

## Redescription of Free-Living Marine Nematode, *Dracograllus filipjevi* Allen and Noffsinger, 1978 (Nematoda: Draconematidae) from Korea

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Received 22 August 2006; Revised 10 September 2006; Accepted 26 September 2006

**Abstract** – A draconematid nematode species, *Dracograllus filipjevi* Allen and Noffsinger, 1978, is described from the washings of shallow littoral coralline algae at Guryongpo in the eastern coast of Korea. This species is recognized by the following characteristics: larger body size, number of posterior sublateral adhesion tubes (9 in male and 12-13 in female) and subventral adhesion tubes (8-9 in male and 9-10 in female), the absence of cephalic acanthiform setae on rostrum, the presence of longitudinally areolated body cuticle with dot-like punctations, the presence of some cuticular collar in swollen pharyngeal region, the shape of amphidial fovea (large, elongate, and loop-shaped in both sexes), the absence of preanal corniform setae, and the absence of lateral differentiation on narrow body region. Morphological features of the species using differential interference contrast photomicrographs are described in detail in the present work. This is the first report of *D. filipjevi* in Korea.

**Key words** – Nematoda, Draconematidae, taxonomy, redescription, *Dracograllus filipjevi*

### 1. Introduction

In Korea, six draconematid nematodes have so far been reported. Rho and Kim (2004a) described the first draconematid species, *Temudraconema koreensis*, collected from the washings of subtidal coarse sediments and various invertebrates (hermit crabs, sponges and bryozoans) from Namae in the eastern coast of Korea. Rho and Kim (2004b) redescribed the second species, *Draconema japonicum*, Kito 1976, which was obtained from the washings of intertidal and subtidal sediments and various

algae from the eastern, southern, and western coasts of Korea. Thereafter, a series of investigations from Korea (Rho and Kim 2005a, b, c) added three new draconematid nematode species (*Paradraconema jejuense* Rho and Kim, 2005a, *Dinetia orientalis* Rho and Kim, 2005b, and *Dracogalerus koreanus* Rho and Kim, 2005c). Recently, Rho *et al.* (2006) described a new subtidal draconematid species, *Dinetia decraemerae* Rho *et al.*, 2006, which was obtained from the washings from coarse sediments and small (*ca* 30 cm long) logs collected at the depth of 200-250 m, off Samchuk in the eastern coast of Korea.

Until now, only two *Dracograllus* species, *D. filipjevi* and *D. gerlachi* Allen and Noffsinger, 1978, have been recorded in the Northwest Pacific (Allen and Noffsinger 1978). So far, the taxonomic study on the genus *Dracograllus* Allen and Noffsinger 1978 from Korea has not yet been conducted. During a survey on the free-living marine nematofauna in Korea, *Dracograllus filipjevi* was obtained for the first time from the washings of shallow littoral coralline algae, which were collected from 3 to 5 m deep at Guryongpo in the eastern coast of Korea.

In the present paper, we provide here redescription and differential diagnoses of the species with detailed illustrations and differential interference contrast (DIC) photomicrographs. This is the first discovery of *D. filipjevi* in Korea.

### 2. Materials and Methods

Nematodes were obtained from the washings of shallow littoral coralline algae. Samples were collected at a depth

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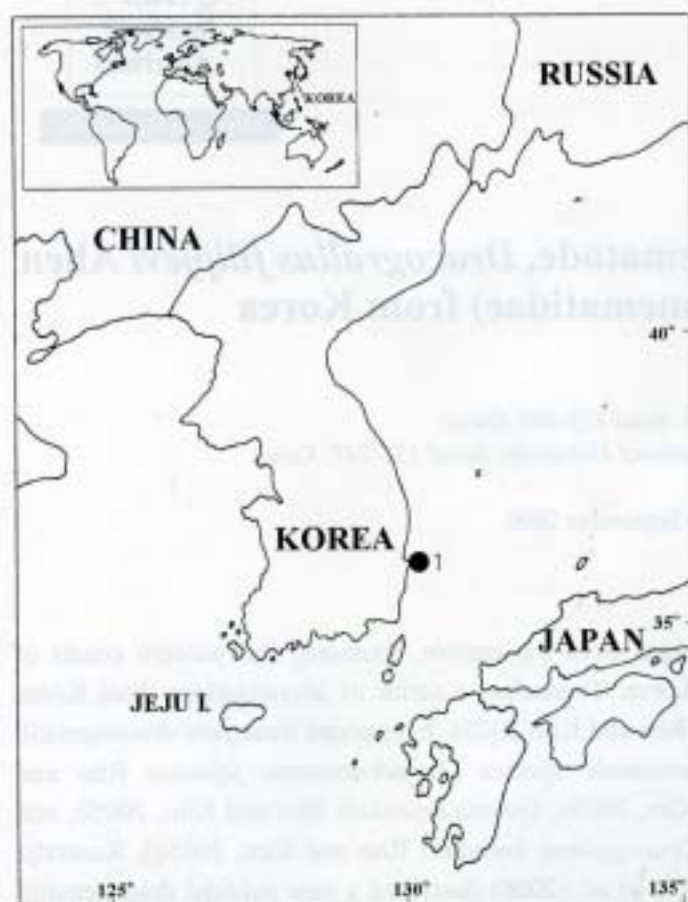


Fig. 1. Map showing the sampling locality. 1. Daebo-ri, Guryongpo.

of 3-5 m deep at Guryongpo on the eastern coast of Korea (Figure 1). Samples were filtered through a 67  $\mu$ m mesh sieve in the field after freshwater rinsing for less than a minute for osmotic shock (Kristensen 1989). The contents of the sieve were fixed in 4% buffered formalin in sea water and sorted using a dissecting microscope (Leica MZ16). Specimens were transferred to anhydrous glycerin according to Seinhorst (1959) and mounted in anhydrous glycerin between two coverslips on a H-S slide (Shirayama *et al.*, 1993). Specimens were examined, photographed, and drawn using Nomarski differential interference contrast (DIC) with an Olympus BX51 microscope equipped with a drawing tube and a Nikon Coolpix 990 digital camera.

Terminology mostly follows Decraemer (1989). Abbreviations used in the text are as follows: abd=anal body diameter; CAT=cephalic adhesion tubes; Ceph Acan-set=cephalic acanthiform setae; Corn-set=corniform setae; gub=length of gubernacular apparatus; L=body length; mbd Ph=maximum body diameter in pharyngeal region; (mbd)=minimum body

diameter; mbd=maximum body diameter at mid body level; PAT=posterior adhesion tubes; ph=length of pharynx; spic=length of spicule measured along the median line; SIATl=length of sublateral adhesion tubes; SIATn=number of sublateral adhesion tubes; SvATl=length of subventral adhesion tubes; SvATn=number of subventral adhesion tubes; t=tail length; tnr=length of non-striated tail end; V=position of the vulva as a percentage of the total body length from anterior; a, b, c, c'=proportions of de Man; a=body length divided by body maximum width; b=body length divided by the pharynx length; c=body length divided by the tail length; c'=tail length divided by the anal body diameter. All measurements are in  $\mu$ m; mean value in parentheses.

### 3. Systematic Accounts

Family Draconematidae Filipjev, 1918

Subfamily Draconematinae Filipjev, 1918

Genus *Dracograllus* Allen and Noffsinger, 1978

*Dracograllus filipjevi* Allen and Noffsinger, 1978

(Figures 2-7)

*Dracograllus filipjevi* Allen and Noffsinger, 1978, p. 72, figs. 117-120.

**Habitat and locality:** Daebo-ri, Guryongpo, Korea (36°01'38"N, 129°34'66"E), collected on 9 May 1998 by H. S. Rho. Daebo-ri, Guryongpo, Korea (36°01'38"N, 129°34'66"E), collected on 16 July 2006 by H. S. Rho and Jeom Rae Lee. The nematodes were obtained from the washings of shallow littoral calcareous algae collected at a depth of 3-5 m by skin diving.

**Material examined:** 3 ♂♂ and 2 ♀♀ are in the third author's collection at the specimen conservation room of the Invertebrate Resources Bank of Korea (IRBK), Seoul National University (IRBK701-IRBK705). All are mounted in anhydrous glycerine between two coverslips on H-S slides, sealed with nail polish.

#### Measurements:

**Male:** L=671, mbd=55, (mbd)=16, mbd Ph=50, ph=105, abd=22, t=74, tnr=35, spic=50, gub=12, CAT=8, SIATl=30, SIATn=9, SvATl=19, SvATn=8-9, a=12.2, b=6.4, c=9.0, c'=3.4.

**Female:** L=570, mbd=45, (mbd)=16, mbd Ph=41, ph=105, abd=16, t=72, tnr=43, CAT=8, SIATl=25, SIATn=12-13, SvATl=20, SvATn=9-10, a=12.7, b=5.4, c=7.9, c'

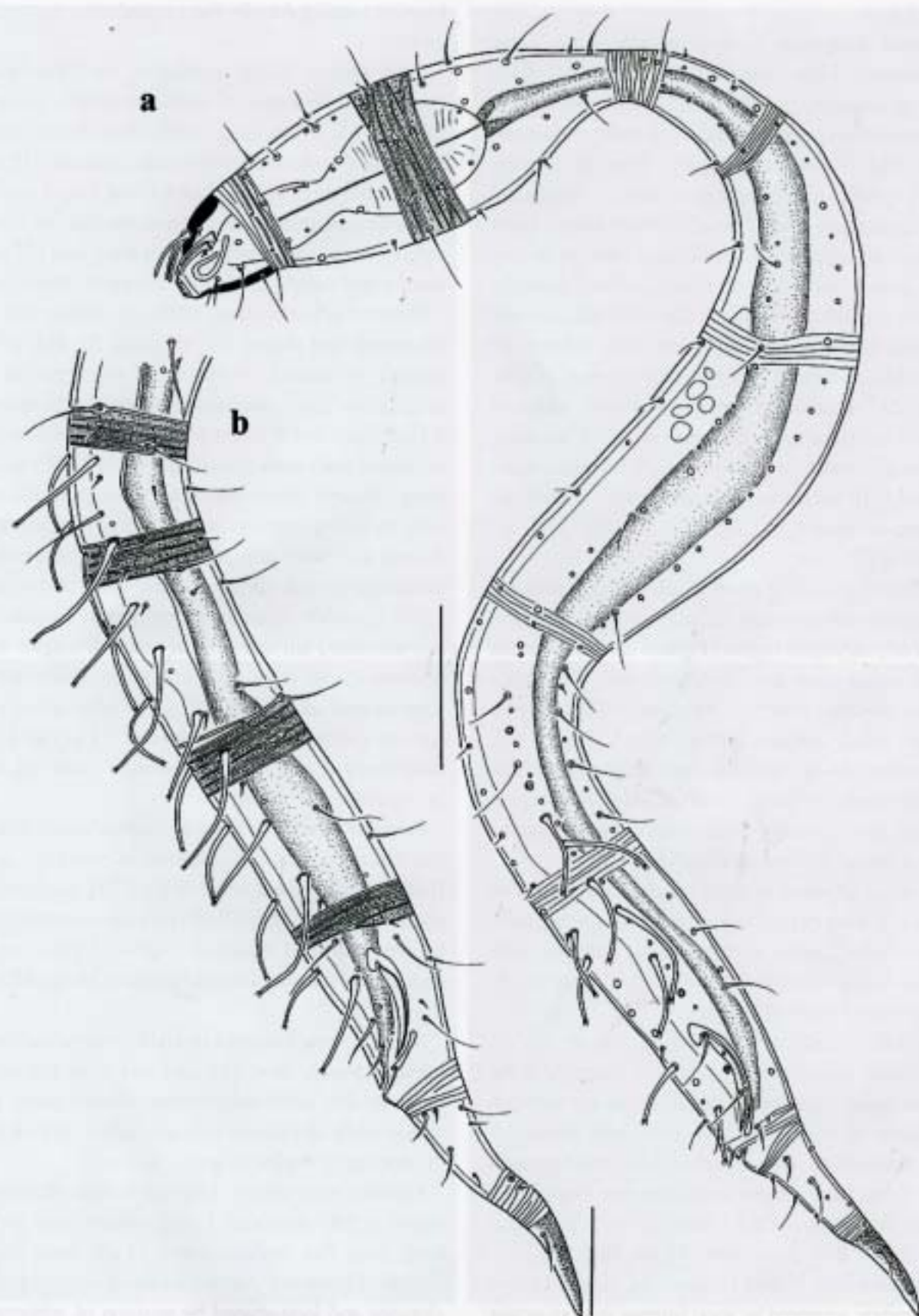


Fig. 2. *Dracograllus filipjevi*, male. (a) habitus, lateral view, (b) mid and posterior body region, lateral view. Scale bars= 50  $\mu$ m (a), 30  $\mu$ m (b).



=4.5, V=53.1.

**Differential diagnosis:** Body relatively stout, long. Swollen anterior body region 21-23% of total body length. Body annules, except in tail, lined with minute dot-like ornamentation; dot-like punctations more conspicuous in lateral field of mid-body region. Rostrum slightly wrinkled. Cephalic acanthiform setae absent. Amphidial fovea large, elongate, loop-shaped in both sexes. Eight CAT slender, arranged almost middle of rostrum in two transverse rows. Narrow neck region without laterally differentiated annulations. Some somatic setae with cuticular collar in pharyngeal region. Adhesion tubes slender: all posterior adhesion tubes (PAT) with slightly marked bell-shaped end. PAT arranged on 4 longitudinal rows: sublateral rows with 9 adhesion tubes in male and 12-13 adhesion tubes in female, and subventral rows 8-9 adhesion tubes in male and 9-10 adhesion tubes in female. Subventral preanal Corn-set absent.

#### Description:

**Male:** Habitus typical of *Dracograllus*. Body relatively large and arched dorsally and ventrally; mid-body region as swollen as pharyngeal region (Figures 2a, 3a). Swollen pharyngeal region offset from wider mid-body by narrow neck region. Swollen pharyngeal region 21-23% of total body length. Body annules, except in tail (Figure 4d), lined with minute dot-like ornamentation; dot-like punctations more conspicuous in lateral field of mid-body region (Figures 2b, 3c-d); slender neck region without narrow longitudinal lateral differentiation (Figure 2a).

Somatic setae arranged in eight longitudinal rows with minute (3  $\mu$ m), short (9  $\mu$ m) and long (21  $\mu$ m) setae, more or less alternating; some somatic setae provided with slightly developed cuticular collar at their insertion in pharyngeal region (Figures 3c-d).

Rostrum with slightly wrinkled cuticle (Figure 3b); lip region extruded. Labial sensory setae not observed. Four fine cephalic setae, 9  $\mu$ m long. Eight CAT slender, arranged almost middle of rostrum in two transverse rows. All CAT with enlarged tip. Several subcephalic setae present. Amphidial fovea large (16  $\mu$ m long), elongate loop-shaped by position of sublateral CAT; ventrally whirled; ventral arm more longer than dorsal arm (Figure 3b).

Pharynx dumb-bell shaped (Figures 2a, 4a), with less developed corpus, separated by short isthmus from muscular posterior large endbulb; nerve ring at level of isthmus; surrounded by numerous nuclei. Cardia short (8  $\mu$ m long).

Intestine running dorsally from reproductive system (Figures 2a-b).

Reproductive system typical of the Draconematidae; extending to beginning of swollen mid-body region (Figure 2a). Spicules 50  $\mu$ m long, slightly arched; with large offset capitulum (Figure 4c). Gubernacular apparatus (12  $\mu$ m long) paired with slightly developed distal lateral enlargement of the corpus, parallel to spicules. Ventral corniform setae absent. Two pairs of anal setae in male: one (13  $\mu$ m long) anterior and one (13  $\mu$ m long) posterior to cloacal opening.

Posterior adhesion tubes relatively slender, with slightly developed bell-shaped end (Figures 2b, 4b), all located anterior to cloacal opening/anus and arranged in four longitudinal rows: two sublateral rows each consisting of 9 (left side) and 9 (right side) adhesion tubes, and two subventral rows each consisting of 9 (left side) and 8 (right side) adhesion tubes; sublateral rows each intermingling with two long somatic setae (25  $\mu$ m long) (Figure 2b). Alternating long and short sublateral adhesion tubes intermingled with minute somatic setae (4  $\mu$ m long).

Tail gradually tapering to cylindrical smooth tip end; non-annulated tail end 47% of total tail length; its cuticle perforated with three pairs of somatic setae: one pair of setae situated subdorsally, one pair of setae situated laterally, and one pair of relatively long setae (11  $\mu$ m long) situated sublaterally. Long subdorsal somatic setae not observed in annulated tail region.

**Female:** Similar to male in most respects (Figures 5a, 6a). Greatest body width at level of vulva (45  $\mu$ m long). Body annules, except in tail (Figure 7d), lined with minute dot-like ornamentation; dot-like punctations more conspicuous in lateral field of mid-body region (Figure 7a); slender neck region without narrow longitudinal lateral differentiation (Figure 5a).

Somatic setae arranged in eight longitudinal rows with minute (5  $\mu$ m), short (13  $\mu$ m) and long (36  $\mu$ m) setae, more or less alternating; some somatic setae provided with slightly developed cuticular collar at their insertion in pharyngeal region (Figures 5a-b, 6b).

Rostrum with slightly wrinkled cuticle (Figure 5c); lip region slightly protruded. Labial sensory setae about 4  $\mu$ m long. Four fine cephalic setae, 13  $\mu$ m long. Eight CAT slender (Figure 5c). Amphidial fovea large (14  $\mu$ m long), elongate and loop-shaped by position of sublateral CAT; ventrally whirled; ventral arm more longer than dorsal arm (Figures 3b-c, 6c).

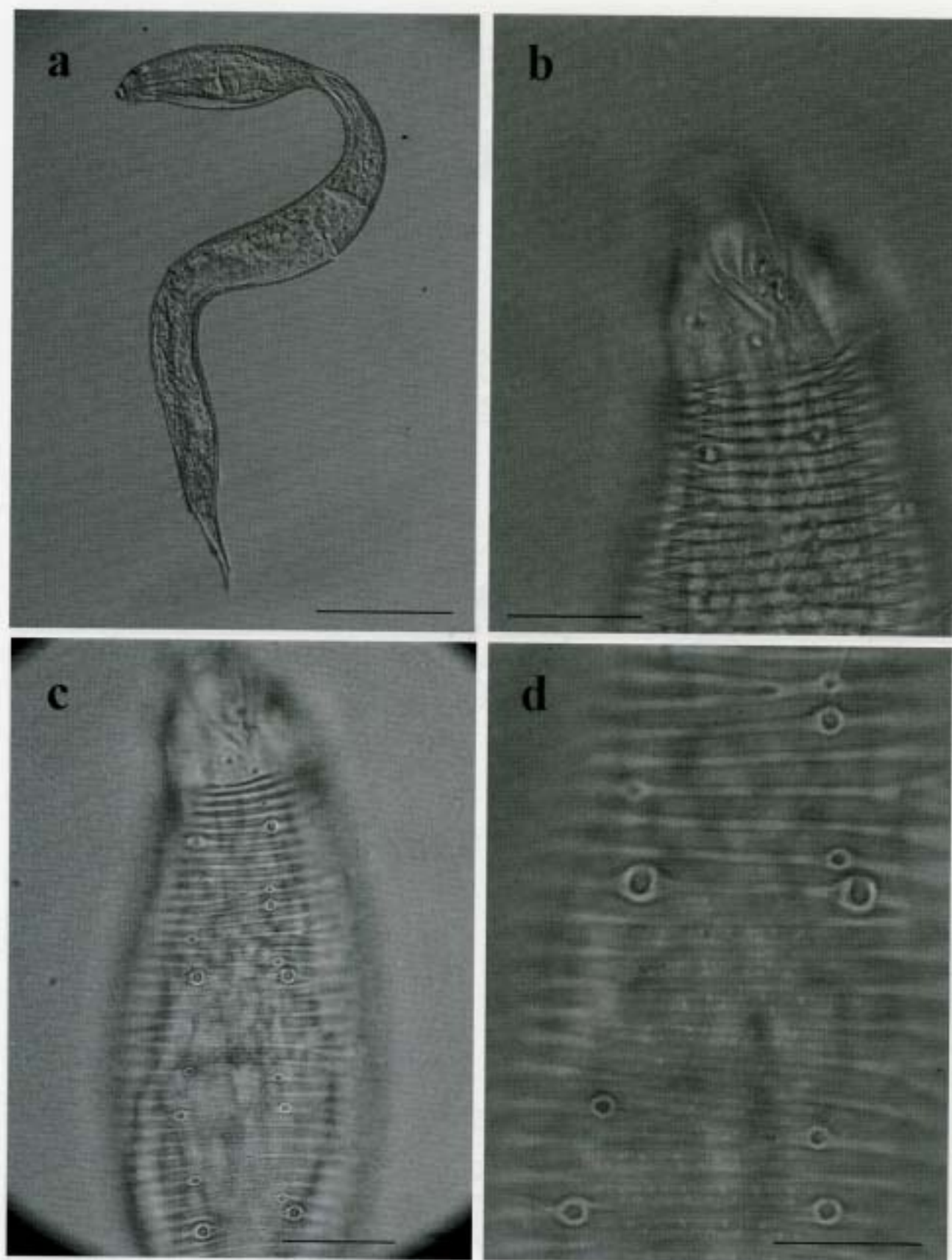


Fig. 3. *Dracograllus filipjevi*, male. (a) habitus, lateral view, (b) head region and amphidial fovea, lateral view, (c) body annulation of anterior body region, lateral view, (d) detail of body annulation of the pharyngeal region, lateral view. DIC micrographs. Scale bars=100 µm (a), 20 µm (b, c), 10 µm (d).



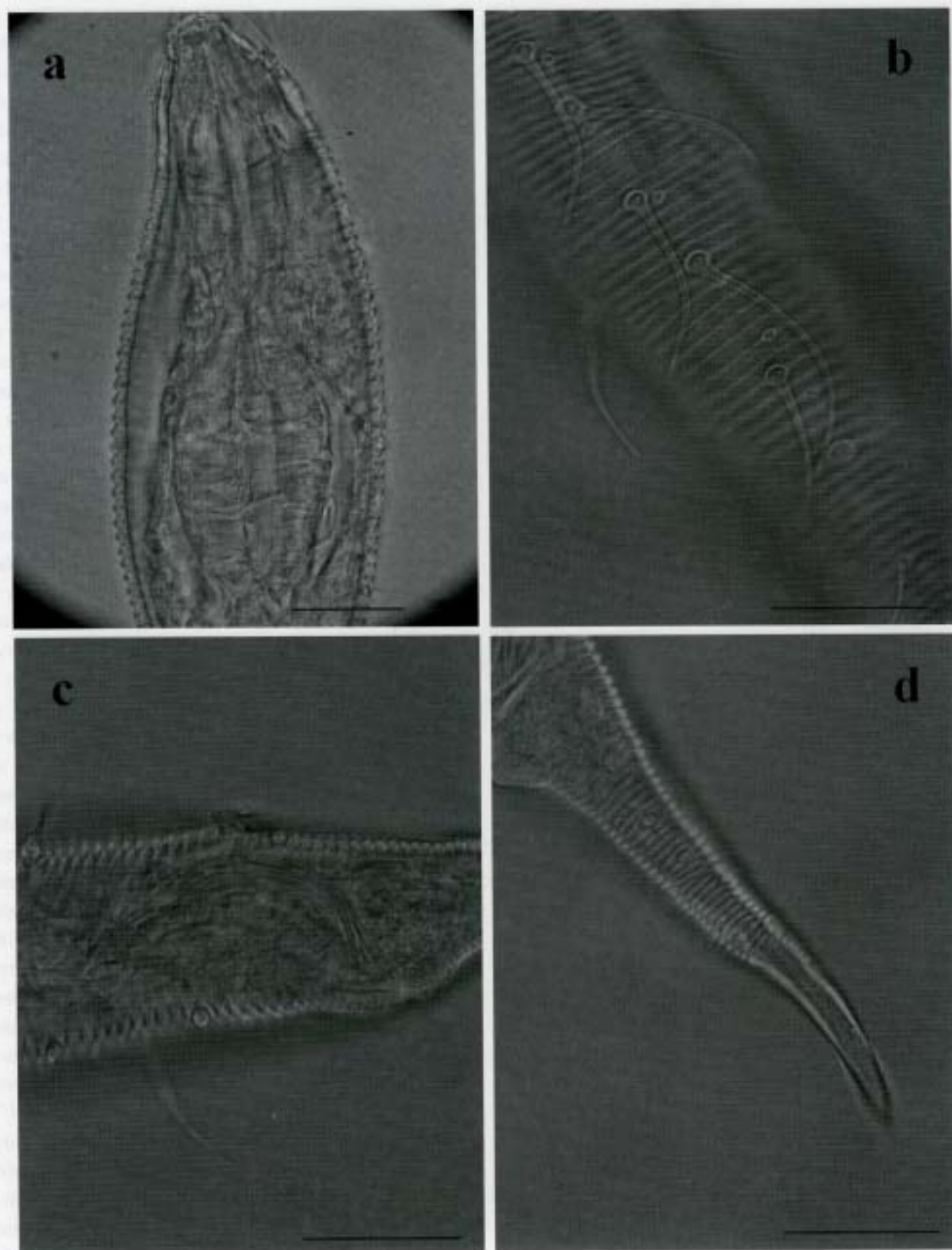


Fig. 4. *Dracograllus filipjevi*, male. (a) pharyngeal apparatus, lateral view, (b) posterior sublateral adhesion tubes, lateral view, (c) spicules and gubernacular apparatus, lateral view, (d) tail region, lateral view. DIC micrographs. Scale bars=20  $\mu$ m (a-d).

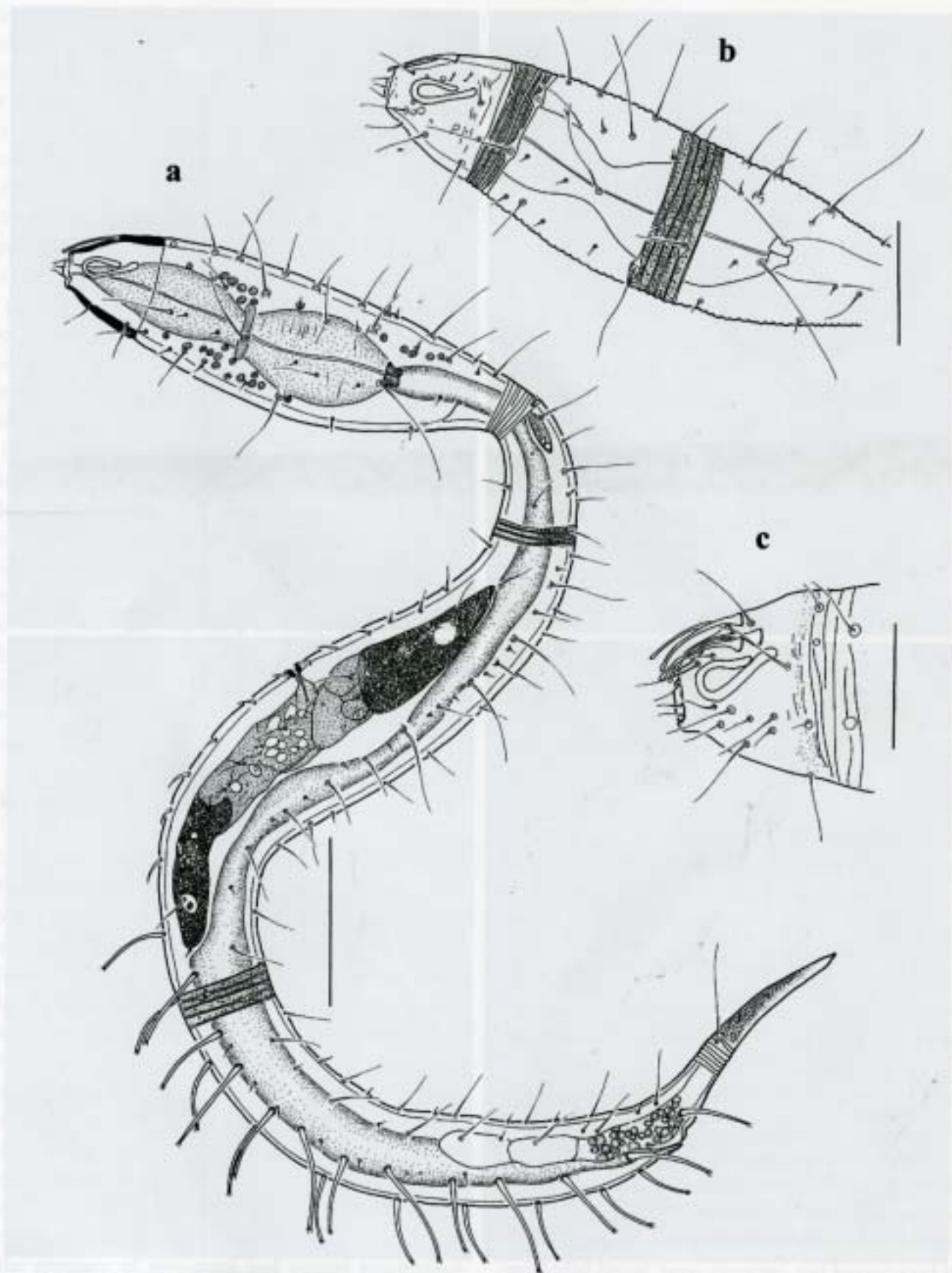
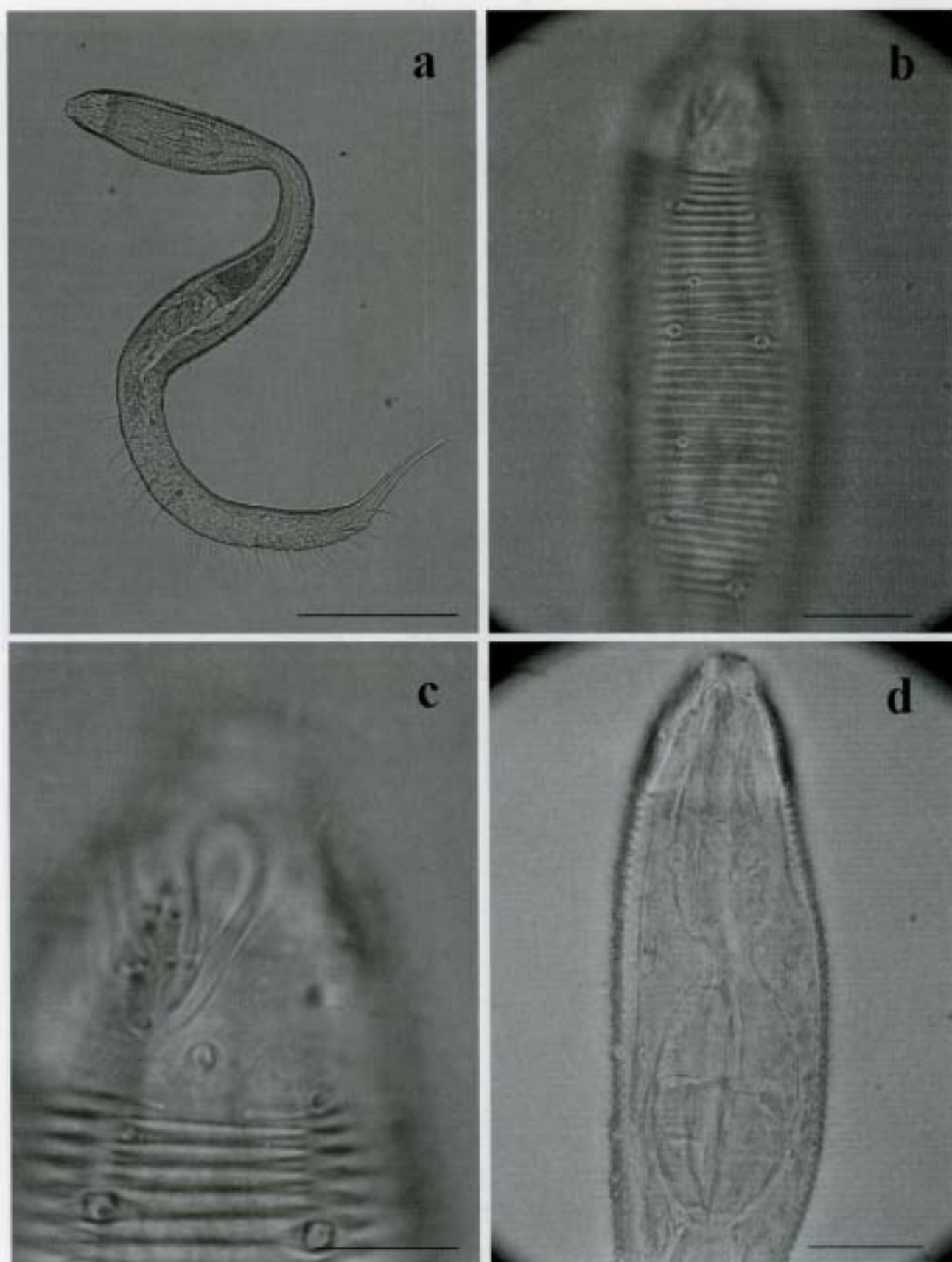


Fig. 5. *Dracograllus filipjevi*, female. (a) habitus, lateral view, (b) head and pharyngeal region, lateral view, (c) head and amphidial fovea, lateral view. Scale bars=50 µm (a), 30 µm (b), 20 µm (c).



**Fig. 6.** *Dracograllus filipjevi*, female. (a) habitus, lateral view, (b) body annulation of anterior body region, lateral view, (c) head region and amphidial fovea, lateral view, (d) pharyngeal apparatus, lateral view. DIC micrographs. Scale bars=100  $\mu$ m (a), 20  $\mu$ m (b, d), 10  $\mu$ m (c).



Pharynx dumb-bell shaped (Figures 5a-b, 6d), with less developed corpus, separated by short isthmus from muscular posterior large endbulb; nerve ring at level of isthmus; surrounded by numerous nuclei (Figure 5a). Cardia short (6  $\mu$ m long). Intestine running dorsally from reproductive system (Figures 5a, 6a).

Reproductive system didelphic-amphidelphic, with reflexed ovaries. Both branches reflexed to left side (Figures 5a, 7b). Vagina short, bipartite with sclerotised distal region; vulva located near mid-body, not encircled by any projections, two pairs of paravulval (one prevulval and one postvulval) setae present.

Posterior adhesion tubes relatively slender, with slightly developed bell-shaped end (Figures 5a, 7c). PAT arranged in four longitudinal rows: two sublateral rows each consisting of 12 (left side) and 13 (right side) adhesion tubes (one of them on tail), and two subventral rows each consisting of 10 (left side) and 9 (right side) adhesion tubes; intermingling somatic setae absent. Alternating long and short sublateral adhesion tubes intermingled with minute somatic setae (4  $\mu$ m long).

Non-annulated tail end 60% of total tail length; its cuticle perforated with two pairs of somatic setae: two pairs of setae situated subdorsally. Long subdorsal somatic setae, 29  $\mu$ m long. Caudal glands extending anterior beyond cloacal opening.

#### 4. Discussion

The members of the genus *Dracograllus* Allen and Noffsinger, 1978 are distinguished morphologically from all other genera (*Draconema* Cobb, 1913, *Dracograllus* Allen and Noffsinger, 1978, *Paradraconema* Allen and Noffsinger, 1978, and *Tenuidraconema* Decraemer, 1989) of the subfamily Draconematinae Filipjev, 1918 by the following diagnostic characteristics: (1) the lack of prominently enlarged body annules anteriorly on swollen pharyngeal region, (2) the absence of eyespots and sublateral cephalic acanthiform setae on rostrum (an exception is *D. stekhoveni* Allen and Noffsinger, 1978), (3) the presence of pedicel setae and of very fine PAT with clear differences in length among them, (4) the presence of more developed swollen anterior body region (18-25% of total body length), and (5) the presence of subventral and ventral longitudinal rows of long, stiff, posteriorly directed somatic setae in front of PAT (Allen and Noffsinger 1978; Clasing 1980;

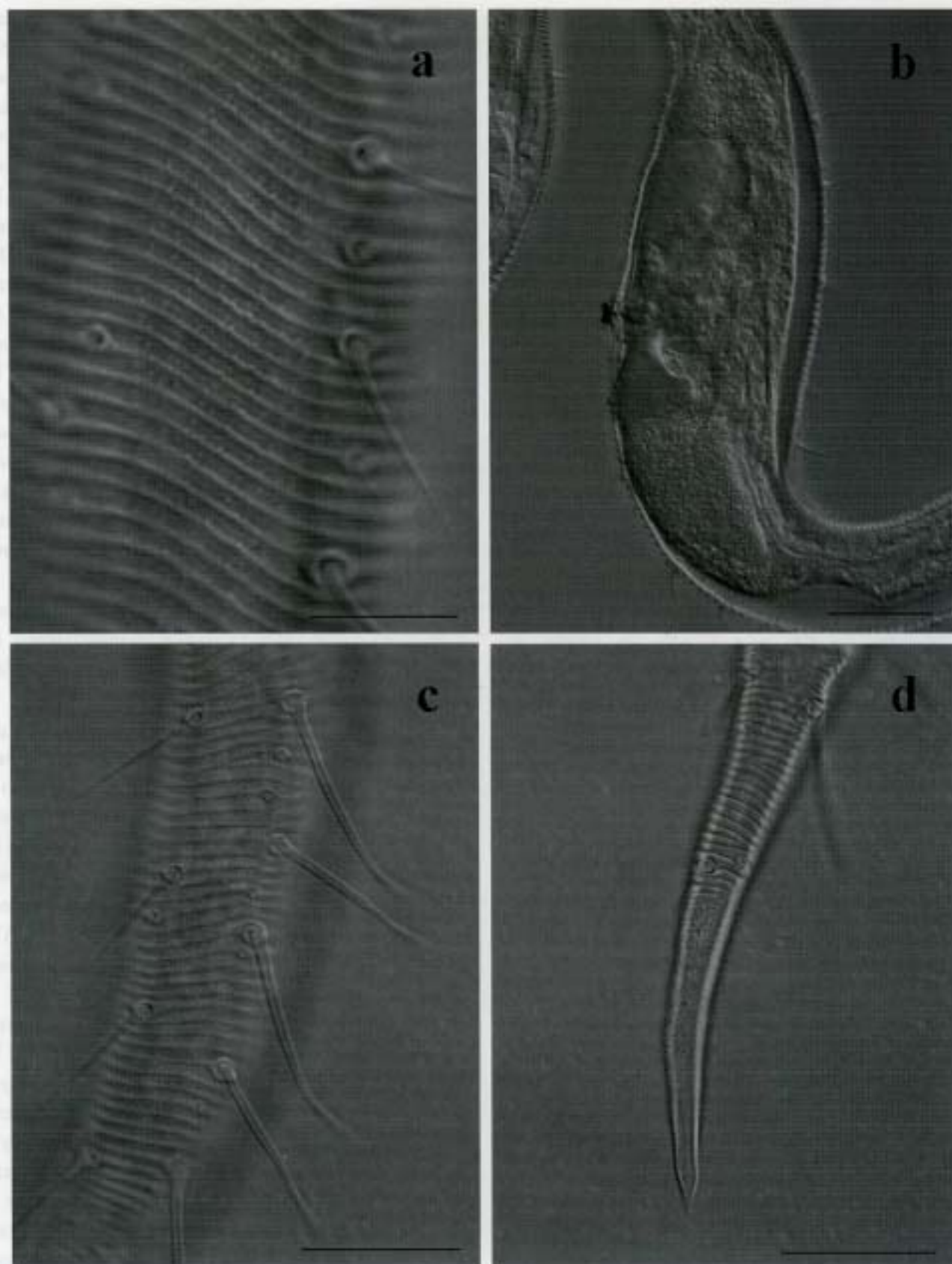
Decraemer and Gourbault 1986; Decraemer 1988; Decraemer 1989; Verschelde and Vincx 1993; Decraemer *et al.* 1997).

At present, the genus *Dracograllus*, with 24 species, constitutes the largest genus of the family Draconematidae Filipjev 1918. Twenty-four species are as follows: *D. antillensis* Decraemer and Gourbault, 1986, *D. chiloensis* Clasing, 1980, *D. chitwoodi* Allen and Noffsinger, 1978, *D. cobbi* Allen and Noffsinger, 1978, *D. cornutus* Decraemer, 1988, *D. demani* Allen and Noffsinger, 1978, *D. eira* (Inglis, 1968), *D. falcatus* (Irwin-Smith, 1918), *D. filipjevi* Allen and Noffsinger, 1978, *D. gerlachi* Allen and Noffsinger, 1978, *D. gilbertae* Verschelde and Vincx, 1993, *D. grootaerti* Decraemer, 1988, *D. kreisi* Allen and Noffsinger, 1978, *D. laingensis* Decraemer, 1988, *D. mawsoni* Allen and Noffsinger, 1978, *D. minutus* Decraemer, 1988, *D. papuensis* Decraemer, 1988, *D. pusillus* Decraemer, 1988, *D. solidus* (Gerlach, 1952), *D. spinosus* Decraemer, 1988, *D. stekhoveni*, *D. timmi* Allen and Noffsinger, 1978, *D. trispinosus* (Allen and Noffsinger, 1978), and *D. wieseri* Allen and Noffsinger, 1978.

Of these, only two species, *D. filipjevi* from holdfasts of kelp from Japan, and *D. gerlachi* from brown algae growing on rocks from Japan, have been recorded in the Northwest Pacific (Allen and Noffsinger 1978).

According to the taxonomic key characters of the genus *Dracograllus* in Allen and Noffsinger (1978) and Decraemer (1988), the genus can be divided artificially into two groups on the basis of the number of CAT on rostrum. The first group is characterized by having 12 to 18 CAT on rostrum, and includes four recorded species (*D. cornutus*, *D. falcatus*, *D. gerlachi*, and *D. stekhoveni*). The second group is characterized by having six to eight CAT on rostrum, and comprises 20 recorded species including *D. filipjevi*.

Allen and Noffsinger (1978) first described a draconematid nematode, *Dracograllus filipjevi*, from holdfasts of Kelp from Japan (Oarai, Ibaraki-ken, Honshu Island). *Dracograllus filipjevi* is mainly distinguished from its congeners in having the following characteristics: (1) larger body size (500-700  $\mu$ m long), (2) the absence of Ceph Acan-set, (3) the presence of longitudinally areolated body cuticle with dot-like punctations, (4) the presence of some cuticular collar in swollen pharyngeal region, (5) the shape of amphidial fovea: large, elongate, and loop-shaped in both sexes, (6) the absence of preanal Corn-set, (7) the absence of lateral differentiation on narrow body region, and (8)



**Fig. 7.** *Dracograllus filipjevi*, female. (a) detail of body annulation of mid-body region, lateral view, (b) female reproductive system, lateral view, (c) posterior sublateral adhesion tubes and somatic setae, lateral view, (d) tail region, lateral view. DIC micrographs. Scale bars=10  $\mu$ m (a), 30  $\mu$ m (b), 20  $\mu$ m (c, d).



the number and arrangement of posterior sublateral and subventral adhesion tubes (9 sublateral and 8-9 subventral PAT in male, and 12-13 and 9-10 in female). The present Korean specimens agree well with Allen and Noffsinger's (1978) original description, especially in the number of eight CAT, the longitudinally areolated body cuticle with dot-like punctations, the slightly developed cuticular collar in swollen pharyngeal region, and large, elongate and loop-shaped amphidial fovea in both sexes. However, the Korean specimens of *D. filipjevi* are not well accorded with Allen and Noffsinger's (1978) original description in the number of posterior subventral adhesion tubes of male as follows: 8 to 9 in Korean specimens as compared to 9 to 11 in the original description.

**Distribution:** Japan (Allen and Noffsinger 1978) and Korea (Daebu-ri).

## Acknowledgements

We appreciate the anonymous reviewers for their helpful comments that greatly improved the manuscript. This work was supported by the Korea Research Foundation Grant (KRF-2005-070-C00124).

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