological diversity" means the variable among living organism from all sources including terrestrial and aquatic systems and ecological complexes of which they are part; this includes diversity within species and of ecosystem.

Species can be counted and the number of species present at a site might seem to be a quantitative measure of its biodiversity and allow comparison with other sites. But this assumes that all species at a site, within and across systematic groups, contribute to it through biodiversity of a site ideally to say something about how different the inhabitants are from each other.

Soil biota plays an important role in the production in any crop ecosystem. Soil organisms are not just inhabitants of the soil rather they are important component of soil communities (Cluzeau et. al., 1992). Earthworms are also called “The intestine of the earth” and are one of the best soil conditioners available to the farmers. They are extremely important in soil formation, principally, through their activities in consuming organic matter, fragmenting it and mixing it intimately with mineral particle to form aggregates. During their feeding earthworm promotes microbial activity, which also accelerates the break down of organic matter and stabilization of soil aggregates (Mischiels et.al., 2001). Many species are sensitive to impact of human activities.
The distribution and abundance of species are determined by a combination of factors including biogeographically history, environmental condition (e.g. temperature, salinity, storms), availability of spatial and food resources, rates of reproduction, mortality and migration and intra- and inter species interactions (e.g. predator and competitor) (Branch, 1976; Underwood, 1988). At local scale the availability and use of resources and interactions with other individuals are key factors regulating the morphology and behavior of individuals and these in turn affect population (Hopkins and Gartner 1992; De’ath and Moran, 1998).

The diversity index gives a measure of the individual present in a community and global loss of thousands of species as a result of population and habitat destruction. Such studies assist environmental biologists to predict where and how many species go extinct so that certain effective measures may be undertaken to protect them. Not much information is available on these aspects regarding the population of the earthworm from this region.

Benefits and functions of earthworms in agro-ecosystems are being recognized (Edwards and Bohlen, 1996) and it is important to identify the management practices that encourage earthworms in the modern farming systems. There have been numerous reports indicating higher earthworm population (Bohlen et. al. 1995; Jordan et. al. 1997). Chan (2001) reported total earthworm populations under no-tillage have been found to be 2-9 times greater than that found under conventional tillage. The higher earthworm populations have often been attributed to the more favourable soil conditions, namely presence of surface litter, more favourable temperature and moisture conditions, and the lack of disturbance (Lee, 1985).

Kladivko et. al., (1997) studied the responses of earthworm populations to conservation tillage have been variable and there have been reports of negative responses of earthworm abundance to no-tillage. The reasons for the variable response to no-tillage are not entirely clear. Differences in soil properties could be one factor (Kladivko et. al., 1997). Although there is a general awareness of
the potentially toxic effects of some agricultural chemicals on earthworms (Lee 1985; Edwards and Bohlen 1992), little information is available on the impact of many of these chemicals on earthworm populations and diversity under different tillage systems. There have been very few reports on the changes in earthworm populations under different management regimes over a longer time period.

The present study area from the Baramati is an attempt to define the status of the species and to establish some nomenclatural stability. It is also cautionary in that taxonomic progress can only be made by resolving, as far as possible, the inherited conflicts in species descriptions.

**MATERIAL AND METHODS**

Application of statistical methods to biological data as biostatistics or biometry is an important tool in biological research. It generates useful information for interpretation of the results obtained during biological experimentation of the research and development.

Population densities of earthworm species were estimated by quadrats method of Greig and Smith (1983). Quadratenotes a unit area of square rectangular or circular quadrat of unique length and radius respectively. This can be used to study the sessile and fixed animals.

It is necessary to determine the “minimum size of quadrates”, before proceeding to study the community, so it can be used in field application for community study. Presently in biodiversity measurement and community composition study, the quadrat method has its own importance and frequently used in identification of relative abundance of species and quantification of the resources.

The present study was carried out at 10 selected sites from Baramati soil during October 2002 to August 2004. To study earthworm species distribution of a series of 10 quadrates (1m X 1m) were laid at an interval of 200 m along soil of Baramati.
The relative density, relative frequency and relative abundance were computed following the method of Sutherland (1997).

1) *Polypheretima elongata:*

1) **Relative density** = \[
\frac{\text{No. of individual species}}{\text{No. of individuals of all species}} \times 100
\]

\[
= \frac{1}{44} \times 100 = 36.974\%
\]

2) **Relative frequency** = \[
\frac{\text{Total No. of quadrates in which species occurred}}{\text{Total No. of quadrates studied}} \times 100
\]

\[
= \frac{10}{10} \times 100 = 100\%
\]

3) **Relative abundance** = \[
\frac{\text{Total No. Of quadrates in which species occurred}}{\text{Total No. of quadrates of species occurrence}} \times 100
\]

\[
= \frac{10}{44} \times 100 = 22.727\%
\]

Like wise all the calculations of *Pheretima posthuma, Perionyx sansibaricus* and *Lampito mauritii* were done and plotted in Table No. 1.2.
RESULTS

The data on relative density, frequency and abundance of four types of earthworm species found at soil of Baramati are presented in Table No. 2.2. Among these Polypheretima elongata, Pheretima posthuma, Lampito mauritii and Perionyx sansibaricus were found widely distributed with 36.97%, 34.45%, 18.48% and 10.08% relatively density and 45.45%, 41.66%, 24.39% and 22.72% Lampito mauritii, Perionyx sansibaricus, Pheretima posthuma and Polypheretima elongate relative abundance. It was observed that highest density was found in the species Polypheretima elongata and lowest distributed earthworm species was Perionyx sansibaricus as comparable to other two worms.

DISCUSSION

Soil fauna is influenced by environmental factors and changes in soil physical and chemical properties of soil influence their number and local distribution patterns (Ettema et al., 1998, 2002). Some of these changes, such as seasonal variations, are time-related, affecting animal life cycles and their annual population dynamics. Moreover, differences in resource availability also play an important role to terminal some life history traits such as growth, size at maturity, number and size of offspring and length of life (Stearns, 1992). Earthworms represent a major group into the soil fauna and seasonal factors play an important role in explaining changes in size and biomass of their populations (Edwards and Bohhlen, 2004). Because earthworm species exhibit different ecological preferences, the influence of environmental factors on population dynamics differs among earthworms of different ecological categories (Rozen, 1998).

The soil conditions that affect earthworm activity like temperature, moisture and food (Edwards and Bohhlen, 2004). However epigamic earthworm species are found living and feeding in the litter layer. In the present study, the distribution of three species viz. Polypheretima elongate, Lampito mauritii and Perionyx sansibaricus were recorded. The species richness observed in the present study is low in comparison to those reported in other parts in India such
as seven species by Kale and Krishnamoorthy, (1981), six species by Ismail, (1986), five species by Mohanjit, (1986), and Tiwari (1983). Observation of the present study demonstrated that all species of earthworm occurring in Baramati were widely dispered with respect to C:N ratio which coincides with the observation of Kale and Krishnamoorthy (1981). The study revealed that the earthworms Polyperetima elongate and Lampito mauritii were abundantly distributed in the soil, where C:N ratio is higher and Perionyx sansiburcus was abundantly distributed in the soil rich in organic carbon and nitrogen contents leading to low C:N ratio.

The basic aspects of the life cycle of *Eisenia fetida* are relatively well documented due to the importance of this species in waste management. The growth and reproduction of this earthworm species is affected by several factors such as food quality, moisture, temperature and population density, as showed under laboratory conditions (Dominguez, 2004). Partly due to the particular distribution of this species, mainly associated to compost and manure piles (Bouche, 1972; Watanable and Tsukamoto, 1976).

In the present work, *Polypheretima elongata, Pheretima posthuma, Lampito mauritii* and *Perionyx sansibaricus* were found widely distributed with 36.97%, 34.45%, 18.48% and 10.08% relatively density and 22.72%, 24.39%, 45.45% and 41.66% relative abundance (Table No. 2.2). Lowest distributed earthworm species was *Perionyx sansibaricus*. The *Polypheretima elongata* is the largest group of earthworms in the world, consisting of more than 700 nominal species and subspecies (Sims and Easton1972). It is also the largest group in India. Because it is too large to be handled, Sims and Easton (1972) divided the genus into 8 genera by phonetic analysis according to the greatest number of shared morphological attributes.

Lavelle (1978) reported the species *Millsonia lamtoiana* ranged in density from 0.02 to 1.43 ind.m\(^{-2}\) and biomass from 0.01 to 8.43g fresh weight mb\(^2\) in the Ivory Coast, rather high values are not match with *Millsonia lamtoiana*. Soil moisture is the most important of all environmental variables for earthworms in tropical soils (Lavelle, 1983). Garnsey (1994) also reported earthworm biomass
in the Midlands of Tasmania, *Millsonia carininguensis* has a patchy distribution pattern with high density spots alternating with low density areas. Earthworm aestivation has been observed throughout temperate regions (Nordström, 1975; Anderson, 1980) in Africa (Madge, 1969) and in Australia (Garnsey, 1994), grasslands are known to support high earthworm populations and biomass (Lee, 1985). Litter composition is the primary factor determining these high values (Mishra and Ramakrishnan, 1988). Differences in the litter quality, and large inputs of cattle dung which is rapidly incorporated into the soil by this species and dung beetles, may also be factors responsible for the enhancement of earthworm activity in improved pastures.

Understanding the earthworm diversity of any region requires consideration of the species recorded from adjacent countries as distributions often overlap borders. Gates (1972) described about 174 mainly pheretimoid species from Myanmar (Burma), with much information on their relationships to other Oriental faunas. In contrast, the British Island of similar to Japan have only 48 taxa comprising species that are unlikely to be entirely endemic, having colonized after the last ice age, and many of which are also recorded as common exotics elsewhere (Sims & Gerard 1985, 1999). Approximately 160 species are known from North America that was also widely calculated. 350 species are reported from India; 193 species (170 native) from New Zealand (Rossi, 2003).
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