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Earthworm Resources of Western Himalayan Region, India

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ABSTRACT

The aim of the study was to update the existing information on earthworm biodiversity in the study area with particular reference to vermicomposting species. A field survey of earthworms in Doon valley of Western Himalayan region conducted in September 2009, enlists 12 species belonging to 7 genera and 4 families. Information on earthworms' scientific name, family, origin, locality and voucher specimen number, date of collection, general habitat are given for each species discussed in the text. *Drawida nepalensis*, *Eutyphoeus orientalis*, *Lampito mauritii* and *Perionyx sansibaricus* have been identified as potential species for vermicomposting with a preference for dung heap. *Eutyphoeus pharpiangianus* Michaelsen, *Octochaetona betarix* Beddard, *Lampito mauritii* Kinberg, *Metaphire anomala* Michaelsen, *Metaphire posthuma* Vaillant are reported for the first-time from the study area. Need for exploration of such unstudied areas for earthworm biodiversity has been re-stressed.

Key words: Earthworm, Doon valley, Western Himalaya, vermicomposting, biodiversity

INTRODUCTION

Indian earthworm fauna is predominantly represented by native species, which constitutes about 89% of total earthworm diversity in the country (Verma *et al.*, 2010a; Julka and Paliwal, 2005a). Earthworm explorations in Western Himal dates back to 1889 (Verma *et al.*, 2010b). Paliwal and Julka (2005) described the earthworm species of *Typhoeus masoni* (Syn. *Eutyphoeus orientalis*) for the first-time from Dehradun (Uttarakhand). Large-scale developmental activities like rapid industrialization and urbanization has eventually caused degradation of forests (Pal *et al.*, 2009). Therefore, the native species are threatened because of extensive destruction of their natural habitats (Sinha *et al.*, 2003). And, conservation of earthworm biodiversity can only be achieved through protection of biological habitats (Choudhuri *et al.*, 2008) that require a detailed periodical survey and inventory of the existing bioresources.

Stephenson (1923) listed 28 species of earthworms from this region in the publication Fauna of British India (Volume on Oligochaeta). Information on diversity of earthworms of this region was further enriched by Cernovitov (1931), Soota (1970), Halder (1980), Julka and Paliwal (2000, 2005c). Thereafter, the taxonomical studies in this region have been more or less neglected. The present investigation is based on this rationale and updates existing knowledge about the earthworm diversity in the study area.

MATERIALS AND METHODS

Field work was carried out in September 2009. The methodology adopted for earthworm collection was based on Gates (1972). 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 h, followed by their preservation in 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 confirmed at Zoological Survey of India (ZSI), Kolkata. Voucher specimens collected and examined in the present work are deposited in the Museum of VRS, for future reference and study.

Study site: Uttarakhand, a newly created State in India, is surrounded by Nepal in the East, China in the North, Himachal Pradesh in West and UP in South. The area from which data were derived is situated at 235 km North-East of Delhi, between 30° 19' N latitude and 78° 04' E longitude (Fig. 1). The areas and their surroundings visited include Dehradun, Mussoori and

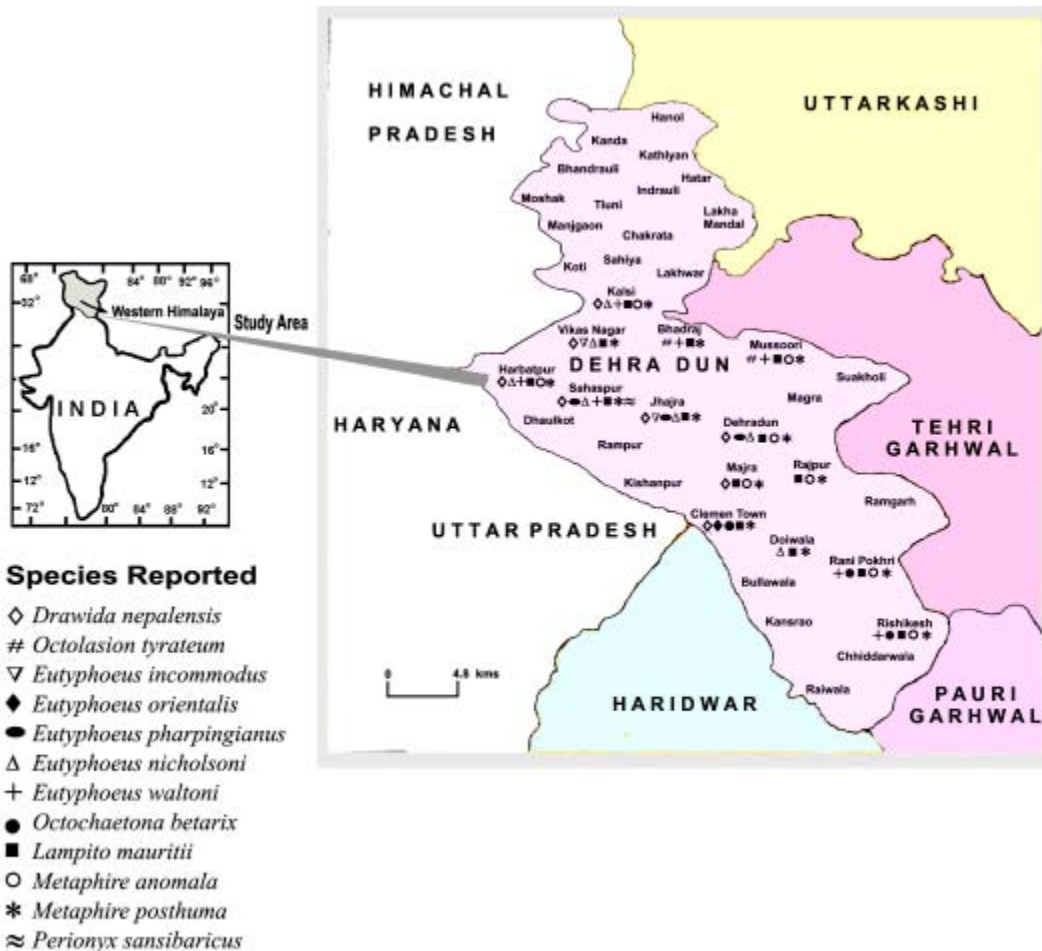


Fig. 1: Study area: Western Himalaya (Doon Valley), India

Table 1: Survey record of earthworm diversity in the study area

Date(s) of survey	Location covered	Altitude	Latitude	Longitivity	Collection No.
04. 09. 09	Rishikesh	532 M	30.12° N	78.08° E	a/01 to a/03
04. 09. 09	Ranipokhri	485 M	30.18° N	78.12° E	b/01 to b/03
04. 09. 09	Doiwala	496 M	30.11° N	78.07° E	c/01 to c/03
05. 09. 09	Kalsi	309 M	30.46° N	77.77° E	d/01 to d/05
05. 09. 09	Vikasnagar	452 M	30.43° N	78.01° E	e/01 to e/05
05. 09. 09	Harbatpur	427 M	30.45° N	77.71° E	f/01 to f/05
05. 09. 09	Sahaspur	420 M	30.38° N	77.80° E	g/01 to g/03
05. 09. 09	Jhajra	410 M	30.35° N	77.71° E	h/01 to h/03
06. 09. 09	Mussoori	1.823 M	30.45° N	78.67° E	i/01 to i/03
06. 09. 09	Bhadraj	208 M	30.48° N	77.95° E	j/01 to j/03
07. 09. 09	Majra	218 M	30.69° N	77.86° E	k/01 to k/03
07. 09. 09	Clementown	393 M	30.27° N	78.07° E	l/01 to l/03
07. 09. 09	Rajpur	258 M	30.48° N	30.28° E	m/01 to m/03
08. 09. 09	Dehradun	640 M	30.45° N	78.07° E	n/01 to n/05

Table 2: Analysis of soil sample

Collection sites	Soil texture	pH
Rishikesh	Balui	5.42
Ranipokhri	Balui domat	5.74
Doiwala	Stony balui	6.72
Kalsi	Balui domat	5.84
Vikasnagar	Balui	7.57
Harbatpur	Balui domat	5.42
Sahaspur	Clay	5.58
Jhajra	Balui	6.14
Mussoori	Stony	6.17
Bhadraj	Stony	5.85
Majra	Baluidomat	7.19
Clementown	Baluiblack	6.33
Rajpur	Stony balui blakish	6.80
Dehradun	Baluisoil	6.52

Rishikesh rural and forest pockets. Doon valley is surrounded by the Mussoori in the North and the Shiwalik hills in the South West, the rivers Ganga and Yamuna in the East and West, respectively. The entire valley is drained by the river Song. Climate of the area is temperate and humid. Temperature ranges between 36 and 16.7°C during summer (March-June) and 23.4 to 5.2°C (November-February); mean annual rainfall is 15.23 cm (July-October). Forest types are diverse ranging from temperate to dry deciduous (Table 1).

Earthworm and soil sampling: Earthworms and soil samples for taxonomic studies were collected by digging and hand sorting method. Samples were collected from diverse ecological niches viz. Dense forest; Grass land (Ungrazed); Grass land (Grazed); Cultivated land (Maize Crop); Dung heap; Stream bank; Under stones and Bank of river.

Analysis of soil samples: Soil samples were analyzed for soil texture by international pipette method (Piper, 1966); pH by digital meter (Misra, 1968) (Table 2).

RESULTS

The earthworm species collected and identified from the study area are arranged family-wise in alphabetical order. Each entry gives the information in sequence: Earthworms' scientific name, voucher specimen no., date of collection and general habitat. A brief introductory note on each family is also preceded before the text. Species marked asterisked (*) are reported for the first time from the study area.

Moniligastridae: A family of primitive earthworms in East and South Asia. A few species are hydrophilous and some are common in arable soils but most are confined to primary forests. Of the Indian genera *Desmogaster*, *Drawida* and *Moniligaster*, *Drawida* are the largest genera in terms of number of species. Its natural distribution extends from the Indian peninsula to the Eastern Himalaya. Occurrence of *Drawida nepalensis* in the Western Himalaya is suspected to be due to recent introduction (Julka, 1995).

***Drawida nepalensis* Michaelsen:**

- **Origin:** Native
- **Locality and Collection no(s):** Kalsi: d/02, d/03, d/04, d/05; Vikasnagar: e/01, e/02, e/03, e/04; Harbatpur: f/01; Sahaspur: g/01, g/02, g/03; Jhajra: h/01, h/02, h/03; Majra: k/01, k/02; Clementown: l/01; Dehradun: n/01, n/04
- **Date(s) of collection:** 05. 09. 09 to 08. 09. 09
- **General habitat:** Cultivated land (maize crop), sewage, river bank, grass land (ungrazed) and dung heap

Lumbricidae: Lumbricids occurring in the Western Himalaya, are well known peregrines which have possibly been transported to this region in soil around roots of exotic plants. They have successfully colonized in certain areas of hills.

***Octolasion tyrateum* Savigny:**

- **Origin:** Exotic
- **Locality and collection no(s):** Mussoori: i/01; Bhadraj: j/02
- **Date of collection:** 06. 09. 09
- **General habitat:** Cultivated land

Octochaetidae: Endemic Octochaetids in this region belong to the genus *Eutyphoeus* are represented by fairly large sized geophagous worms of 5 species which are inhabitants balui domat soil. They form casts on soil surface in the form of coiled towers. *Octochaetona betarix*, a native worm occurs in agriculture land (paddy crop) and soil rich in organic matter.

***Eutyphoeus incommodus* Beddard:**

- **Origin:** Native
- **Locality and collection no(s):** Vikasnagar: e/02, e/03
- **Dates of collection:** 05. 09. 09
- **General habitat:** Under stones embedded in stream water, grass land (ungrazed)

***Eutyphoeus orientalis* Stephenson:**

- **Origin:** Native
- **Locality and collection no(s):** Clementtown: e/01
- **Date(s) of collection:** 07. 09. 09
- **General habitat:** Dense forest (grazed), dung heap

***Eutyphoeus pharpius* Michaelsen*:**

- **Origin:** Exotic
- **Locality and collection no(s):** Sahaspur: g/02, g/03; Jhajra: h/01; Dehradun: n/02
- **Date(s) of collection:** 05. 09. 09 to 08. 09. 09
- **General habitat:** Cultivated land (sugarcane), mixed forest

***Eutyphoeus nicholsoni* Beddard:**

- **Origin:** Native
- **Locality and collection no(s):** Doiwala: c/01, c/03; Kalsi: d/02, d/03, d/04, d/05; Vikasnagar: e/01, e/02, e/04; Harbatpur: f/02, f/03; Sahaspur: i/03; Jhajra: h/01, h/02; h/03; Dehradun: n/04, n/05
- **Date(s) of collection:** 04. 09. 09 to 09. 09. 09
- **General habitat:** Agriculture land (maize crop), garden (ungrazed), Dense forest (grazed), River bank

***Octochaetona betarix* Beddard*:**

- **Origin:** Native
- **Locality and collection no(s):** Rishikesh: a/02; Ranipokhri: b/02, b/03; Clementtown: e/01
- **Date(s) of collection:** 04. 09. 09 to 09. 09. 09
- **General habitat:** Dense forest, cultivated land, grassland (ungrazed), stones embedded under stream line

***Eutyphoeus waltoni* Michaelsen:**

- **Origin:** Native
- **Locality and collection no(s):** Rishikesh: a/01, a/02, a/03; Ranipokhri: b/02; Kalsi: d/01, d/02; Harbatpur: f/02, f/03; Sahaspur: g/01, g/02; Mussoori : i/03
- **Date(s) of collection:** 04. 09. 09 to 06. 09. 09
- **General habitat:** Under high mountain, stream bank above water line, leaf litter, grassland (ungrazed)

Megascolecidae: Its distributional range extends between warm-temperate Asia and Australia. Native species of *Lampito mauritii* have been recorded from almost all Western Himalayan districts in Uttarakhand. *Metaphire anomala* is well known inhabitant of litter and *Metaphire posthuma* inhabits in gravelly soils near water line. Endemic Megascolecids in this region belong to the genus

Perionyx. Species explosion seems to have occurred in the Eastern Himalaya, a region with considerable and regular rainfall and high organic matter in the soil.

***Lampito mauritii* Kinberg*:**

- **Origin:** Native
- **Locality and collection no(s):** Rishikesh: a/01, a/02, a/03; Ranipokhri: b/01, b/02; Doiwala: c/01, c/02; Kalsi : d/01, d/02, d/03, d/04, d/05; Vikasnagar: e/01, e/02, e/03; Harbatpur: f/02, f/03; Sahaspur: g/01; Jhajra: h/02, h/03; Mussoori: i/01, i/02; Bhadraj: j/01, j/02, j/03; Majra: k/01, k/02; Clementown: l/01, l/03; Rajpur: m/01, m/02, m/03; Dehradun: n/01, n/02, n/03, n/04
- **Date(s) of collection:** 04. 09. 09 to 08. 09. 09
- **General habitat:** Cultivated land (maize crop), sewage, garden (ungrazed), leaf litter, river bank, under stones embedded in streams, under high mountain, dense forest (grazed), grass land (grazed), dung heap

***Metaphire anomala* Michaelsen*:**

- **Origin:** Native
- **Locality and collection no(s):** Rishikesh: a/01, a/02, a/03; Ranipokhri: b/03; Kalsi: d/04; Harbatpur: f/02, f/03; Mussoori: i/02; Majra: k/01; Clementown: l/01; Rajpur : m/02, m/03; Dehradun: n/04, n/05
- **Date(s) of collection:** 04. 09. 09 to 09. 09. 09
- **General habitat:** Leaf litter, cultivated land, dense forest, river bank, under high mountains and grassland (grazed)

***Metaphire posthuma* Vaillant*:**

- **Origin:** Exotic
- **Locality and collection no(s):** Ranipokhri: b/02; Doiwala: c/01, c/02, c/03; Kalsi: d/02, d/05; Vikasnagar: e/01, e/02, e/03, e/04; Harbatpur: f/01, f/03; Sahaspur: g/01, g/02, g/03; Jhajra: h/02, h/03; Majra: k/01, k/03; Clementown: l/01, l/02, l/03; Rajpur: m/01, m/02, m/03; Dehradun: n/05, Mussoori: i/2, i/3, Bhadraj: j/02
- **Date(s) of collection:** 04. 09. 09 to 09. 09. 09
- **General habitat:** Sloopy ground, riverbank, under stone embedded in streams, cultivated land (paddy crop), Dense forest and grass land (ungrazed)

***Perionyx sansibaricus* Michaelsen**

- **Origin:** Native
- **Locality and collection no(s):** Sahaspur: g/02
- **Date of collection:** 05. 09. 09
- **General habitat:** River bank, dung heap, dense forest

DISCUSSION

The present study records 12 species of earthworms from Doon valley of Uttarakhand State in India, representing 7 genera and 4 families. Of these, *megascolecidae* represents the most active

Table 3: Fauna of Western Himalayan region (Doon valley)

Fauna	Harbat-						Clemen-							
	Rishikesh	Ranipokhri	Doiwala	Kalsi	Vikas nagar	pur	Sahaspur	Jhajra	Mussoori	Bhadraj	Majra	town	Rajpur	Dehradun
Family:														
Moniligastridae														
<i>Drawida</i>	-	-	-	+	+	+	+	+	-	-	+	+	-	+
nepalensis														
Family:														
Lumbricidae														
<i>Octolasion</i>	-	-	-	-	-	-	-	-	+	+	-	-	-	-
<i>tyrateum</i>														
Family:														
Octochaetidae														
<i>Eutyphoeus</i>	-	-	-	-	+	-	-	+	-	-	-	-	-	-
<i>incommodus</i>														
<i>Eutyphoeus</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>orientalis</i>														
<i>Eutyphoeus</i>	-	-	-	-	-	-	+	+	-	-	-	-	-	+
<i>pharpiingianus</i>														
<i>Eutyphoeus</i>	-	-	+	+	+	+	+	+	-	-	-	-	-	+
<i>nicholsoni</i>														
<i>Eutyphoeus</i>	+	+	-	+	-	+	+	-	+	+	-	-	-	-
<i>waltoni</i>														
<i>Octochaetona</i>	+	+	-	-	-	-	-	-	-	-	-	+	-	-
<i>betarix</i>														
Family:														
Megascolecidae														
<i>Lampito</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>mauritii</i>														
<i>Metaphire</i>	+	+	-	+	-	+	-	-	+	-	+	-	+	+
<i>anomala</i>														
<i>Metaphire</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>posthuma</i>														
<i>Perionyx</i>	-	-	-	-	-	-	+	-	-	-	-	-	-	-
<i>sansibaricus</i>														
	5	5	3	6	5	6	7	6	5	4	4	5	3	6

+: Present, -: Absent

earthworms *Lampito mauritii* and *Metaphire posthuma* are predominant species with wide distribution in the study area at all sites (Table 3). The moderately active earthworms of the family octochaetidae and moniligastridae are short moving. A review of pertinent literature indicates that species marked asterisked (*) have not been recorded earlier from the study area (Julka, 1995; Paliwal and Julka, 2005).

High diversity at moderate altitudes may be due to soils rich in organic matter and subtropical and mild temperate climate. Low number of species at higher elevations is possibly due to extreme cold and unfavorable soil conditions. The present observations agree with the species-altitudes relationship studies in other parts of the world. An inverse relationship recorded in 1959 between number of species of megascolecidae and altitude on mountains in North Iceland of New-Zealand. Sergienko (1969) have also opined that the number of Lumbricid species decrease with rise in altitude in Russia and France, respectively.

The study indicates that of the species recorded from the study area, 09 are native to Indian subcontinent and the remaining 03 are well known peregrine of extra Indian origin. *Drawida nepalensis*, *Eutyphous orientalis* *Lampito mauritii* and *Perionyx sansibaricus* have been identified

Table 4: Relative Density (RD %) and Relative Frequency (RF %) of earthworms in different habitats in Western Himalaya, (Doon valley) India

Habitat	Cultivated land		Grassland (ungrazed)		Grassland (grazed)		Mixed forest		Stream bank		Dung heap	
	RD	RF	RD	RF	RD	RF	RD	RF	RD	RF	RD	RF
<i>Drawida nepalensis</i>	4.4	80	5.2	20	6.6	40	6.6	40	0.9	20	5.0	80
<i>Octolasion tyrateum</i>	6.5	20	-	-	-	-	-	-	-	-	-	-
<i>Eutyphoeus incommodus</i>	-	-	6.5	20	-	-	-	-	-	-	-	-
<i>E. orientalis</i>	-	-	-	-	-	-	7.7	20	-	-	0.9	60
<i>E. pharpius</i>	6.5	10	-	-	-	-	0.9	20	-	-	-	-
<i>E. nicholsoni</i>	9.4	40	9.4	40	-	-	77.5	100	-	-	-	-
<i>E. waltoni</i>	9.4	60	6.5	40	-	-	-	-	0.9	20	-	-
<i>Octochaetona betarix</i>	41.4	60	9.4	60	6.8	60	-	-	0.9	10	-	-
<i>Lampito mauritii</i>	40.4	80	52.5	100	16.8	40	60.4	80	-	-	60.9	80
<i>Metaphire anomala</i>	-	-	-	-	33.6	20	70	20	-	-	-	-
<i>M. posthuma</i>	80.0	60	56.4	60	-	-	70.4	40	0.9	10	-	-
<i>Perionyx sansibaricus</i>	-	-	-	-	-	-	77.5	80	0.9	10	94.1	100

as potential species for vermicomposting, with a preference for dung heap comprising very high organic matter (Table 4). Since, these species thrive well in cattle dung and soils rich in organic matter, they could be best suited and used in vermicomposting because of their affinities for high organic matter.

The majority of native species of earthworms have been recorded from 1000 to 2000 m altitudes whereas exotic species are found between 300 and 4000 m. Species from other biogeographical regions occur primarily at elevations between 300 and 2000 m. Further, the peregrine exotic species in Western Himalaya are suspected to have been introduced to Doon hills, possibly as a result of their transportation in soil around roots of exotic plants and through other agencies (Julka and Paliwal, 2005b). Introduction of peregrines in soil around roots of plants or otherwise has also been recognized by Gates (1972) during his studies on the oligochaetes intercepted by US Bureau of Plant Quarantine. Out of 50 exotic species so recorded by Gates, incidentally, 20 species were reported in Western Himalaya.

Table 4 indicates the species habitat preference for each of the twelve species collected from the study area. This shows that three species viz., *Drawida nepalensis*, *Octochaetona betarix* and *Lampito mauritii* show preference for a wide range of ecosites as observed by earlier workers (Gates, 1972). *Drawida nepalensis* is the most eurytopic species, recorded in cultivated land, grassland (ungrazed and grazed), mixed forest, stream bank and dung heap but with higher frequencies in ungrazed grassland. Among lesser eurytopics *E. nicholsoni* recorded in cultivated land, ungrazed grassland and mixed forest, while *E. waltoni* thrives best in cultivated and ungrazed grassland, stream bank and *Metaphire posthuma* in cultivated land, ungrazed grassland, mixed forest, stream bank, *D. nepalensis*, *E. orientalis*, *L. mauritii* and *P. sansibaricus* are indeed coprophilous; they are encountered in other habitats as well, but with very low frequency except *D. nepalensis* which has been recorded from wide range of habitats. Species with restricted habitat preference are *Octolasion tyrateum*, *E. incommodus*, *E. orientalis*, *E. pharpius* and *Metaphire anomala* agreeing with field reports of Paliwal and Julka (2005).

The study represents a contribution to our present knowledge on the contemporary biodiversity of earthworm resources in the study area and contribute material for the preparation of earthworm

inventory for the region. It is likely that through such investigations in unexplored areas, new species which are very specific in vermicomposting may be discovered.

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