INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
08–042/AWB/2008/10–6–681–684
http://www.fspublishers.org

Full Length Article

Biodiversity of Earthworm Species from Various Habitats of District Narowal, Pakistan

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ABSTRACT

The burrowing activity and relative abundance of the earthworms in different localities viz., grassy land, river bank, forest plantation and cultivated land were studied from January 2005 to December 2005. A total mean number of 2458.59 earthworm specimens, with three replicates, were collected representing five families, 12 genera and 20 species. The Megascolecidae comprised 73.30, Lumbricidae 12.05, Moniligastridae 8.00, Naididae 3.35 and Tubificidae 3.23% of the total record. Three species of Megascolecidae viz. *Pheretima hawayana*, *Pheretima posthuma* and *Pheretima morrisi* were the most abundant and active at all sites during the month of July and August, whereas their activity was the lowest in May and June. The relative abundance was at peak in July but declined down to minimum in December. These findings exhibited great fluctuations in earthworm population over the months and warrant more research on their role to improve the soil for agriculture in the study area and elsewhere in Pakistan.

Key Words: Biodiversity; Earthworms; Habitats; Burrowing activity; Relative abundance; Pakistan

INTRODUCTION

Narowal is situated in the North East of the Punjab and comprises rich agricultural land. The pattern of the temperature and rainfall is spread over two seasons; Rabi and Kharif. The main crops of the area are wheat and rice. The soil is mostly loamy clay and loamy. Soil texture plays a crucial role in its water holding capacity. The same is true for various faunal species, which are important for adding the nutrients to the soil by the breakdown of organic matter and making it suitable for the agriculture. In this regard, earthworms are said to play a great role. The diversity of earthworm community is influenced by the characteristics of soil, climate and organic resources of the locality as well as history of land use. The species poor communities are characterized by extreme soil conditions such as low pH, poor fertility, low fertility litter or a high degree of soil disturbance (Edwards & Lofty, 1977). The most significant soil factors affecting the distribution of different species of earthworm are the C/N ratio, pH and contents of Al, Ca, Mg, organic matter, silt and coarse sand.

Biodiversity is not only an issue of curiosity, but also stands firm on the political agenda as a resource for humanity (Heywood, 1996). A number of biologists have confirmed and documented the biodiversity study of earthworms in various parts of the world (Tsai *et al*. 1999 & 2000; Blakemore, 2000, 2002, 2003; Chang & Chen, 2004, 2005a & b; Blakemore *et al*., 2006; Sautter *et al*., 2006). Earthworms are the moist soil dwelling creatures, which make up a large part of total biomass of invertebrates of soil and act as intermediate host for a number of parasites e.g., *Amoebotaenia cutmeata* and *Heterakis gallinarum* (Soulsby, 1982). Earthworms in the soil act as aerators, grinders, crushers, chemical degraders and biological stimulators (Edwards & Bohlan, 1996). Although, earthworms are well studied organisms all over the world, they are badly neglected creatures in Pakistan. A number of biologists have confirmed the importance of earthworms in soil fertility (Nijhawan & Kanwar, 1952; Mc & Kevan, 1955; Edwards & Lofty, 1977). Bhatti (1962); Ghafoor (2003); Ghafoor *et al.* (1988; 1989); Ghafoor and Qureshi (1999) have listed the fauna of a few localities in Pakistan.

The main objective of the present research was to gain a piece of scientific information about kind of earthworms, their relative abundance, seasonal fluctuations of population and burrowing activity in different habitats of District Narowal. Such information could be used to suggest measures for the improvement of soil to increase agricultural production.

MATERIALS AND METHODS

For the collection of earthworms, various fields in the cropland of Narowal were sampled at regular interval of time from January 2005 to December 2005. The samples were taken fortnightly in triplicate. A tin quadrangle covering a space of 0.46 m square up to the depth of 0.76 m in the soil was used for each sample. In each field, four

To cite this paper: Ghafoor, A., M. Hassan and Z.H. Alvi, 2008. Biodiversity of earthworm species from various habitats of district Narowal, Pakistan. *Int. J. Agri. Biol.*, 10: 681–4

quadrangles were installed in a row with a distance of 0.91 m. To exploit the maximum expulsion of earthworms, different solutions such as aqueous solution of potassium permanganate, formaline and simple water were sprayed on the soils of the quadrangles. After an interval ranging from 60-100 min., soil dug by a hoe was sorted out for the earthworms. After anesthetizing in 10% alcohol for 20-60 sec., the specimens were washed with tap water and kept in 10% formaline for 24 h. Then these specimens were permanently kept in 5% formalin solution.

A total mean number of 2458.59 earthworms specimens (with three replicates) were collected from various habitats viz., grassy land, river bank, forest plantation and cultivated land of District Narowal. The specimens dug out were preserved following Stephenson (1923). The samples were initially placed in weak spirit for about an hour. Then, they were hardened by keeping them in 10% formalin. The specimens were identified by using keys, diagrams and description provided by Stephenson (1923) and Bhatti (1962). Mean and standard deviation of number of earthworms belonging to different families (with three replicates) were statistically calculated.

RESULTS

A total mean number of 2458.59 earthworm specimens were collected from all four localities during the study period, representing five families, 12 genera, 20 species of earthworms. The biodiversity and distribution pattern of earthworms at the ground level were determined. Out of total specimens recorded Megascolecidae accounted for 73.30%, which were the most active earthworms. The species belonging to this family were *Pheretima hawayana, P. posthuma, P. minima, P. morssi* and *P. diffringens.* The moderately active earthworms of the families Lumbricidae 12.05% and Moniligastridae comprised 8% (Table I).

The earthworms belonging to these families were *Helodrilus foetidus*, *Lumbricus rubillus* and *Drawida pullucida.* Slow moving earthworms belonged to the families Naididae and Tubificidae (Fig. 1). At all four sites, three Megascolecidae species were *P. hawayana*, *P. posthuma* and *P. morrisi*. All predominant species were more active during July-August. The number of the earthworms was found to be at peak during the rainy season July-September (Table II). Moderately active earthworms were observed during autumn and spring season and then a sudden decline was found from November onwards to a low density in December-January (Fig. 2).

DISCUSSION

Several authors have discussed the usefulness and deficiencies concerning interpretation of digging out data of earthworms for the estimation of species abundance and species richness. Stephenson (1923), Raw (1959) and Lewis and Taylor (1979) opinioned that digging method is only suitable means for sampling of earthworms and appears to be the best available method at present. In the present investigation, the peak in relative abundance, species richness and species diversity of earthworms during July-

Table I. Number (Mean ± SD) of families, genera, species, number of earthworm specimens and their percentages

S. No.	Families of Earthworms	Number of specimen	Percentage	Number of Genera	Number of species
1	Megascolecidae	1802.20± 6.10	73.30	5.10±0.25	8.25±0.60
2	Lumbricidae	296.25±7.15	12.05	3.12±0.02	5.31±0.14
3	Moniligastridae	198.50±6.20	08.00	2.06±0.01	4.22±0.12
4	Naididae	82.28±7.20	03.35	1.01±0.01	2.01±0.02
5	Tubificidae	79.36±4.25	03.23	1.01±0.01	2.03±0.01
6	Total	2458.59	12.30	12.30	21.82

SD: Standard deviation

Table II. Number (Mean ± SD*) of earthworm specimens (with three replicates) belonging to different species and genera collected during January through December from various habitats of District Narowal

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1]*P. hawayana*	3.01±0.25	16. ±1.25	39.1±3.10	52.25±2.50	75.30±3.42	99.25±5.10	114.2 ±8.20	123.28±9.33	107.60±8.22	69.41±4.50	33.30±2.10	9.21±0.50
P. posthuma	2.00±0.12	13. ±1.24	19.1±1.75	33.21±2.10	41.11±3.11	52.26±3.80	79.24±4.70	83.21±5.60	67.40±3.50	36.25±2.12	23.20±1.61	4.11±0.25
P. minima	2.00±0.13	9.01±0.60	17.21±1.10	19.12±1.11	27.12±2.10	33.14±2.70	46.1±3.10	57.13±2.7	38.30±3.01	21.20±1.25	10.21 0.25	3.01±0.20
P .morrisi	1.00±0.01	3.02±0.20	5.0±0.50	7.01±0.70	13.13±1.10	16.10±1.20	27.1±1.70	39.15±2.10	24.21±1.70	16.20±1.11	5.23±0.70	2.01±0.60
P. diffringens	-	1.01±0.10	3.0±0.06	5.01±0.70	159. ±0.81	18.12±1.12	27.2±2.10	33.12±2.70	26.15±2.40	9.16±0.60	1.01±0.02	-
Helodrilus foetidus	-	1.01±0.09	2.0±0.10	4.21±0.20	9.10 ±0.80	13.01±0.09	18.2±0.99	30.10±1.21	14.10±1.11	3.10±0.08	1.01±0.01	-
Lumbricus rubillus	-	1.00±0.02	2.0±0.04	3.01±0.10	8.11±0.25	11.10±1.01	13.1±0.81	25.11±1.00	911 ±0.88	4.10±0.20	1.01±0.01	-
Drawida pellucida	-	-	-	2.01±0.25	5.10 ±0.31	7.10±0.61	11.0±1.00	24.20±1.25	1012 ±0.62	3.11±0.23	-	-
Rest of species	5.02±0.20	13.12±0.5	21.1±0.91	35.23±1.11	47.70 ±2.10	58.29±2.25	63.1 ±2.50	78.30±3.11	55.33 ±2.50	31.10±1.25	19.00±1.11	8.13±0.60

Mean ± standard deviation
P: Pheretima

Fig. 1. Richness of earthworm families in Narowal soil

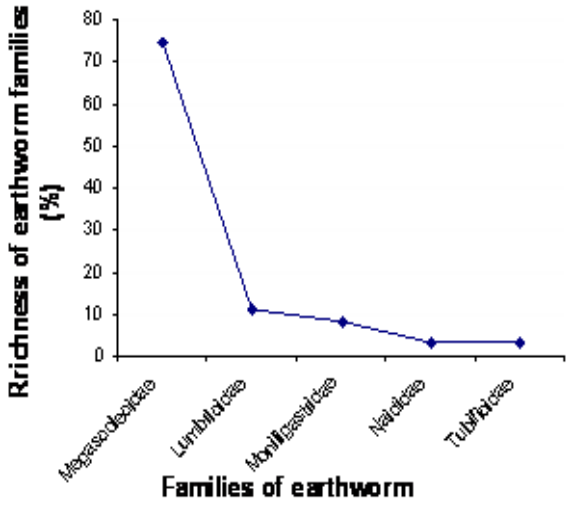
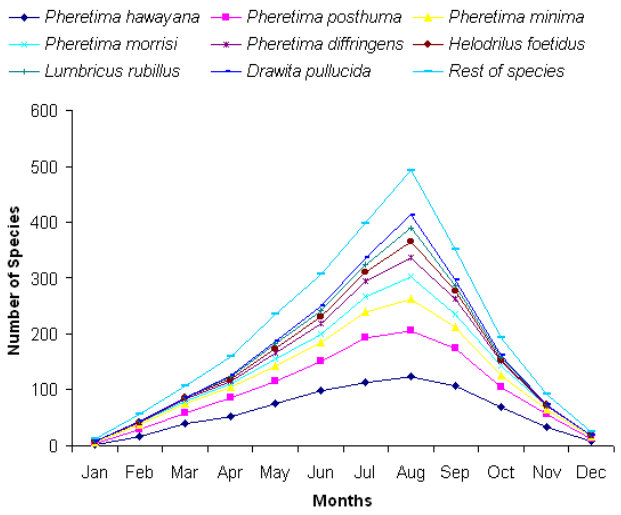


Fig 2. Changes in species diversity of earthworms collected from district Narowal during different months



August support the hypothesis that the more productive habitats can support more species (Pianka, 1974). Auerswald *et al*. (1996) reported that many soil properties influence the earthworm population and activity. Mannan *et al.* (1994) described the effect of different environmental factors and vegetation on abundance, morphometry and distribution of *P. posthuma.* It was found that the season, soil type, moisture contents, day time temperature and vegetation and significantly affected population density of the earthworm.

In the present study, different soil types of habitats and temperature of the months (July-August) affected significantly ($P<0.05$) on the biodiversity and activity of the earthworms. The present findings uphold the results of the above mentioned researchers. The coexistence of more species during July-August is due to the availability of surplus organic and inorganic food and reduced micro-climate changes during these months. Similar studies, but from different habitats of District Sargodah, six species were identified (Mumtaz, 2000). The effect of moisture on the abundance of earthworms species was also studied (Kretzschmar & Bruchous, 1991) and the temperature and the moisture effect were also noted by Edwards and Bohlan (1996); Chang and Chen, (2004, 2005a & b), Blakemore *et al*. (2006) and Sautter *et al*. (2006).

In conclusion, *Pheretima* earthworms were the most abundant and active species in different habitats of District Narowal during July-August. So, further research is imperative to ascertain and develop the technique to exploit these earthworm species in the improvement of soil to increase agricultural production.

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(Received 20 May 2008; Accepted 23 July 2008)