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Studies on Population Density of Adult Earthworms in Urban Sewage Areas of Nagole, Hyderabad

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Abstract:

Urban areas are polluted with sewage and earthworms have been used for sewage treatment since decades. In this study we investigated the population densities of earthworms in relation to various physico-chemical variables of sewage of urban system of Nagole,Hyderabad. Three different species of earthworms namely *Octochactona phillotti, Barogasterannandelei* and *Drawida linnora* species belonging to the family of Octochaetidae and Monibgastridae were recorded in the sewagearea within the limits of study area. The percentage of adult earthworms in sewage area of urban system ranged from 7±2.645 to 1.333±0.574 from January to December 2007, highest being in January. The diversity of earthworms varied during the study period. Highest population density was observed during rainy season. The present investigation could generate information on the ecology of earthworms of urban environment and on the role of earthworms in decomposition of sewage of urban environment.

Key words: Earthworm, Nagole, Population, Sewage

INTRODUCTION

Earthworms are little wriggling worms that inhabit the soil system.These invertebrates, belong to the phylum-Annelid, Order-Oligochaeta, Class-Clitellata (Edwards and Lofty, 1972). They range from a fraction of a cm to one or two meters on length, and commonly known as the farmer's friend. Earthworms are considered as nature's plough, they have been working long before man started plaguing the soil (Darwin 1881; Phillips et al., 2021). Much research has been done on the effects of earthworms on soil structure and fertility, and on crop-growth, which concluded that the earthworm activities such as burrowing, casting etc. ameliorated the physico-chemical status of the soil(Allee et al., 1930; Evans and Guild, 1947; Reddy and Pasha 1993).

Earthworms keep soil healthy, they can help repair damaged soil and may provide solutions to man-made problems.They can decontaminate land by enhancing 'bioremediation' – the process by which micro-organisms consume and break down environmental pollutants converting them to non-toxic molecules. They are known to produce vermicompost by using any organic waste like agricultural waste, city garbage, industrial waste and sewage waste (Žaltauskaitė 2022; Domínguez, 2021).Several authors have attempted to correlate the distribution and population density of various species of earthworm with soil type (Smetak et al., 2007; Gilibert etal., 2022). Thus, it is important to know the significance of earthworms and also to find out the factors that diminish the earthworms' population in sewage. In south India, the species diversity of earthworms is very less and the earthworm activity is less in sewage, which may be because of unfavorable environmental conditions.Nevertheless, attempts were made to investigate some aspectsof the ecology of earthworms of sewage of urban systems, whichis a prerequisite to research on their role in decomposition, diversity anddensity in the sewage of urban environment, Hyderabad.

The Present investigation was carried out at Nagole near Uppal Area, Hyderabad (Latitude17.3814909, Longitude 78.5551322 & Altitude of 536 mts to mean sea level) in Telangana region of Deccan plateau, India (Plate 1) and was restricted to a few sites of the edge of domestic sewage (Plate 2) during Jan 2007 to Jan 2008. Nagole is one of the domestic locality of Hyderabad situated very near to Uppal Area. There is a Musi River which is passing from the outskirts of Nagole. Generally most of the drainage of Hyderabad is diverted into Musi River. A road bridge over Musi River connects Nagole and Uppal. Near the bridge, there is a slum area where the sewage is almost stagnant at both ends. This slum is a muddy area with sewage emanating bad smell. The soil is always dumpy and semi-wet.

MATERIALS AND METHODS

Soil samples collection

Soil samples were collected from sewage areas while sampling the Earthworms for analysis of soil (physico–chemical characteristics). Ten soil samples were collected at random and mixed together in order to make compound samples. These samples were air dried and collected in polythene bags, labeled and preserved for carrying out analytical work in the laboratory. It was done following the methods of Jackson (1967).

The earthworms were sampled by hard sorting method in three randomly selected areas, each of size 25x25 cm and 25 cm depth in each plot (replicate) every month during two crop seasons. (July to September, 1989 and June to October, 1990) each covering both rainy (June to September) and Post training (October to January) seasons. Thus, their populations were sampled eight times in total during the period, 1989 – 1990. each time, an iron grid of 25 cm^2 size was placed on the randomly selected area and cleared up the above ground vegetation inside the frame and dug up to the depth of 25 cm in the morning hours (0600 to 0800 hrs.) The earthworms were searched and collected from each such area, put in a polythene bag and brought to the laboratory. They were washed of the adhered soil particles, soaked with filter paper to remove the water attached to their outer body wall and their number was enumerated. They were weighed (with gut content) for biomass (wet), narcotized with absolute ethanol, and sorted into various age groups such as adults (with clitellum) and juveniles (without clitellum and small worms). They were processed through 4% formalin overnight, and preserved in 80% ethanol. The adults identified approximately, sent for more (specific) identification to expert taxonomist at Zoological Survey Of India.Their population densities were converted to m^{-2} across 15 treatments. The data on the population densities of adult earthworms and their biomass across the soil management treatments and seasons were analyzed by ANOVA using GENSTAT

RESULTS & DISCUSSION

Qualitative and Quantitative composition

Various species of earthworms were recorded in the sewageareawithin the limits of urban system of Nagole,Hyderabad as presented in Table 2.

Table 2: Diversity of earthworms recorded in sewage

S.No.	Family	Species
1.	Octochaetidae	*Octochactona phillotti* (michaelsen)
2.	Octochaetidae	*Barogaster annandelei* (stephenson)
3.	Monibgastridae	*Drawida linnora*

Seasonal Earthworm Population Structure

Earthworm population was recorded in sewage area. Earthworms are collected from m^2 area. In sewage areas, during the study period the population was more in month of August 2007. 32 earthworms are there in m^2 area. Adults are more recorded in the month of January 2007&2008(67.7%). Earthworm adult population was more in sewage area. In sewage area, in months of January to June 2007 & August, September, November 2007 & January 2008 adults are recorded more than juveniles. Remaining months of July, October, juveniles are recorded more than adults.

In sewage area the number population range of adults was 4 to 21 per m^2 area, the highest length of adult earthworm is 25 cm during the month of July and lowest length of adult earthworm is 6 cm. during the month of February (Table 3& Table 4).

Population Abundance

The total population density of adult *Octochactona phillotti* ranged from 1.33 ± 0.57 to 7 ± 2.64 in m^2 during the study period. They were recorded in higher number during post monsoon (7 ± 2.64) in January 2007, 5.33± 1.52 m^2 in February 2007 4.66 ± 0.66 in March, 2.33 ± 0.664 in April, and 1.66 ± 0.57 in May. Further the percentage of adult worms were increased in June 6.0 ± 1.73, July 3.66 ± 1.29 again increased 6.66 ± 0.74 in August followed by 5.0 ± 0.5 in September, 3.0 ± 0.5 in October, 2.33 ± 0.33 in November 1.33 ± 0.33 in December again percentage of adult increased in January 2008 to 7.0 ± 2.64 and in February 2008 to 6.66 ± 0.74. Maximum number (21) adults were recorded in January 2007 and January 2008 and minimum (4) was recorded in December 2007. The length of the earthworms also recorded seasonally, maximum length was 25.0 cm. in July 2007 and minimum length of adult was recorded 14 cm in October 2007. The population density of adult and juvenile earthworms in sewage area is presented in Figure 1. The diversity of earthworms from January to May gradually decreased and suddenly raised height in June and gradually decreased in number upto December 2007 and again population density increased in January 2008. The result indicates that during the rainy season the population density is high than the summer and winter season.

Table 3: Number of earthworms collected from m^2 area in Sewage area during the study period

Month	Total No. of Adults	Min length cm.	Adult Max length Cm.
Jan	21	10	19
Feb	16	6	21
Mar	14	10	20
Apr	7	13.5	16
May	5	4.5	18
Jun	18	10.5	19
Jul	11	11	25
Aug	20	7.3	20
Sep	15	10	23
Oct	9	10	14
Nov	7	8	15
Dec	4	12	17
Jan	21	10	19

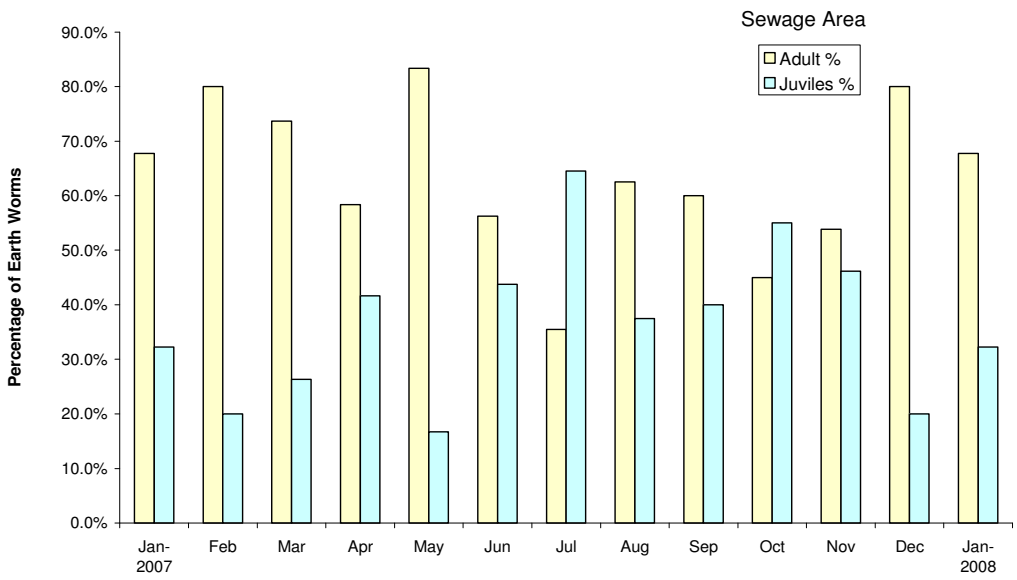

Figure 1. Seasonal Variation of Adults and Juviniles of Earth Worms in Sewage Area during the study period

Table 4: Percentage of earthworms in sewage area during the study period

Month	Spot	Adults	No. of Earthworms	Mean±SE	Adult %
January	1	21	6	7±0.408	
	2		10	7±1.224	67.7%
	3		5	7±0.816	
February	1	16	7	5.333±0.680	80.0%

	2		4	5.333±0.544	
	3		5	5.333±0.129	
March	1	14	5	4.666±0.136	
	2		5	4.666±0.136	
	3		4	4.666±0.270	73.7%
April	1	7	3	2.333±0.272	
	2		2	2.333±0.129	
	3		2	2.333±0.129	58.3%
May	1	5	2	1.666±0.136	
	2		2	1.666±0.136	
	3		1	1.666±0.270	83.3%
June	1	18	8	6.0±0.816	
	2		5	6.0±0.408	
	3		5	6.0±0.408	56.3%
July	1	11	4	3.666±0.136	
	2		5	3.666±0.544	
	3		2	3.666±0.941	35.5%
August	1	20	5	6.666±0.678	
	2		7	6.666±0.136	
	3		8	6.666±0.544	62.5%
September	1	15	5	5.0±0.4	
	2		5	5.0±0.5	
	3		5	5.0±0.6	60.0%
October	1	9	2	3.0±0.408	
	2		4	3.0±0.408	
	3		3	3.0±0	45.0%
November	1	7	2	2.33±0.129	
	2		2	2.33±0.129	
	3		3	2.33±0.273	53.8%
December	1	4	2	1.33±0.273	
	2		1	1.33±0.129	
	3		1	1.33±0.129	80.0%

Population density in relation with soil temperature

The population density of earthworms in relation with soil temperature is very significant. When temperature (32.2^{o}C) is high the population density of earthworms was decreased. When the temperature was 27.7^{o}C to 23.0^{o}C the population density of earthworms were increased.However, when the temperature was 20^{o}C, the population density again decreased (Figure 2).

The present investigation showed that higher temperature (32.0^{o}C) and lower temperature (20.0^{o}C) is not suitable for growth of earthworms. It indicates that at higher temperature the earthworms undergo aestivation and at lower temperature they undergo hibernation.

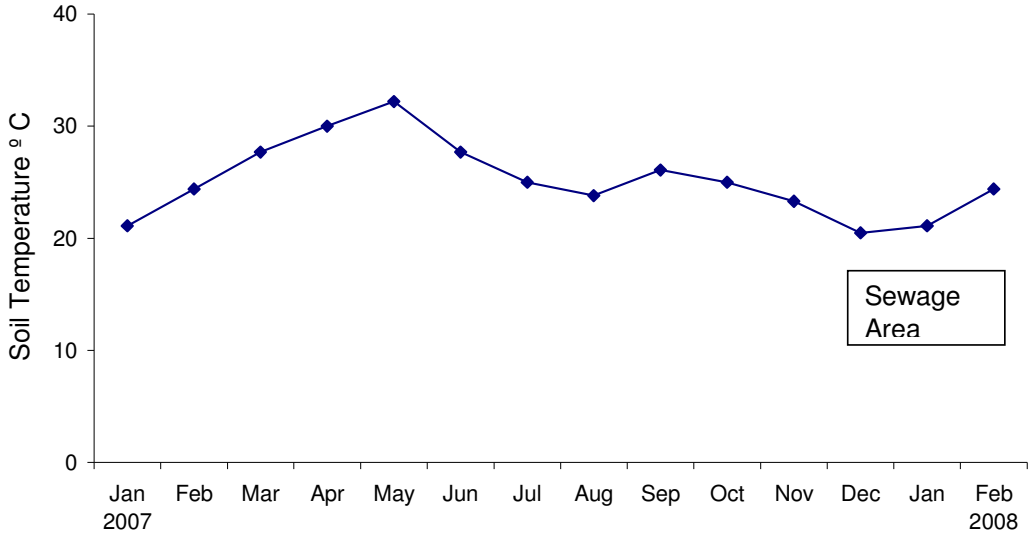

Figure 2. Monthly variation of soil temperature at sewage area during the study period

Conclusion

Present survey indicates the presence of three species of earthworm species belonging to two different families of Oligochaeta (Maniligastridae, Octochaetidae) in different habitats of the Nagole area of Hyderabad.The earthworm diversity is poor in Hyderabad maybe attributed to climatic conditions and soil texture in the area. During the investigation of the study in sewage only three species are found in Hyderabad. This showed that the soil layers and food availability in sewage are not suitable for propagation of earthworms.

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