

# FIRST RECORD OF OCNERODRILID EARTHWORM FROM SELECTED REGION OF THE GANGETIC PLAIN OF BIHAR, INDIA

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## KEYWORDS

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## ABSTRACT

Owing to nonavailability of any report on earthworms belonging to family Ocnerodrilidae, the present survey was conducted in the Gangetic plain region of Bihar. A single species *Ocnerodrilus occidentalis* Eisen was recorded during the survey representing the genus *Ocnerodrilus* Eisen of the family. This species has been reported from different parts of India. The paper deals with details of its diagnosis.

## INTRODUCTION

Fragoso and Rojas (2009) and Hernandez-Garcia *et al.*, (2018), reviewed the widespread Ocnerodrilidae family, which consists of 37 genera and 172 species with 9 cosmopolitan species, and provided keys to the genera known until then. Gates (1972) and Fragoso and Rojas (2009) proposed two sub-families as Ocnerodrilinae and Malabariinae. Gates in 1966 while revising the families and genera had defined and expanded Ocnerodrilinae which is more specious and wider spread, while the proposed other subfamily Malabariinae includes species only from India, China and Myanmar (Fragoso and Rojas, 2009) which are without extramural glands and internal calciferous lamellae.

The species of sub family Malabariinae Gates (1966) by absence of 'ocnerodriline diverticula' indicates towards a different origins, which according to Blakemore (2013) shows probability of being elevation to separate family status. Gates (1942, 1979) has also suggested that the family Ocnerodrilidae to be considered as closest to ancestral forms and also a more primitive sibling group of the Megasclecoidea.

South and Central America, sub-Saharan Africa and India are the regions where all the endemic genera belonging to family Ocnerodrilinae are confined. A large number of new species and several new genera have been recently found in Brazil (Hernandez-Garcia *et al.*, 2018; James *et al.*, 2023). Nine genera are reported from Africa and five from Asia (India, China and Myanmar). Many genera have been reported from

wetlands of Southern Brazil. Some of the Brazilian genera are quite resistant to disturbance and occur in cropland with intensive agricultural practices in Southern Brazil (Lima and Rodriguez, 2007; Bartz *et al.*, 2013, 2014; Ferreira *et al.*, 2023).

As reported by Misirlioglu *et al.*, (2023) nine widespread anthrochorous ocnerodriles namely *Eukerria eiseniana* (Rosa), *Eukerria kuekenthali* (Michaelsen), *Eukerria saltensis* (Beddard), *Eukerria stagnalis* (Kinberg), *Gordiodrilus elegans* (Beddard), *Gordiodrilus habessinus* (Michaelsen), *Gordiodrilus paski* (Stephenson), *Nematogenia lacuum* (Beddard), and *Ocnerodrilus occidentalis* (Eisen) have been recorded. These species are not semi aquatic forms but usually occur in wet or saturated soils which are near to water sources. The presence of many parthenogenetic morphs in some species like the present one *O. occidentalis* has extensive synonymies which needs to be examined (James *et al.*, 2023). The use of molecular methods will now certainly play an important role in settling the issue. *Ocnerodrilus occidentalis* Eisen, has been extensively studied taxonomically. Similar to *O. occidentalis* further work is warranted on the poorly known ocnerodriles, particularly using more detailed genetic methods, in order to confirm the presence of potential cryptic species (Fragoso and Rojas, 2009). *Ocnerodrilus occidentalis* Eisen, has been found from different locations in Jharkhand (Srivastava *et al.*, 2003; Srivastava and Sinha, 2004; Sinha *et al.*, 2002, 2003, 2008, 2013) and also from different parts of India like Punjab (Dhiman and Battish, 2006), Rajasthan

(Tripathi and Bhardwaj, 2004, Kumar *et al.*, 2021), Odisha (Julka and Senapati, 1987), Uttarakhand (Joshi *et al.*, 2010), Jammu and Kashmir (Julka and Paliwal, 2005), Kerala (Narayanan *et al.*, 2014) and Himachal Pradesh (Ahmed *et al.*, 2020).

The review of literature revealed that there is no report and systematic account on the earthworms belonging to the family Ocnerodrilidae from the Gangetic plain of Bihar till date. Keeping the gap of information in background the survey was made and the communication deals with for the first time taxonomic details of the species of the family.

## MATERIALS AND METHODS

Some 27 randomly selected locations in the Gangetic plain, spread over few districts (Srivastava *et al.*, 2021, 2022), were selected for periodic earthworm sampling. Earthworms were sampled by monolith method by digging the soil in a particular geometry up to a depth of 25 cm (Sinha and Srivastava, 2001). The earthworms so collected were hand sorted (Sinha and Srivastava, 2001; Sinha *et al.*, 2013) and preserved in 70% alcohol and some in 4% formaldehyde solution with addition of some amount of glycerine. Apart from collection by monolith method, earthworms were also searched under litter beds in forest and orchard floor by cleaning the fallen litters, twigs and bark pieces. The garbage sites were searched by spreading the garbage heaps. From each sampling point where earthworms were found, some soil samples were collected and brought to laboratory for their physio-chemical analysis. Soil temperature and pH and was recorded by soil thermometer and portable digital pH meter respectively; for estimating moisture content the oven drying method was applied while Walkley and Black (1934) method was adopted for total organic matter (TOM) and organic carbon (OC) content estimation.

## RESULTS

The physico chemical characteristics of soils collected from sampling sites are shown in Table 1. The physio-chemical profile of the samples depicted the alkaline nature of soil with moderate or low amount of total organic matter and organic carbon. Soil moisture was never recorded to be less than 25% where earthworms were found. Sandy loam type of soil was found.

A single species belonging to family Ocnerodrilidae have been identified.

Genus *Ocnerodrilus* Eisen

**Diagnosis.** Setae Lumbricine. Male pores on *xvii*; a pair of prostatic pores, combined with male pores, on *xvii*, seldom a second pair on *xviii*; male genitalia degraded due to parthenogenesis in some species. Oesophagus without gizzard, but with a pair of extramural calciferous glands in *ix*; intestinal caeca, supra-intestinal glands and typhlosole absent.

**Distribution.** Tropical America and Tropical Africa. Peregrine species transported to several parts of the world.

*Ocnerodrilus occidentalis* Eisen (Plate 1 and Figure 1)

1878. *Ocnerodrilus occidentalis* Eisen, *Nova Acta R. Soc. Sci. Upsaliensis*, 3. **10(4)**: 218 (Type locality: California, U.S.A.); Stephenson, 1923, *Fauna Br. India, Oligochaeta*: 484-485; Gates, 1972, *Trans. Am. Phil. Soc.*, **62(7)**: 273; Gates, 1973, *Bull. Tall Timbers Res. Stat.*, **14(7)**: 14.

**Diagnosis.** Length 12-69 mm, diameter 1-2 mm, 70-84 segments. Epilobitic prostomium, tongue open, sometimes closed. Annular clitellum, *xiii*, *xiv-xix*, *xx*. Setae *aa = bc*, *dd = 1/2 C*. Paired male pores (combined with prostatic pores), minute, at centres of whitish porophores on *xvii*, each porophore lateral to *b*. Paired female pores, on *xiv*, at or slightly lateral to *b*. Absence of spermathecal pores and genital markings.

Septa present from 4/5, 7/8-10/11 slightly muscular. Intestine begins in *xii*. Testes holandric, and male funnels free, in *x* and *xi*; seminal vesicles absent. Prostates paired, in *xvii*, sometimes extending to *xviii-xxx*. Spermathecae absent.

**Distribution.** India: Bihar (S1, S2, S3, S4, S5), Rajasthan, Uttarakhand, Punjab, Jharkhand, Kerala, Orissa, Himachal Pradesh, Andaman Islands. Burma, Pakistan, Sri Lanka, U.S.A., Mexico, Denmark, Italy, Greece, Cape Verde island, Rhodesia, Southwest Africa, Great Comoro island, Central Asia, Singapore, China, Japan, Philippine islands, British Solomon island.

**Material Examined.** 5 mature worms.

**Remarks.** *Ocnerodrilus occidentalis* is polymorphic. It is known for parthenogenetic morphs without spermathecae and seminal vesicles. Morphs with degraded male terminalia in various forms (absence of testes, male gonoducts, prostates and male pores) have also been recorded.

**Habitat.** Found in a wide range of moist habitats in alkaline sandy loam and clay loam soils specially in lowland and upland pastures, crop fields, compost pits and sewage.

**Biology.** A maximum population of about 7600 m<sup>2</sup> from a protected upland pasture has been recorded by Sinha *et al.*, (2003), while Dash and Patra (1977) and Senapati (1980)

**Table 1. Sampling centre with their latitude and longitudes and some edaphic characteristics.**

District	Sampling sites	Latitude	Longitude	pH (M ± SD)	Moisture content (M ± SD)	OM (M ± SD)	OC (M ± SD)
Vaishali	Minapur (S1)	25.74°N	85.199°E	7.7 ± 0.61	28.5 ± 2.28	7.9 ± 0.063	4.6 ± 0.036
	Panapur (S2)	25.66°N	85.27°E	7.2 ± 0.57	25.3 ± 2.02	7.4 ± 0.059	4.3 ± 0.034
Saran	Dighwara (S3)	25.74°N	85.01°E	7.2 ± 0.57	27.4 ± 2.19	7.4 ± 0.059	4.3 ± 0.034
	Salhadi (S4)	25.736°N	85.037°E	7.9 ± 0.63	27.1 ± 2.16	6.2 ± 0.049	3.6 ± 0.028
	Minapur (S5)	26.34°N	85.60°E	7.8 ± 0.62	26.8 ± 2.14	7.2 ± 0.057	4.2 ± 0.033

pH in unit; moisture in percentage; Organic matter (OM) and Organic carbon (OC) in mg g<sup>-1</sup> soil



Plate 1: *Ocnerodrilus occidentalis*

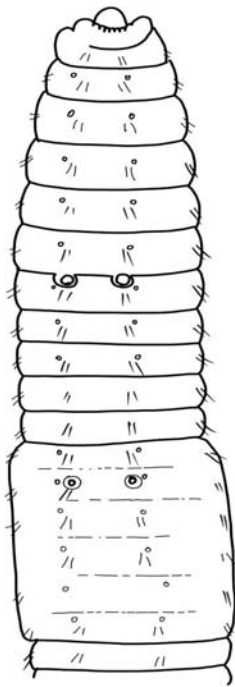


Figure 1: *Ocnerodrilus occidentalis* Eisen, Ventral view of anterior segments

observed about 550 m<sup>2</sup>. Clitellate worms are available during the rainy season and juveniles are abundant during the post-rainy season period. Reproduction by parthenogenesis is suspected, as cocoons were not observed in the field as well as in the laboratory cultures. This species undergoes diapause at low soil moisture (< 15g%).

## DISCUSSION

India, including sub-Saharan Africa and South and Central part of America, is considered as region of confinement of endemic genera of Ocnerodrilinae earthworms. The family Ocnerodrilidae has been considered as closest to ancestral forms and also a more primitive sibling group of the Megascolecoida (Gates 1942, 1979; Blakemore, 2013). *Ocnerodrilus occidentalis* is moisture saturated soil dwelling species. It is an endogeic and peregrine species.

But the occurrence of a species of earthworms in a particular climoedaphic condition depends on nature of soil

characteristics and conditions of climate change (Gastine *et al.*, 2003). Their mode of distribution in the soil are various. The significance of diverse soil habitats is one of the most influencing factors affecting the overall earthworm distribution (Rajkhowa *et al.*, 2014; Soro *et al.*, 2019). This applies with *Ocnerodrilus occidentalis* as well, as a single species has been recorded which indicates influence of all these factors.

Habitat preference of various earthworm species of earthworms have been studied and also considered as a factor influencing their occurrence and distribution (Scullion and Malik, 2000). The species-specific distribution of earthworms in ecosystems like the presence of a species in a particular habitat and its absence from other habitats has been credited to variability of habitat in specific characteristics (Tripathi and Bhardwaj, 2004; Soro *et al.*, 2019). These specific characteristics affecting distribution of earthworm communities include the physico-chemical characteristics of the soil and environmental factors such as moisture, temperature, pH and soil texture also (Fokam *et al.*, 2016). Changes in land use patterns have also directly affected the composition and population structure of earthworm communities in different agroclimatic regions. The Gangetic plain comes under intensive agricultural practice zone. It seems one of the probable reason of encounter of single species of the family.

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