

## Diversity, distribution and abundance of earthworms in Pondicherry region

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**Abstract:** Distribution pattern of earthworm fauna in Pondicherry region and its population densities were studied. Ten species of earthworms *Drawida willsi*, *D. limella*, *D. scandens*, *Pontodrilus bermudensis*, *Pontoscolex corethrurs*, *Lampito mauritii*, *Perionyx excavatus*, *Eudrilus eugeniae*, *Octochaetona serrata* and *O. barnesi* belonging to seven genera and six families were noted. Earthworm species diversity in fourteen localities from different habitats is presented. *L. mauritii* was dominant in all the habitats of the region. Diversity index and species richness is presented. Among the different species, based on age group and population densities (number m<sup>-2</sup>), earthworm density was maximum in vermiculture area (358) and lowest in saline (25) habitats. Species richness was found higher in Villianur locality, where the number of habitats was also high.

**Resumen:** Se estudió el patrón de distribución de la fauna lumbrícola y sus densidades poblacionales en la región pondicherry. Fueron observadas diez especies de lombrices de tierra pertenecientes a siete géneros y seis familias: *Drawida willsi*, *D. limella*, *D. scandens*, *Pontodrilus bermudensis*, *Pontoscolex corethrurs*, *Lampito mauritii*, *Perionyx excavatus*, *Eudrilus eugeniae*, *Octochaetona serrata* y *O. barnesi*. Se presenta la diversidad de especies de lombrices en 14 localidades de diferentes hábitats. *L. mauritii* fue dominante en todos los hábitats de la región. Se presenta el índice de diversidad y la riqueza de especies. Entre las diferentes especies y de acuerdo con el grupo de edad y las densidades poblacionales (número m<sup>-2</sup>), la densidad de las lombrices fue máxima en el área de vermicultura (358) y mínima (25) en hábitats salinos. La mayor riqueza de especies fue hallada en la localidad Villianur, donde el número de hábitats también fue alto.

**Resumo:** Os padrões de distribuição da fauna de minhocas na região de Pondicherry e as densidades das suas populações foram estudadas. Dez espécies de minhocas *Drawilda willsi*, *D. limella*, *D. scandens*, *Pontodrilus bermudensis*, *Pontoscolex corethrurs*, *Lampito mauritii*, *Perionyx excavatus*, *Eudrilus eugeniae*, *Octochaetona serrata* e *O. barnesi* pertencendo a sete géneros e seis famílias foram registadas. A diversidade específica de minhocas em catorze localidades de habitats diferentes esteve sempre presente. Entre as diferentes espécies, com base nos grupos etários e densidades populacionais (número m<sup>-2</sup>), a densidade de minhocas era máxima nas áreas vermiculares (358) e mais baixa nos habitats salinos (25). Encontrou-se que a riqueza específica foi mais elevada na localidade de Villianur, onde o número de habitats também era o mais elevado.

**Key words:** Abundance, distribution, diversity, earthworm, Pondicherry region.

## Introduction

Earthworms, the soil macroinvertebrates, are prominent among soil fauna and regulate the soil processes (Ismail 1997). They are found in all types of soils with sufficient moisture and food (Ghosh 1993). They act as decomposers and also a rich protein source (Neuhauser *et al.* 1979). Belonging to class *Oligochaeta*, earthworms form the major terrestrial and soil inhabiting organisms of Phylum *Annelida* (Ghosh 1993). In India, Julka (1993) reported 509 species and 67 genera of earthworms.

Review of literature reveals that earthworm population dynamics in relation to different soil types is known (Dash & Patra 1977; Fragoso *et al.* 1999). Ghosh (1993) presented the ecological aspects of Indian earthworms along with their vermicomposting technique. However, there is no report on distribution and abundance of earthworms in Pondicherry region. To fill in this lacuna, the present study was undertaken. The study focuses on population density, species wise age and depth distribution in different habitats of different localities.

## Materials and methods

The identified earthworm sampling sites in Pondicherry region are depicted (Fig.1). Pondicherry lies at 12°N latitude and 79°E longitude on the east coast of India. The survey and collection was done for two years starting from October 2000 to September 2002. Collections were made twice a month in the following habitats: (i) paddy field, (ii) coconut field, (iii) saline soil area, (iv) municipal solidwaste (MSW) dumped area, (v) groundnut field, (vi) poultry waste dumped area, (vii) vermiculturing area, (viii) cowdung dumped area, (ix) near fresh water bodies, (x) sewage water canals and (xi) industrial area. Collection, preservation and counting of the earthworm species was based on age structure: [(a) juveniles, (b) non-clitellates and (c) clitellates], depth: [(a) epigeic (1 cm to 5 cm depth), (b) anececic (10 cm to 30 cm depth), (c) endogeic (30 cm to 50 cm depth)] and habitat following Ghosh (1993), Ismail (1997) and Jimenez *et al.* (2000). Species richness and diversity of species



**Fig. 1.** Map showing collection sites of earthworm species.

( $d^1$ ) was calculated based on Shannon-Wiener Index (Zar 1999).

## Results and discussion

A total of ten species (seven genera under five families) of earthworms collected from Pondicherry region are presented in Table 1. Habitat wise distribution of different species of earthworms in Pondicherry region is presented in Table 2. Among the identified species, *L. mauritii* was the only species common across all the localities and habitats, except in Ariyankuppam saline habitat. *P. bermudensis*, reported to be frequent in estuarine waters (Ismail 1997) and *P. corethrurs* mostly observed in soils with low salinity and high organic matter (Kale 1998) were recorded in Ariyankuppam saline habitat. *D. willsi* occurs in all localities and mostly prefers paddy fields except in Ariyankuppam. *D. scandens* / *D. limella* occur in paddy fields of Bahour, Abishaegapakkam, Villianur, Madagadipet, Kariyamanikkam, Karayanputhur and Kirumampakkam. However, *D. limella* was also recorded near fresh water habitats. Characteristically none of the species of *Drawida* was found in coconut field. The hardness of the soil of the coconut field in

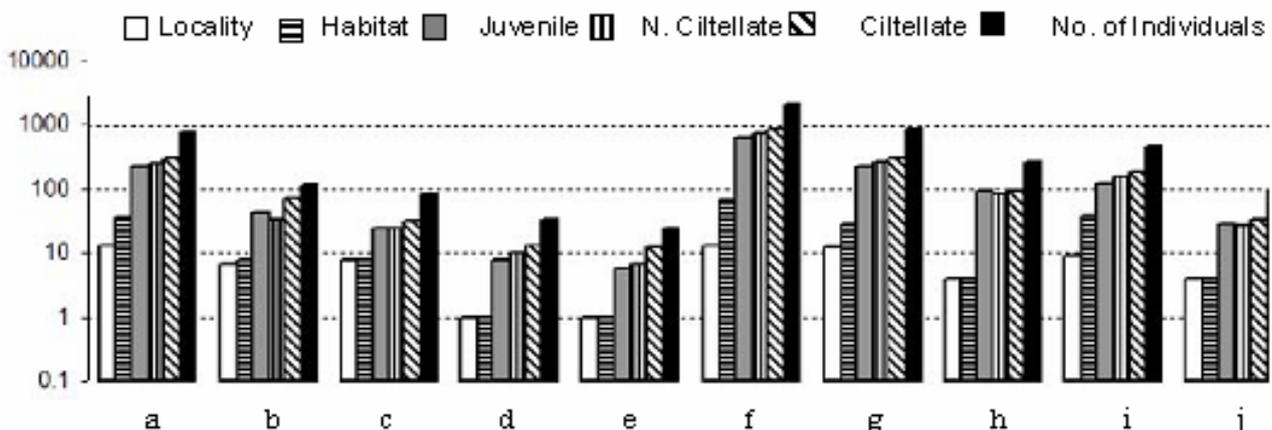
**Table 1.** Systematic position of earthworm species present in Pondicherry region.

Order	Family	Genera	Species
I-Moniligastrida	Moniligastridae	<i>Drawida</i>	<i>D. willsi</i> (Michaelsen) <i>D. limella</i> (Gates) <i>D. scandens</i> (Rao)
II-Haplotaxida	Glossocolecidae	<i>Pontoscolex</i>	<i>P. corethrurs</i> (Muler)
	Megascolecidae	<i>Lampito</i>	<i>L. mauritii</i> (Kinberg)
		<i>Perionyx</i>	<i>P. excavatus</i> (Perrier)
	Acanthodrilidae	<i>Pontodrilus</i>	<i>P. bermudensis</i> (Beddard)
	Octochaetidae	<i>Octochaetona</i>	<i>O. serrata</i> (Gates) <i>O. barnesi</i> (Stephenson)
Eudrilidae		<i>Eudrilus</i>	<i>E. eugenia</i> (Kinberg)

comparison to that of the other clay/loamy soils, besides the higher C:N ratio appear to be the unfavorable factor. With the exception of Ariyankuppam and Thavalakuppam *P. excavatus* was recorded from all other localities. *Eeugeniae* was inhabiting vermiculture areas (G, Table 2) of Auroville, Villianur, Madagadipet and Pilliarkuppam localities. *O. serrata* though occurs in many localities, was not found in Pondicherry town, Kalapet, Auroville and Karayanputhur areas. *O. barnesi* was found in Bahour, Abishaegapakkam, Villianur and Kariyamanikkam localities. The general pattern of their distribution has been attributed to the electrical conductivity of the soil water, (Hooger *et al.* 1983), soil pH (Phillipson *et al.* 1978) besides TOC, TON and C:N ratio (Syers & Springett 1983). The physico-chemical parameters like EC, pH, TOC, TON, total hardness, besides the soil type of the samples collected from different habitats have been

analyzed and presented (Table 3). Edwards & Lofty (1972) have reported that earthworm activity is influenced by the soil parameters besides feed. Influence of soil conditions on earthworm population is also reported by Chaudry & Mitra (1983).

The diversity index and species richness of earthworms in Pondicherry region was calculated (Table 4). From Shannon diversity index, it is apparent that the number of species and species richness is highest (1.3215) in Villianur locality and lowest (1.0168) in Kalapet locality. In Villianur locality, the clay loamy soil with an electrical conductivity of 1.2, pH 6.9 along with moisture holding capacity of 43.16%, appear to be favourable for higher earthworm diversity. However, in Kalapet locality, low species richness can be attributed to the dry red soil which has low moisture holding capacity in addition to the low availability of

**Fig. 2.** Population density of earthworm species (a=*D. willsi*, b= *D. limella*, c= *D. scandens*, d= *P. bermudensis*, e=*P. corethrurs*, f= *L. mauritii*, g= *P. excavatus*, h= *E. eugenia*, i= *O. serrata*, j= *O. barnesi*) of Pondicherry region.

carbon and nitrogen. A significant decline in abundance and biomass of earthworms in summer can be attributed to changes in soil temperature and moisture (Whalen *et al.* 1998). Kale (1998) reported that abundance and diversity of earthworm species is affected by carbon and nitrogen content of the soil.

the available organic resources, are the land use pattern and disturbance (Edwards & Bohlen 1996). However, Lee's (1985) observation that commonly less than half a dozen earthworm species are found in a given soil corroborates the present findings.

Reports (Fragoso *et al.* 1999) suggest that the species number in a given earthworm community, which is the easiest measure of species diversity, range from 3-17 in tropical and temperate ecosystems. In this respect, Pondicherry region, with earthworm communities having 3 to 8 species, exhibit the similar diversity. The factors that influence the diversity of earthworm community at a given locality, apart from the type of soil, climate and

The population density (number/m<sup>2</sup>) of earthworm species based on their distribution in different localities, age and habitats is presented in Fig. 2. In the depth wise distribution of earthworm species of Pondicherry region the epigeic earthworms are *P. bermudensis* (32), *P. corethrurs* (26), *P. excavatus* (275), and *E. eugeniae* (828). The endogeic earthworms include *O. serrata* (465), and *O. barnesi* (90), and the aneic earthworms include *D. willsi* (792), *D. limella*

**Table 3.** Physico-chemical characters of soil from different habitats.

Habitat (soil samples)	Soil type	Moisture holding capacity (%)	Total hardness	pH	EC	TOC(%)	TON (%)	C:N ratio
Paddy field	Clay soil	23.0	429	6.7	0.8	0.65	0.294	2.24
Coconut field	Clay loamy	43.1	592	6.9	1.2	0.75	0.145	5.17
Saline soil area	Clay soil	38.1	658	7.5	2.5	0.50	0.121	4.13
Municipal solid waste	-	26.2	351	6.9	2.2	0.75	0.225	3.41
Ground nut field	Loamy soil	40.1	366	7.2	1.1	0.55	0.215	2.50
Poultry waste area	-	59.9	305	6.4	1.5	0.95	0.394	2.43
Vermiculture area	Loamy soil	63.6	275	7.2	1.4	0.72	0.222	3.27
Cowdung dumped area	-	40.4	345	6.4	1.9	0.55	0.211	2.75
Fresh water bodies	Clay loamy	36.0	597	6.8	1.0	0.42	0.142	3.0
Sewage water canals area	-	39.5	462	6.3	1.7	0.50	0.225	2.5
Industrial area	Loamy soil	13.1	412	6.2	2.7	0.65	0.294	2.24

**Table 4.** Earthworm diversity index and species richness in fourteen localities of Pondicherry region.

Localities	Number of habitats	Number of species	Species richness (D')	Diversity index
Villianur	8	8	1.178	1.321
Bahour	5	7	1.137	1.310
Abishaegapakkam	8	7	1.052	1.337
Kariyamanikkam	6	7	1.137	1.969
Kirumampakkam	4	6	1.072	1.375
Pilliarkuppam	4	6	0.964	1.195
Madagadipet	7	6	0.969	1.317
Karayanputhur	5	5	0.746	1.117
Ariyankuppam	3	4	0.755	0.692
Thavalakuppam	4	4	0.631	1.082
Auroville	2	4	0.626	1.337
Sanyasikuppam	5	4	0.602	1.064
Pondicherry	3	3	0.466	1.087
Kalapet	3	3	0.448	1.016

(114), *D. scandens* (84), and *L. mauritii* (2179). Analysis of variance with respect to different parameters was calculated (Table 5). The population density of earthworm is significantly different ( $p < 0.01$ ) among the species in relation to locality, habitat, age, and number of individuals present. The study revealed that earthworm *L. mauritii* showed higher population density-836-clitellates, 724-non-clitellates and 619-juveniles, indicating a pyramidal arrangement of age wise distribution. Population density was less in *P. corethrurs* with only 13-clitellates, 7-non-clitellates and 6-juveniles of earthworms.

The highest number of earthworms were found near fresh water bodies (358) and lowest in the saline area (25). Similar observations were reported by Sarwar Jahan *et al.* (2005). The pyramidal age group distribution of earthworm population with maximum immature number of worms than mature worms at most of their active period of life was devised by Evans *et al.* (1948) and Lavelle (1978). Of the three morpho-ecological categories Bouche (1977) in the present study, the 'aneceic' type of earthworms were dominant with 226 of them occurring in habitat B- i.e. the coconut field. Coconut field habitat was followed by vermiculture (G) area with regard to population density. The high availability of feed and moisture content maintained in this man made environment appear to be the positive factors. Fragoso *et al.* (1999) have reported that the structural composition in earthworm communities varies depending on the type of agro -ecosystem. Similar observations are evident from the data of the present study.

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