Biodiversity of Earthworm Resources in Gangetic Plain of Uttar Pradesh, India

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ABSTRACT.— Based on an extensive survey of Gangetic Plain of Uttar Pradesh during August – October 2008, the communication reports 11 taxa of earthworms, namely, Eutyphoeus incommodus, E. orientalis, E. pharipingianus, E. waltoni, Lampito mauritii, Metaphire anomala, M. birmanica, M. posthuma, Pellogaster bengalensis, Perionyx sansibaricus, Polychperetima elongata belonging to 6 genera and 2 families that were commonly found in the study area. This constitutes 2.6 per cent of total Indian earthworm fauna. Of these, 4 taxa are exotic with extra-Indian origin. Collection and environmental information on each occurrence of a species are given. The study contributes first-hand material on earthworm fauna of the study area, thus far neglected, and likely to add more native species to the existing ones, which are very specific for vermicomposting processes.

KEY WORDS: biodiversity, earthworm, agro-climatic zones, Gangetic Plain, India

INTRODUCTION

Earthworms (folk names, include dew-worm, rain worms, night crawler, angle worm, and Kechua, Giduala, in Uttar Pradesh) are important biological resources that have a tremendous potential in agro-ecosystems because they significantly affect soil physical structures and organic matter dynamics, and promote plant growth (Lee, 1985; Lavelle et al., 1988). India is a diverse country harbouring a very high diversity of earthworms, mostly concentrated in Western Ghats and Eastern Himalayas both of which are recognized as biodiversity ‘hot spots’. Although this area is only 2% of the world’s land mass, it supports about 105 per cent of the total known global earthworm diversity, estimated at 4000 species.

The Indian earthworm fauna is predominantly composed of native species, which constitute about 89% of total earthworm diversity in the country (Julka and Paliwal, 2005). Forests in India have been cleared on a large scale primarily for agricultural practices, construction and other developmental activities. Changes in land use pattern have directly affected the composition and population structure of earthworm communities in different agro-climatic regions of the country (Blanchart and Julka, 1997; Behera et al., 1999; Bhadauria et al., 2000). Native species are threatened because of rapid and extensive destruction of their natural habitats.

During the last few decades, the earthworms of the Indian subregion have been studied to some extent, such as the Eastern Himalayas (Julka, 1975a, 1976a, 1977, 1981); Khasi and Garo hills (Julka, 1977); Orissa (Julka, 1976b, 1978); South India (Jamieson, 1977); Eastern Himalayas (Julka and Rao, 1982); Western Himalayas (Julka, 1979; Halder, 1980); Andaman and Nicobar Islands (Julka and Halder, 1975a; Sotta and Halder, 1980). However, the Gangetic Plains of Uttar Pradesh have been more or less neglected as compared to other
parts of the country. Further, earthworms have gained renewed scientific attention in India and abroad because of their wide application in the production of vermicompost, and as sources of animal protein for domesticated animals. However, out of 418 species of earthworms known from the country (Julka and Paliwal, 2005) only half a dozen are frequently used for vermiculture and vermicomposting. Therefore, there is an urgent need to undertake extensive survey of earthworms in such unexplored areas with a view to (i) study their biodiversity; (ii) search for more native species which may be used for vermicomposting; (iii) contributing material for preparation of an earthworm inventory of the study area and; (iv) suggest measures for their conservation and protection, particularly the species which are either threatened or on the verge of extinction. The present attempt, therefore, is to provide a preliminary inventory of the contemporary earthworm fauna of the study area.

The Indo-Gangetic Alluvial plains (IGP) is among the most extensive fluvial plains of the world and cover several states of the northern, central and eastern part of India. The IGP occupies total area of approximately 43.7 m hectare and represent eight agro-ecological regions (AER) and 14 agro-ecological subregions. The area of the IGP is nearly 13% of the total geographical area of the country (Pal et al., 2009).

The Gangetic Plain of Uttar Pradesh from which data were derived is situated between 23° 52’ and 31° 28’ N latitudes and 77° 3’ and 84° 39’ E longitudes (Fig.1) are highly fertile with alluvial soils having flat topography broken by numerous ponds, lakes and rivers slopes. Climate of the area is tropical with wide variation because of dissimilarity in altitudes ranging from 200 to 550 metre. The minimum and maximum temperature ranges from 3°c to 4°c and 43°c.

**FIGURE 1.** Study area: Gangetic Plain of U.P., India.
to 45°C for the months of January and May respectively, with mean annual rainfall 120-160 cm falling mostly in the monsoon season from June to September. The area is bound in the west by the Indus river and on the south by the Vindhya mountain range. The vegetation of area is mainly dry deciduous (Khan, 2002; Kumar et al., 2002). The preferential habitat types from which collections were made included grasslands (grazed and ungrazed), mixed forests, river banks, dung heap, orchards and cultivated fields in the plots located in 236, 286 square kilometers of study area.

**MATERIALS AND METHODS**

In the course of fieldwork, the authors visited different districts encompassing the various agro-climatic zones of the study area viz, South Western semidry region, Western plain, Mid Western, Mid region, Eastern region, Vidarv, North east, Tarai, and Bundelkhand region of the study area during August – October 2008 (Table 1). **Earthworm sampling.**— Earthworm for taxonomic studies were collected by the digging and hand sorting method. Samples were taken from diverse ecological niches of the study area.

The methodology adopted for earthworm collection was based on Julka (1988). Collected worms were washed in fresh water and stored in test tubes in the field. Ethyl alcohol was gradually added to the test tube and then transferred to the dish containing a solution of 5% formalin for fixation and kept for a period 6-8 hrs, followed by their preservation in 70% ethyl alcohol or 5% formalin. All specimens were serially numbered and necessary field data such as habitat, locality, soil texture, colour and occurrence recorded.

Earthworms were identified with the help of monographs and other available literature on the subject (Stephenson, 1923; Gates, 1972; Julka, 1988) at the Vermiculture Research Station (VRS), D.S. College, Aligarh and later confirmed by experts at Zoological Survey of India, Kolkata. Voucher specimens of all specimens

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**TABLE 1.** Survey record of Earthworm biodiversity in Gangetic Plain of U.P.

<table>
<thead>
<tr>
<th>Date(s) of survey</th>
<th>Zone</th>
<th>Collection no.</th>
<th>Districts covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.08.08 to 25.08.08</td>
<td>South-western semidry region</td>
<td>D/01 to D/42</td>
<td>Agra, Etah, Mathura</td>
</tr>
<tr>
<td>21.08.08 to 03.09.08</td>
<td>Western plain</td>
<td>B/43 to B/57</td>
<td>Bulandshahar, Hapur, Meerut</td>
</tr>
<tr>
<td>03.09.08 to 04.09.08</td>
<td>Mid western</td>
<td>E/58 to E/72</td>
<td>Badaun, Bareilly, Moradabad</td>
</tr>
<tr>
<td>08.09.08 to 10.09.08</td>
<td>Mid region</td>
<td>C/73 to C/87</td>
<td>Kanpur, Lucknow, Unnao</td>
</tr>
<tr>
<td>09.09.08 to 12.09.08</td>
<td>Eastern region</td>
<td>H/88 to H/102</td>
<td>Azamgarh, jaunpur, Varanasi</td>
</tr>
<tr>
<td>10.09.08 to 19.09.08</td>
<td>Vidarv</td>
<td>I/103 to I/117</td>
<td>Chandoli, Mirzapur, Sonbhadra</td>
</tr>
<tr>
<td>18.09.08 to 21.09.08</td>
<td>North east</td>
<td>G/18 to G/132</td>
<td>Basti, Gorakhpur, Santkabirnagar</td>
</tr>
<tr>
<td>14.10.08 to 16.10.08</td>
<td>Tarai</td>
<td>A/133 to A/147</td>
<td>Lakheempur kheri, Pilibhit, Rampur</td>
</tr>
<tr>
<td>16.10.08 to 18.10.08</td>
<td>Bundelkhand region</td>
<td>F/148 to F/162</td>
<td>Banda, Chitrakut, Jhansi</td>
</tr>
</tbody>
</table>
examined and reported in the present work are deposited in the Museum of VRS, for future reference and study.

Analysis of soil samples. – Soil samples collected from various study sites were analyzed for soil texture by international pipette method (Piper, 1966), moisture by oven drying method (Santhanam et al. 1989), pH by digital meter (Misra, 1968), and total organic matter by Walkley and Black’s method (1934) and the data is presented in Table 2.

Systematic enumeration. – Adverting shortly to the presentation of data, the earthworm species collected from the study area are arranged in alphabetical order. Each entry gives the information (in a format): earthworm’s scientific name, family, distribution, locality and voucher specimen number, date of collection, general habitat etc.

1) *Eutyphoeus incommodus*; Octochaetidae


*Date of collection*: 18.08.08 to 17.10.08.

*General habitat*: Grassland (unglazed), cultivated land (paddy crop).

2) *Eutyphoeus orientalis*; Octochaetidae

*Locality and collection no.*: Santkabirnagar G/124.

*Date of collection*: 19.09.08.

*General habitat*: Grassland (ungrazed).

3) *Eutyphoeus pharpingianus*; Octochaetidae

*Locality and collection no.*: Bulandshahr: B/46; Hapur: B/49, B/50, B/52; Meerut: B/53, B/56; Kanpur: C/75, C/77; Unnav: C/80; Aligarh: D/04; Etah D/14; Badaun: E/65, E/67; Bareilly: E/72; Gorakhpur: G/128; Santkabirnagar: G/123, G/125; Varanasi: H/88, H/89, H/91; Jaunpur: H/95, H/96; Azamgarh:
4) *Eutyphoeus waltoni*; Octochaetidae  
*Locality and collection no.*: Santkabirnagar G/127.  
*Date of collection*: 19.09.08.  
*General habitat*: River bank.

5) *Lampito mauritii*; Megascolecidae  
*Locality and collection no.*: Pilibhit: A/135; Lakhimpurkheri: A/138, A/140, A/142; Bulandsahar: B/43 to B/46, B/51; Kanpur: C/74; Unnav: C/78 to C/81; Lucknow: C/183; Aligarh: D/02, D/03, D/21, D/23, D/24, D/38, D/39, D/42; Agra: D/33, D/34, D/36, D/37; Etah: D/07, D/08; Mathura: D/20, D/21, D/23, D/24; Moradabad: E/58, E/59, E/61; Badaun: E/67; Bareilly: E/68, E/70; Basti: G/120; Jhansi: F/149, F/150, F/152; Banda: F/153 to F/156; Chitrakut: F/155, F/159 to F/162; Basti: G/120 to G/122; Sant kabirnagar: G/126, G/127; Gorakhpur: G/128, G/130 to G/132; Mirzapur: I/104, I/106; Sonbhadra: I/108, I/109, I/110, I/112; Chandoli: I/113, I/115, I/117.  
*Date of collection*: 18.08.08 to 18.10.08.  
*General Habitat*: Garden (ungrazed), cultivated land, river bank.

6) *Metaphire anomala*; Megascolecidae  
*Locality and collection no.*: Bulandshahr B/43.  
*Date of collection*: 21.08.08.  
*General habitat*: Cultivated land.

7) *Metaphire birmanica*; Megascolecidae  
*Locality and collection no.*: Jaunpur: H/96.  
*Date of Collection*: 11.09.08.  
*General habitat*: River bank.

8) *Metaphire posthuma*; Megascolecidae  
*Date of collection*: 18.08.08 to 18.10.08.  
*General Habitat*: Garden (ungrazed), cultivated land, river bank.

9) *Pellogaster bengalensis*; Octochaetidae  
*Date of collection*: 20.08.08 to 10.09.08.  
*General habitat*: Grassland (ungrazed), cultivated land (paddy crop), river bank.

10) *Perionyx sansibaricus*; Megascolecidae  
*Date of collection*: 20.08.08 to 10.09.08.  
*General habitat*: Grassland (ungrazed), cultivated land.

11) *Polypheretima elongata*; Megascolecidae
**RESULT AND DISCUSSION**

Of the 236 field samples of earthworms collected and identified from certain districts of Uttar Pradesh (Fig.1), encompassing various agro-climatic zones of the Gangetic Plain of India, the present study has brought to light 11 species including 4 exotics with extra-Indian origins. It has been observed that *Metaphire posthuma* is a predominant species with wide distribution within the study area.

In recent years, the diversity of Indian earthworms has been mainly studied by Julka (1988). He revised the Indian members of the family Octochaetidae in the publication ‘Fauna of India’ providing illustrated descriptions of 154 taxa including 6 new genera and 16 new species. The knowledge on the earthworm fauna of India has also been enriched by Julka and Senapati (1987), Senapati et al. (1990), Julka and Paliwal (1994), Paliwal and Julka (2005). However, a close review of literature on the study of earthworms in U.P. indicates that the first report appeared in 1912. Subsequently many workers contributed to the study until 1988. Thereafter, the taxonomical studies in the region have been more or less neglected between 1989-2009 except for few fragmentary reports (Table 3). The present work, therefore, is a humble attempt in this direction and contributes to update our contemporary knowledge on the biodiversity of earthworms resources in the study area. Further, collection of an epigeic species *Eutyphoeus pharpingianus* from dung heap in this survey is a significant contribution. This species could be potentially useful in the vermicomposting and investigations in this direction are under progress.

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**LITERATURE CITED**


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