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SEASONAL VARIATION IN DENSITY AND BIOMASS OF EARTHWORMS PERIONYX SANSIBARICUS MICHAELSON IN GARBAGE DUMPING SITE AT RANCHI, INDIA.

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Abstract :

Study on Seasonal variation in density, biomass and population growth rate of the earthworm *Perionyx Sansibaricus* in a garbage site revealed a peak density of 10,050/m^2 in August and lowest of 375/m^2 in June. Immatures dominated the population through out the year. Biomass of the earthworm varied from a minimum of 11.63g to a maximum 328.38 g dry wt./m^2. The rate of population growth reached a maximum value of +3.18 in July 2000 when environment was favourable. But it declined to -0.875 in June when environment was unfavourable in term of moisture and temperature.

Keywords *: Population, Ecology, Earthworms, Perionyx Sansibaricus, garbage*

MATERIALS AND METHODS:

Sampling Site :

The site was a wet organically rich garbage near Ranchi University Hostel, Morabadi Campus located between 25° 15'N latitude and 83° 20'E longitude at a height of 666m above mean sea level. The average physicochemical characteristics of garbage were as follows (Table 1)

Table-1- Physico chemical Characteristics of garbage site

Depth		-	8 ft
Temperature	(°c)	-	27°C
Moisture	(g%)	-	35
Carbon	(g%)	-	28.5
Nitrogen	(g%)	-	0.75

Earthworms were sampled and hand sorted once in a month from October 1999 to September 2000 from 0-20 cm depth following Dash and Patra (1972, 1977) and Ali et al (1973) from an area of 20 x 20 x 20cm during morning hour. Five samples were collected from each month.

On the basis of length and Clitellar development the individuals were divided in to 3 age classes (i) juvenile (<2cm, non clitellate), (ii) Immature (≥ 2cm < 4cm, non clitellate), and (iii) Adult (≥ 4cm, clitellate).

Five freshly collected worms of each size group were weighed separately after gut clearance and were kept in oven at 85° C for 24 hrs to obtain dry weight. Gut clearance of worms was made by keeping them immersed in distilled water (changed every 12hrs) in glass petri dishes for about 3-4 days.

Rate of Reproduction

The rate of reproduction was calculated following Sahu and Senapati (1988). The data on earthworm cocoon production in one of the important aspects in determining the reproductive strategy of earthworm. However, Sahu and Senapati (1988) have indicated the possibility of utilizing Juvenile : adult ratio in the absence of cocoon data giving reliable results

Rate of Population Growth :

Since *Perionyx sansibaricus* is a r-selection species it shows exponential growth which was calculated by the formula.

$$N_t = N_o e^{rt}$$

Where Nt = Population size after t time
No = Population size at the beginning
t = time interval
r = rate of population growth

RESULTS AND DISCUSSION.

Density & Biomass

The population density of earthworms varies considerably in different habitats and different geographical regions. Fundamentally the high and low population density depends upon habitat suitability and prevailing climatic conditions. Population density and biomass of *Perionyx sansibaricus* as shown in Table-2 reveals that the average monthly density was 3554/m^2 with a biomass of 130.21 g dry wt/m^2. Of the avarage monthly worm population the Juveniles, immatures and mature worms constituted 781/m^2 1971/m^2 802/m^2 respectively.

The density varied from 375 to 10,050/m^2 with a biomass of 11.63 to 328.38 g dry wt/m^2. A peak number of 10.050/m^2, recorded in the month of August 2000 where as a minimum of 375/m^2 was observed in the month of June 2000

The number of Juveniles during the study period varied from maximum of 2500/m^2 recorded in the month of July 2000 to a minimum of 75/m^2 in the month of May 2000. The number of immature worms ranged from 375 in June 2000 to 5900/m^2 in August 2000. The maximum number of mature worms was 1950m/^{2} in the month of July 2000 whereas a minimum of 150/m^2 was in April 2000. No earthworm population of Juveniles and mature worms were observed in the month of June 2000.

Population structure constituted 8.33 - 27.70% of Juveniles, 44.50-100% of immature and 16.21-31.89% of adults during the study period from October 1999 to September 2000.

The contribution of Juvenile worms to the total worm population was minimum being 8.33% in the month May 2000 and maximum being 27.7% in July 2000.In case of immature worms a minimum of 44.50% was observed in the month of October 99 and a maximum of 100% was present in June 2000. The mature worms had a maximum share of 31.89% of total population in November 1999 and a mimimum of 16.21% in April 2000.

The youngest age group i.e. juvenile forming the smallest component of the total pupulation indicate rapid transformation and/or high mortality and/or discontinuous reproduction resulting in an instability in the age structure.

Fig. 1. shows the rate of reproduction of *Perionyx sansibaricus* at the site which ranged between 0.428 and 1.282 recorded during the months of May 2000 and July 2000 respectively. The rate of reproduction of *Perionyx sansibaricus* was > 1 in the month of December 99, July 2000 and August 2000. The rate of reproduction was zero in the month of June 2000.

The rate of population growth (Fig.1) ranged between +3.180 to -0.085. The maximum value was obtained in the month of June 2000. Positive value of r was obtained during March, July and August 2000 and negative values were obtained during March,

July and August 2000 . The positive values indicate growth in population whereas the negative value indicated decline in population denstity.

DISCUSSION.

The present work was confined to garbage site and only the earthworm specis P. sansibaricus was found varying from 375/m^2 to 10.050/m^2. Sahu *et al.* (1988) while working on *Dichogaster bolaui* from upland grazed pasture receiving kitchen waste and dung deposit site receiving dung from nearby area reported minimum population of 8030/m^2 in pasture and 12617/m^2 in dung deposit site. The population density found by Sahu et al. (1988) was either very less or nil from November to June while during the present work a sizeable population was attained throughout the year probably because the area received rains every month during the study period. It appears that out of the two important environmental variables ,moisture and temperature wchih put pressure on population density, moisture was not a limiting factor during the present investigation. However, the higher peaks were found associated with high rainfall. Mishra and Dash (1984) reported that earthworm activity in Indian conditions is limited to rainly and post rainy season, but *Perionyx sansibaricus* in the present study was found throughout the year because of optimum moisture availability throughout the year at the garbage site. This particular characteristic of the species makes it suitable for vermicomposting. Dash (1999) has also mentioned *Perrionyx sansibaricus* as one of the important earthworm species found suitable for vermicomposting.

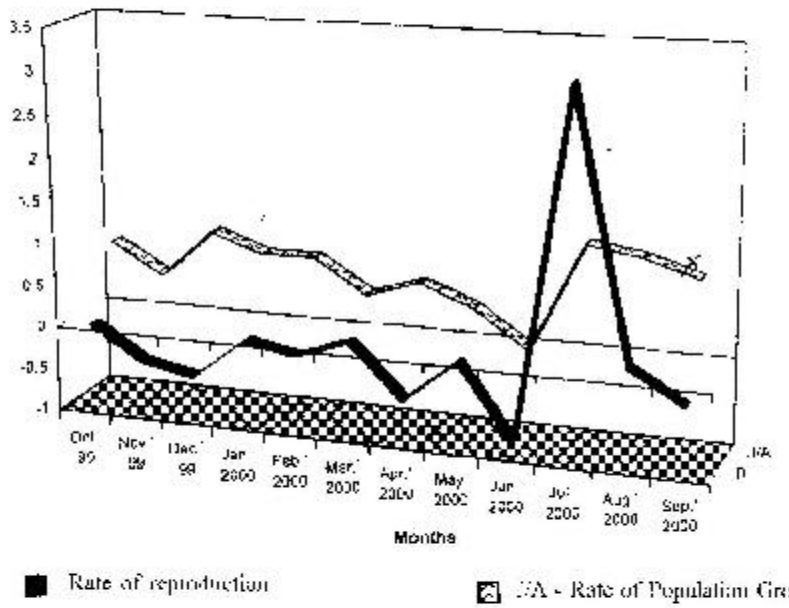
The biomass (live wt.) of *Perionyx sansibaricus* was observed to be 58.25-1647.08 g live wt/m^2 (Table-2) during the present study. The recorded biomass is considerably higher than that of the reports of Dash & Patra (1977), Lavelle (1978), and Senapati & Dash (1981) for tropical pasture. Sahu *et al.* (1988) reported a biomass of 0-66. 2g live wt/m^2 from a pasture receiving kitchen waste and in a dung deposit site respectively which was the highest biomass reported so far for *Dichogaster bolaui*. *Dichogaster bolaui* is a small epigeic species with high population density and high reproductive rate whereas *Perionyx sansibaricus* is a large species which occurred throughout the period of study without showing any stress. Further a rebuilding of population biomass was not observed which could probably resulted into very high biomass for the species during the present work. A population biomass of 0.86- 67 g live wt/m^2 and 0-183.33 g live wt/m^2 in control and 50% waste water irrigated plot respectively was reported by Mishra and Sahoo(1997).

As reported by Sahu et al. (1998) the ratio of total cocoons to adults and total juveniles to adults in all the sampling occasions did not show signficant difference indicating the use of Juvenile : adult ratio as an alternate method of calculating rate of reproduction in the absence of cocoon data which has been followed in the present work. The rate of reproduction showed a variation from 0.428 to 1.282. The rate of reproduction on the basis of alternative method (J/A) for *Dichogaster bolaui* at dung deposit site has been recorded as 2.18 during December and 2.95 during July by Sahu et al (1988). These two high rates signify bimodal peak pattern. In present study however a similar biomodal peak pattern has been observed. The probable duration for completion of life cycle of *P. sansibaricus* might be about 5-6 months at the garbage site. The expected duration that an individual is supposed to

Table 2. Population density (No/m^2) and Biomass (g dry wt/m^2) of *Perionyx sansibaricus*.

Months	Population density No/m^2			Total Worms	Total Biomass
	Juvenile worms	Immature worms	Mature worms	No/m^2	g dry wt/m^2
Oct.'99	1100	1925	1300	4325	158.18
Nov.'99	450	1525	925	2900	129.0
Dec.'99	450	850	425	1725	62.69
Jan.'2000	425	750	500	1675	68.67
Feb '2000	300	800	350	1450	62.33
Mar '2000	175	1025	375	1575	67.74
Apr.'2000	100	675	150	925	37.27
May.'2000	75	650	175	900	36.28
Jun.'2000	-	375	-	375	11.63
Jul '2000	2500	4575	1950	9025	323.01
Aug.'2000	2250	5900	1900	10,050	328.38
Sep.'2000	1550	4600	1575	7725	277.38

Fig. 1 Shows the population growth pattern *Perionyx Sansibaricus*.



live is known as life span. Since *P. sansibaricus* population reached zero level and showed annual colonization of worms, so the duration of the life cycle might be equal to the life span. This is under verification through laboratory culture experiments.

Environmental resistance causes negative impact through mortality on the growth of the population, hence higher the environmental resistance on the species lower is the population growth. After deducting the impact of environmental resistance from the rate of reproduction rate of *P. sansibaricus* population was always higher (Fig 1) except July where it is lower than the growth rate of the population probably because the environmental resistance is least in this month as discussed earlier. Two environmental variables namely temperature and moisture are most favourable during this month.

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