# Earthworms of Indian Botanic Garden, Kolkata

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**Abstract**

The present study was carried out during 2012-2014 at Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah. Out of the total 1805 earthworms collected, 14 species were identified belonging to 7 genera under 3 families and 2 orders. Among these, one species *Metaphire birmanica* is new in this state.

**Introduction**

Earthworms, belonging to the Phylum Annelida and class Oligochaeta are widely distributed throughout the world but dominant in the temperate and tropical soils. Their population contributes about 80% of total biomass of the soil ecosystem.

Michaelsen (1900) was the first to make comprehensive investigations into earthworm taxonomy based on few morphological characters. His seminal work together with Stephenson's contribution (Stephenson, 1930) to earthworm systematics published thirty years later, has constituted the backbone of the classical phylogenetic system of earthworms. Later, several contributors studied and developed new systems of oligochaete classification. Studies are being continued till today and now the described earthworm species is approximately 4400 worldwide (Sinha 2009) described in 20 families (Reynolds and Cook, 1993; Blakemore 2010).

At present the Indian earthworm fauna comprises about 590 species placed in 10 families and 69 genera (Julka *et.al.* 2009). Out of these, 67 species of earthworms are known to occur in West Bengal. Perrier (1872) was first to report of an earthworm species *Perichaeta houlleti* from West Bengal. Later Beddard (1883, 1900, 1902), Michaelsen (1907, 1910), Stephenson (1916, 1917, 1931), Gates (1937, 1945 a,b), Halder and Julka (1967), Julka (1975), Soota and Halder (1977), Halder (1998), Chowdhury and Hazra (2008, 2009), Sharma *et.al*. (2008), Bandopadhyay *et.al.* (2008), Biswas *et.al.* (2008), Chowdhury *et.al.* (2010), Goswami and Mandal (2014), contributed substantially to the taxonomic studies of earthworm from West Bengal.

To know the present state of earthworm fauna of West Bengal several systematic field surveys are being conducted by different workers. One such study on earthworms was conducted in the unexplored Acharya Jagadish Chandra Bose Indian Botanic Garden to find ecological diversity based on identification and classification of collected earthworms. Out of the total 1805 earthworms collected, 14 species were identified belonging to 7 genera under 3 families and 2 orders. Earthworm species were identified based on their external morphology and internal anatomy and using existing taxonomic keys. Among these, one species *Metaphire birmanica* is new to this state.

**MATERIALS AND METHODS**

**Study Area**

The Acharya Jagadish Chandra Bose Indian Botanic Garden (IBG) was chosen as the study area. The garden covers an area of about 273 acres on the west bank of river Ganges (Hooghly) near Howrah. The garden is scientifically planned, and plants of the same group are grown together. Five distinctly different areas in IBG are chosen as per plantation for conducting the present study: each specified for growing cluster of similar types of plants in a specified area.

The study area is characterized by rainy season from June to September. It is situated in the hot moist sub-humid agro-ecological situation having annual rainfall between 1100 to 1500 mm of which 75-80% received during June to September. The mean annual maximum and minimum temperature fluctuates from 40.2° to 10.8° C and relative humidity ranges between 66 to 85%. The soils of this district have been formed from the alluvium deposited by river Ganga and its tributaries.

**Earthworm Sampling**

Sampling was carried out monthwise for the period of two years from June 2012 to May 2014 for a separate ecological study. Living earthworm samples were collected by digging and hand sorting method. The worms were narcotised in 70% alcohol and then washed and preserved in 10% formalin with proper labelling. The specimens were studied under the Leica EZ4 stereozoom microscope. All the studied specimens are deposited to National Zoological Collection (NZC) of Zoological Survey of India, Kolkata. Registration numbers provided in material examined.

**GPS of five habitats**

Conifer: N22°33.513´E 088°17.561´; Keora: N 22°33.378´E 088°17.609'; Flower garden: N 22°33.573´E 088°17.576´; Bamboo: N 22°33.307´E 088°17.797´; Great Banyan Tree: N 22°33.635´E088°17.215'.

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**Following photo plates are showing the external genital organs of earthworms collected from IBG along with two castings.**

*Amynthas alexandri*

*Lampito mauritii*

*Metaphire anomala*

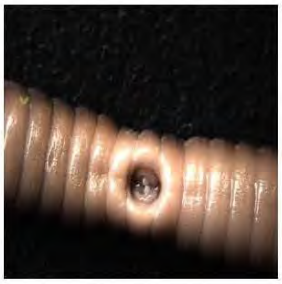
*Metaphire birmanica*

*Metaphire houlleti*

*Metaphire peguana*

*Metaphire posthuma*

*Perionyx excavatus*



*Prionyx simlaensis*

*Eutyphoeus incommodus*

*Eutyphoeus orientalis*

*Eutyphoeus waltoni*

*Drawida nepalensis*

Casting of *Eutyphoeus* sp.

Casting of *Metaphire posthuma*

**SYSTEMATIC ACCOUNT**

**Class: OLIGOCHAETA**
**Order: Haplotaxida**
**Family: Megascolecidae**

**Key to genera of the family Megascolecidae of Indian Botanic Garden (IBG)**

1.Nephridia stomate, holonephric; colour usually reddish to violet; gizzard vestigial, in segment v or vi .....*Perionyx*
Nephridia astomate, meronephric; usually brown and slate coloured; gizzard well developed.....2
2. Gizzard in front of 7/8.....3
Gizzard behind 7/8 .....4
3. Female pores in xiv,male pores in xviii .....*Lampito*
4. Male pores discharging directly onto body surface.....*Amynthas*
Male pores discharging into copulatory pouches opening onto body surface through secondary male pores.....*Metaphire*

**Genus 1. *Amynthas* Kinberg, 1867**

1867. *Amynthas* Kinberg, *Ofvers. K. Vetensk. Acad. Forh. Stockh*., 23: 97 (Type species, *Amynthas aeruginosus* Kinberg, 1867)
1972. *Amynthas* Sims and Easton, *Biol. J. Linn. Soc.,* 4: 211.

**Diagnosis:** Body cylindrical. Setae numerous, i.e. Perichaetine. Clitellum annular. Combined male and prostatic pores paired. Copulatory pouches absent. Oesophagus with a single gizzard between septa 7/8 and 9/10, and without pouches. Micromeronephridia astomate.

**Type Species:** *Amynthas aeruginosus* Kinberg, 1867.

**Distribution:** Oriental and Australasian regions, Oceania

**Key to the species of the genus *Amynthas* of Indian Botanic Garden (IBG)**

1. Spermathecal pores four pairs in furrows 5/6/7/8/9 .....2

2. Preclitellar genital markings absent.....*A. alexandri*

**1. *Amynthas alexandri* (Beddard, 1900)**

1900. *Amyntas alexandri* Beddard, Proc. Zool. soc. Lond., 1900: 998. (Type loc. - Probably Kolkata, West Bengal, India; type in Brit. Mus (Nat. Hist.), London).
1909. *Pheretima alexandri*, Michaelsen, *Mem. Indian Mus.*, 1: 109.
1972. *Amynthas alexandri alexandri*, Sims and Easton, *Biol. J. Linn. Soc.,* 4: 234.
1982. *Amynthas alexandri*, Julka, *Rec. Zool. Surv. India*., 80: 135.

**Diagnosis:** Length 137–178 mm., diameter 4–6 mm., 112–130 segments. Colour dark brown on dorsum. Prostomium rudimentary.

**Type locality:** Probably Kolkata, West Bengal, India.

**Habitat:** Found in several habitats like bamboo, keora and flower garden, waste lands & deciduous forest.

**Materials examined:** 3 exs.: Keora habitat, IBG Howrah; 21.vii.2012; R. Goswami coll; An 4056/1 ZSI. 3 exs.: Flower garden habitat, IBG Howrah; 3.x. 2013; R. Goswami coll; An-SZ54 ZSI.1 ex.: Keorahabitat, IBG Howrah; 23.vii.2014; R. Goswami coll; An-SZ23 ZSI.

**Distribution:** India: West Bengal – IBG Howrah; Kolkata; Darjeeling and Jalpaiguri districts; Andaman and Nicobar Islands; Assam; Himachal Pradesh; Madhya Pradesh; Maharashtra; Uttar Pradesh.

**Outside India:** Myanmar (Burma), Thailand.

**Remarks:** This species was earlier known as *Pheretima alexandri*. Sims and Easton (1972) recorded the genus *Pheretima* into six different genera and now the species is known as *Amynthas alexandri*.

**Genus 2. *Lampito* Kinberg, 1867**
1867. *Lampito* Kinberg, *Öfvers. K. Vetens Akad. Forhandl. stockolm,* 23: 103. (type species, *Lampito mauritii* Kinberg, 1866).
1987. *Lampito,* Julka & Senapati, *Rec. Zool. Surv. India., Occ. paper,* 92: 8.

**Diagnosis:** Clitellum annular. Dorsal pores present. Biprostatic, male pores (combined with prostatic pores) paired on xviii. Female pores paired on xiv . Septa all present from 4/5. Single oesophagial gizzard in V.

**Distribution:** India: Palni and cardamom hills in South India.

**Remarks:** *Lampito mauritii* is the only species found in this genus in West Bengal.

**2. *Lampito mauritii* Kinberg, 1867**

1867. *Lampito mauritii* Kinberg, *Ofvers. K. Vetens Akad. Forhandl. stockolm,* 23: 103. (Type locality, Mauritius. Types, in the Naturhistoriska Riksmuseet, Stockholm.)
1987. *Lampito mauritii*, *Julka & Senapati, Rec. Zool. Surv. Of India, Occ. paper no. 92: 9.*

**Diagnosis:** Length 95–155 mm; diameter 3–6 mm. Segments 157–201. Prostomium prolobic. Clitellum retained from 13/14. Setae perichaetine and none between male pores. Genital markings absent.

**Habitats:** Soil with abundant organic matter like leaf litter, compost pit and manure heap. Grassland, forest, sewage canal, kitchen drainage.

**Materials examined:** 7exs.: Flower Garden habitat, IBG Howrah; 8.viii. 2012; R. Goswami coll; An 4069/1 ZSI. 2exs.: Conifer habitat, IBG Howrah; 13.iii.2013; R. Goswami coll; An4155/1 ZSI. 7exs.: Flower garden habitat, IBG Howrah;19.ii.2014; R. Goswami coll; An-SZ101 ZSI.

**Castings:** Small heaps of threads constricted to small ball like pellets on the surface of soil.
**Distribution:** India; West Bengal- IBG Howrah; Andaman and Nicobar Islands; Andhra Pradesh; Bihar; Gujarat; Karnataka; Kerala; Laccadive and Minicoy Islands; Madhya Pradesh; Maharashtra; Orissa; Rajasthan; Tamil Nadu; Uttar Pradesh.

**Outside India:** Zanzibar, Comoros., Madagascar, Seychelless., Mauritius, Pakistan, China, Maldives, Sri Lanka, Bangladesh, Myanmar (Burma), Thailand, Malay Peninsula, Indonesia, Philippines, Hong kong, New Caledonia.

**Economic Importance:** These worms are suitable as waste conditioners. Used as fish bait and also fish and chicken feed. It can control plant parasites.

**Remarks:** Its origin is in India (Western Ghats of South India), but first discovered from Mauritius.

**Genus 3. *Metaphire* Sims & Easton, 1972**
1867. *Rhodopis* Kinberg, *Ofvers. K. Vetensk Acad. Forh. Stockh*., 23:102 (non Reichenbach, 1854, *J . Orn. Lpz*., 1: 174).
1937. *Pheretima* (in part), Gates, *Rec. Indian Mus.*, 39: 187.

1972. *Metaphire* Sims and Easton, *Biol. J . Linn.Soc.,* 4: 215.
1987. *Metaphire*, Julka & Senapati, *Rec. Zool. Surv. India, Occ. paper no.* 92: 10.

**Diagnosis:** Body cylindrical. Perchaetine. Clitellum annular, xiv - xvi. Spermathecal pores usually large transverse slits. Female pore single, rarely paired. Male pores combined with prostatic pores, paired. Holandric, rarely proandric or metandric.
**Type species:** *Rhodopis javanica* Kinberg, 1867.

**Distribution:** Oriental region from Japan southwards through the Indo–Australasian .

**Key to the species of the genus *Metaphire* of IBG**
1. Male pores on segment xx.....*M. anomala*
Male pores on segment xviii.....2
2.Spermathecal pores 4 pairs located in furrows 5/6/7/8/9;
Genital markings paired on equators of segments xvii and xix.....*M. posthuma*
Spermathecal pores 3 pairs.....3
3. Spermathecal pores in furrows 5/6/7/8;
Genital markings absent.....*M. birmanica*
Spermathecal pores in furrows 6/7/8/9. Invaginated spermathecal pores recognizable internally by the presence of stalked glands. Genital markings small, within copulatory pouches.....*M. houlleti*
Genital markings 2 pairs across 17/18 and 18/19 .....*M. peguana*

**3. *Metaphire anomala* (Michaelsen, 1907)**

1907. *Pheretima anomala*, Michaelsen, *Jb. hamb. wiss. Anst*., 24: 167. (Type loc. – Shibpur, West Bengal, India; types in Zoologisches Institute und Zoologisches Museum Universitat, Hamburg.)
1972. *Metaphire anomala*, Sims and Easton, *Biol. J . Linn. Soc.,* 4: 237.
1987. *Metaphire anomala*, Julka & Senapati, *Rec. Zool. Surv. India, Occ. paper no.* 92: 10.

**Diagnosis:** Length 102–151 mm., diameter 5–5.5 mm., 127–130 segments. Colour light, reddish on dorsum. Prostomium epilobic, tongue open. Clitellum annular. Female pore single, median, presetal, on xiv. Spermathecal pores absent (athecal morphs). Genital markings paired, discoidal papillae, on setal arcs of xviii–xxii, sometimes on xvii and xxiii, occasionally on xxiv (one of the marking either on left or right side on xvii, xxiii, xxiv may be lacking).

**Type locality:** Botanical Garden, IBG Howrah near Kolkata, West Bengal, India.

**Materials examined:** 5exs.: Bamboo habitat, IBG Howrah; 22.xi.2012; R. Goswami coll; An4110/1 ZSI. 1ex.: Flower garden habitat, IBG Howrah; 4.xii. 2013; R. Goswamicoll; An-SZ92 ZSI.

**Distribution:** India; West Bengal: IBG Howrah; Kolkata; Himachal Pradesh, Madhya Pradesh.

**Outside India:** Myanmar (Burma), Thailand, Vietnam, China.

**Remarks:** This species is not common in India. In west Bengal A morph of *anomala* group (Gates, 1972) is found in and around IBG of Howrah.
**4. *Metaphire birmanica* (Rosa, 1888)**

1888. *Perichaeta birmanica* Rosa, *Annali Mus. civ. Stor. Nat. Genova,* 26:164. (Type loc. Bhamo. Types in the Genoa Mus.)
1900. *Pheretima birmanica,* Michaelsen, *Das Tierreich*, 10: 255.
1972. *Metaphire birmanica,* Sims and Easton, *Biol. J . Linn. Soc.,* 4 (3): 238.

**Diagnosis:** Length 112–185 mm., diameter 4.5–6 mm., 110-116 segments. Colour brownish to slate on dorsum. Prostomium epilobic, tongue open. Combined male and prostatic pores paired, minute on xviii. Female pore single, median, presetal on xiv. Spermathecal pores paired in furrows 5/6/7/8. Genital markings absent. Pigmented, pigment red. Septa 5/6/7 muscular. Gizzard large; intestine begins in xv; intestinal caeca paired, manicate, in xxvii, extending forward to xxiv; typhlosole simple, lamelliform. Holandric.

**Habitat:** Flower garden, grass lawn, bamboo habitat, paddy field, soil with manure, under the stone and forest of hills. Prefers to stay in the deep clay.

**Materials examined:** 4exs.: Flower garden habitat, IBG Howrah; 21.xi.2012; R. Goswami coll; An4114/1 ZSI. 5exs.: Flower garden habitat, IBG Howrah; 11.xi.2013; R. Goswamicoll; An-SZ75 ZSI.

**Type locality:** Bhamo, Myanmar (Burma).

**Distribution:** India, West Bengal: IBG Howrah, Kolkata, Himachal Pradesh, Uttar Pradesh.

**Outside India:** Myanmar (Burma).

**Remarks:** Regeneration of tail region is possible.

**5. *Metaphire houlleti* (Perrier, 1872)**

1872. *Perichaeta houlleti*, Perrier, *Nouv. archs. Mus. Hist. nat. Paris*, 8: 99. (Type loc. – Calcutta, West Bengal, India; types in Museum National d' Histoire Naturelle, Paris).
1900. *Pheretima houlleti* (in part), Michaelsen, *Tierreich*, 10: 273.

1972. *Metaphire houlleti houlleti*, *h .rugosa; campanulata campanulata, c. meridian, c . wimberleyana*: Sims and Easton, *Biol. J. Linn. Soc.,* 4 (3): 238.
1982. *Metaphire houlleti*, Julka, *Rec. Zool. Surv. India,* 80: 142.

**Diagnosis:** Length 63-109 mm., diameter 3-4 mm., segments 98–105. Colour brownish on dorsum. Prostomium epilobic, tongue open. Combined male and prostatic pores paired. Female pore single, median, presetal, on xiv. Spermathecal pores paired, transverse slits, in 6/7/8/9. External genital markings absent.

**Type locality:** Kolkata, West Bengal, India.

**Materials examined:** 1ex.: Flower Garden habitat, IBG Howrah; 15.x.2012; R.Goswami coll, An4107/1 ZSI.1ex.: Keora habitat, IBG Howrah; 19.ix.2013; R. Goswami coll; An-SZ28 ZSI.

**Habitats:** Garden soils, marshy soil, soil with stones, rotten and wet leaves of bamboo, under logs, deciduous forest.

**Distribution:** India: West Bengal: IBG Howrah, Andaman & Nicobar Islands, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala.

**Outside India:** Australia, Bahamas, Bangladesh, Caroline Islands, China, Cuba, Fiji, France, French Guiana, Indonesia, Madagascar, Malay Peninsula, Myanmar, Nepal, Pakistan, Philippines, Salvador, Sierra Leone, Singapore, Sri Lanka, Thailand, U.S.A. (Florida), Vietnam.

**Remarks:** Lowland tropical species. According to Gates (1972) *houlleti* species has seven morphs. In West Bengal, recorded species shows H morph, larger Hp morph and smaller Hp morph.

**6. *Metaphire peguana* (Rosa, 1890)**

1890. *Perichaeta peguana* Rosa, *Ann . Civ. Mus. Sto. Nat. Genova*, 30: 113. (Type loc. – Rangoon, Mayanmar; type in the Genoa Museum.)
1900. *Pheretima peguana*, Michaelsen, *Das Tierreich*, 10: 292.
1972. *Metaphire peguana*, *Metaphire saigonensis,* Sims and Easton, *Biol. J. Linn. Soc.,* 4 (3): 239.
1980. *Metaphire peguana*, Soota & Halder, *Rec. Zool. Surv. India,* 77: 3.

**Diagnosis:** Length 140–240 mm.; diameter 5–8 mm.; segments 97–124. Prostomium epilobic, tongue open. Clitellum xiv–xvi. Genital markings 2 pairs, transversely elliptical, with firm glistening surface and obvious central aperture, across 17/18 and 18/19. Male pores minute on xviii.

**Material examined:** 14exs.: Conifer habitat, IBG Howrah; 21.vii.2012; R. Goswami coll; An4054/1 ZSI. 16exs.: Bamboo habitat, IBG Howrah; 29.viii. 2013; R. Goswamicoll; An-SZ5 ZSI.

**Habitats:** Garden soil, deciduous forest, banana groves.

**Distribution:** India: West Bengal–IBG Howrah, Kolkata, Jalpaiguri; Andaman.

**Outside India:** Indonesia, Malay Peninsula, Myanmar, Thailand, Vietnam.

**Remarks:** This is a very rare species in India and reported to occur only from Kolkata and Howrah. Originated in Myanmar.

**7. *Metaphire posthuma* (Vaillant, 1868)**
1868. *Perichaeta posthuma* Vaillant, *Annls. Sci. nat*. (ser. 5), 10: 228. (Type loc.– Java; types in Museum National d' Histoire Naturelle, Paris)
1900. *Pheretima posthuma*, Michaelsen, *Tierreich*, 10: 295 .
1972. *Metaphire posthuma*, Sims and Easton, *Biol. J. Linn. Soc*., 4 (3): 239.
1980. *Metaphire posthuma,* Soota & Halder, *Rec. Zool. Surv. India,* 76: 200.

**Diagonisis:** Length 75–140mm., diameter 4.5–5 mm., 100–113 segments. Colour light to dark grey, brown. Prostomium epilobic, tongue open. Combined male and prostatic pores paired, minute and invaginated on xviii. Female pore single on xiv. Spermathecal pores minute, superficial in furrows 5/6/7/8/9. Genital markings paired, circular papillae with centres slightly median to male pore lines on setal arcs of xvii and xix, rarely xx.

**Type locality:** Java, Indonesia.

**Material examined:** 1ex.: Bamboo habitat, IBG Howrah; 30.vi.2012; R. Goswami coll; An4039/1 ZSI. 15exs.: GBT habitat, IBG Howrah; 14.v.2013; R. Goswami coll; An-SZ3 ZSI. 9exs.: GBT habitat, IBG Howrah; 23.vii.2014; R. Goswami coll; An-SZ160 ZSI.

**Habitats:** Loam soil, grassland, wastewater saturated mud and under manure heap.

**Castings:** Small spheroidal pellets (Gates, 1930) are deposited on the soil (photo plate attached).

**Distribution:** India: West Bengal: Howrah IBG, Kolkata; Andaman & Nicobar Islands; Bihar; Gujarat, New Delhi; Himachal Pradesh; Jammu & Kashmir; Madhya Pradesh; Maharashtra; Orissa; Punjab; Rajasthan; Uttar Pradesh.

**Outside India:** Bangladesh, China, Christmas Island, Indonesia, Malaysia, Mayanmar, New Hebrides, Pakistan, Philippines, Seychelles Archipelago, Taiwan, Tinian, Thailand, Santa Cruz, U.S.A., Vietnam.

**Remarks:** These worms are very active. When touched during collection it coils immediately. Abundant in India as well as in West Bengal. Their population is highest in IBG.

**Genus 4. *Perionyx* Perrier, 1872**

1872. *Perionyx* Perrier, *Nouv. Archs Mus. Hist. nat. Paris*, 8: 126. (Type species: *Perionyx excavatus* Perrier, 1872)
1889. *Megascolex* (in part), Vaillant, *Hist . Nat. Anneles*, 3 (1): 62.
1893. *Perionyx,* Beddard, *Proc. Zool. Soc. Lond.,* 1892: 685 .
1987. *Perionyx,* Julka & Senapati, *Rec. Zool. Surv. India, Occ. Paper No.* 92: 13.

**Diagnosis:** Perichaetine, setae numerous. Clitellum annular, setae retained. Combined male and prostatic pores paired, on xviii; female pore unpaired.

**Type species:** *Perionyx excavatus* Perrier, 1872.

**Distribution:** India, Myanmar, possibly Malaysia and Sri Lanka.

**Key to the species of the genus *Perionyx* of IBG**

1. Last pair of hearts in xii .....2
Last pair of hearts in xiii .....3
2. Male pores transverse slits on slightly raised, transversely elliptical white areas, near mid ventral line , penial setae with spines..... *P.excavatus*
3. Male genital field with elongated penes..... .....*P. simlaensis.*

**8. *Perionyx excavatus* Perrier, 1872**

1872. *Perionyx excavatus* Perrier, *Nouv. Archs Mus. Hist. nat. Paris*, 8: 126. (Type loc.– Saigon, Vietnam; types in Museum National d' Histoire Naturelle, Paris)
1923. *Perionyx fulvus* Stephenson, *Fauna Br. India, Oligochaeta*: 333.
1924. *Perionyx excavatus* Stephenson, *Rec. Indian Mus* ., 26: 340.
1987. *Perionyx excavatus* Julka & Senapati, *Rec. Zool. Surv. India, Occ. Paper No.* 92: 13.

**Diagonosis:** Length 66–113 mm., diameter 2.5–3.5 mm., 122–136 segments. Colour purple to reddish brown dorsally, ventrally pale. Prostomium epilobic, tongue open. Combined male and prostatic pores paired, tiny, within a single male field. Female pore on xiv. Spermathecal pores paired, small, in furrows 7/8/9.

**Type locality:** Ho Chi Minh City, Vietnam.

**Habitats:** Found mainly in moist sites with rich organic soil like manure and compost heaps, sewage sludge, at the edge of ponds, kitchen drainage and under earth's crust.
**Castings:** Small slender stick like formation on top of the soil.

**Economic Importance:** As the rate of reproductive growth is very high, this species is used for vermicomposting, waste management and food for fish and chicken.

**Materials examined:** 2exs.: Conifer habitat, IBG Howrah; 21.vii.2012; R. Goswami coll; An4055/1 ZSI.7exs.: Keora habitat, IBG Howrah; 14.v.2013; R. Goswami coll; An-SZ2 ZSI. 2exs.: Flower garden habitat, IBG Howrah; 19.iii.2014; R. Goswami coll; An-SZ111 ZSI.

**Distribution:** India: West Bengal: IBG Howrah, Burdwan, Kolkata, Darjeeling; Andaman, Arunachal Pradesh, Assam; Himachal Pradesh; Karnataka; Tamil Nadu.

**Outside India:** Comoro, Dominica, Hawaii, Taiwan, Fiji, Indonesia, Malaysia, Malay Peninsula, Myanmar, Mauritius, Philippines, Samoa, South Africa, Sri Lanka.

**Remarks:** Endemic species and prefers a temperature range from 21$^{o}$ C -27$^{o}$ C. Cannot withstand low temperature.

**9. *Perionyx simlaensis*** (Michaelsen, 1907)

1907. *Perionychella simlaensis* Michaelsen, *Jb. hamb. wiss. Anst*., 24: 157.
1923. *Perionyx simlaensis* Stephenson, *Fauna Br. India, Oligochaeta*: 359.
1960. *Perionyx simlaensis* Gates, *Bull . Mus. Comp. Zool. Harv.*, 123: 234.

**Diagonosis:** Length 85–155 mm., diameter 3–5 mm., 139–175 segments. Colour violet red dorsally, grey ventrally. Prostomium epilobic, tongue open. Combined male and prostatic pores minute, paired, on xviii, each pore at the base of an elongate and medially grooved pene, arising from the centre of a somewhat spherical to ovoidal cushion – like large porophore, both porophores located in a broad transverse depression. Spermathecal pores paired in furrows 7/8/9.

**Type locality:** Dharampur, Shimla Hills, Himachal Pradesh.

**Habitat:** Moist place with high organic matter, bank of streams, ponds, lakes and sewage canals.

**Materials examined:** 5exs.: Bamboo habitat, IBG Howrah; 4.xii.2013; R. Goswami coll., An4237/1 ZSI. 8exs.: Keora habitat, IBG Howrah; 19.ii.2014; R. Goswami coll., An4252/1 ZSI.
**Distribution:** India: West Bengal: IBG Howrah, Himachal Pradesh; Uttar Pradesh.
**Remarks:** This species is endemic to Himachal Pradesh and first found in Shimla.

**Family: OCTOCHAETIDAE**

**Key to the genera of the family Octochaetidae of IBG**

1. Oesophagus with a single gizzard.....2
Oesophagus with two gizzards.....4
2. Discrete calciferous glands present.....3
3. Prostates one pair, male and prostatic pores on segment xvii; calciferous glands intramural, one pair, in segment xii.....*Eutyphoeus*
4. Calciferous glands one pair, each gland trilobed with one vertical lobe in each of segments xv, xvi and xvii.....*Dichogaster*

**Genus 5. *Dichogaster* Beddard, 1888**
1888. *Dichogaster* Beddard, Q. *Jlmicrosc. sci*., 29: 251. (Type species, probably *Dichogaster damonis* Beddard, 1888)
1897. *Balanta* Michaelsen, *Jb. hamb. wiss. Anst*., 15: 165.
1972. *Dichogaster* Gates, *Trans. Am. Phil. Soc.,* 62 (7): 227.
1987. *Dichogaster* Julka & Senapati, *Rec. Zool. Surv. India, Occ. Paper No.* 92: 21.

**Diagnosis:** Lumbricine. Dorsal pores present. Clitellum, intersegmental furrows obliterated, dorsalpores occluded, setae retained. Male pores paired, in seminal grooves, on xviii or 17/18; prostatic pores 2 pairs, at the end of seminal grooves, on xvii and xix, or one pair on xvii.

**Type species:** *Dichogaster damonis* Beddard, 1888.

**Distribution:** Tropical Africa and America, India. species of *bolaui* group widely transported to other regions.

**Remarks:** The genus is represented in IBG by only one species *Dichogaster bolaui.*

**10**. ***Dichogaster bolaui* (Michaelsen, 1891)**
1891. *Benhamia bolavi* Michaelsen, *Jb. Hamb. Wiss. Anst*., 8: 9. (Type loc.- Bergedorf, Hamburg, Germany; types in Zoologisches Institute and Zoologisches Museum Universitats, Hamburg)
1900. *Dichogaster bolaui*, Michaelsen, *Tierreich*, 10: 340.
1987. *Dichogaster bolaui,* Julka & Senapati, *Rec. Zool. Surv. India, Occ. Paper No.* 92: 22.

**Diagnosis:** Length 20-22 mm, diameter 1.5–2 mm., 81-95 segments. Prostomium epilobic, tongue pointed and closed. Clitellum annular, xiv–xviii. Male pores minute, paired, in slightly concave grooves, on xviii at A lines; prostatic pores paired, minute, at the ends of seminal grooves on xvii and xix at A. Female pore unpaired on xiv. Spermathecal pores paired in furrows 7/8/9, at A. Genital markings absent.

**Type locality:** Bergedorf, Hamburg, Germany.

**Habitat:** Found in various habitats. Top soil which has high organic matter, compost pits, human drainage canals, rotten tannery.

**Castings:** Small round pellets heaps on soil surface.

**Economic Importance:** Useful as waste conditioner.
**Materials examined:** 2exs.: Flower garden habitat, IBG Howrah;27.ix.2012; R. Goswami coll., An4085/1 ZSI. 1ex.: Flower garden habitat, IBG Howrah; 3.x. 2013; R. Goswami coll., An-SZ52 ZSI.

**Distribution:** India: West Bengal: IBG Howrah, Kolkata, Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh.

**Outside India:** Madagascar and its adjacent islands, Germany, Pakistan, China, Japan, Sri Lanka, Bangladesh, Malay Peninsula, Myanmar, Indonesia, Philippines, Vietnam, Hainan island, Australia, some islands in the Pacific Ocean, USA, South Africa, Cape Verde Island, Comoro Island, West Indies (Haiti, Jamaica, Dominican Republic, Trinidad), Mexico, Panama, Colombia, French Guiana, Brazil, Argentina, Bolivia, Venezuela.

**Remarks:** It is originated probably from West Africa and transported throughout in India.

**Genus 6. *Eutyphoeus* Michaelsen, 1900**
1883. *Typhoeus* Beddard, *Ann. Mag. nat. Hist*., (ser. 5). 12: 219. (non Leach, 1815, *Brewster's Edin Ency*., 9(1): 97). (Type species: *Typhoeus orientalis* Beddard, 1883)
1900. *Eutyphoeus* Michaelsen, *Tierreich*, 10: 322.
1987. *Eutyphoeus* Julka & Senapati, *Rec. Zool. Surv. India, Occ. Paper No.* 92: 25.

**Diagnosis:** Lumbricine setae. Dorsal pores present. Clitellum annular. Spermathecal pores one pair,

superficial in 7/8. Female pores minute, on xiv. Male pores paired, just posterior to prostatic pores, on xvii; seminal grooves absent.

**Habitat:** Open areas under grass, flower garden and less visible in shade where grass does not grow.

**Castings:** Anal ejection forms a mud tower on soil surface, which has a central internal passage and at the top the tower is either open or covered (photo plate attached).

**Type species:** *Typhoeusorientalis* Beddard, 1883.
**Distribution:** India (from Myanmar border to the gangetic plain and west through the Himalaya, and Orissa), Bangladesh, Myanmar, Nepal, Pakistan, Vietnam.

**Key to the species of the genus *Eutyphoeus*of IBG**

1. Holandric .....2
Metandric .....3
2. Penial setae present.....*Eutyphoeus incommodus*
3. Penes short, annular .....*Eutyphoeus orientalis*
Penes elongate and tubular.....*Eutyphoeus waltoni*

**11. *Eutyphoeus incommodus* (Beddard, 1901)**
1901. *Typhoeus incommodus* Beddard, *Proc. Zool. Soc. Lond.,* 1901: 200. (Type loc. – Kolkata, West Bengal; typus amissus).
1903. *Eutyphoeus incommodus* Michaelsen, *Diegeographische Verbreitung der Oligochaten: 109.*
1987. *Eutyphoeus incommodus* Julka & Senapati, *Rec. Zool. Surv. India, Occ. Paper No.* 92: 25.

**Diagnosis:** Length 42–147 mm., diameter 4-6 mm., 92–189 segments. Prostomium combined pro/ epilobic. Lumbricine setae. Male pores paired. Female pores paired. Spermathecal pores paired. Genital markings paired.

**Type locality:** Kolkata, West Bengal, India.

**Materials examined:** 2exs.: GBThabitat, IBG Howrah; 19.xii.2012; R. Goswami coll, An4136/1 ZSI. 1ex.: Coniferhabitat, IBG Howrah;13.3.2013; R. Goswami coll, An4154/1 ZSI. 2exs.: GBThabitat, IBG Howrah; 23.vii..2014; R. Goswami coll, An-SZ157 ZSI.

**Distribution:** India**:** West Bengal: IBG Howrah, Kolkata, Bihar, Haryana, Himachal Pradesh, Orissa, Punjab, Rajasthan, Uttar Pradesh.

**Outside India:** Pakistan.

**12. *Eutyphoeus orientalis* (Beddard, 1833)**

1833. *Typhoeus orientalis* Beddard, *Ann. Mag. nat. Hist*., (ser. 5). 12: 219 (Type loc.–Kolkata, West Bengal, India; typus amissus)
1938. *Eutyphoeus orientalis* Gates, *Rec. Indian Mus*., 40: 98.
1966. *Eutyphoeus orientalis Soota, Rec. Zool. Surv. India,* 64: 179.

**Diagnosis:** Length 130-250 mm., 5-10 mm., 130-217 segments, Clitellum xiv –xvi. Prostomium pro/ tanylobic. Genital markings paired, segmental. Spermathecal pores small. Female pore single, on left side. Male pores discharge into paired vestibula (bivestibulate) opening onto the body surface through circular to transversely elliptical or slit-like apertures in *ab*. Penes short and annular, each pennis on the roof of a deep vestibulum.
**Type locality:** Kolkata, West Bengal, India.

**Material examined:** 3exs.: Bamboo habitat, IBG Howrah; 30.vi.2012; R. Goswami coll, An4038/1 ZSI. 1ex.: GBThabitat, IBG Howrah; 19.9.2013; R. Goswami coll, An-SZ40 ZSI.

**Habitat:** Recorded from pasture soils (Soota, 1970). It occurs from June to September, during monsoon season.

**Castings:** Deposits slender thread form tower like casts.

**Distribution:** India: West Bengal-IBG Howrah, Kolkata, Bihar, Uttar Pradesh.

**Outside India:** Bangladesh.

**Remarks:** Species is abundant in Uttar Pradesh.

**13. *Eutyphoeus waltoni* Michaelsen, 1907**
1907. *Eutyphoeus waltoni* (in part) Michaelsen, *Jb. hamb. wiss. Anst*., 24: 179. (Type loc. – Mainpuri, Uttar Pradesh, India; types in Zoological Survey Of India, Kolkata)
1907. *Eutyphoeus bengalensis* Michaelsen, *Jb. hamb. wiss. Anst*., 24: 183. (Type loc.-Saraghat, Bangla Desh; types in Zoological Survey Of India, Kolkata & Hamburg Museum.)
1923. *Eutyphoeus waltoni* (in part) Stephenson *Fauna Br. India*, *Oligochaeta*: 455.
1966. *Eutyphoeus waltoni, Soota, Rec. Zool. Surv. India,* 64: 179.

**Diagnosis:** Length 53–230 mm, diameter 4–8 mm., segments 115–201. Prostomium pro-or tanylobic. Clitellum annular. Male pores at *ac* opening onto the body surface through circular apertures or transverse slits, discharge into deep, well–like paired vestibula

(bivestibulate). Peneelongated, tubular, 1 mm. long. Female pore single on the left side of xiv. Genital markings paired.

**Type locality:** Mainpur, Uttar Pradesh, India.

**Material examined:** 1ex.: Flower garden habitat, IBG Howrah; 19.9.2013; R. Goswami coll, An-SZ35 ZSI. 5exs.: Flower garden habitat, IBG Howrah; 23.vii.2014; R. Goswami coll, An-SZ152 ZSI.
**Habitat:** Garden, flower bed, cultivated land.

**Castings:** Threaded tower like cast. This species gives large castings among *Eutyphoeus* genus in Bengal and Bihar (Roy, 1958).

**Distribution:** India: West Bengal-IBG Howrah, Kolkata, Bihar, Gujarat, Himachal Pradesh, Madhya Pradesh, Punjab, Uttar Pradesh.

**Outside India:** Bangladesh.

**Remarks:** This species has bioluminescence.

**Order MONILIGASTRIDA**
**Family MONILIGASTRIDAE**

**Genus 7. *Drawida* Michaelsen 1900**
1886. *Moniligaster* (in part), Beddard, *Ann. Mag. nat. Hist*., (ser. 5). 17:94. (Type species: *Moniligaster barwelli* Beddard).
1900. *Drawida* Michaelsen, *Das Tierreich*, Berlin, 10: 114
1923. *Drawida* Stephenson, *Fauna Br. India, Oligochaeta*: 124.
1987. *Drawida* Julka & Senapati, *Rec. Zool. Surv. India, Occ. Paper No.* 92: 37.
**Diagonosis:** Male pores paired at or near inter segmental furrow 10/11; female pores paired, at or just posterior to inter segmental furrow 11/12; spermathecal pores paired, at or close to 7/8. Clitellum in x – xiii.

**Type species:** *Moniligaster barwelli* Beddard, 1886.

**Distribution:** India, Borneo, China, Indo–China, Japan, Java, Korea, Malay Peninsula, Manchuria, Myanmar, Nepal, Philippines, Siberia, Sri Lanka (?), Sumatra, Thailand.

**Remarks:** The family is represented in West Bengal by a single genus *Drawida* and a single species *D. nepalensis* .

**14*. Drawida nepalensis* Michaelsen 1907**
1907. *Drawida nepalensis* Michaelsen, *Mitt. naturh. Mus. Hamb.*, 24: 146. (Type loc. – Gowchar, Nepal; typus amissus).
1909. *Drawida burchardi,* Michaelsen, *Mem. Indian Mus*., 1; 149.
1961. *Drawida nepalensis* Gates, *J. Burma res. Soc. 50th Anniv. Pub. No*. 1: 57 .
1982. *Drawida nepalensis* Julka, *Rec. Zool. Surv. India,* 80: 147.

**Diagonosis:** Length 74–133mm., diameter 3–4 mm., 136–177 segments. Clitellum ix–xiv. Setae lumbricine. Male pores paired, in furrow 10/11. Female pores at b in 11/12. Spermathecal pores paired.

**Type locality:** Gowchar near Kathmandu, Nepal.

**Material examined:** 15exs.: Keorahabitat, IBG Howrah; 21.vii.2012; R. Goswami coll, An4058/1ZSI. 5exs.: Conifer habitat, IBG Howrah; 11.xi.2013; R. Goswami coll, An-SZ70 ZSI. 1ex.: Conifer habitat, IBG Howrah; 23.vii.2014; R. Goswami coll, An-SZ150 ZSI.

**Habitat:** Cultivation field, soils rich with organic nutrient like bamboo leaf litter, flower gardens, forests.

**Distribution:** India: West Bengal: IBG Howrah, Kolkata, Andaman & Nicobar Islands; Arunachal Pradesh; Assam; Bihar; Himachal Pradesh; Jammu & Kashmir; Meghalaya; Sikkim; Uttar Pradesh.

**Outside India:** Bangladesh, Indonesia, Myanmar, Nepal, Pakistan.

**Remarks:** This species is useful in vermiculture.

**References**
**Bandyopadhyay, P.K., C.K. Mandal and A.K. Mitra (2008).** Earthworms of North 24 Parganas West Bengal *Rec, Zool. Surv. India*. 108 (Part -3): 21- 25.

**Beddard, F.E. (1883).** Note on some earthworms from India. *Annals and Magazine of Natural History* (Series 5) 12: 213-224.

**Beddard, F.E. (1900).** On a new species of earthworm from India belonging to the genus Amyntas. *Proceedings of the Zoological Society of London* 1900: 998-1002.

**Beddard, F.E. (1902).** On two new earthworms of the family Megascolecidae. Annals and Magazine of Natural History (Series 7) 9: 456-463.

**Biswas S.K., G.C. Ray, C.K. Mandal and A. Misra (2008).** Record and abundance of Earthworms at Ballavpur Wildlife Sanctuary Birbhum West Bengal Rec. zool. Surv. India: l08 (Part-3) : 97-108,

**Blakemore, R.J. (2010).** Cosmopolitan earthworms–an eco-taxonomic guide to the peregrine

species of the world, 4th edition. Computer CD guide. Pages 850+ ~350 Figs.

**Chowdhury, A. and A.K. Hazra (2008).** Occurrence of the Earthworm *Perionyx simlaensis* (Michaelsen) from West Bengal. *Journal of Threatened Taxa*.

**Chowdhury, A. and A.K. Hazra (2009).** Earthworm fauna of Bibhutibhusan Sanctuary, West Bengal. *Bionotes ,* Vol. 11 No. 1 pp. 16.

**Chowdhury, A., A.K. Hazra and A.P. Nandi (2010).** New record of the earthworm *Drawida papillifer papillifer* Stephenson from West Bengal, India. *Journal of Threatened Taxa* 2(2): 716-717.

**Gates, G.E. (1937).** Indian earthworms. I. The genus Pheretima. *Records of the Indian Museum* 39: 175-212.

**Gates, G.E. (1945a).** On some Indian earthworms. II. J.R. *Asiat. Soc. Beng* . 11: 54-91.

**Gates, G.E. (1945b).** On some Indian earthworms. *Proc. Indian Acad. Sci.* (B) 21: 208-258.

**Goswami, R. and C.K. Mandal (2014).** Earthworms of South 24 Parganas with ecological notes. *Rec. Zool. Surv. India.* 114 (Part-4) 681-686.

**Halder, K.R. (1998).** Annelida: Oligochaeta: Earthworms. In: State Fauna Series3 (Zoological Survey of India): Fauna of West Bengal 10: 17-93.

**Halder, K.R. and J.M. Julka (1967).** On the occurrence of Pheretimapeguana (Rosa) (Oligochaeta: Megascolicidae) from Kolkata. *Current Science* 36(17): 467.

**Julka, J.M. (1975).** Notes on the earthworms from Darjeeling district, with descriptions of two new species. *Mitteilungen Aus Dem Zoologischen Museum in Berlin* 51(1):19-27.

**Julka, J.M., R. Paliwal, and P. Kathireswari (2009).** "Biodiversity of Indian earthworms-an overview," in Proceedings of Indo-US Workshop on Vermitechnology in Human Welfare, C. A. Edwards, R. Jayaraaj, and I. A. Jayraaj, Eds., pp. 36–56, Rohini Achagam, Coimbatore, India.

**Michaelsen, W. (1900).** In: *Das Tierreich 10: Vermes, Oligochaeta*. Friedländer & Sohn, Berlin. Pp. xxix+575, figs. 1-13.

**Michaelsen, W. (1907).** *NeueOligochaeten von Vorderindien, Ceylon, Birma und der Andaman Inseln. Jahrbuch der Hamburg ischen Wissenschaftlichen Anstalten 24:143-188.*

**Michaelsen, W. (1910).** Die Oligochaeten fauna der Vorder-indischceylonischen Region. Abhandlungen aus dem Gebiete der Naturwissenschaften, Hamburg 19 (5): 1-108.

**Perrier, E. (1872).** Récherches pour sevir á I' histoire des Lombriciensterrestres. Nouvelles archives du Mu seumd' Histoire Naturelle, Paris 8: 5-198.

**Reynolds, J.W. and D.C. Cook (1993).** *Nomenclatura Oligochaetologica Supplementum Tertium: A Catalogue of Names, Descriptions and Type Specimens of the Oligochaeta*. Saint John, Canada: New Brunswick Museum Monographic Series (Natural Science) No. 9.

**Sharma, R.N., J.K. Mazumder, G.C. De and C.K. Mandal (2008).** Studies of earthworm population in saline and non saline soils of Midnapore and Barddhaman districts of West Bengal. Rec. zool. Surv. India: I08 (Part-3) : 49-54

**Sinha, R.K. (2009).** Earthworms: the miracle of nature (Charles Darwin's'unheralded soldiers of mankind & farmer's friends'). *Environmentalis*t 29: 339-340.

**Soota, T.D. and K.R. Halder (1977).** A new locality of *Metaphire californica* (Kinberg, 1867) (Oligochaeta: Megascolecidae) from Kalimpong, Darjiling district, West Bengal. *Newsletter of the Zoological Survey of India* 3(3): 129.

**Stephenson, J. (1916).** On a collection of Oligochaeta belonging to the Indian Museum. *Records of the Indian Museum* 12: 299-354.

**Stephenson, J. (1917).** On a collection of Oligochaeta from various parts of India and further India. *Records of the Indian Museum* 13: 353-416.

**Stephenson, J. (1923).** *Oligochaeta The Fauna of British India including Ceylon and Burma*. Taylor and Francis Ltd., London, xxiv + 518pp

**Stephenson, J. (1930).** The Oligochaeta. Clarendon Press, Oxford, 978pp.

**Stephenson, J. (1931)**. Description of Indian Oligochaeta. II. *Rec. Indian Mus* . 33:173-202