



Research Article

ADDITIONS TO THE NEMATODE FAUNA (PLECTIDAE AND CEPHALOBIDAE) OF INDIA

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ABSTRACT

The studies on the soil samples collected from high altitude regions (above 3800 m) of Gangotri valley in Gangotri National Park, Uttarakhand revealed two species of soil nematodes for the first time viz., *Plectus parietinus* Bastian, 1865 and *Stegelletina devimucronata* (Sumenkova, 1964) Bostrom and De Ley, 1996. Both these species are additions to the nematode fauna of India. The present population of *Plectus* and *Stegelletina* species shows conformity to *Plectus parietinus* and *Stegelletina devimucronata* respectively, in most morphometric characteristics except the body length of *Plectus parietinus*, which is slightly longer than the previously reported studies. Data on their morphometrics and distribution are provided.

Keywords: Soil- inhabiting nematode, Morphology, Distribution, Gangotri National park, Indian Himalayan Region.

INTRODUCTION

The genus *Plectus* was first described by Bastian (1865). Revisionary work on the genus *Plectus* were done by Maggenti (1961a, b), later several workers have contributed to studies on *Plectus* (Andrassy, 1985; Andrassy, 1998; Zell, 1993; De Ley and Coomans, 1994; Holovachov, 2001). There are 76 *Plectus* species records across the world (Borgmeier *et al.*, 2022; Schmidt-Rhaesa *et al.*, 2013) and eleven species records from India (*Plectus aquatilis* Andrassy, 1985; *Plectus cirratus* Bastian, 1865; *Plectus communis* Bütschli, 1873; *Plectus geophilus* de Man, 1880; *Plectus glandulatus* Tahseen, Baniyamuddin, Hussain & Ahmad, 2004; *Plectus magadani* Kuzmin, 1979; *Plectus minimus* Cobb, 1893; *Plectus parvus* Bastian, 1865; *Plectus refusus* Tahseen, Ahmad & Jairajpuri, 1995; *Plectus zelli* Tahseen, Ahmad & Jairajpuri, 1992; *Plectus indicus* Khera, 1972). The developmental biology and description of *Plectus zelli* was given by Tahseen from India (Tahseen *et al.*, 1992). Later six known species of *Plectus* were also recorded from India (Tahseen & Mustaqim, 2011). The genus *Stegelletina* was described under family cephalobidae (Andrassy, 1984). There are currently nine valid species of genus *Stegelletina* and

addition alone species *inquirenda* (Abolafia & Shokoohi, 2017). There is no available species record of *Stegelletina* from India.

Data on the nematode fauna of high altitude region of Gangotri National Park (GNP) are scarce and limited to genus level (Kashyap *et al.*, 2020, 2022). The present paper reports two species of soil-inhabiting nematodes for the first time from India viz. *Plectus parietinus* Bastian, 1865 and *Stegelletina devimucronata* (Sumenkova, 1964) Bostrom and De Ley 1996, collected from high altitude forest region of Gangotri National Park.

MATERIAL AND METHODS

Gangotri National Park covers a wide altitudinal range from 1200 to 6000 m altitude areas of western IHR and comes under biographical zone 2B of Western Himalaya (Rodgers & Panwar, 1988). High altitude of GNP comprises of two valleys - Gangotri and Nelang. The sampling for the study of soil-inhabiting nematodes were done during 2018-19 and sampling sites were located in subalpine and alpine region of the valley comprising of Deodar, Blue pine, Birch and alpine scrub- *Artemisia* and

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Caragana as dominant plant species along the elevation in the region. Stratified random sampling technique was used for sampling. The soil samples were processed by sieving and decantation technique. The nematodes extracted from processed samples were fixed in hot Formalin: Acetic Acid fixative and kept for 24 hr. at room temperature. For dehydration, the nematodes were transferred to a mixture of a glycerol and alcohol (95 parts of ethanol and 5 parts of

glycerol) and then placed in a desiccator containing anhydrous Calcium Chloride for degradation (Seinhorst, 1959). The wax ring method was used for mounting and sealing of the nematodes (Maeseneer & D'Herde, 1963). The mounted nematodes were studied under compound microscope BX 51 DIC Olympus microscope and photographs with DP20 digital camera.

Table 1. Distribution of the two species of soil-inhabiting nematodes recorded in the study.

Species	Distribution in India	Distributional Record in World
<i>Plectus parietinus</i>	-	Germany, Sweden, U.K, Iceland, Romania, Netherlands, South Africa, Antarctica, U.S.A, Faroe Islands, Denmark, Peru, Australia, Korea.
<i>Stegelletina devimucronata</i>	-	Turkey, Portugal, Greece, Albania, Iran.

Systematic accounts

Phylum	-	Nematoda Cobb 1932
Class	-	Chromadorea Inglis, 1983
Subclass	-	Chromadoria Pearse, 1942
Order	-	Plectida Gadea, 1973
Superfamily	-	Plectoidea Orley, 1880
Family	-	Plectidae Orley, 1880
Genus	-	<i>Plectus</i> Bastian, 1865
Species	-	<i>Plectus parietinus</i> Bastian, 1865
Order	-	Rhabditida Chitwood, 1933
Superfamily	-	Cephaloboidea Filipjev, 1934
Family	-	Cephalobidae Filipjev, 1934
Genus	-	<i>Stegelletina</i> Andrassy, 1984
Species	-	<i>Stegelletina devimucronata</i> (Sumenkova, 1964) Boström & De Ley, 1996

RESULTS AND DISCUSSION

Stegelletina devimucronata (Sumenkova, 1964)

Material Examined: 4 Females, India, Uttarakhand, District Uttarkashi, Gangotri National Park, Bhojwasa, 30°57'08.67" N, 79°03'24.18" E & 4016 m 18.x.2016; coll. P. Kashyap. (Reg.No. ZSI-HQ/NZC/ WN.3874)

Description: Table 2; Figure 1.

Female: Moderately arcuate ventrad body. Annulated cuticle; Lateral field having three lines. Lip region 7.8-8 µm wide. Slender-conical labial probolae, around 3 µm long, single bifurcation at their tip forming two prongs. Cheilorhabdia small and rounded; rest of the stoma region is slightly sclerotized and usually unnoticeable. Oval shaped basal bulb with well-developed valves. Excretory pore at the level of isthmus. Corpus 1.5-2.5 times long as isthmus. Vulva flat or slightly protruding, offset spermatheca. Vulva located at about 2-3rd of body length. Phasmids located at anterior half of tail. Straight and short vagina. Tail finely rounded/conoid with ragged mucro.

Male: Not Found

Habitat and Locality: Collected from soil near Juniper species in alpine region of bhojwasa in Gangotri National Park, Uttarakhand.

Plectus parietinus (Bastian, 1865)

Material Examined: 4 Females, India, Uttarakhand, District Uttarkashi, Gangotri National park, Gaumukh, 30°56'52.75"N, 79°03'20.26"E, 3847 m, 18.x.2016, coll. P. Kashyap (Reg. No. ZSI-HQ/NZC/ WN.3875).

Description: Table 2; Figure 2.

Female: Body large sized (1.3-1.6 mm) ventrally curved on fixation, wide (92-95 µm) at mid body region. Distinctly annulated thick cuticle, 3.5- 4 µm on mid region. Lip region strongly set off by a constriction, 17- 19 µm wide. Circular amphid, 3- 4 µm wide, located at anterior to mid of stoma. Stoma 40 µm long. Pharynx differentiated into anteriorly corpus, middle narrow isthmus and basal pharyngeal bulb pyriform shaped 42-43 µm wide. Nerve

ring located at 156- 165 μm from anterior region. Excretory pore present slightly below nerve ring, distance from anterior end to excretory pore is **173-183 μm** i.e. $\sim 72\%$ of pharyngeal length. Didelphic, amphidelphic female reproductive system with well developed reflexed ovaries, measuring 260-279 μm and 243-258 μm respectively. Vulva has transverse slit. Distance between vulva and anus measures 618 μm . ventrally arcuate tail, 103-111 μm long

with a spinneret at terminal. Tail gradually tapers towards tip.

Male: Not Found

Habitat and Locality: Collected from soil of alpine region between bhojwasa and Gaumukh in Gangotri National Park, Uttarakhand.

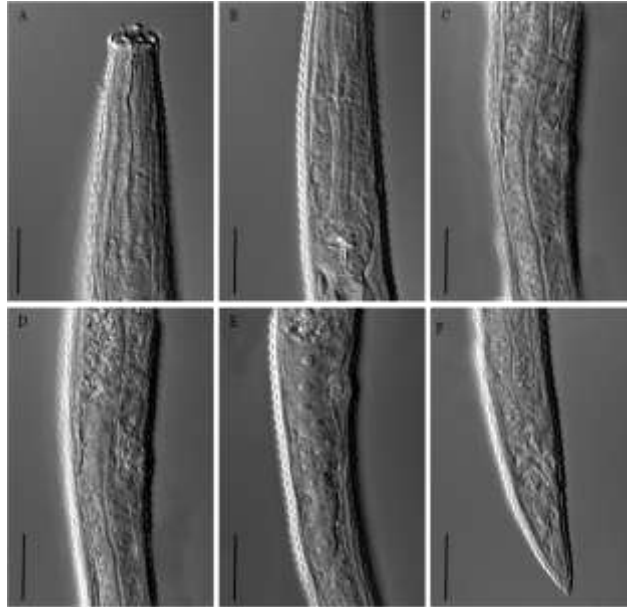


Figure 1. *Stegelletina devimucronata* (Sumenkova, 1964) Bostrom and De Ley, 1996: A- Anterior region, B- Pharyngeal region, C, D, E- Vulva Region, F- Tail.

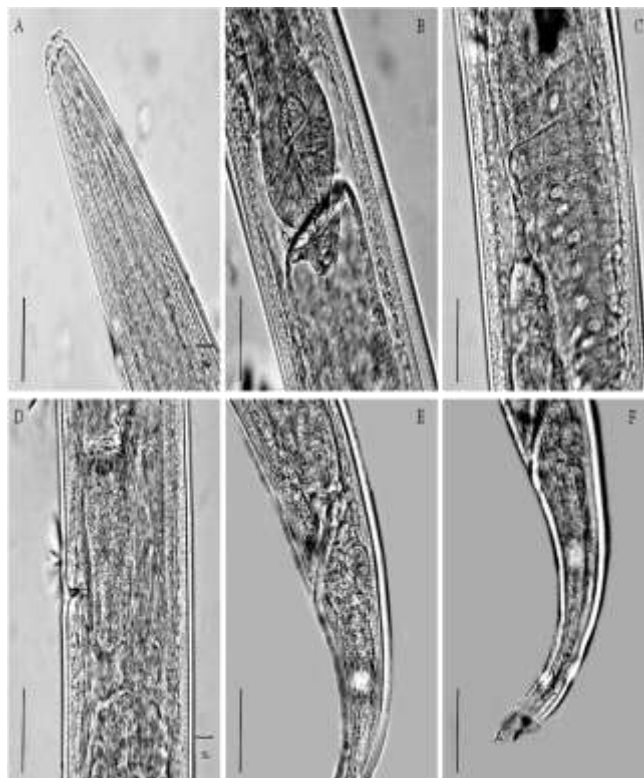


Figure 2. *Plectus parietinus* Bastian, 1865: A- Anterior region, B- Pharyngeal bulb, C- Ovary, D- Vulva, E= Anus region, F- Tail.

Table 2. Morphometric data of recorded specimens found in the present study Measurements (in μm : mean \pm standard deviation (range)).

Characters	<i>Plectus parietinus</i>	<i>Stegelletina devimucronata</i>
Length (L)	1534.25 \pm 97.57 (1467 - 1679)	299.67 \pm 5.03 (295 - 305)
a	17.20 \pm 0.4 (16.68 - 17.67)	18.36 \pm 0.38 (17.94 - 18.69)
b	4.89 \pm 0.16 (4.69 - 5.08)	3.27 \pm 0.02 (3.25 - 3.28)
c	14.3375 \pm 0.6 (13.65 - 15.12)	14.5 \pm 0.26 (14.24 - 14.75)
c'	2.84 \pm 0.05 (2.77 - 2.89)	2 \pm 0.1 (1.91 - 2.1)
V	53.94 \pm 1.4 (52.41- 57.24)	65.51 \pm 0.74 (64.75 - 66.22)
Body diameter	90 \pm 4.08 (85 - 95)	16.33 \pm 0.58 (16 - 17)
Stoma length	29.5 \pm 0.57 (29 - 30)	6.17 \pm 0.76 (5.5 - 7)
Pharyngeal length	247 \pm 2.82(243 - 249)	71.67 \pm 3.06 (69 - 75)
Nerve Ring	163 \pm 2.16 (160 - 165)	56.33 \pm 1.53 (55 - 58)
Anal body diameter	38 \pm 1.63 (36 - 40)	10.33 \pm 0.58 (10 - 11)
Tail length	108 \pm 3.55 (103 - 111)	20.67 \pm 0.58 (20 - 21)
Lip diameter	18.5 \pm 0.57 (18 - 19)	9 \pm 0
Lip Height	5.32 \pm 0.12 (5.2 - 5.5)	2 \pm 0
Amphidial aperture from anterior end	14.82 \pm 0.23 (14.5 - 15)	-
Vulva to anus	705 \pm 9.2 (698 - 718)	86.67 \pm 2.52 (84 - 89)
Bulb length	45.25 \pm 1.7 (43 - 47)	13.67 \pm 0.58 (13 - 14)
Anterior to Excretory pore	180.25 \pm 0.57 (178 - 183)	61.33 \pm 0.58 (61 - 62)

S. devimucronata is characterized by having two digitate projections on the tines in lip region which differs it from other known species of *Stegelletina* (*S. leopolitensis* and *S. similis* has one digitate projections on each lips). *S. devimucronata* is closed related with *S. leopolitensis* and *S. similis* in terms of lip morphology (presence of digitate projections) and shape of the tail (ragged mucro tail terminus). *S. devimucronata* population is same as described by Sumenkova, 1964; Karegar *et al.*, 1998; Bostrom, 1993; Bostrom and De Ley, 1996. Although specimen from India are smaller (295 – 305 μm in females) vs 305-325 μm by Karegar *et al.*, 1998 and 414-463 μm in females by Bostrom (1993). This species is being recorded for the first time and first species record of the genus from India. *Plectus parietinus* differs from all other *plectus* species by having more pronounced hypodermal glands, comparatively small amphid, well-defined offset lips by a constriction. Present species conforms to the illustration given by Maggenti (1961). The dimensions of the species from India are very similar to the earlier reported *P. parietinus* from South Korea by Geun Eun *et al.*, 2016. This species is being recorded for the first time and 12th species of the genus from India.

CONCLUSIONS

Present study deals with two known species of soil inhabiting nematodes viz. *Stegelletina devimucronata* (Sumenkova, 1964) Bostrom and De Ley, 1996 and *Plectus parietinus* Bastian, 1865 are new records from India. Further research is needed to better understand and characterise the diversity of soil inhabiting nematodes in Gangotri National Park.

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REFERENCES

- Abolafia, J. and Shokoohi, E. (2017). Description of *Stegelletina lingulata* sp. n. (Nematoda, Rhabditida, Cephalobidae) from xeric environments in Iran. *Zootaxa*, 4358(3), 462-470.
- Andrassy, I. Klasse. (1984). Nematoda (Ordnungen Monhysterida, Desmoscolecida, Araeolaimida, Chromadorida, Rhabditida). Stuttgart, Gustav Fischer Verlag, pp. 509.
- Andrassy, I. Nematodes in the Sixth Continent. (1998). *Journal of Nematode Morphology and Systematics*, 1,107-186.

- Andrássy, I. (1985). The genus *Plectus* Bastian, 1865 and its nearest relatives (Nematoda: Plectidae). *Acta Zoologica Hungarica*, 31, 1-52.
- Bastian, H. C. (1865). Monograph of the Anguillulidae, or free Nematoids, Marine, Land, and Freshwater; with Descriptions of 100 New Species. (The Transactions of the Linnean Society of London, 25 (2), 73-184.
- Borgmeier, A., Gattoni, K., Harris, T., Higgins, R., Mullin, P., Porazinska, D., Powers, K., Wedin, D., and Powers, T. (2022). *Plectus* of the Prairie: A Case Study of Taxonomic Resolution from a Nematode Biodiversity Survey. *Journal of Nematology*, 54(1), 20220039.
- Bostrom, S. and De Ley, P. (1996). Redescription of *Cervidellus vexilliger* (de Man, 1880) Thorne, 1937 (Nematoda: Cephalobidae) and taxonomical consequences. *Fundamental and Applied Nematology*, 19, 329-340.
- De Ley, P. and A. Coomans. (1994). Terrestrial nematodes from the Galápagos Archipelago IV: The genus *Plectus* Bastian, 1865, with description of three new species (Leptolaimina: Plectidae). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie*, 64, 43-70.
- De Maeseneer J. and C. J. d'Herde. (1963). Methodes utilisees pour l'etude des anguillules libres du sol. *Revue Agriculture, Bruxelles*, 16,441-447.
- Eun, G., Ha, J., Kang, H., Kim, Y., Choi, I., & Kim, D. (2016). First record *Acrobeles ciliatus* (Rhabditida) and *Plectus parietinus* (Plectida) from South Korea. *Journal of Species Research*, 5 (3), 318-323. <https://doi.org/10.12651/JSR.2016.5.3.318>
- Holovachov, O. (2001). Description of *Plectus* (*Ceratoplectus*) *brzeskii* sp. nov. (Nematoda: Plectidae) from New Caledonia. *Annales Zoologici*, 51, 1-4.
- Kashyap, P., Afzal, S., Rizvi, A.N., Ahmad,W., Uniyal, V.P and Banerjee, D. (2022). Nematode community structure along elevation gradient in high altitude vegetation cover of Gangotri National Park (Uttarakhand), India. *Scientific Reports*, 12, 1428. <https://doi.org/10.1038/s41598-022-05472-9>.
- Kashyap, P., Rizvi, A.N., Bhattacharya, T. and Uniyal, V. P. (2020). Community structure and habitat specific variations of soil-inhabiting nematodes in the forests of Gangotri National Park, Uttarakhand, India. *Indian Journal of Nematology*, 50(2), 107-116.
- Maggenti, A.R. (1961a). Morphology and biology of the genus *Plectus* (Nematoda: Plectidae). *Proceedings of the Helminthological Society of Washington*. 28, 118-130.
- Maggenti, A.R. (1961b). Revision of the genus *Plectus* (Nematoda: Plectidae). *Proceedings of the Helminthological Society of Washington*, 28, 139-166.
- Rodgers, W.A. and Panwar, H.S. (1988). Planning a wildlife protected area network in India . Vol 2. Project FO: IND/82/003. FAO, Dehradun, India. pp.339.
- Schmidt-Rhaesa, A., Bain, O., Baldwin, J. G., Beveridge, I., Bezerra, T. C., Braeckman, U., Coomans, A., Decraemer, W., Derycke, S., and Durette-Desset, M. C. (2013). *Nematoda*. Berlin: De Gruyter. Vol.2.
- Seinhorst, J. W. (1959). A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. *Nematologica*, 4, 67-69.
- Sumenkova, N.I. (1964). [*Cervidellus devimucronatus* nov. sp. (Nematoda; Cephalobidae)]. *Trudy Gel'mintologicheskoi laboratorii Akademii Nauk SSSR* 14, 234-237.
- Tahseen, Q. and Mustaqim, M. (2011). Descriptions of six known species of *Plectus* Bastian, 1865 (Nematoda, Plectida, Plectidae) from India with a discussion on the taxonomy of the genus. *Zootaxa*, 3205, 1-25.
- Tahseen, Q., Ahmad, I., Jairajpuri, M.S. (1992). SEM observations and developmental biology of *Plectus zelli* n. sp. (Nematoda: Araeolaimida). *Fundamental and Applied Nematology*, 15, 503-510.
- Zell, H. (1993). Die Gattung *Plectus* Bastian, 1865 sensu lato (Nematoda, Plectidae)-Ein Beitrag zur Ökologie, *Biogeographie, Phylogenie und Taxonomie der Plectidae*. *Andrias*, 11, 1-173.