

# Rediscovery of the earthworm *Megascolex hendersoni* Michaelsen, 1907 (Clitellata: Megascolecidae) from the Western Ghats biodiversity hotspot of India

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**Abstract.** *Megascolex hendersoni* Michaelsen, 1907, is a poorly understood species that has only been known from the type collection. Present report concerns its rediscovery from the Palani Hills of Kerala state, near its type locality in 2013. The paper provides the description of the collected specimens, highlighting their ecological and distribution aspects.

**Keywords.** Chinnar Wildlife Sanctuary, Kerala, Palani Hills, Pampadum Shola National Park, shola forest.

## INTRODUCTION

India is one of the mega earthworm diversity countries of the world with 457 valid species recorded (Narayanan *et al.* 2023a). The Western Ghats – Western Coastal Plains stands out as the region with the highest level of earthworm species richness in India that comes to about 53% of the country's earthworm diversity (Julka *et al.* 2009, Narayanan *et al.* 2020a, 2023a). Kerala is a narrow coastal equatorial tract of India (between 8°17' – 12°47'N and 74°52' – 77°24'E) that lies within the Western Ghats biodiversity hotspot. Earthworm taxonomic studies of the state were started towards the end of the 19<sup>th</sup> century by Bourne (1894). Several species in Kerala are known only from the original descriptions and most of them were recorded more than 80–90 years ago (Narayanan *et al.* 2016a). New species are being discovered and previously unrecorded species are reported from the state (Julka *et al.* 1997, Nair *et al.* 2010, Narayanan *et al.* 2016b, c,

2017, 2019a, b, c, 2020b, 2021a, 2022, 2023b, George *et al.* 2017, Anuja *et al.* 2020, Lone *et al.* 2022) highlighting the fact that so much still to be learned about the earthworm diversity of this unique region. The genus *Megascolex* of the family Megascolecidae is predominantly confined to the Western Ghats mountain range of India and Sri Lanka (Stephenson 1923, Narayanan *et al.* 2020a, 2021b). A total of 68 valid species are known to occur in this genus (Stephenson 1923, Narayanan *et al.* 2020a, 2021b, 2023a, Lone *et al.* 2022). Among these, 36 and 31 species are endemic to Sri Lanka and Peninsular India respectively, with one *M. insignis* Michaelsen, 1910 as the only species found in both countries (Michaelsen 1910, Narayanan *et al.* 2020a, 2021b, 2023a, Lone *et al.* 2022). As part of an ongoing study on the earthworm diversity of Kerala state, we made a survey of the earthworms at shola forests in the Munnar region of Idukki district that revealed the occurrence of previously unreported species *Megascolex hendersoni* Mich-

aelsen, 1907, from Kerala state. Michaelsen's (1907, 1909) descriptions of the species was based on four mature specimens, but clitellum is not prominent and could be distinguished only by darker colouration.

From the literature survey it is clear that our finding is a rediscovery after its original description. Herein we are providing a detailed description of the specimens collected from the Munnar region.

## MATERIALS AND METHODS

Earthworms were collected by digging and hand sorting method (Julka 1990). Collected specimens were preserved in 5% formalin and relevant anatomical characteristics of earthworms were observed after dorsal dissection under a stereomicroscope (Nikon SMZ800N). Specimens were identified using Michaelsen (1909) and Stephenson (1923) and deposited in the earthworm laboratory of the Advanced Centre of Environmental Studies and Sustainable Development, Mahatma Gandhi University, Kottayam, Kerala, India.

## TAXONOMY

### Family Megascolecidae Rosa, 1891

#### *Megascolex hendersoni* Michaelsen, 1907

(Figures 1 A–F; Table 1)

*Megascolex hendersoni* Michaelsen, 1907: 162.

*Megascolex hendersoni*: Michaelsen 1909: 184.

*Megascolex hendersoni*: Stephenson 1923: 246.

*Type locality.* Tiger Shola near Kodaikanal (10.25°N, 77.52°E), Tamil Nadu state, India.

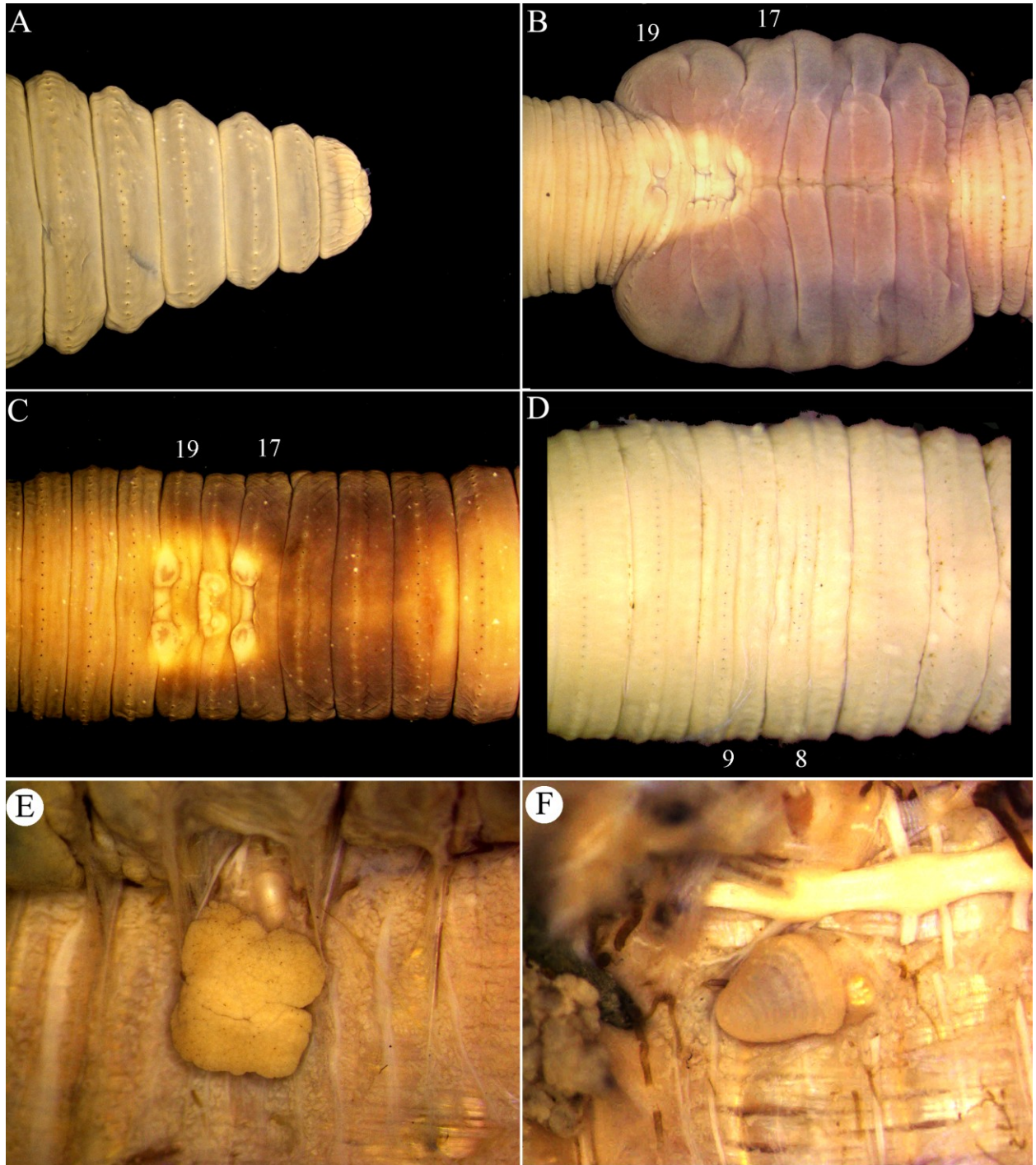
*Type material.* ZMUH 7149, ZSIC 2925 (Reynolds & Wetzel 2019).

*Material examined.* 2 clitellates, 3 pre-adults, 3 juveniles (Reg. No. ACESSD/EW/1138), between Check Post and Bander (Vandaravu) in Pam-

padum Shola National Park (10°8'3.7"N, 77°15'59.8"E), Idukki District, Kerala State, India, 2064 m a.s.l., Shola forest gully – in very wet clayey soil, 27 May 2013, leg. S.P. Narayanan, A. Sasi, S. Sathrumithra and T. Augustine; 7 pre-adults, 1 juvenile (Reg. No. ACESSD/ EW/1139), near to Bander (Vandaravu) (10°8' 8.5"N, 77°16'10.4"E) in Pampadum Shola National Park, Idukki District, Kerala State, India, 2270 m a.s.l., Shola forest – in wet water seeping area with clayey soil, 24 November 2013, leg. S.P. Narayanan, A. Sasi, S. Sathrumithra and T. Augustine; 1 pre-adult, 4 juveniles (Reg. No. ACESSD/ EW/1140), Mattuchola (10°14'28.7"N, 77°14'12.9"E) near Kambakallu in Chinnar Wildlife Sanctuary, Idukki District, Kerala State, India, 1954 m a.s.l., shola forest – beneath rock within stream and bank, 24 November 2013, leg. T. Augustine, D. Kuriakose, S. Sathrumithra and S.P. Narayanan.

*Diagnosis.* Length 140–403 mm, width 5–12.5 mm, segments 110–176. Colour bluish brown on dorsum, pale ventrally. Setae perichaetine, enlarged in anterior and posterior portions. Prostomium epilobous. Clitellum on segments 13–19 (= 7), ring-shaped in front, saddle shaped in ½17–19. Male field concave. Female pore paired, presetal, on segment 14. Spermathecal pores in intersegmental furrow 8/9. Genital markings three pairs, on segments 17, 18, 19. Septa 7/8–13/14 strongly thickened. Gizzard enlarged, in front of septum 6/7. Last pair of hearts in segment 13. Prostates confined to segment 18, tongue-shaped. Spermathecal ampulla sac-like, diverticulum indistinctly stalked, with 3–5 oval or rounded seminal chambers, adhere to the duct.

*Description. External:* Length 207–403 mm, width 8–12.5, segments 143–176. Colour bluish brown dorsally, iridescent, ventrum pale. Perichaetine; setae present on second segment (Fig. 1A), setae enlarged, in anterior and posterior portions, central portion not so; setal formula  $aa = 1.26-2$   $ab = 1.71-2$   $yz = 0.46-0$ . 5  $zz$  on segment 8 ( $n = 2$ ); 37–47 on segment 5, 41–61 on segment 8, 48–53 on segment 12, 49–71 on segment 20, 54–61 on segment 26 ( $n = 3$ ). Prostomium



**Figure 1.** *Megascolex hendersoni* Michaelsen, 1907, **A** = Prostomium and anterior segments, **B** = Male field and genital markings of clitellate specimen in prime condition, **C** = Male field and genital markings of a pre-adult specimen, **D** = Spermathecal pores, **E** = Prostate, **F, G** = Spermathecae.

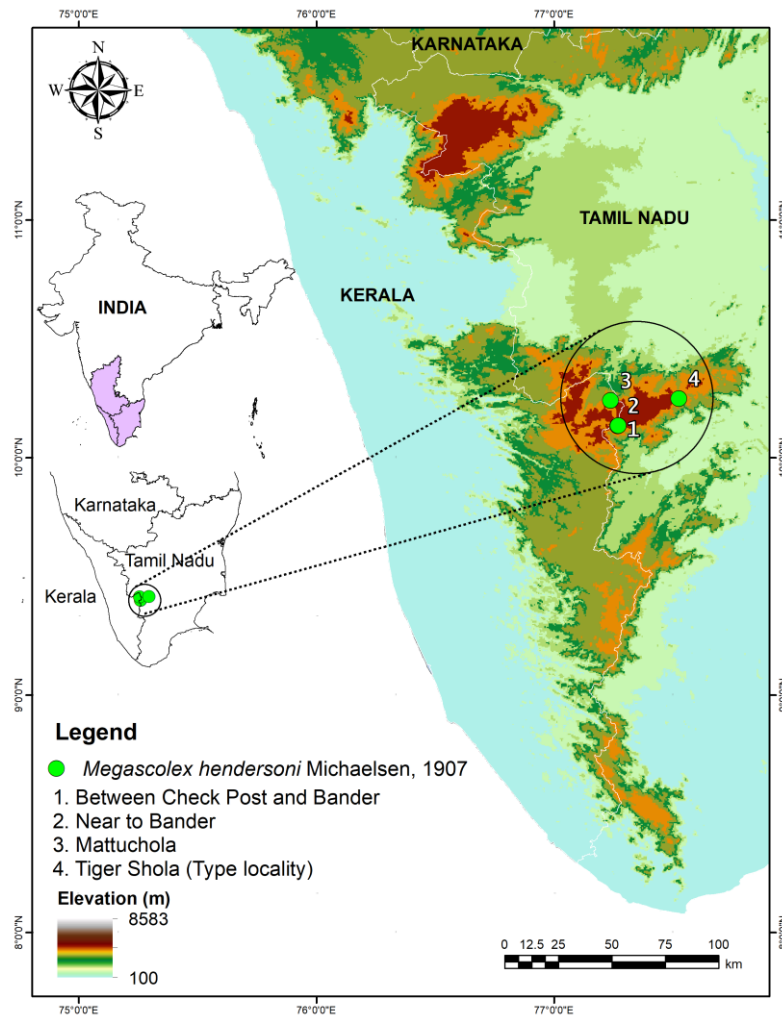


Figure 2. Distribution of *Megascolex hendersoni* Michaelsen, 1907 in India

Table 1. Body dimensions of selected *M. hendersoni* specimens from three localities

Collection site	Length (mm)	Width (mm)	No. of segments
Between check post and Bander (ACCESSD/EW/1138)	207	8	176
	260	7.5	169
	286	8	178
Near Bander (ACCESSD/EW/1139)	258	9	164
	236	9	150
	286	9	176
Mattuchola (ACCESSD/EW/1140)	403	12	143

epilobous (Fig. 1A), with numerous longitudinal striations touching the second segment; anterior segments annulated, setae present on prominent middle ridge. First dorsal pore in intersegmental furrow 5/6. Clitellum on segments 13–19 (= 7), ring-shaped in front, saddle shaped in ½17–19,

swollen in prime condition (Fig. 1B), in preadult specimens not prominent, recognized by darker brown colour than the rest of body (Fig. 1C), setae are slightly visible. Male field concave, distinct, whitish in colour, male pores paired, on segment 18 (Fig. 1B, C), slightly posterior to setal

arc, on small, nearly circular papillae, in line with setae *bc* 0.04–0.06 body circumference apart ( $n = 3$ ); setae absent between male pores. Female pores minute, paired, on segment 14, presetal, in setal line *a*, slightly variable in certain specimens. Spermathecal pores one pair, at intersegmental furrow 8/9 (Fig. 1D), between setal lines *bc*; 0.05–0.07 body circumference apart ( $n = 3$ ). Genital markings three pairs, small, transversely oval, posterior to setal arc, on segments 17, 18, and 19 (Fig. 1B, C), close to intersegmental furrow, sometimes in grooves, between *bc* setal lines, those on segment 18 united with male porophores. Nehridiopores inconspicuous. Penial setae absent.

*Internal:* Septa 7/8–13/14 strongly thickened, especially 10/11/12. Gizzard very large, in front of septum 6/7, pushed back to segment 9. Oesophagus swollen in segments 12, 13, 14, calciferous glands-like, without internal lamellae. Intestine begins in segment 16. Typhlosole present, ridge-like projection. Testes and funnels free. Last pair of hearts in segment 13. Holandric, seminal vesicles paired, in segments 9 and 12, racemose, posterior pair bigger, with elongated thin branches, anterior one thick and bushy attached to septum 9/10. Prostates (Fig. 1E) confined to segment 18, racemose, glandular, incised, tongue-shaped, duct thick, muscular, short, straight, ectal end wide. Spermathecae (Fig. 1F), ampulla sac-like, duct 1/3<sup>rd</sup> long and thick as ampulla, diverticulum indistinctly stalked, with 3–5 oval or rounded seminal chambers hanging down and adherent to duct. Micromeronephidia present, prominent from clitellum to posterior segments.

*Ingesta.* Mainly colloids of soil, mica and pebbles, also large pieces of fibrous plant matter, tiny pieces of leaves or barks.

*Distribution.* India: Kerala: District Idukki: between check post and Bander (Vandaravu), near Bander, both in Pampadum Shola National Park and Mattuchola in Chinnar Wildlife Sanctuary (present records); Tamil Nadu: District Dindigul: Tiger Shola near Kodaikanal (Michaelsen 1907) (Fig. 2).

*Remarks.* Diagnosis of the species has been updated based on the present materials from Kerala. In life, Mattuchola specimen showed rose coloured prostomium. Length, width and number of segments of selected specimens are given in Table 1. Location of the female pore is generally in *a* setal line, but some individuals showed variation as the following - specimens from, between check post and Bander [ACCESSD/EW/1138]: specimen I) left hand side (LHS): in line with setae *a*, right hand side (RHS): in line with setae *a*; specimen II) LHS: in line with setae *a*, RHS: in line with setae *a*; specimen III) LHS: between *a* and *b* setal lines, RHS: in line with setae *a*; specimen from near Bander [ACCESSD/EW/1139]: IV) LHS: median to setae *a*, RHS: between *ab* setal lines; and Mattuchola specimen [ACCESSD/EW/1140]: V) LHS: between *ab* setal lines, RHS: median to setae *a*. The number of setae in segments 5, 8, 12, and 20 of the present study are in contrast to the original count provided by Michaelsen (1907, 1909), his counts are based on a single specimen. When dug out from the soil, it moved with great agility in serpentine fashion. They inhabit the wet clayey soils of shola forest. Endemic to the Western Ghats Mountain ranges (Palani Hills of Kerala and Tamil Nadu states).

## DISCUSSION

*M. hendersoni* belongs to a group of species characterized with one pair of spermathecal pores in intersegmental furrow 8/9, penial setae absent, spermathecal diverticulum without distinct secondary diverticulum. Apart from *M. hendersoni*, this group has four more species viz., *M. quintus* Stephenson, 1913, *M. pattipolensis* Stephenson, 1913, *M. kempi* Stephenson, 1915, and *M. hortonensis* Stephenson, 1915. In the group, *M. hendersoni* is endemic to India whereas, rest of the species are restricted to Sri Lanka (Stephenson 1923, Narayanan et al. 2021b). Out of the 32 *Megascolex* species recorded from India (Narayanan et al. 2023a), *M. hendersoni* is the only species with a single pair of spermathecal pores in the intersegmental furrow 8/9. At the same

instance it can be differentiated from all the known members of group by the position of seminal vesicles in segments 9 and 12, whereas the remaining members of this group has the seminal vesicles in segments 11 and 12 (Stephenson 1923).

It is important to note that the 25.06% (117 spp.) of species described from India are known only from their respective type localities (Narayanan et al. 2023a). Previously *M. hendersoni* was also known only from the type locality. It is now rediscovered nearly after 120 years from the Palani Hills part of the Kerala state. The body dimensions of the current specimens are higher than those previously recorded by Michaelsen (1907, 1909). Current specimens are collected from an altitudinal range of 1954 – 2270 m a.s.l., whereas the types were from 5500 ft (= 1676.54 m) (Michaelsen 1907). This species is confined to the shola forests above 1676 m in the Palani Hills of Kerala and Tamil Nadu. The high diversity of earthworms in Western Ghats is mainly due to the geological history, and diverse physiography. Palani Hills are currently subject to increasing anthropogenic developmental activities, especially the shola forests, where *M. hendersoni* is found inhabiting. It is the 25<sup>th</sup> species recorded in the *Megascolex* genus from the state (Narayanan et al. 2016a). In India conservation and management of aboveground biodiversity has been paid more attention compared to that of belowground biodiversity (Julka & Paliwal 2005). Hence surveys of underexplored and unexplored forests especially the shola-grassland complex of Kerala may unearth many new earthworm species.

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## REFERENCES

- ANUJA, R., NARAYANAN, S.P., SATHRUMITHRA, S., THOMAS, A.P. & JULKA, J.M. (2020): First record of exotic earthworm *Eukerria kuekenthali* (Michaelsen, 1908) (Annelida: Oligochaeta) from Kerala, India. *Journal of the Bombay Natural History Society*, 117: 165–167.  
<https://doi.org/10.17087/jbnhs/2020/v117/131225>
- BOURNE, A.G. (1894): On *Moniligaster grandis*, A.G.B., from the Nilgiris, S. India; together with descriptions of other species of the genus *Moniligaster*. *Quarterly Journal of Microscopical Science*, 36: 307–384.  
<https://doi.org/10.1242/jcs.s2-36.143.307>
- GEORGE, J., DEEPTHI, M.P., SAMINATHAN, K. & KATHIRESWARI (2017): *Biodiversity and ecological category of earthworms in Periya of Wayanad forest division, Kerala*. In: ANON. (Ed.) Conference Proceedings on “Life Science: Research, Practices and Application for Sustainable Development”, September 2017, Macmillan publishers, p. 7–8.
- JULKA, J.M. & PALIWAL, R. (2005): *Distribution of earthworms in different agro-climatic regions of India*. In: RAMAKRISHNAN, P.S., SAXENA, K.G., SWIFT, M.J., RAO, K.S. & MAIKHURI, R.K. (Eds.) *Soil Biodiversity, Ecological Processes and Landscape*, Oxford and ABH Publications Co. Pvt. New Delhi, p. 3–13.
- JULKA, J.M. (1990): *Annelida*. In: JAIRAJPURI, M.S. (Ed.), *Collection and Preservation of Animals*, Zoological Survey of India, Calcutta, p. 57–64.
- JULKA, J.M., GIRI, S., PANIGRAHI, P.K. & SENAPATI, B.K. (1997): *Parryodrillus lavellei* gen. nov. and sp. nov. (Octochaetidae, Oligochaeta) from Western Ghats, South India. *European Journal of Soil Biology*, 33(3): 141–144.
- JULKA, J.M., PALIWAL, R. & KATHIREWARI, P. (2009): *Biodiversity of Indian earthworms - an overview*. In: EDWARDS, C.A., JAYARAJ, R. & JAYARAJ, I. A. (Eds.) *Proceedings of Indo-US Workshop on Vermitechnology in Human Welfare*, Rohini Achagam, Coimbatore, India, p. 36–56.
- KATHIREWARI, P., JEYARAJ, R. & JEYARAJ, A. (2005): Distribution and diversity of earthworm resources in Kanjikode, Palakkad district, Kerala state, India. *Pollution Research*, 24: 117–120.
- LONE, A.R., THAKUR, S.S., TIWARI, P., JAMES, S.W. & YADAV, S. (2022): Phylogenetic relationships in earthworm *Megascolex* species (Oligochaeta: Megascolecidae) with addition of two new species. *Diversity*, 14: 1006.  
<https://doi.org/10.3390/d14111006>

- MICHAELSEN, W. (1907): Neue Oligochaeten von Vorder-Indien, Ceylon, Birma, und den Andaman-Inseln. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, 24: 143–188.
- MICHAELSEN, W. (1909): The Oligochaeta of India, Nepal, Ceylon, Burma and the Andaman Islands. *Memoirs of the Indian Museum*, 1: 103–253.
- NAIR, K.V., MANAZHY, J., MANAZHY, A. & REYNOLDS, J.W. (2007): Earthworm (Annelida: Oligochaeta) fauna of Kerala, India: 1. some species from Thiruvananthapuram corporation. *Megadriologica*, 11(8): 85–90.
- NARAYANAN, S.P., SATHRUMITHRA, S., CHRISTOPHER, G., THOMAS, A.P. & JULKA, J.M. (2016a): Checklist of the earthworms (Oligochaeta) of Kerala, a constituent of Western Ghats biodiversity hotspot, India. *Zootaxa*, 4193(1): 117–137. <http://doi.org/10.11646/zootaxa.4193.1.5>
- NARAYANAN, S.P., SATHRUMITHRA, S., KURIAKOSE, D., CHRISTOPHER, G., THOMAS, A.P. & JULKA, J.M. (2016b): Are exotics *Amyntas alexandri* (Beddard, 1900) and *Metaphire peguana* (Rosa, 1890) (Clitellata: Oligochaeta: Megascolecidae) a threat to native earthworms in Kerala, India? *Journal of Threatened Taxa*, 8(2): 8938–8942. <https://doi.org/10.11609/jott.2872.8.6.8938-8942>
- NARAYANAN, S.P., SATHRUMITHRA, S., ANUJA, R., CHRISTOPHER, G., Sureshan, P.M., THOMAS, A.P. & JULKA, J.M. (2016c): Recent records of rare earthworm genera from Kerala, India. *Malabar Trogon*, 14(1–3): 38–43.
- NARAYANAN, S.P., SATHRUMITHRA, S., CHRISTOPHER, G. & JULKA, J.M. (2017): New species and new records of earthworms of the genus *Drawida* from Kerala part of the Western Ghats biodiversity hotspot, India (Oligochaeta, Moniligastridae). *ZooKeys*, 691: 1–18. <https://doi.org/10.3897/zookeys.691.13174>
- NARAYANAN, S.P., SATHRUMITHRA, S., CHRISTOPHER, G., THOMAS, A.P. & JULKA, J.M. (2019a): First record of some earthworm species (Oligochaeta: Megadrile) from Kerala part of the Western Ghats biodiversity hotspot. *National Academy Science Letters*, 42(6): 509–512. <https://doi.org/10.1007/s40009-019-00797-y>
- NARAYANAN, S.P., SATHRUMITHRA, S., ANUJA, R., CHRISTOPHER, G., THOMAS, A.P. & JULKA, J.M., (2019b): First record of the exotic *Metaphire bahli* (Gates, 1945) (Oligochaeta: Megascolecidae) from India. *Opuscula Zoologica Budapest*, 50(1): 99–103. <https://doi.org/10.18348/opzool.2019.1.99>
- NARAYANAN, S.P., THOMAS, B., SREERAJ, P.R., JOSEPH, R., SATHRUMITHRA, S., KURIEN, V.T., ANUJA, R., KUNNATH, S.M., JOHN, J., THOMAS, A.P., JULKA, J.M. & REYNOLDS, J.W. (2019c): The first record of *Megascolex lawsoni* (Beddard, 1886) (Clitellata: Megascolecidae) from the state of Kerala, India. *Megadriologica*, 24(6): 67–73.
- NARAYANAN, S.P., PALIWAL, R., KUMARI, S., AHMED, S., THOMAS, A.P. & JULKA, J.M., (2020a): *Annelida: Oligochaeta*. In DIRECTOR (Ed.) Faunal Diversity of Biogeographic Zones of India: Western Ghats. Zoological Survey of India, Kolkata, India, p. 87–102.
- NARAYANAN, S.P., THOMAS, B., SUNISH, K.S., ANUJA, R., SATHRUMITHRA, S., SMIJA, M.K., CHRISTOPHER, G., THOMAS, A.P. & JULKA, J.M. (2020b): First record of exotic *Dichogaster saliens* (Beddard, 1893) and *Metaphire posthuma* (Vaillant, 1868) (Annelida: Oligochaeta) from Kerala, southern India. *Records of the Zoological Survey of India*, 120(2): 161–166. <https://doi.org/10.26515/rzsi%2Fv120%2Fi2%2F2020%2F131422>
- NARAYANAN, S.P., SATHRUMITHRA, S., ANUJA, R., CHRISTOPHER, G., THOMAS, A.P. & JULKA, J.M. (2021a): Three new species and four new species records of earthworms of the genus *Moniligaster* Perrier, 1872 (Clitellata: Moniligastridae) from Kerala region of the Western Ghats Biodiversity Hotspot, India. *Zootaxa*, 4949(2): 381–397. <https://doi.org/10.11646/zootaxa.4949.2.11>
- NARAYANAN, S.P., KUMARI, S., KURIEN, V.T., THOMAS, A.P., PALIWAL, R. & JULKA, J.M. (2021b): A comprehensive checklist of the earthworms (Annelida: Clitellata: Megadrili) of Sri Lanka, a component of the Western Ghats – Sri Lanka biodiversity hotspot. *Travaux du Muséum National d’Histoire Naturelle “Grigore Antipa”*, 64(1): 7–36. <https://doi.org/10.3897/travaux.64.e56877>
- NARAYANAN, S.P., ANUJA, R., THOMAS, A.P. & PALIWAL, R. (2022): A new species of *Moniligaster* Perrier, 1872 (Annelida, Moniligastridae) from India, with status revision of *M. deshayesi* minor Michaelsen, 1913. *Opuscula Zoologica Budapest*, 53(1): 31–50. <https://doi.org/10.18348/opzool.2022.1.31>
- NARAYANAN S.P., PALIWAL R., KURIEN, V.T., THOMAS A.P. & JULKA J.M. (2023a): *Earthworms*

- (Clitellata: Moniligastrida, Crassicitellata) of India: Distribution and Status. Department of Printing and Publishing, Mahatma Gandhi University, Kottayam, 378 pp.
- NARAYANAN, S.P., KURIEN, V.T., ANUJA, R., HASYAGAR, V., THOMAS, A.P., PALIWAL, R. & JULKA, J.M. (2023b): Earthworm (Clitellata, Megadrili) fauna of Kuttanad wetland, southern part of Vembanad-Kol Ramsar site, India. *Opuscula Zoologica Budapest*, 54: 3–21. <https://doi.org/10.18348/opzool.2023.1.3>
- REYNOLDS, J.W. & WETZEL, M.J. (2019): Nomenclatura Oligochaetologica – a catalogue of names, descriptions and type specimens. EditioSecunda. Available from: <http://www.inhs.illinois.edu/people/mjwetzelnomenclato> (accessed 11 November 2019).
- STEPHENSON, J. (1913): On a collection of Oligochaeta, mainly from Ceylon. *Spolia Zeylanica*, 8: 251–276. <https://doi.org/10.5962/bhl.part.1527>
- STEPHENSON, J. (1915): On some Indian Oligochaeta, mainly from Southern India and Ceylon. *Memoirs of the Indian Museum*, 6: 35–108.
- STEPHENSON, J. (1923): *The Fauna of British India, including Ceylon and Burma – Oligochaeta*. Taylor and Francis, London, 518 pp.
-