

Recorded Distribution of Earthworms of the Family Octochaetidae In Dakshina Kannada District, South West Coast, Karnataka

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Abstract- A systematic survey on earthworm species diversity from Dakshina Kannada district, Karnataka state, India, has been conducted for the first time between January 2007 to December 2008. The study constitute mainly from Mangalore, Bantwal, Belathangady, Puttur and Sullia talukas. Habitat such as Banana plantation, Cashew plantation, Areca plantation, Vegetable garden, paddy fields were surveyed. Morphometric details of all the earthworms collected in the study area were recorded and species were identified. The study has revealed total of 11 species belonging to the family Octochaetidae in the order Haplotoxida. Species distribution pattern, their richness and habitat specificity have been studied and discussed in the paper.

Index Terms- Earthworms, Distribution, Octochaetidae, Dakshina Kannada, South West coast, India.

I. INTRODUCTION

Earthworms are important soil invertebrates belonging to the Phylum Annelida and Class Oligochaeta. Since long earthworms have been known as “Farmer’s friend”, “Nature’s best fertilisers” and “Intestine of earth”. Earthworms includes 3 orders, 4 suborders, 7 super families, 27 families and 8 sub families. There are about 5575 species of megadriles in the world [1]. Goto and Hatai, 1899[2], reported earthworms of Japan., Zoogeography and ecology of earthworms. Carpathian Mountains in Poland has been reported [3]. Reynolds (1994a)[4] and Reynolds *et al.* (1995b)[5], recorded earthworms from Bangladesh. Reynolds 1995[6] reported the status of exotic earthworm systematic and biogeography in North America. Distribution of earthworms in the north west of Iberian peninsula has been recorded [7]. While Reynolds and Wetzel (2004b, 2008)[8-9] reported all earthworms in North America including Mexico, Bermuda, Hawaii and Puerto Rico. Earthworms and their distribution in New Zealand has been reported [10]. Terrestrial earthworms of Singapore have been investigated by [11]. Earthworms in relation to soil property in Mexico has been studied by [12]. Biodiversity of earthworms of Pakistan have been reported by [13]. Diversity and distribution of terrestrial earthworms from Thailand were recorded by [14].

The earliest record on Indian earthworms was done by [15] from western Himalayan region. A comprehensive checklist of earthworms of Indian subcontinent was prepared by [1]. Even

though many parts of the country has not been explored for the study of earthworms many areas. Taxonomic work on Indian earthworms have been carried out by [16, 17, 18; [19]; [20]; [21]; [22]; [23]; [24]; [25]; [26]. Dhiman and Battish, 2006 [27], reported the habitat and taxonomic characters of some earthworm species of the Punjab. Checklist of 51 earthworms of Western Himalaya was listed by [28]. The earthworm diversity of the Western Ghats is very fragmentary [29]; [30, 31, 32, 33, 34; [35]; [36], [37]; [24]. Diversity and distribution of earthworm in Uttarakhand, was done by [38]. However, these efforts have yielded several endemic species of earthworms from different parts of the Western Ghats. However, there is a very limited data on diversity analysis including the species distribution pattern and abundance from different regions of Karnataka in general and D.K. district in particular. Terrestrial earthworms of Singapore have been investigated by [39]. Blakemore, 1994[40] compiled a list of about 1600, mainly ecological reference for the period 1970-1990. Ghafoor and Qureshi, 1999 [41] listed the fauna of a few localities in Pakistan.

There are only few studies pertaining to the species diversity, distribution pattern, habitat preference, endemic and threat status in India. Eastern Himalayas [42]; [43]; South India [44], [45]; Andaman and Nicobar islands [46], [47], [20], [48], [49], [50], [28] and [27]. Batish and Dhiman, 2002 [51], reported the habitat and taxonomic characters of some earthworm species of Punjab. Earthworm population dynamics was studied in a cultivated soil in central Himalayan Tarai by [52]. Distribution pattern of earthworm fauna in Pandicherry region and its population densities were studied by [53]. Earthworms of Dakshina Kannada district of Karnataka state have not been investigated systematically [20]; [37]; [26]; [54].

In recent years, the diversity of Indian earthworms has been mainly studied by [16]. 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. Begum and Ismail, 2004, [55] collected 5 species of earthworms belonging to family Octochaetidae, the genera *Dichogaster* and *Octochaetona* in around Chennai, Tamil Nadu. The knowledge on the earthworm fauna of India has also been enriched by [56], [57], [58], [28]. Kathireswarriet *et al.*, 2005 [59], reported about 19 species of earthworms of Octochaetidae and present study includes *Celeriella duoedecimalis* and *Hoplochaetella* suctoria from Tamil Nadu. *Dichogaster affinis* (Michaelson, 1890 [60]), is a cosmopolitan earthworm widely distributed in the tropical and

temperate regions around the world [61]. It has been reported from India [62], Burma (= Myanmar)[63]; [62], Thailand [64], [62], Cambodia, Laos, Vietnam [1], Hainan Island [65], Sumatra, Flores [66], Australia [67], New Caledonia [62], Pacific Islands [61], Mexico [68], Central America, Brazil, Africa, Madagascar [62], and Canary Islands [69]. Shen, et al., 2008 [70]

recorded *Dichogaster affinis* as a new record from the Centro Western Taiwan.

II. STUDY AREA

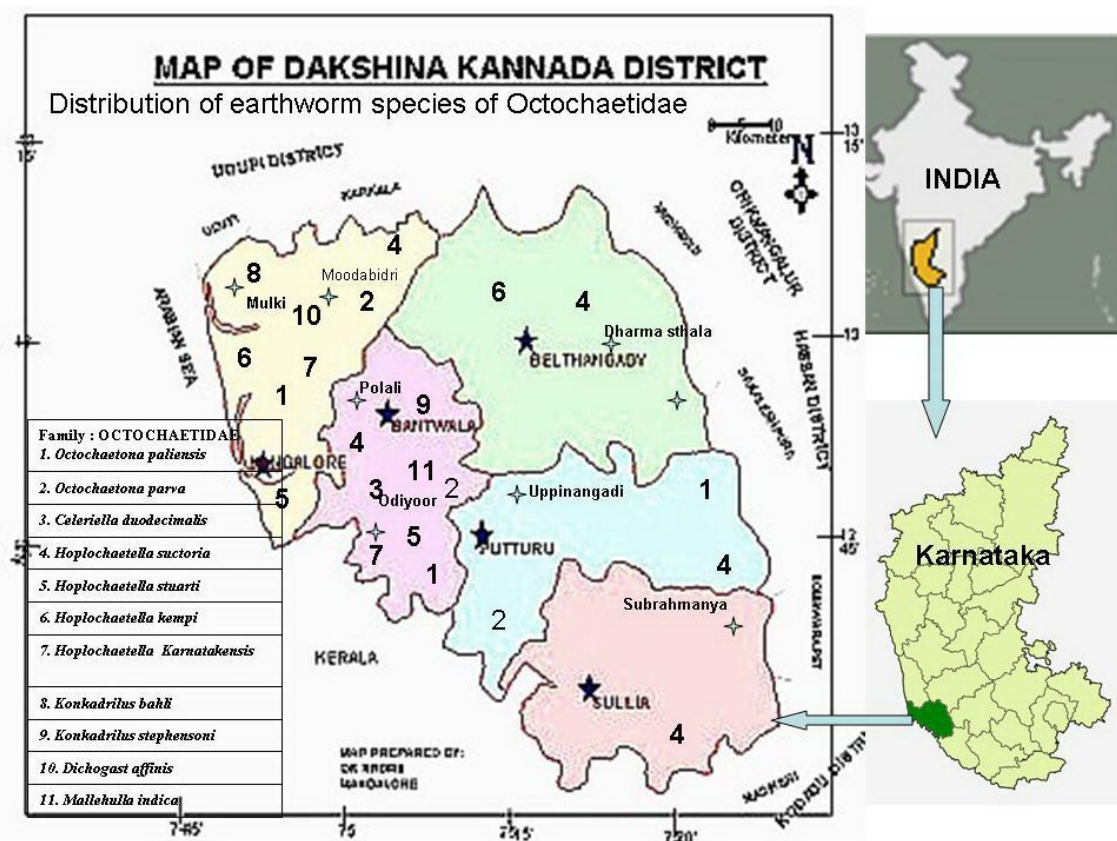


Fig. 1 Map of study area

Dakshina Kannada is an important district of Karnataka state situated on the western coast of India. It is long narrow strip of territory and from east to west it is broken low plateau, which spreads from the western ghats to the Arabian sea. Dakshina Kannada district has an area of 4866 square kilometer which stretch from 12° 57' and 13° 50' north latitude and 74° & 75° 50' east longitude. The district is divided into 5 taluks Mangalore, Bantwal, Belthangady, Puttur and Sullia. It is bordered by Udupi District to north, Chikkamangaluru district to north east and Kasaragod district in Kerala to the south. The Arabian sea bounds it on the west. Mangalore is the head quarters and chief city of the district(Fig.1). The climate of the district shares the wider climatic pattern of the other West Coast districts of India. It is characterized by excessive humidity (78%) during the greater part of the year.

plantation, vegetable garden, areca plantation, banana plantation, cocoa and rubber plantations, flowering gardens and few lentic and lotic water bodies have been selected for earthworm species collection. Sampling were done in triplicate using the quantitative modified hand sorting standard methods of surface 30x30cm area. Later, soil was excavated up to 30 cm depth in each sampling point and available earthworms were collected. Specimens were fixed in 30% alcohol for about 2 minutes for anesthetizing and then transferred to 10% formalin solution for permanent preservation. Earthworms were dissected out immediately after alcohol treatment to study the internal anatomical features for identification. The specimens were deposited in the department museum. Earthworms were identified with the help of monographs and other available literature on the subject [33][62][17] and [1].

III. MATERIALS AND METHODS

A systematic earthworm species diversity survey was conducted at regular interval between January 2007 to December 2008 in the study area. Habitat such as coconut

IV. RESULTS AND DISCUSSION

Earthworm survey conducted in 5 different taluks of Dakshina Kannada District revealed occurrence of 5 genera and 11 species belonging to family Octochaetidae collected from

different habitats such as forest litter, Banana, Areca, Cashew plantations, vegetable gardens and edges of rivers. Species such as *Octochaetona paliensis*, *O. parva*, *Celeriella duodecimalis*, *Hoplochaetella suctoria*, *H. stuarti*, *H. kempfi*, *H. Karnatakensis*, *Konkadrilus bahli*, *K. stephensoni*, *Dichogaster affinis* and *Mallehulla indica* were collected from the study area and comprises 7.14% species (154 species Indian Octochaetids-Julka, 1988 [17]. Systematic seasonal data has shown that in Mangalore, Belthangady and Bantwal taluk, the density of earthworms was found to be very rich. *Octochaetona paliensis* and *Octochaetona parva* are more abundant in agricultural habitat of both Mangalore and Bantwal taluk. *Celeriella duodecimalis* collected from residential area of Bantwal taluk only. *Hoplochaetella suctoria* and *Hoplochaetella stuarti* were abundant in all 5 taluks collected from the habitat such as vegetable gardens and garden leaf litter. *Hoplochaetella kempfi* were abundant in banana plantation of Belthangady taluk. *Konkadrilus bahli* was collected from paddy field of Mangalore and Belthangady talukas and *Konkadrilus stephensoni* was collected from cashew plantation and manure heap only from Bantwal taluk. *Mallehulla indica* was abundant in garden leaf litter and cashew plantation of Mangalore and Puttur taluks. *Dichogaster affinis* was collected in areca nut and coconut plantations of Mangalore and Puttur taluks.

Julka, 1988 [17], reported 18 species of earthworms belonging to the genera *Hoplochaetella* from different places of India and Blakemore, 2006 [1] based on work of Stephenson, 1923 [33], Julka, 1988 [17], Kathireswari et al., 2005 [59], listed 19 species of *Hoplochaetella*. Present study recorded 4 species such as *H. suctoria*, *H. stuarti*, *H. kempfi* and *H. Karnatakensis*. Of these *H. suctoria* has been reported from Goa and Karnataka (Moodabidri) and *H. stuarti*, recorded from Tamil Nadu and Nandi Hills of Karnataka. *H. suctoria* and *H. stuarti* are identical in appearance of suckers but clitellum is indistinct in *stuarti*. Likewise spermathecae is polydiverticulate in *stuarti* and *suctoria* but is bit shorter in *suctoria*. Two new species, *bahli* and *lavellei* of *Hoplochaetella* were also reported by [71]. Six species of *Konkadrillus* reported by [17] and [1], from India. Present study also recorded *K. bahli* and *K. stephensoni*. *K. bahli* which has been also reported from Goa and Karnataka and *K. stephensoni* recorded from Karnataka (Kotegehar, Tirthahalli, Castle rock). Two new species, *K. shimogensis* and *K. gatesi* reported by [71]. 15 species in the genera *Octochaetona* were recorded by Julka, 1988 [17] and included in the check list prepared by Blakemore, 2006 [1] from India. Present study reported 2 species namely *Octochaetona paliensis* and *O. parva* which has been reported earlier from Andhra Pradesh (Nellore, Ongole). Julka, 1988 [17] reported 7 species of earthworms belonging to genera *Celeriella* from Tamil Nadu, Andhra Pradesh and present study recorded *Celeriella duodecimalis*. About 6 species of *Dichogaster* (*Diplotheocodrilus*) were reported from India [17], from Bangladesh [72], America [73] [1], Tamil Nadu [24], and the present study reports *Dichogaster affinis* from south India. In the genus *Mallehulla* only one species *Mallehulla indica* was reported from Karnataka [37] and Maharashtra [17]. The same species has been recorded in the literate soil with pH 6 under decaying leaves of *Mangifera indica* and *Colocasia* sp. at Bantwal taluk.

V. TAXONOMY

Octochaetona paliensis (Stephenson, 1920) (Fig. 2).

Octochaetona paliensis Stephenson, 1920; *Octochaetetus phillotti* Michelsen, 1907; *O. paliensis* Stephenson, 1920; *O. paliensis* var *riparius* Stephenson, 1920; *O. ganeshe* Stephenson 1923; *O. paliensis* var *riparius* Stephenson, 1923; *O. phillotti* Stephenson, 1923; *O. paliensis* Gates, 1962.

Diagnosis: Length: 92-110 mm; Width: 4-5 mm; Segments: 129-198 with much secondary annulation in pre-clitellar region after 5; Colour: unpigmented; Prostomium: open epilobous; Setae: lumbricine, 8 per segment; Clitellum: annular, bright yellow orange brown in 13-17 segments, setae retained, furrows obscured; Male pores: a distinct bilateral folds in a circular hollow cavity at 1/2 17-1/2 19 regions, probably on 18, in seminal grooves which run vertically from slight prostatic porophores on 17 and 19; Female pores: paired antero-ventral depressed groove on 14; Spermathecal pores: two pairs, intra-segmental, mid-ventral in 8 and 9 in small co-joined pad-like papillae; Spermathecae: clavate ental diverticulum; Testes and male funnel: free in 10 and 11; Nephridia: numerous micro mesonephroid in each segment; Genital markings: median paired on 18; Caecae: absent. Typhlosole: in 22 - 23 to 84-93.

Habitat: Agricultural - banana plantation and residential habitats-house hold area and forest leaf litter.

Distribution: Mangalore- Moodabidri; Puttur-Puttur. Earlier Reported from Madhya Pradesh, Maharashtra, Hyderabad, India (Julka, 1988) [17], Rajasthan, India (Triparthi and Bhardwaj, 2004) [74]. This is the first record from Karnataka.

Remarks: Octochaetids are referred to Monogaster (African), Octochaetona (Indian), Octochaetus (Australia/New Zealand) [75].

Recorded months: June to August.

Octochaetona parva (Gates, 1945).

Octochaetoides parvus Gates, 1945; *Octochaetona parva* Gates, 1962.

Diagnosis: Length: 70-80 mm; Width: 3-5mm; Segments: 80-88; Colour: unpigmented; Prostomium: open epilobous; Setae: lumbricine, 8 per segment; Clitellum: bright yellow orange, annular: 13-17, setae retained, furrows obscured; Male pores: a circular hollow from 1/2 17 - 1/2 19; probably on 18, in seminal grooves which run vertically from slight prostatic porophores on 17 and 19; Male genital field indistinct; Female pores: paired antero-ventral depressed groove on 14; Spermathecal pores: two pairs: intra-segmental, mid-ventral in 8 and 9 in small co-joined pad-like papillae; Spermathecae: clavate ental diverticulum duct shorter than ampulla; Testes and male funnel: in 10 and 11; Seminal vesicles: in 11 and 12; Nephridia: numerous micro mero-nephridia in each segment; Genital markings: unpaired on 20/21/22; Caecae and Typhlosole: indistinct.

Habitat: Agricultural -banana plantation and residential habitats - vegetable gardens (Ladies finger)

Distribution: Mangalore-Moodabidri; Bantwal-Adyanadka, Arikepdavu, Saardka; Puttur-Puttur. Earlier Recorded from Andhra Pradesh, India (Julka, 1988) [17]. This is the second record from India. Endemic to India.

Recorded months: June to October.

Celeriella duodecimalis Michelsen, 1907.

Celeriella duodecimalis Michelsen, 1907; *Spenceriella duodecimalis* Stephenson, 1923; Stephenson, 1924; *Celriella duodecimalis* Gates, 1958.

Diagnosis: *Length:* 82-160 mm; *Width:* 2.5- 3 mm; *Segments:* 119-127; *Colour:* dorsal dark brown and ventral pale; *Prostomium:* open epilobous; *Setae:* numerous, lumbricine; *Clitellum:* annular in ½ 13-17; *Male pores:* minute, combined male pore and prostatic pores, discharging at the centres of paired, spheroidal porophores on the 18; *Female pores:* one pair in between aa line on 14; *Spermathecal pores:* minute in 7/8. *Spermathecae:* paired in 8, with a digitiform ectal diverticulum which is three-fourth as long as combined length of the duct and ampulla; *Testes and male funnels:* in 10 and 11; *Seminal vesicles:* racemose type; *Genital markings:* absent; *Caecae* and *Typhlosole:* indistinct.

Habitat: Residential habitat- flower garden soil.

Distribution: *Bantwal*-Alike, Vittal. Reported earlier from Tamil Nadu, Andra Pradesh, India (Julka, 1988 [17]; Kathireswari et al., 2005 [59]. First record from Karnataka.

Recorded months: June.

Hoplochaetella suctoria Stephenson, 1917

Hoplochaetella suctoria Stephenson, 1917; *Erythraeodrilus suctorius* Stephenson, 1923; *Hoplochaetella suctoria* Gates, 1940.

Diagnosis: *Length:* 140-210 mm; *Width:* 6-8 mm; *Segments:* 119-145; *Colour:* dorsal dark brown and ventral pale; *Prostomium:* open epilobous; *Setae:* perichaetine, numerous; *Clitellum:* annular, in 13-16; *Male pores:* combined male pore and prostatic pores minute quadriprostate on 17/18 and 18/19; *Female pores:* on 14; *Spermathecal pores:* minute, 2 pairs on 8; *Spermathecae:* 2 pairs each with a circle of 15-20 ventrally directed adherent to the duct, digitiform diverticula; *Genital markings:* without central aperture on 8 and 9; *Testes and male funnels:* in 8 and 9, enclosed in unpaired sacs, formed by the peripheral union of the septa 9/10/11/12; *Seminal vesicles:* in 9,10 and 12; *Vasa deferentia:* enclosed into ejaculatory bulbs before opening into the prostatic ducts; *Caecae:* absent; *Typhlosole:* in 22-24 to 118.

Habitats: Forest -leaf litter, agricultural -banana plantation, and residential habitats- vegetable gardens(Ladies finger)

Distribution: *Mangalore*- Konaje , Moodabidri ; *Bantwal*-Bairikatte, Kanathadka, Kanyana. Reported earlier from Karnataka and Goa, India [17]. Probably endemic South Indian species .

Recorded months: January to December.

Hoplochaetella stuarti (Bourne,1886).

Perichaeta stuarti Bourne, 1886; *Hoplochaetella stuarti* Bourne, 1887; Beddard, 1890; Michelsen, 1900; Stephenson,1923; Gates, 1940.

Diagnosis: *Length:* 100-162 mm; *Width:* 5- 6 mm; *Segments:* 100-119; *Colour:* dorsal dark brown colour ventral

pale; *Prostomium:* open epilobous, open tongue; *Setae:* numerous – perichaetine; *Clitellum:* annular with clear segments, ½ 13-16; *Male pores:* combined male pore and prostatic pores minute quadriprostate on 17/18 and 18/19; *Female pore:* on 14; *Spermathecal pores:* 2 pairs on 7 and 8 and minute; *Spermathecae:* polydiverticulate, 2 pairs each with a circle of 15-22 glove shaped diverticula, each diverticula with 6-12 digitiform seminal chambers; *Testes and male funnels* in 10 and 11, enclosed in unpaired sacs, formed by the peripheral union of the septa 9/10/11/12; *Genital markings:* indistinct; *Caecae:* 4 pairs, dorsolateral in 25; *Typhlosole:* located on 22-24 to 84-86.

Habitat: Agricultural -banana plantations, and residential habitats-garden leaf litter.

Distribution: *Mangalore*- Konaje, *Bantwal* - Kanathadaka, Kanyana. Reported only from andi hills, in Karnataka and Yercaud, in Tamil Nadu , South India [17];[59].

Recorded months: June – October .

Hoplochaetella kempii Stephenson, 1917.

Hoplochaetella kempii Stephenson, 1917; *Erythraeodrilus kempii* Stephenson, 1923; *Hoplochaetella kempii* Gates, 1940; Chapman, 1940.

Diagnosis: *Length:* 75-200 mm; *Width:* 5-6 mm; *Segments:* 98-120; *Colour:* dorsal dark red; *Prostomium:* open epilobous, tongue open; *Setae:* Perichetine numerous (39-79); *Clitellum:* annular type in 13-16; *Male pores:* combined male pore and prostatic pores minute quadriprostate on 17/18 and 18/19; *Female pores:* on 14; *Spermathecal pores:* minute, 2 pairs on 8; *Spermathecae:* 2 pairs each with a circle of 15-20 ventrally directed adherent to the duct, digitiform ental diverticula; *Testes and male funnels:* in 10 and 11 enclosed in unpaired sacs; *Vasa deferentia:* enlarged into ejaculatory ducts. *Genital markings:* oval unpaired with out central aperture lateral to male pore lines; *Caecae:* absent.; *Typhlosole:* in 22/24 to 75/99.

Habitat: Forest-leaf litter, agricultural -banana plantation and residential habitats- garden leaf litter.

Distribution: *Mangalore*-Moodabidri.; *Belthangadi*-Ujire, Bangadi, Kakkinje, Laila, Madantyar, Guruvayana kere, Punjalakatte, Ballamanja. Reported earlier from Talewadi, Moodabidri, Karnataka, India [17].

Recorded months: July to October.

Hoplochaetella Karnatakensis Julka, 1983.

Hoplochaetella karnatakensis Julka, 1983

Diagnosis: *Length:* 70-80 mm; *Width:* 3-4mm; *Segments:* 99- 103; *Colour:* dorsal dark brown, ventral pale; *Prostomium:* open epilobous; *Setae:* perichaetine, numourous; *Clitellum:* annular, ½ 13-½ 16; *Male pores:* combined male pores and prostatic pores minute quadriprostate on 17/18 and 18/19 at centre of depressed oval porophores; *Female pores:* on 14; *Spermathecal pores:* minute, 2 pairs on 8 and 9; *Spermathecae:* 2 pairs each with a circle of 15-20 ventrally directed adherent to the duct, digitiform diverticula; *Testes and male funnels:* in 10 and 11, enclosed in unpaired sacs; *Seminal vesicles:* in 9,10 and

12, *Vasa deferentia*: enlarged into ejaculatory ducts; *Genital markings* : single without central aperture on 19; *Caecae*: absent; *Typhlosole* : 13-85.

Habitat: Residential habitats-areca plant pit.

Distribution: *Mangalore*- Konaje; *Bantwal*- Alike, Bairikakatte. Reported earlier from Kemmengundi, in Karnataka, India [17]. Endemic to India.

Recorded months : July to October.

Konkadrilus bahli (Soota and Julka, 1972).

Konkadrilus bahli (Soota and Julka, 1972).

Diagnosis: *Length:* 110-140 mm; *Width:* 3mm; *Segments:* 240-260; *Colour:* pinkish orange; *Prostomium:* closed epilobic; *Setae:* lumbricine, 8 per segment; *Clitellum:* annular, ½13-17; *Male pore:* minute , on 18; *Seminal grooves* : median slightly concave between setal arcs of 17 and 19; *Female pores:* paired on 14, anteromedian to a line; *Spermathecal pores:* large, transverse slit in 7/8/9 at ab line; *Genital markings:* oval, paired on 17-19; *Spermathecae:* shortly stalked, spheroidal, ental diverticulum, duct longer than ampulla. *Genital markings:* oval, paired in 15/16/17, 19/20-23/24 at aa line; *Testes* and *male funnels:* in 10 and 11; *Caecae:* absent; *Typhlosole:* in 20-21 to 75.

Habitat: Agricultural - paddy field , near edges of river and residential habitats-banana plant pit.

Distribution: *Mangalore*-Mulki , Moodabidri . Reported earlier from Karnataka and Goa [17].

Recorded months: July to October.

Konkadrilus stephensoni (Soota and Julka, 1972).

Konkadrilus stephensoni Soota and Julka, 1972; *Howascolex stephensoni* Soota and Julka, 1972.

Diagnosis: *Length:* 90mm; *Width:* 3mm; *Segments:* 140-156; *Colour:* pinkish orange; *Prostomium:* closed epilobic; *Setae:* lumbricine, 8 per segment; *Clitellum:* annular, ½ 13-16; *Male pore:* minute, median on 18; *Female pores:* paired on 14 anteromedian; *Spermathecal pores:* minute, transverse slit on 8-9 or intersegmental in 7/8/9, at b line; *Spermathecae:* shortly stalked, spheroidal, ental diverticulum, duct longer than ampulla; *Testes* and *male funnels:* in 10 and 11; *Genital markings:* oval, paired.17-19; *Caeca:* absent; *Typhlosole:* 22-21 to 71-96.

Habitat: Agricultural -cashew plantation and residential habitats- manure heap.

Distribution: *Bantwal*- Katukukke, Adyanadka. Reported earlier from Karnataka and Goa [17].

Recorded months: June – October.

Dichogaster (Diplothecodrillus) affinis (Michelson, 1890).

Dichogaster affinis Michaelsen, 1890; *Benhamia affinis* Michelesen , 1890; *Benhamia mexicana* Rosa, 1891; *Benhamia floresiana* Horst, 1893; *Dichogaster affinis* Michelesen, 1900; Stephenson , 1917, 1923, 1931b; Gates, 1942, 1958, 1961,1972; Easton 1984; Talavera, 1992; Hendrix and Bohlen 2002;

Dichogaster sinuosus Stephenson , 1931a, 1931b; *D. sinicus* Chen, 1938. (= *Dichogaster sinensis* Chen, 1938).

Diagnosis: *Length:* 84 mm; *Width:* 2.5-3mm; *Segments:* 110- 150; *Colour:* pigmentless but anterior appears pinkish red; *Prostomium:* closed epilobus, v shaped notch; *Setae:* lumbricine, 8 per segment, small closely paired on ventrum; *Clitellum:* saddle-shaped, on13-21; *Male pores:* in tumid seminal grooves on 17 and 19; *Female pores:* paired just anterior to setae in raised pad on 14 which reaches to 13/14-14/15; *Testes* and *male funnels* : unpaired sacs in 10 and 11; *Seminal vesicles:* reduced in 11 and 12; *Spermathecal pores:* two pairs in 7/8 and 8/9, medio-ventral, in line with setae on ab. *Spermathecae:* two pairs, small each with wide duct bearing mid length on anterior wall, a short-stalked bulbous iridescent diverticula and terminating in a spherical or deformed yellowish ampulla; *Prostates:* 2 pairs in 17 and 18; *Genital markings:* not seen; *Caecae* : absent ; *Typhlosole* : in 21 to 68.

Habitat: Agricultural -arecanut plantation, coconut plantation , near edges of small streams and residential habitats-banana plant pit.

Distribution: *Mangalore*- Surathkal, Moodabidri. Reported earlier from Myanmar [62], [76]; Karnataka, Arunachala Pradesh, Kerala, in India, Sri Lanka, Myanmar, Thailand [17], Australia [40], Florida [77], Guadeloupe [78], Tamil Nadu [24], Taiwan [70], Mexico [9], Nicaragua [79].

Recorded months: June – October .

Mallehulla indica (Julka and Rao, 1982)(Fig.3).

Mallehulla indica Julka and Rao, 1982 .

Diagnosis: *Length:* 50-130 mm; *Width:* 2. 5- 4 mm; *Segments:* 100-112; *Colour:* dorsal brown colour, ventral pale; *Prostomium:* closed epilobous; *Setae:* perichaetine, numerous ; *Clitellum:* annular , ½ 13-½ 16; *Male pores:* paired in seminal grooves on 18 prostatic pores paired on 18-19; *Seminal grooves* : slightly concave between setal arcs of 17-19; *Female pore:* single median on 14; *Spermathecal pores:* paired, small transverse slits in 7/8/9; *Spermathecae:* in 8 and 9, with a small ental diverticulum; *Testes* and *male funnel* : in unpaired ventral sacs in 9 and 12, 4 pairs of penial setae are clearly visible and ornamented; *Genital markings:* absent; *Prostate* : paired in 17 and 19; *Caecae:* absent; *Typhlosole:* in 27-30 to 44-54.

Habitat: Forest- leaf litter , agricultural-cashew plantation, and residential habitats- garden leaf litter .

Distribution: *Bantwal*- Katukukke, Adyanadka. Reported earlier from Maharashtra, India [17].

Remarks : Type locality. Recorded from Moodbidri, Tirtahalli, Kotegehar, Udupi and Venoor , Mercara in Karnataka [37].

Recorded months : June – November .

VI. REPRESENTATIVE EARTHWORM SPECIES

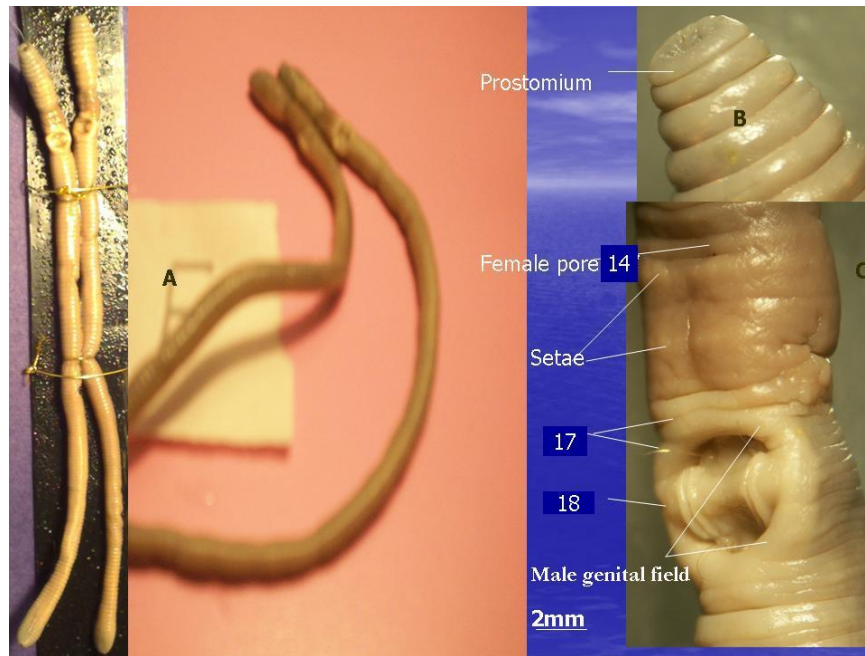


Fig.2. *Octochaetona paliensis*: A. External morphology B. Preclitellar region C. Clitellum and male female genital fields.

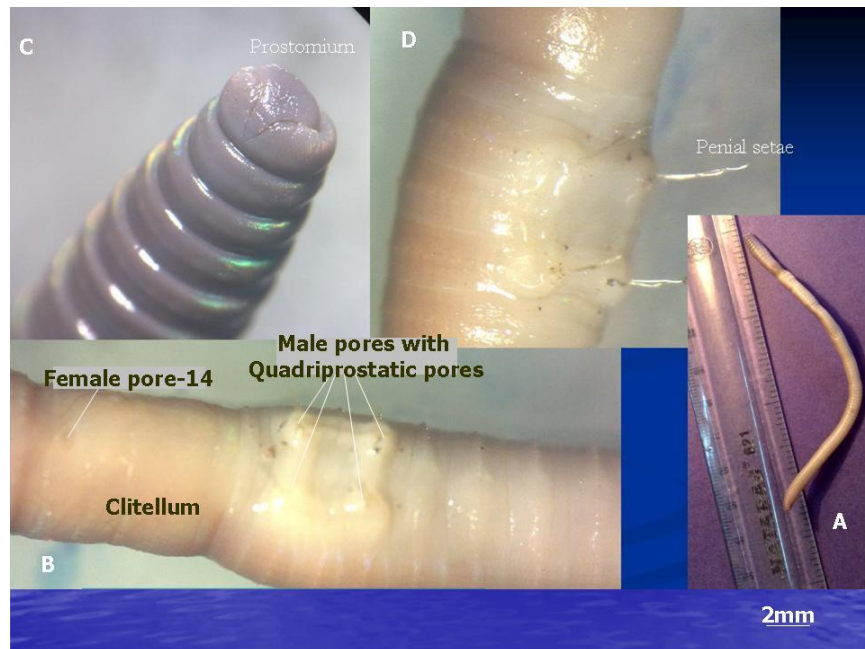


Fig. 3. *Mallehulla indica*: A.External morphology B. Preclitellar region C. Clitellum and male genital field with female pore. D. Penial setae.

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