Taxonomical Studies on Earthworm *species* of Agra Region (Uttar Pradesh)

Gunjan Singh

Abstract: Earthworm are very important organisms of soil they are called friends of the farmer. They are important environmentally and economically so that their identification and classification is very essential. Taxonomy aims to classify organisms based on their similarities and differences. The present study was carried out during 2008 and 2010 in south-western semi dry region of Uttar Pradesh, focusing on identification and classification of local species of earthworm. The earthworm were collected and preserved and then carefully examined in the laboratory. The earthworms identified are belonging to 7 species of 2 Families, Family Octochaetidae species Eutyphoeus orientalis Beddard, Eutyphoeus waltoni Michaelsen, Eutyphoeus incommodus Beddard Family Megascoelidae species Metaphire posthuma vaillant, Mataphire anomola Michaelsen, Lampito mauritii kingberg, Polypheretima elongata kinberg

Keywords: Earthworm diversity, soil analysis, earthworm sampling, earthworm identification, earthworm species of Agra region, (Uttar Pradesh).

1. Introduction

Comprehensive taxonomic and distributional survey of Oligochaetes, particularly the Indian earthworms was done by Stephenson (1923) and published under the title *Fauna of British India series*. Later, this work became obsolete due to nomenclatural changes and discovery of new taxonomic characters. Julka (1988) filled this gap in taxonomic and distributional studies and reviewed the publications of Gates (1937) and others of Earthworms. Presently, Julka's publication titled "Indian Earthworms" is taken as the most recent and scientifically acceptable work on taxonomy of Indian earthworm. Some biological studies of Indian earthworms (Dutt, 1948; Joshi et al., 2000; Nijahwan and Kanwar, 1952; Kambata and Bhatt, 1957, Bhatt et al., 1960) dealt with earthworms role in soil aggregation, effect on soil fertility and their association with micro flora.

India is diverse country harbouring a very high diversity of earthworms. The land area of India is only 2% of world's total land mass but it supports 10.5% of total known global earthworm diversity. The Indian earthworm fauna is predominantly represented by native species which constitute about 89% of total earthworm diversity in the country (Julka and Paliwal, 2005). Julka (1988) described nine families comprising 53 genera and more than 400 species from India. The Family Octochaetidae with 26 genera is more commonly found in Indian ecosystem.

Earthworm resources of India are known particularly from Himalayan, Indo - Gangatic and Deccan peninsula (Julka, 1988). The Deccan peninsula is rich in earthworm fauna and harbours many epigeic and anecic species such as *Dichogaster bolai*, *Dawida willsi*, *Perionyx excavatus*, *P. sansibaricus*, *Lampito mauritii*, *Pellogaster bengaensis* and other species, which have great potentiality for use in vermitechnology (Dash and Senapati, 1985; Dash, 1999). The north - east and Himalayan regions are also rich in many endemic and few exotic species of earthworms (Bhadauria and Rama Krishnan, 1989; Bhadauria et al., 2000; Sinha et al., 2003). However, through human transports, many exotic species have been imported from many other regions of the worlds, especially from Europe, Africa and America and some groups have been distributed worldwide (Jamieson, 1978; Reynolds and Cook, 1976).

Besides Deccan peninsula and Himalayan regions, the Indo-Gangatic plain is also rich in earthworm fauna, especially the endemic species of *Eutyphoeus* in alluvial soils.

Verma et al (2010) surveyed Gangetic plane of Uttar Pradesh, India during August to October 2008, and collected 11 taxa of earthworms belonging to 6 genera and two families. This constitutes 26.3 % of total Indian earthworm fauna. Of these, 4 taxa are exotic with extra Indian origin. Based on survey of earthworms in Doon valley of Western Himalayan region conducted by Verma and Shweta (2011) in September 2009 to 2012 enlists species belonging to 7 genera and 4 families.

Based on this rationale, the present study has been undertaken in certain selected districts of Agra region of U. P (India) with a view to (i) study earthworm biodiversity in the study area; (ii) search for more native species which are very specific and could be used for vermicomposting; (iii) contribute material for preparation of earthworms inventory of the study area; (iv) suggest measures for their conservation and protection, particularly those species which are on the verge of extinction.

The present attempt, therefore, is to scientifically update investigation, identification and documentation of contemporary earthworm fauna of the study area with special reference to search for native vermicomposting species.

India is well reported as compared to other Asian Countries (excluding Myanmar). Presently, 418 valid species / subspecies of earthworms under 69 genera are known from the Indian territory, including the islands of Andaman, Nicobar and Lakshadweep have reported 9 families (as per Brinkhurst and Jamieson's classification of Oligochaeta, and Gates classification of Megascolecidae), Endemism, both at genera and species level, is very high: about 71% of genera and 89% species are endemic. Some exotic peregrine species of earthworms are also found and these are now widespread in disturbed habitats following deforestation and intensive cultivation practices.

2. Material and Methods

<table>
<thead>
<tr>
<th>Date (s) of survey</th>
<th>Location Covered</th>
<th>Altitude</th>
<th>Latitude</th>
<th>Longitudity</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 - 08 - 08 to 20 - 08 - 08</td>
<td>Aligarh</td>
<td>42</td>
<td>25° 57' N</td>
<td>76° 5' E</td>
</tr>
<tr>
<td>20 - 08 - 08 to 22 - 08 - 08</td>
<td>Mathura</td>
<td>287</td>
<td>27° 41' N</td>
<td>77° 6' E</td>
</tr>
<tr>
<td>23 - 08 - 08 to 25 - 08 - 08</td>
<td>Etah</td>
<td>557</td>
<td>27° 58' N</td>
<td>74° 4' E</td>
</tr>
<tr>
<td>26 - 08 - 08 to 28 - 08 - 08</td>
<td>Agra</td>
<td>169</td>
<td>35° 4' N</td>
<td>78° 2' E</td>
</tr>
</tbody>
</table>

**Earthworm Sampling:**

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 of 6 - 8 hrs, followed by their preservation in the 70% ethyl alcohol or 5% formalin. All specimens were serially numbered. 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 at Zoological Survey of India, Kolkata. Voucher specimens examined and reported in the present work are deposited in the Museum of VRS, for future reference and study.

**Analysis of soil sample:**

<table>
<thead>
<tr>
<th>Family and Earthworm species</th>
<th>Soil Temperature</th>
<th>Soil Moisture (%)</th>
<th>Soil pH</th>
<th>Soil Organic Carbon (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Octochaetidae</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eutyphoeus orientalis</td>
<td>26.75 ± 0.48</td>
<td>23.5 ± 4.0</td>
<td>7.45 ± 0.002</td>
<td>0.97 ± 0.002</td>
</tr>
<tr>
<td>Eutyphoeus walloni</td>
<td>26.08 ± 0.10</td>
<td>20.5 ± 5.0</td>
<td>7.48 ± 0.005</td>
<td>0.54 ± 0.002</td>
</tr>
<tr>
<td>Eutyphoeus incommodus</td>
<td>25.95 ± 0.33</td>
<td>24.5 ± 5.0</td>
<td>7.38 ± 0.005</td>
<td>1.04 ± 0.004</td>
</tr>
<tr>
<td>Megascolecidae</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metaphire posthuma</td>
<td>25.33 ± 0.20</td>
<td>25.5 ± 5.0</td>
<td>7.59 ± 0.005</td>
<td>0.25 ± 0.007</td>
</tr>
<tr>
<td>Metaphire anomala</td>
<td>25.02 ± 0.08</td>
<td>23.5 ± 5.0</td>
<td>7.48 ± 0.005</td>
<td>0.25 ± 0.005</td>
</tr>
<tr>
<td>Lampros mauritii</td>
<td>25.67 ± 0.08</td>
<td>27.7 ± 5.0</td>
<td>7.79 ± 0.002</td>
<td>0.65 ± 0.005</td>
</tr>
<tr>
<td>Polypheretima elongata</td>
<td>24.67 ± 0.05</td>
<td>28.0 ± 6.0</td>
<td>7.38 ± 0.004</td>
<td>0.54 ± 0.004</td>
</tr>
</tbody>
</table>

**Study Site**

South western semidry region (district: Agra, Aligarh, Etah, Mathura) in Indo - genetic plain is among the most extensive fluvial plains of the world and cover several state of northern, central and eastern part of India.

The study area is situated between 27°9’2” N latitude and 77°57’39” E longitude, 169 meter altitude, highly fertile with alluvial soil affected by salts, having flat topography broken by numerous ponds, lakes, rivers like Ganga, Yamuna. The minimum and maximum temperature range from 01° C to 47° C for the month of January to May respectively, with an annual rainfall 662 mm. The vegetation is tropical dry and dry deciduous type.

**Soil samples collected from various study sites were analysed for soil colour (Biswas and Narayan sami 1998), pH (Biswas and Narayan sami 1998), soil moisture (Santhanam at el., 1989), total organic carbon (Hesse, 1971), nitrogen (Black and Neely, 1975), phosphorous (Jackson, 1967).**

3. Results

**Soil Analysis:**

Results of the soil analysis show, the pH ranges from 7.45 ± 0.005. Colour may be brown, light brown, deep brown or olive brown. Soil moisture ranges from 20.5 ± 6.0. Total organic carbon ranges from 0.25 ± 0.07. Nitrogen ranges from 0.057 ± 0.01. Phosphorous ranges from 0.20 ± 0.019. The details are shown in table (1.1)

Identification Earthworms:

The earthworms found in all sites belong to two families. Family octochaetidae species Eutyphoeus orientalis Beddard, Eutyphoeus walloni Michaelsen, Eutyphoeus incommodus Beddard Family Megascolecidae species Metaphire posthuma vaillant, Metaphire anomola Michaelsen, Lampito mauritii kingberg, Polypheretima elongata kinberg.

Family: Octochaetidae

**Distinguish feature:** Body cylindrical, dorsal pores present, male pore in front of Clitellum, occupied xvi - xvii segments spermathecal pores present, terrestrial in habitat, arrangement of setae - Lumbrine (8 setae in each segment in 4 pairs) and prostate gland tubular.

**Distribution:** Africa, Australia, India and Burma.
Earthworm species collected from the study area:
1) Eutyphoeus orientalis Beddard
2) Eutyphoeus waltoni Michaelsen
3) Eutyphoeus incommodus Beddard

Eutyphoeus orientalis Beddard (Fig.1.1)
Origin: Native of India
Body length: 70 mm - 120 mm
Body segments: 130 - 111
Prostomium: Combined Pro / tanylobic; Mouth Fleshy lobe like circular structure.
Setae: Lumbricine arrangement (8 setae / segment in 4 pairs; widely paired)
Clitellum: Saddle shape; located ½xiii - xvi segments.
Male pore: xvi segment; discharge into the body surface through circular aperture.

Female pore: xiii segment; single.
Genital markings: xiv / xv segment; xvii / xviii segment. in pairs.
Spermathecal: vii / viii segment; with median diverticula.
Dorsal pore: Present
Prostate gland: Tubular type; with vasa differentia.
Collection & Locality: G/124, Fort Agra
Zone: North - east
Date (s) of collection: 19 - 09 - 2008
General habitat: Grassland (ungrazed).

Eutyphoeus waltoni Michaelsen (Fig.1.2)
Origin: Native of India
Body length: 60 mm - 140 mm
Body segments: 125 - 130
Prostomium: Prolobic, fleshy lobe like circular structure mouth closed.
Setae: Widely paired (8 setae / segment in 4 pairs) Lumbricine arrangement.
Clitellum: Saddle shaped; located in xiii - xvi segments.
Male pore: Located in xvi segment; male pores discharge into deep, paired opening on the body surface, through circular aperture.
Female pore: Located xiii segment; single on the left side.
Genital markings: xiii / xiv and xvi segment; in paired.

Spermathecal: vii / viii / ix segment; bound together with connective tissue.
Dorsal pore: Present
Prostate gland: Tubular type; with vasa deferentia and prostatic duct.
Zone: North - east
Collection & Locality: G/127, Park Agra
Date (s) of collection: 19 - 09 - 2008
General habitat: River Bank.

Eutyphoeus incommodus Beddard (Fig.1.3)
Origin: Exotic
Body length: 32 mm - 53 mm
Body segments: 87 - 117 Segments
Prostomium: Open epilobic type; tongue outside from mouth.
Setae: Closely paired; lumbricine arrangement, 8 setae per segment in 4 pairs.
Clitellum: Saddle shaped; 7mm, in length cupied xiii to xvi segment.
Male pore: xvi segment; discharge on to body surface.
Female pore: xiii segment; median in location.
Genital markings: xiv to xvi and xvii segment; paired.
Spermathecal: vi / vii intersegment; one pair spermatheca, each with 2 median shortly stalked diverticula in the form of circle of 4 opening into short duct.
Dorsal pore: Present
Prostate gland: One pair, tubular type, with vasa differentia and prostate duct.
Zone: Tarai, Western plain, South - western semidry region

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Paper ID: SR23525133954
DOI: 10.21275/SR23525133954
Collection & Locality: D/01, Malviya Library, Agra; D/05, Dept. Chemistry A, M. U. Agra; D/17, Agricultural Research Training center, Mathura
Date of collection: 18 - 08 - 2008 to 17 - 10 - 2008
General habitat: Grassland (ungrazed), cultivated land, wasteland.

Family: Megascolecidae
The Megascolecidae is the largest and widely distributed family of the Oligochaeta; it comprises 30 Indian genera, of which Pheretima (Metaphire) is represented by the largest genus having 13 Indian species. Mostly these are highly peregrine and have established themselves in most of the warmer region of the globe. The distribution range of the family extends between warm - temperate Asia and Australia. Two genera of the pheretimoid group, Amythas and Metaphire are endemic in Burma, and Andaman and Nicobar Islands, but are peregrine in other parts. While is Pheretima and Polypheretima are exotic in the subcontinent (julka, 1993).

Distinguish Features: Body cylindrical, dorsal pores present, male pore in front of clitellum located in xviii segment, female pore in xiv segment, genital marking present in all species except Lampito mauritii and Metaphire birmanica; Clitellum annular type, spermathecae present in all species but absent in Metaphire anomala; Prostomium rudimentary in Polypheretima elongate; Prostate gland racemose type.

Metaphire posthuma Vaillant (Fig.1.4)
Origin: Native of India
Body length: 60 mm - 150 mm
Body segments: 122 - 190 segments
Prostomium: Open epilobic, Mouth open
Setae: More than 8 setae in each segment Perichitine arrangement in regular rows
Clitellum: Clitellum annular type, xiv - xvi segments.
Male pore: Male pore in xviii segmented in pouch
Female pore: In xiv segment along the mid ventral line
Genital markings: Pouch like body extended from xvi and xix segment in pair
Spermathecal: v / vi / vii / viii / ix segment unidiverticulate, one small diverticula aries from main ampulla
Prostate gland: Racemose type, each with prostatic duct

Metaphire anomala Michelsen (Fig.1.5)
Origin: Native of India
Body length: 50 mm - 100 mm
Body segments: 107 - 120 segments
Prostomium: Open epilobic type
Setae: More than 8 setae in each segment, Perichitine arrangement Clitellum: Clitellum saddle shaped extend from xiv to xvi segment
Male pore: Male pore in xx segment in pair discharge in body surface each within conspicuous pouch Female pore: Single median in xiv segment
Genital markings: Genital marking present in xvii, xviii, xix and xxi, xxii segments in body surface
Spermathecal: Absent
Prostate gland: Prostate and one pair racemose type each with prostatic duct
Collection & Locality: B/43, Agra road, Agra
Zone: Western plain
Date (s) of collection: 21 - 08 - 2008
General habitat: Cultivated land
Lampito mauritii Kinberg (Fig.1.6) Origin: Native of India
Body length: 60 mm - 150 mm
Body segments: 130 - 307 segments
Prostomium: Open epilobic
Setae: Many setae per segment (Perechitine arrangement)
Clitellum: Annular type, xiv - xvii segments.
Male pore: Male pore on xvii segment on slightly raised areas in body surface, large penial setae projected from each male pore
Female pore: Female pore paired in segment xiv
Genital markings: Absent

Polypheretima elongata Kinberg (Fig.1.7)
Origin: Exotic
Body length: 70 mm - 100 mm
Body segments: 106 - 128 segments
Prostomium: Rudimentary
Setae: More than 8 setae in per segment (Perechitine arrangement)
Clitellum: xiv - xvi segments, Annular type
Male pore: Male pore on xviii segment in pouch Female pore: Median single in xiv segment
Genital markings: Present in xix, xx, xxi segments in pair after male pore in body surface
Spermatheca: v / vii / vii intersegment, unidiverticulate
Prostate gland: Racemose type prostate gland with prostatic duct and vasa deferentia

Spermatheca: 3 pairs in inter segmental furrow vii / vii / viii / xix segment, each with bidevarticulate two diverticula arise from both side of median duct
Prostate gland: Racemose type one pair each with vasa deferentia, prostatic duct, penial setae present
Collection & Locality: D/04, Aligarh City School Baroli Nagla, Aligarh
Zone: South western semidry region
Date (s) of collection: 18 - 08 - 2008
General habitat: Grazed grassland

4. Discussion
The texture of the soil has great influence in the distribution and population structure of earthworm. The soil collection site ranges from clayloam to silty clayloam from Grassland (ungrazed, grazed), mixed forest, river bank, dung heap and cultivated land.

Systematic exploration in the study area were undertaken in certain districts of Agra region of (U. P.). All earthworm specimens were preserved and processed customary way following Julka (1988). The specimens were provisionally identify in the laboratory and later confirmed at ZSI Kolkata in most of the cases.
45 field samples of the existing earthworm were collected and identified. The study has bought to light confirms the existence of 7 species of 2 families octochaetidae species Eutypheus orientalis Beddard, Eutypheous waltowi Michaelaen, Eutypheous incommoedus Beddard Family Megascoecidae species Metaphire posthuma vaillant, Mataphire anomola Michaelaen, Lampito mauritii kingberg, Polypheretima elongata kinbeeg.

References


