

## Description of two new species of Plectinae (Nematoda: Araeolaimida) from India

Qudsia TAHSEEN, Mohammad BANIYAMUDDIN, Ather HUSSAIN and Wasim AHMAD\*

Section of Nematology, Department of Zoology, Aligarh Muslim University, Aligarh-202002, India

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**Summary** – Two new plectid species from India are described and illustrated. *Plectus glandulatus* sp. n. has 917-1307  $\mu\text{m}$  long body; strongly annulated cuticle; conspicuously large hypodermal glands; ovoid amphidial apertures; offset lip region; separate, globular, lips; thickly cuticularised, arcuate, cheilostomal walls; basal bulb with four to five paired denticulate ridges; a pair of pseudocoelomocytes located posterior to the cardia and tail with a subterminal spur and three pairs of caudal setae. *Chiloplectus indicus* sp. n. has 695-1041  $\mu\text{m}$  long body; thick, transversely annulated, cuticle; three lateral incisures; markedly offset, narrow, lip region; lips with conical apices and slightly raised papillae; inner margin of lips forming well cuticularised oral framework; prohabdion as long as wide and comprising 20% of the stoma length; basal bulb with six pairs of denticulate ridges; paired pseudocoelomocytes located posterior to the cardia, genital tract weakly developed and tail with one median spur and two pairs of caudal setae.

**Keywords** – *Chiloplectus indicus*, description, new species, *Plectus glandulatus*, taxonomy.

The genus *Plectus* Bastian, 1865 was established by Bastian (1865). In 1905, Bastian designated *P. parietinus* Bastian, 1865 as the type species of the genus. The genus has a worldwide distribution and is represented by a large number of species. In recent years, Andr ssy (1984), Ebsary (1985), Maggenti *et al.* (1990), Kito *et al.* (1991), Tahseen *et al.* (1992), Abdel Rahman (1993), Zell (1993), De Ley and Coomans (1994) and Khan and Araki (2001) have added several species to the group. Zell (1993), in his voluminous compilation, included 49 valid species in the subgenus *Plectus*. Subsequently, De Ley and Coomans (1994), while describing three new species, accepted the subgeneric status of *Ceratoplectus* Andr ssy, 1984, as suggested by Zell (1993), but declined the synonymy and subgeneric status of all Wilsonematinae Chitwood, 1951 under the genus *Plectus*. We also accept the status of the subfamily Wilsonematinae (*sensu* Andr ssy, 1984) and its genera.

The genus *Chiloplectus* Andr ssy, 1964 was proposed by Andr ssy (1984) with three species: *C. globilabiatatus* (Kirjanova, 1958) Andr ssy, 1984; *C. andrassyi* (Timm, 1971) Andr ssy, 1984; and *C. globocephalus* (Mulk & Coomans, 1978) Andr ssy, 1984. Andr ssy (1985) described *Chiloplectus loricatus* and transferred *C. globocephalus* back to the genus *Plectus*. Holovachov

*et al.* (2000) made detailed morphological studies on the species *C. loricatus* Andr ssy, 1984, and *C. andrassyi*. They synonymised *C. loricatus* with *Plectus cancellatus* Zullini, 1978 and transferred the latter to the genus *Chiloplectus*. *Chiloplectus globilabiatatus* was considered as a *species inquirenda*, thereby supporting the opinions of Zell (1993), Bostr m (1997) and Andr ssy (1998). An amended diagnosis of the genus was also provided with a key to the identification of four species, *viz.*, *C. andrassyi*; *C. cancellatus* (Zullini, 1978) Holovachov, Susulovsky & Bostr m, 2000; *C. masleni* Bostr m, 1997 and *C. coloradensis* Zell, 1993. Subsequently, Oca na *et al.* (2001), emphasised the number of denticulate ridges and the projections at the side of spinneret as important differential characters for the diagnosis of *C. cancellatus* obtained from Spanish fir woodlands.

The present paper describes two new species, *Plectus glandulatus* sp. n. and *Chiloplectus indicus* sp. n., both collected in India.

### Materials and methods

Soil samples containing the new species were processed by sieving and decantation and modified Baermann funnel

\* Corresponding author, e-mail: ahmadwasim57@yahoo.co.in

techniques. The extracted nematodes were heat relaxed, fixed in FA, dehydrated by a slow evaporation method and mounted in anhydrous glycerine. Drawings were made using a drawing tube attachment on an Olympus BX-51 DIC microscope and LM pictures were taken using an Olympus DP-11 digital camera.

*Plectus glandulatus*\* sp. n.  
(Figs 1, 2)

MEASUREMENTS

See Table 1.

DESCRIPTION

*Female*

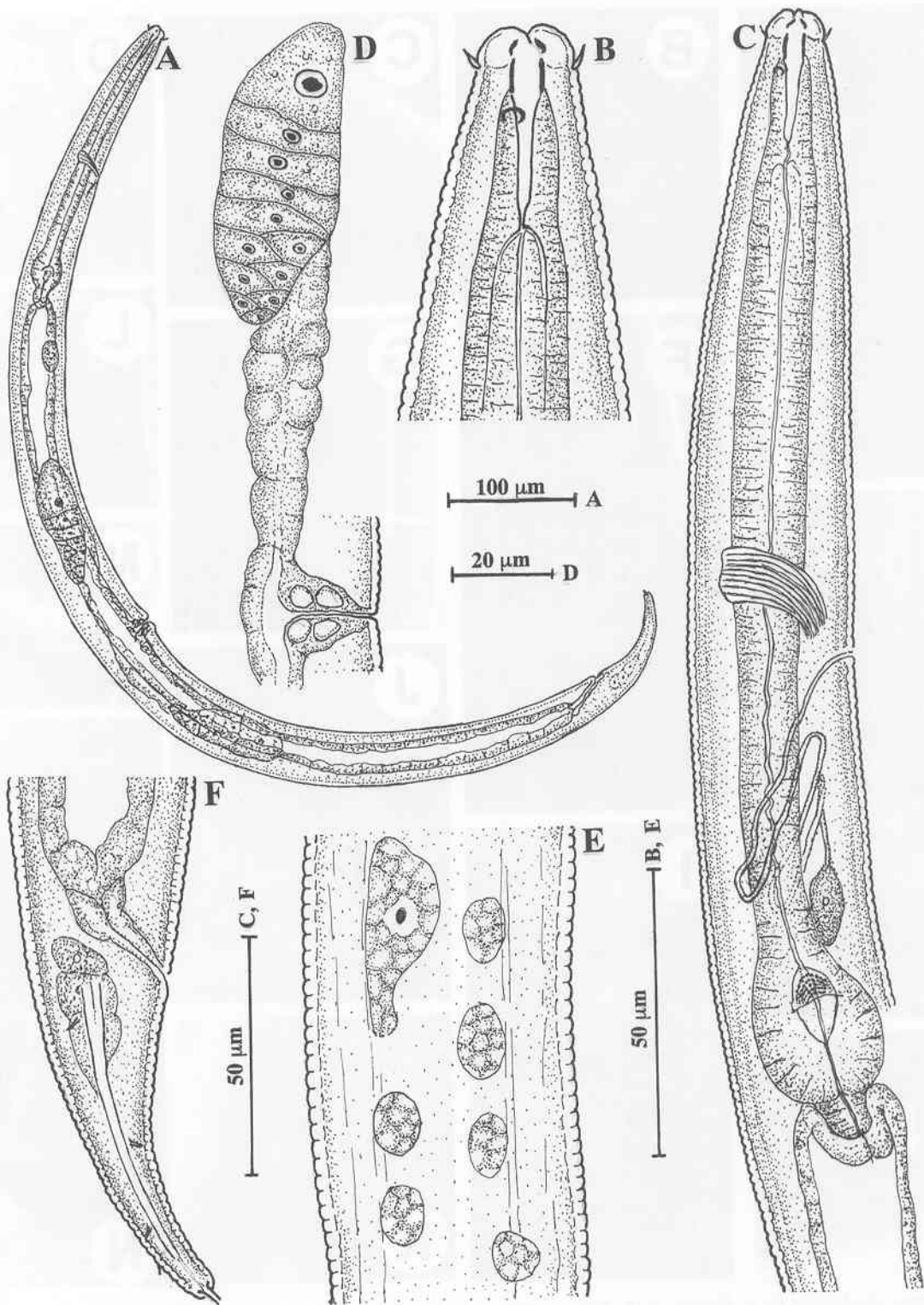
Body arcuate, particularly towards posterior extremity. Cuticle 2.5-4.0  $\mu\text{m}$  thick, strongly annulated; annules 1-2.5  $\mu\text{m}$  wide in different body regions; inner cuticle striated, longitudinal striae absent. Lateral fields marked by two close alae separated by an areolated area. Tail region with single ala reaching to tip. Sub-cuticular hypodermal glands dimorphic, 37-65 in number, located between base of stoma and anal opening. Smaller ovoid glands, 11-17  $\times$  9-15  $\mu\text{m}$  in size, arranged in tandem either in single row or in two alternate rows. Hypodermal glands located in region of intestine, exceptionally large, five to seven in number, 35-50  $\times$  12-24  $\mu\text{m}$  in size and with an extension. Between vulva and anus are 22-43 glands. Lip region strongly offset from body contour; lips globular, separated completely from each other, with opposable margins cuticularised anteriorly for ca 25-33% of their length. Inner labial sensilla bordering oral aperture; outer labial sensilla located in depressions on lips. Cephalic setae originating from third or fourth annule. Cervical setae numbering eight to ten and starting at stoma base. Cheilostom arcuate, cuticularised. Gymnostom (= prohabdion, as used by Maggenti (1961) in his diagnosis of the Plectidae) 6-7  $\mu\text{m}$  long, thick, cuticularised, 1.3-1.5 times longer than wide, and ca 25% of stoma length. Stegostom narrower with isomorphic base. Amphidial apertures ovoid, located anterior to middle of stoma at eight to ten annules from base of lips. Pharynx surrounding narrow part of stoma; differentiated into anterior corpus, slightly narrower isthmus and a basal bulb with post-bulbar extension leading

\* The species name refers to the presence of exceptionally large and complex hypodermal glands.

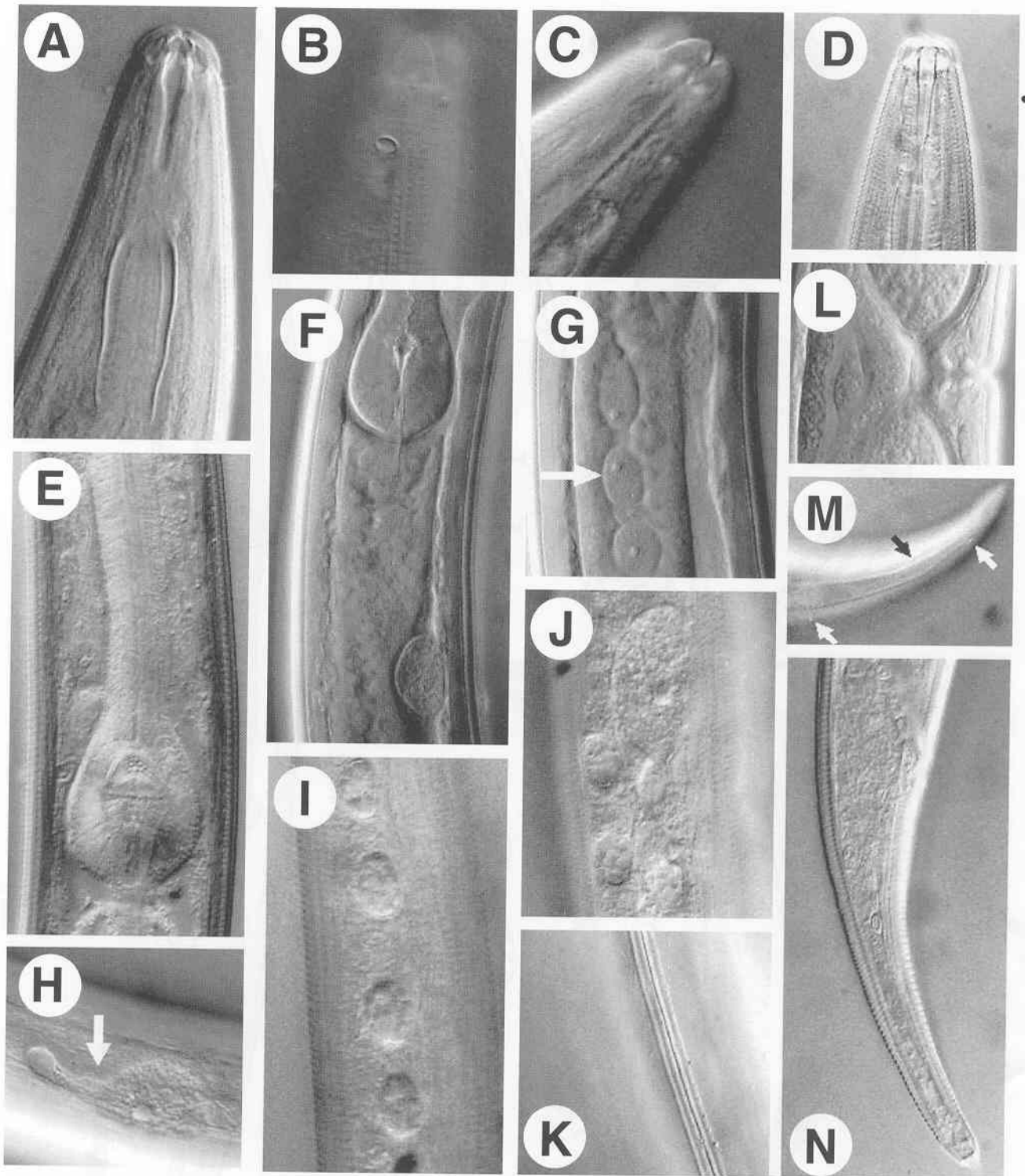
**Table 1.** Morphometric data for *Plectus glandulatus* sp. n. and *Chiloplectus indicus* sp. n. Measurements are in  $\mu\text{m}$  and in the form: mean  $\pm$  standard deviation (range).

Character	<i>Plectus glandulatus</i> sp. n.		<i>Chiloplectus indicus</i> sp. n.	
	Female		Female	
	Holotype	Paratypes	Holotype	Paratypes
n	—	15	—	13
L	1086	1087 $\pm$ 109 (917-1307)	829	881 $\pm$ 105 (695-1041)
a	20.9	19.0 $\pm$ 2.3 (15.0-24.0)	22.7	24.4 $\pm$ 2.9 (19.0-28.0)
b	4.5	4.6 $\pm$ 0.3 (4.1-5.0)	4.0	3.9 $\pm$ 0.3 (3.6-4.3)
c	12.9	13.0 $\pm$ 1.9 (10.0-15.0)	8.6	9.7 $\pm$ 0.75 (8.0-11.0)
c'	4.2	3.0 $\pm$ 0.7 (2.3-4.4)	4.4	4.0 $\pm$ 0.4 (3.3-4.6)
V	48.8	49.8 $\pm$ 1.4 (47.4-52.3)	51.9	51.5 $\pm$ 2.4 (48.0-58.0)
Body diam.	52	58 $\pm$ 11 (45-79)	36.0	37 $\pm$ 7 (27-52)
Stoma length	30.0	29.1 $\pm$ 5.1 (25.0-40.0)	20.0	20.8 $\pm$ 1.1 (18.0-23.0)
Pharyngeal length	240	235 $\pm$ 13.9 (205-259)	206.0	220 $\pm$ 16.5 (192-254)
Nerve ring	127	124 $\pm$ 8.1 (103-140)	111.0	114 $\pm$ 7.7 (99-122)
Anal body diam.	20.0	28.0 $\pm$ 4.6 (20.0-35.0)	21.0	22.8 $\pm$ 2.7 (17.0-28.0)
Tail length	84	82 $\pm$ 14.8 (65-129)	96	91 $\pm$ 11.5 (68-105)
Lip diam.	15.0	13.8 $\pm$ 1.5 (11.0-16.0)	11.0	11.7 $\pm$ 1.4 (9.0-13.0)
Lip height	5.0	5.76 $\pm$ 0.83 (5.0-8.0)	4.0	4.7 $\pm$ 0.6 (3.0-6.0)
Amphidial apertures from anterior end	11.0	12.5 $\pm$ 1.2 (11.0-15.0)	10.0	10.9 $\pm$ 0.4 (10.0-12.0)
G <sub>1</sub> (%)	28.1	23.9 $\pm$ 6.1 (16.9-30.0)	13.9	14.2 $\pm$ 3.1 (10.9-18.3)
G <sub>2</sub> (%)	29.5	23.7 $\pm$ 8.7 (15.6-29.5)	13.5	12.89 $\pm$ 2.27 (10.5-15.5)

to a cardia. Nerve ring at ca 52-54% of neck length. Excretory pore slightly posterior to nerve ring with long, cuticularised, double looped gland duct; right loop of excretory duct slightly larger than left one. Hemizonid anterior to excretory pore. Basal pharyngeal bulb pyriform 30.2  $\pm$  4.2  $\times$  34.9  $\pm$  3.5  $\mu\text{m}$  in size with four to five



**Fig. 1.** *Plectus glandulatus* sp. n. Female. A: Entire; B: Anterior region; C: Pharyngeal region; D: Reproductive system, anterior part; E: Midbody region showing hypodermal glands; F: Posterior region.



**Fig. 2.** *Plectus glandulatus* sp. n. Female. A-D: Anterior region; E: Posterior part of pharynx; F: Pharyngo-intestinal junction; G: Intestinal lumen showing cells; H-J: Hypodermal glands (arrow in H points to gland extension); K: Lateral field; L: Vulval sphincter muscles; M, N: Posterior region (arrows in M point to caudal setae).

pairs of denticulate ridges in grinder (valve plate). One pair of ovoid pseudocoelomocytes present *ca* one body diam. posterior to cardia. Left pseudocoelomocyte located slightly more anterior in position to right. Intestine thick walled with distinct lumen. Linearly arranged cells with prominent nuclei observed in lumen of two specimens. Reproductive system didelphic. Ovaries well developed, reflexed; anterior ovary on left and posterior on right side of intestine. Eggs usually present in uterine tract and measuring  $53 \pm 6.6 \times 38 \pm 8.2 \mu\text{m}$  in size with markings on shell (wrinkled outline in cross section); sperms not found in the genital tract. Vagina straight, *ca* one third of vulval body diam. long; epiptygmata in form of refringent vaginal walls; two sets of thick sphincter muscles appearing elliptical in cross section. Vulval lips slightly protruding. Rectum about as long as anal body diam. Tail ventrally arcuate, narrowing gradually towards tip; caudal setae including one subterminal spur and three paired setae (two latero-dorsal and one latero-ventral pair) bordering lateral ala. Subterminal (mid-dorsal) spur located about two to three tail tip diam. ( $11-14 \mu\text{m}$ ) anterior to tail terminus.

#### Male

Not found.

#### TYPE HABITAT AND LOCALITY

Samples containing *Plectus glandulatus* sp. n. were obtained from a ditch in Kishtwar, State of Jammu and Kashmir, India.

#### TYPE MATERIAL

Holotype female and ten female paratypes on slide '*Plectus glandulatus* sp. n./1-7' deposited in Nematode Collection of the Department of Zoology, Aligarh Muslim University, Aligarh, India. Two paratype females on slide '*Plectus glandulatus* sp. n./8' deposited at the Laboratory of Nematology, Wageningen University and Research Center (WUR), 6700 ES Wageningen, The Netherlands.

#### DIAGNOSIS AND RELATIONSHIPS

*Plectus glandulatus* sp. n. is a large species, 917-1307  $\mu\text{m}$  long, and with a strongly annulated cuticle, conspicuously large hypodermal glands, ovoid amphidial apertures, offset lip region, separate globular lips, strongly cuticularised, arcuate, cheilostomal walls, a pair of pseudocoelomocytes located posterior to the cardia, basal bulb with four to five paired denticulate ridges and three pairs

of caudal setae and a subterminal spur situated about two to three tail tip diam., *i.e.*,  $11-14 \mu\text{m}$ , anterior to the tail terminus.

The new species most resembles *P. parietinus* in all morphometric details, but differs in having unusually large hypodermal glands ( $35-50$  vs  $12-17 \mu\text{m}$ ), ovoid vs circular amphidial apertures, strongly cuticularised, arcuate, cheilostom vs cheilostom not cuticularised, smaller prorhabdion (gymnostom) in relation to stomal length ( $25\%$  vs  $33\%$  of stomal length), caudal setae arranged as two subdorsal and one subventral pair (vs one subdorsal and two subventral pairs), and subterminal (mid-dorsal) spur about two to three tail tip diam. anterior to tail terminus vs about one tip diam. from the extremity in *P. parietinus* *apud* Andr assy, 1985).

The new species also comes close to *P. infundibulifer* Andr assy, 1985 in having a large number of hypodermal glands, but differs in having a relatively smaller 'a' value ( $15-24$  vs  $21-27$ ), stoma with cylindroid gymnostom (= prorhabdion) vs funnel-shaped gymnostom and stegostom narrowing vs attenuated, larger hypodermal glands ( $35-50$  vs  $<20 \mu\text{m}$ ), weak vs well developed vaginal muscles and caudal setae arranged as two subdorsal and one subventral pair vs one subdorsal and one subventral pair.

*Plectus glandulatus* sp. n. also resembles *P. rotundilabiatus* Zell, 1993 in most morphometrics, but differs in having ovoid vs circular amphidial apertures, strongly cuticularised arcuate cheilostom vs cheilostom not cuticularised, smaller prorhabdion ( $25\%$  vs  $50\%$  of the stegostom), caudal setae arranged as two subdorsal and one subventral pair vs two lateral and one subventral pair (see Fig. 33 in Zell, 1993) and in the absence vs presence of males.

The new species further resembles *Plectus velox* Bastian, 1865 in morphometric details, but differs in having strongly cuticularised, arcuate, cheilostom vs cheilostom not arcuate or cuticularised, stoma markedly narrowing posterior to prorhabdion vs stoma gradually narrowing, larger hypodermal glands, smaller number of caudal setae (three vs five to six pairs) and absence of males (vs males reported in *P. velox* *apud* Zell, 1993).

From *Plectus lamproptychus* De Ley & Coomans, 1994, *P. glandulatus* differs in having a longer body ( $917-1307$  vs  $721-889 \mu\text{m}$ ), strongly cuticularised arcuate cheilostom vs cheilostom not cuticularised, longer pharynx ( $205-259$  vs  $174-190 \mu\text{m}$ ), longer stoma ( $25-40$  vs  $24-26 \mu\text{m}$ ), greater number of cervical setae ( $8-10$  vs  $6$ ) and relatively greater number of hypodermal glands ( $24-43$  vs  $19-25$ ).

## REMARKS

*Plectus glandulatus* sp. n. possesses one pair of pseudocoelomocytes located posterior to the cardia, a feature not usually described in other *Plectus* species, although stated to be a characteristic of the genus *Chiloplectus* *vide* Holovachov *et al.* (2000). Nevertheless, the presence of paired pseudocoelomocytes is a feature commonly found in Adenophoreans and can play an important role in diagnostics. The new species also stands apart on the basis of the conspicuously large hypodermal glands bearing extensions, a feature not reported in other species of the genus. The presence of refringent vaginal walls (epitygmata) has also been observed in the species, thereby indicating this as a species character rather than a generic one.

*Chiloplectus indicus*\* sp. n.  
(Figs 3, 4)

## MEASUREMENTS

See Table 1.

## DESCRIPTION

*Female*

Body arcuate, more so towards posterior extremity. Cuticle 1.9-3.0  $\mu\text{m}$  thick, strongly annulated, annules 1.5  $\mu\text{m}$  wide, inner cuticle striated; longitudinal striae absent. Lateral fields with three incisures. Sub-cuticular hypodermal glands absent. Lip region strongly offset, narrower than adjoining body contour; lips conical, separated from each other by a distinct gap, with inner setose projections pointing towards oral aperture; outer labial sensilla present in depressions on lips as observed in *en face* view. Cephalic setae 3-4  $\mu\text{m}$  long, originating from second to third annule. Cervical setae seven to nine in number, extending from base of stoma to cardia. Stoma with cuticularised cheilostom. *En face* showing strongly cuticularised V-shaped bars with arms located along margins of adjacent lips; Gymnostomal part (prorhabdion) of stoma 4.82  $\pm$  0.64  $\mu\text{m}$  long and wide, strongly cuticularised, occupying *ca* 20% of stoma length, separated from narrower part of stoma by a spur. Pharyngeal tissue surrounding base of prorhabdion; narrowest part of stegostom with

isomorphic base. Amphidial apertures plectoid, located anterior to middle of stoma, at five to six annules from base of lips. Pharynx differentiated into corpus, slightly narrower isthmus and a basal bulb with post-bulbar extension leading to a small cardia. Nerve ring at *ca* 52-54% of pharyngeal length; excretory pore at 56-59% of pharyngeal length with long, coiled, cuticularised gland duct; loop of excretory duct not discernible due to cellular bodies. Deirids slightly posterior to excretory pore. Basal pharyngeal bulb ovoid, 34.6  $\pm$  6.9  $\times$  23.5  $\pm$  2.5  $\mu\text{m}$  in size with six pairs of denticulate ridges in grinder (valve plate). One pair of oblong pseudocoelomocytes present *ca* one body diam. posterior to cardia. Intestine thin walled with wide lumen. Reproductive system didelphic; genital tract weakly developed. Ovaries small, reflexed; anterior ovary located on right and posterior on left side of intestine. Intra-uterine eggs not present. Vagina straight, 15-17  $\mu\text{m}$  long or *ca* 25-33% of vulval body diam.; sphincter muscles weak, represented by four faint, elliptical, cross sections. Vulval lips protruding, posterior lip more protuberant than anterior in some specimens; epitygma absent. Rectum *ca* as long as anal body diam. Tail ventrally curved, gradually narrowing towards tip with a subterminal mid-dorsal spur and three pairs (one latero-dorsal, one subdorsal and one latero-ventral) of caudal setae. Subterminal seta (spur) located two to three tail tip diam. or 17-21  $\mu\text{m}$  anterior to tail end.

*Male*

Not found.

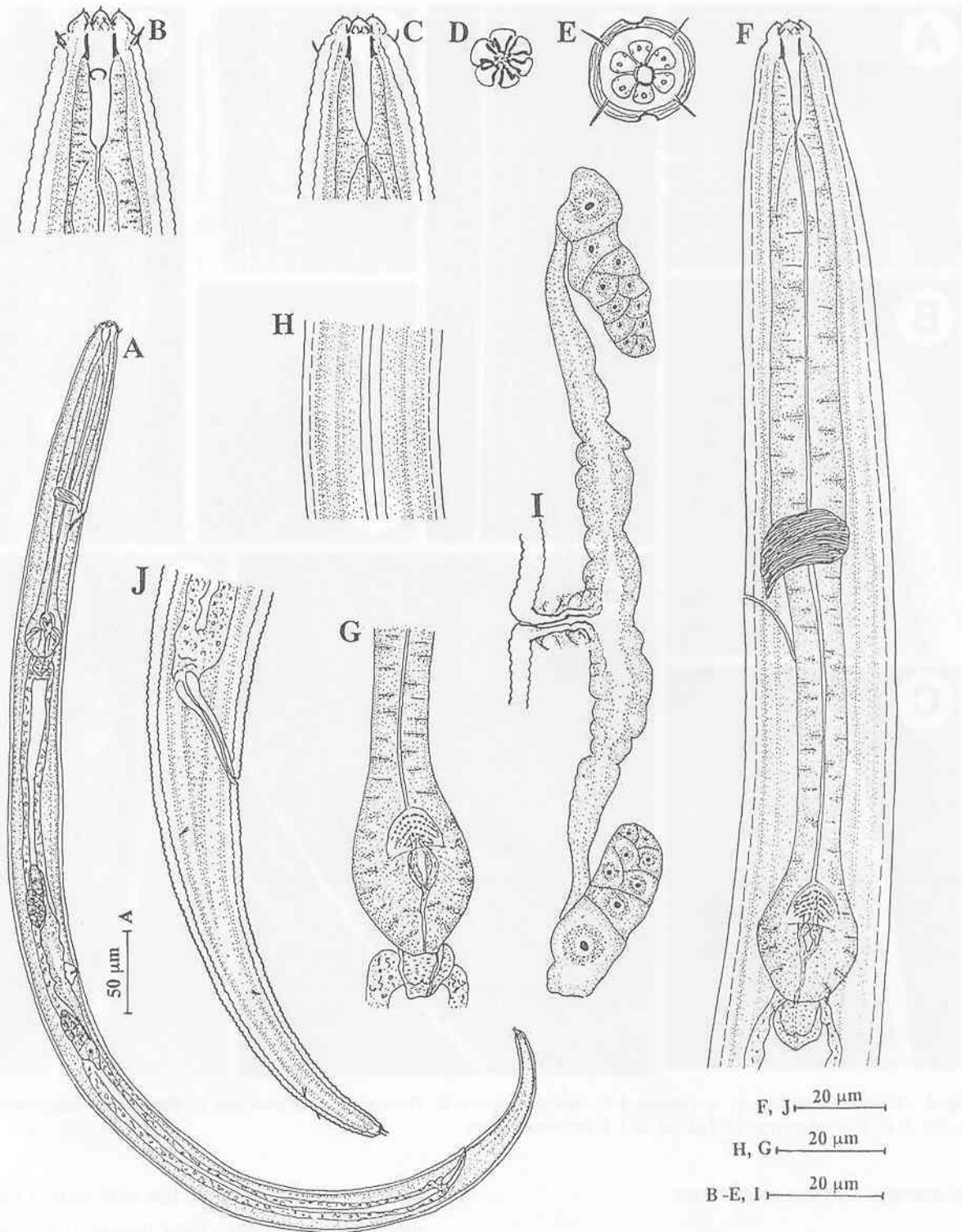
## TYPE HABITAT AND LOCALITY

Samples containing *Chiloplectus indicus* sp. n. were obtained from bamboo forest, Sector IV, Papumpare, Itanagar, Arunachal Pradesh, India.

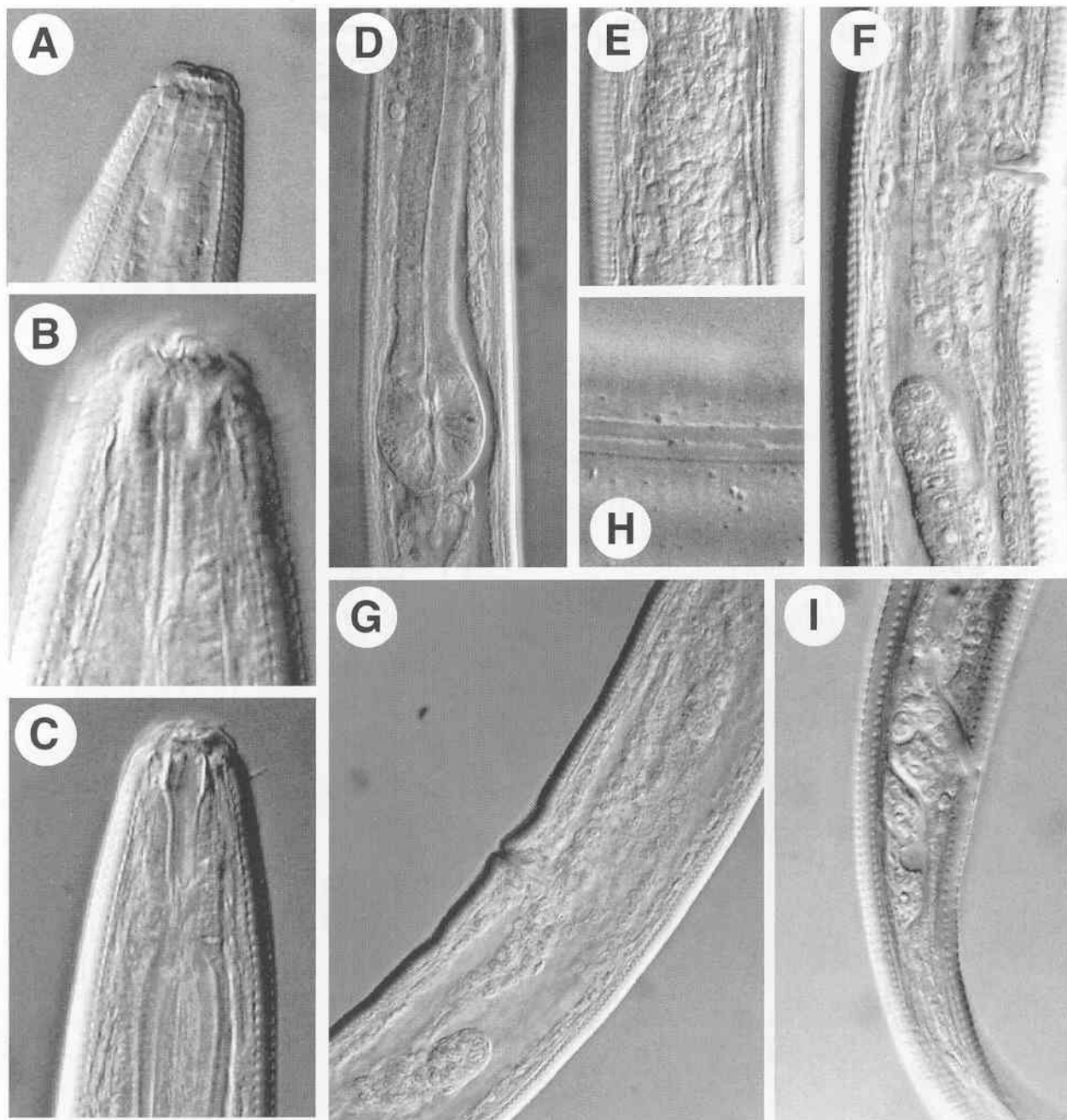
## TYPE MATERIAL

Holotype female and 17 female paratypes on slide '*Chiloplectus indicus* sp. n./1-14' deposited in Nematode Collection of the Department of Zoology, Aligarh Muslim University, Aligarh, India. Four paratype females on slide '*Chiloplectus indicus* sp. n./15-16' deposited at the Laboratory of Nematology, Wageningen University and Research Center (WUR), 6700 ES Wageningen, The Netherlands.

\* The name of the species is derived from India, the country of origin.



**Fig. 3.** *Chiloptectus indicus* sp. n. Female. A: Entire; B, C: Anterior region; D: En face view; E: Body section at level of amphids; F: Pharyngeal region; G: Pharyngeal bulb; H: Lateral field; I: Reproductive system; J: Posterior region.



**Fig. 4.** *Chiloplectus indicus* sp. n. Female. A-C: Anterior region; D: Posterior part of pharynx; E: Pharyngeal region with cellular bodies; F, G: Genital system; H: Lateral field; I: Posterior region.

#### DIAGNOSIS AND RELATIONSHIPS

*Chiloplectus indicus* sp. n. is characterised by a medium to large sized body (695-1041  $\mu\text{m}$  long) with thick, transversely annulated, cuticle, three lateral incisures;

markedly offset lip region; lips with conical apices and slightly raised papillae; inner margin of lips forming a well cuticularised oral framework with cuticularised V-shaped bars lying along adjacent lip margins; prorhab-



dion as long as protostom diameter and occupying *ca* 20% of stoma length; basal bulb with six pairs of denticulate ridges; paired pseudocoelomocytes located posterior to cardia; small ovaries; genital tract weakly developed with no uterine eggs and tail with three pairs of caudal setae and a median spur at two to three tail tip diam. anterior to tail end.

The new species resembles *C. andrassyi* in morphometric characteristics, but differs in having adjacent lip margins with cuticularised bars *vs* lip margins without cuticularised bars, prorhabdion as long as protostom diam. *vs* prorhabdion half as long as protostom diam., three *vs* four incisures in the lateral field, relatively posterior vulva ( $V = 48-58$  *vs*  $41-50$ ), weakly developed reproductive tract (*vs* reproductive tract well developed), greater number of caudal setae (seven *vs* six) and absence of males (*vs* males reported in *C. andrassyi*).

The new species differs from *C. masleni* in having adjacent lip margins with cuticularised bars *vs* lip margins without cuticularised bars, straight *vs* arcuate prorhabdion, oval-shaped *vs* pear-shaped basal bulb, anteriorly *vs* posteriorly placed amphidial apertures, and a relatively posterior vulva ( $V = 48-58$  *vs*  $47$ ).

From *C. coloradensis* the new species differs in having smaller b-value ( $3.6-4.3$  *vs*  $4.5-5.0$ ) and c'-value ( $3.3-4.6$  *vs*  $5.3-6.9$ ), prorhabdion as long as protostom diameter *vs* only half of protostom diameter, comparatively posterior vulva ( $V = 48-58$  *vs*  $41-46.9$ ), and posteriorly placed caudal spur ( $17-21$  *vs*  $21-32$   $\mu\text{m}$ ).

*Chiloplectus indicus* sp. n. differs from *C. cancellatus* in having a relatively thinner cuticle ( $1.9-3.0$  *vs*  $3.3-7.3$   $\mu\text{m}$ ) without longitudinal striae (*vs* longitudinally striated), three *vs* four lateral incisures, smaller stoma ( $18-23$  *vs*  $24-31$   $\mu\text{m}$ ), six *vs* seven to ten denticulate ridges in the basal bulb, weakly developed reproductive tract without intra-uterine eggs *vs* well developed reproductive tract with intra-uterine eggs, and absence of males *vs* presence.

*Chiloplectus indicus* sp. n. also has superficial similarities to *Plectus patagonicus* de Man, 1904, a poorly known species based on a single specimen and synonymised with *P. parietinus* by Goodey (1951), a proposal that was approved by Andrassy (1984). Zell (1993) re-described it with a question mark and ascribed populations from different localities to the species, thereby broadening the range of morphometric values. De Ley and Coomans (1994) accepted Zell's description.

Although *C. indicus* sp. n. undoubtedly belongs to *Chiloplectus*, not *Plectus*, we differentiate the two species

herein for the sake of completeness. In addition to the generic differences, *C. indicus* sp. n. differs from the populations of *P. patagonicus* described by Zell (1993) and De Ley and Coomans (1994) in lip shape (lips with conical apices showing raised outer sensilla *vs* lips with rounded apices); inner lip margins setose towards oral aperture *vs* lip margins not setose; lateral fields with three *vs* four lines; fewer cervical setae (seven to nine *vs* 16-23); paired pseudocoelomocytes present *vs* pseudocoelomocytes not reported; deirids papilliform *vs* setiform; and the position of the caudal spur ( $17-21$  *vs*  $10-14$   $\mu\text{m}$ ).

## Acknowledgement

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