

A New Free-living Marine Nematode Species of the Genus *Dracogalerus* Allen and Noffsinger (Nematoda: Draconematidae) from a Shallow Subtidal Zone of Jeju Island, Korea

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Abstract: A new species of free-living marine draconematid nematode, *Dracogalerus koreanus* n. sp., is described from the shallow subtidal coarse sediments and various invertebrates of Jeju Island, Korea. This is the first record of this genus from Korea. *Dracogalerus koreanus* n. sp. is morphologically most similar to *D. cryptocephalus* (Irwin-Smith) in having similar head shape (rostrum broadly rounded anteriorly) and eight cephalic adhesion tubes, but differs by the small number of rounded protuberances on the ventral side of non-annulated tail end (5 vs 6), small number of posterior subventral adhesion tubes in male (5-6 vs 8), intermingled somatic setae (5-6 vs absent), spicules (slightly curved and relatively thick vs strongly curved and very slender), and higher "c" value in male (8.8 vs 7.5).

Key words: Marine Nematoda, Draconematidae, *Dracogalerus*, new species, Korea

Currently, only three species of the genus *Dracogalerus* Allen and Noffsinger (1978) have been recorded from the world: *D. cryptocephalus* Irwin-Smith (1918), *D. afrikaanus* Allen & Noffsinger (1978), and *D. bastiani* Allen & Noffsinger (1978) (Irwin-Smith, 1918; Allen and Noffsinger, 1978).

About 87 years ago, Irwin-Smith (1918) described the first *Dracogalerus* species from intertidal zones of Vacluse, Port Jackson in Australia as *Notochaetosoma cryptocephalus* Irwin-Smith. Long after Irwin-Smith, Allen and Noffsinger (1978) described two new species of the genus *Dracogalerus*, *D. afrikaanus* and *D. bastiani*, from marine algae from South Africa, and transferred *N. cryptocephalus* to the genus *Dracogalerus* based on the observation of the type material.

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So far, the taxonomic study on the genus *Dracogalerus* from Korea has been entirely lacking. During a biodiversity survey on the free-living marine draconematid nematodes, a new draconematid species, *Dracogalerus koreanus* n. sp., was collected from the washings of the shallow subtidal coarse sediments and various invertebrates of Jeju Island in Korea.

The object of the present paper is to report the first recorded *Dracogalerus* species from the northwest Pacific. In addition, the present paper contains the description of a new draconematid species, *Dracogalerus koreanus* n. sp., with illustrations and differential interference contrast (DIC) photomicrographs.

MATERIALS AND METHODS

The nematodes were obtained from the washings of shallow subtidal coarse sediments and various invertebrates (sponges and bryozoans), which were collected from 10 to 35 m deep by SCUBA diving at Jeju Island on the southern coast of Korea (Fig. 1). Samples were filtered through a sieve with 67 μ m mesh in the field after freshwater rinsing for less than 1 min for osmotic shock (Kristensen, 1989), and then fixed in 5% buffered formalin in sea water. Specimens were mounted in anhydrous glycerin between two coverslips on H-S slides (Shirayama et al., 1993), and measured and photographed using a differential interference contrast (DIC) microscope (Olympus BX-60). All drawings were made with the aid of a camera lucida.

Terminology mostly follows Decraemer (1989). Abbreviations used in the text are as follows: abd = anal body diameter; CAT = cephalic adhesion tubes; gub = length of gubernaculum; L = body length; mbd Ph = maximum body diameter in pharyngeal region; (mbd) = minimum body diameter; mbd =

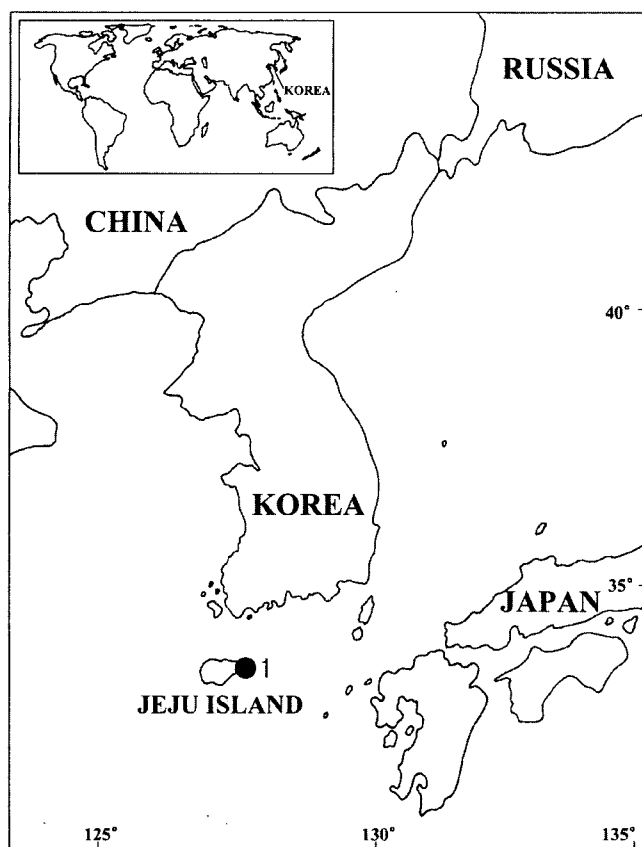


Fig. 1. A map showing the type locality of *Dracogalerus koreanus*. 1. Seongsanpo.

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. All measurements are in μm with mean value in parentheses.

TAXONOMY

Family Draconematidae Filipjev, 1918
 Subfamily Draconematinae Filipjev, 1918
 Genus *Dracogalerus* Allen and Noffsinger, 1978

Dracogalerus koreanus n. sp.
 (Figs. 2-7)

Type specimens: Holotype and four paratypes are mounted in anhydrous glycerine between two coverslips on H-S slides, sealed with nail polish. Two paratypes (one female and one juvenile) will be deposited in the nematode collection of the Royal Belgian Institute of Natural Sciences, Brussels, Belgium. Holotype and the other two

paratypes (one female and one juvenile) are kept in the author's collection at the specimen room of the Department of Biological Sciences, Seoul National University (SNU500-SNU502).

Type locality and habitat: Korea, Jeju Island, Seongsanpo (33° 27' 81" N, 126° 55' 95" E), collected on 9 Jun. 2001 by H. S. Rho and S. H. Kim. The nematodes were obtained from the washings of shallow subtidal coarse sediments and various invertebrates (sponges and bryozoans), which were obtained from 10 to 35 m deep by SCUBA diving.

Diagnosis: Body without conspicuously swollen regions, nearly equal in entire length, greatest width at mid-body. Anterior body region hardly swollen. Rostrum broadly rounded anteriorly. Body cuticle thick and with well-developed groove. Eight CAT with not swollen base and open tip, located on mid-rostrum. Amphidial fovea spiral. Buccal cavity narrow, unarmed. Pharynx about cylindrical; lumen wall slightly swollen in terminal part. Adhesion tubes: all PAT with well marked bell-shaped end. PAT arranged on 4 longitudinal rows in male, 2 sublateral rows each consisting of 8 adhesion tubes with 5 to 6 intermingled somatic setae, and 2 subventral rows each consisting of 5 (left side) and 6 (right side) adhesion tubes, without intermingled somatic setae. Posterior subventral adhesion tubes becoming slightly shorter caudally. All PAT anterior to cloacal opening/anus. Five pairs of small somatic setae present on non-annulated tail region; 2 pairs of somatic setae inserted subdorsally and 3 pairs of somatic setae inserted subventrally. Non-annulated tail end with 5 ventrally rounded protuberances in male.

Measurements

Holotype male: L = 1230, mbd = 59, (mbd) = 40, mbd Ph = 43, ph = 152, abd = 35, t = 140, tnr = 80, spic = 83, gub = 12, SIATl = 36, SIATn = 8, SvATl = 32, SvATn = 5-6, a = 20.8, b = 8.1, c = 8.8, c' = 4.

Female: L = 1210, mbd = 61, (mbd) = 40, mbd Ph = 40, ph = 160, abd = 25, t = 117, tnr = 79, SIATl = 28, SIATn = 10-12, SvATl = 27, SvATn = 8, a = 19.8, b = 7.5, c = 10.3, c' = 4.7, V = 45.1%.

Second stage juvenile: L = 800, mbd = 41, (mbd) = 33, mbd Ph = 38, ph = 112, abd = 25, t = 86, tnr = 51, SIATl = 29, SIATn = 4, a = 19.5, b = 7.1, c = 9.3, c' = 3.4.

Descriptions

Holotype male: Body long, without conspicuously swollen regions, nearly equal in entire length, greatest body width at mid-body (Figs. 2A, 3A). Pharyngeal region 12.4% of total body length. Body cuticle with thick annulation and well-

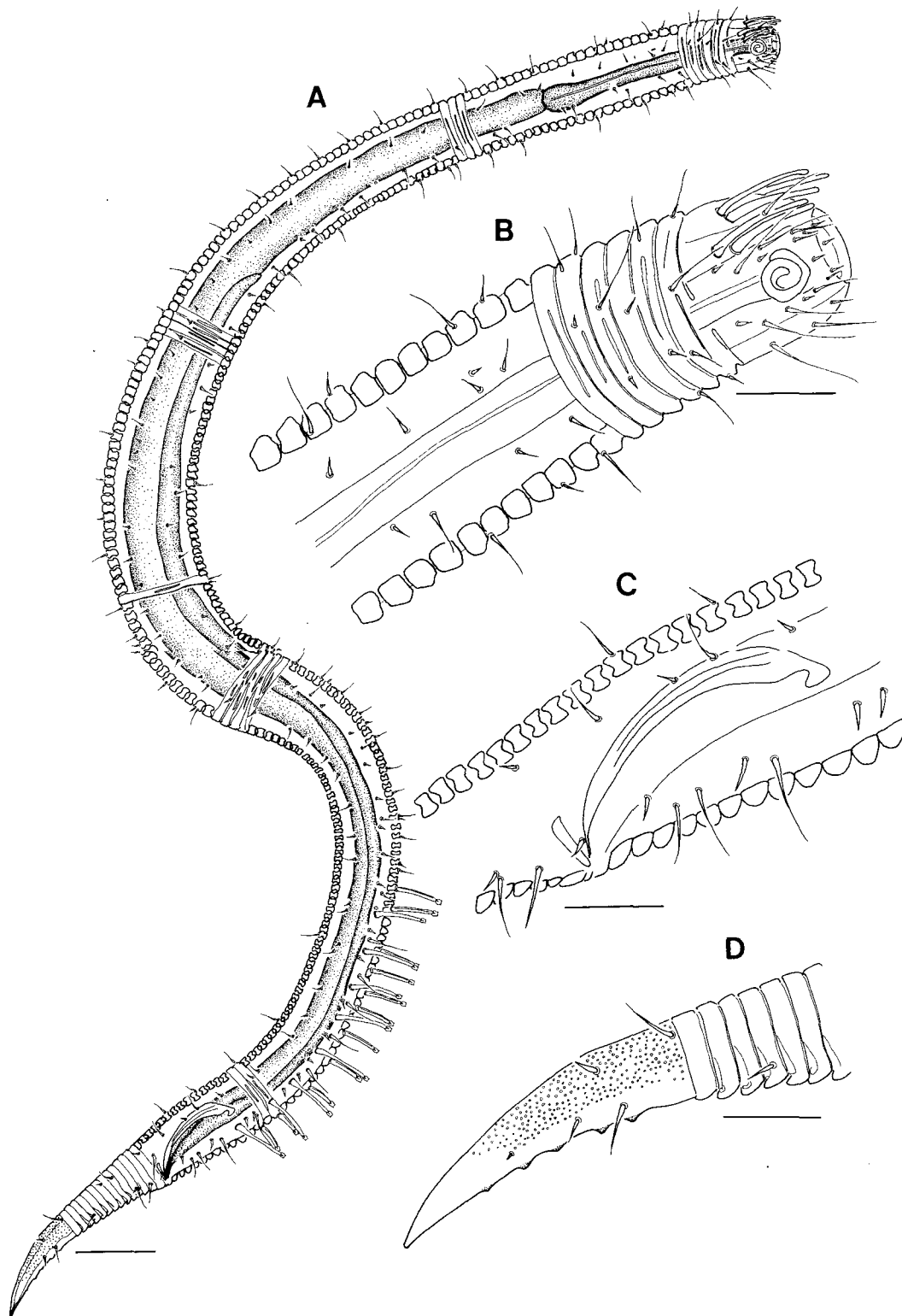


Fig. 2. *Dracogalerus koreanus* n. sp., male (holotype). A, Habitus, lateral view. B, Head region, lateral view. C, Copulatory apparatus, lateral view. D, Tail region, lateral view. Scale bars = 50 μ m (A) and 20 μ m (B-D).

developed transverse groove (Figs. 2B, 3C). Somatic setae very short and fine, but slightly widened at their base, arranged in 8 longitudinal rows (2 subdorsal, 4 sublateral,

and 2 subventral) on pharyngeal and mid-body region. Head with well-cuticularized rostrum, not ornamented; greatest width subterminally, gradually tapering anteriorly

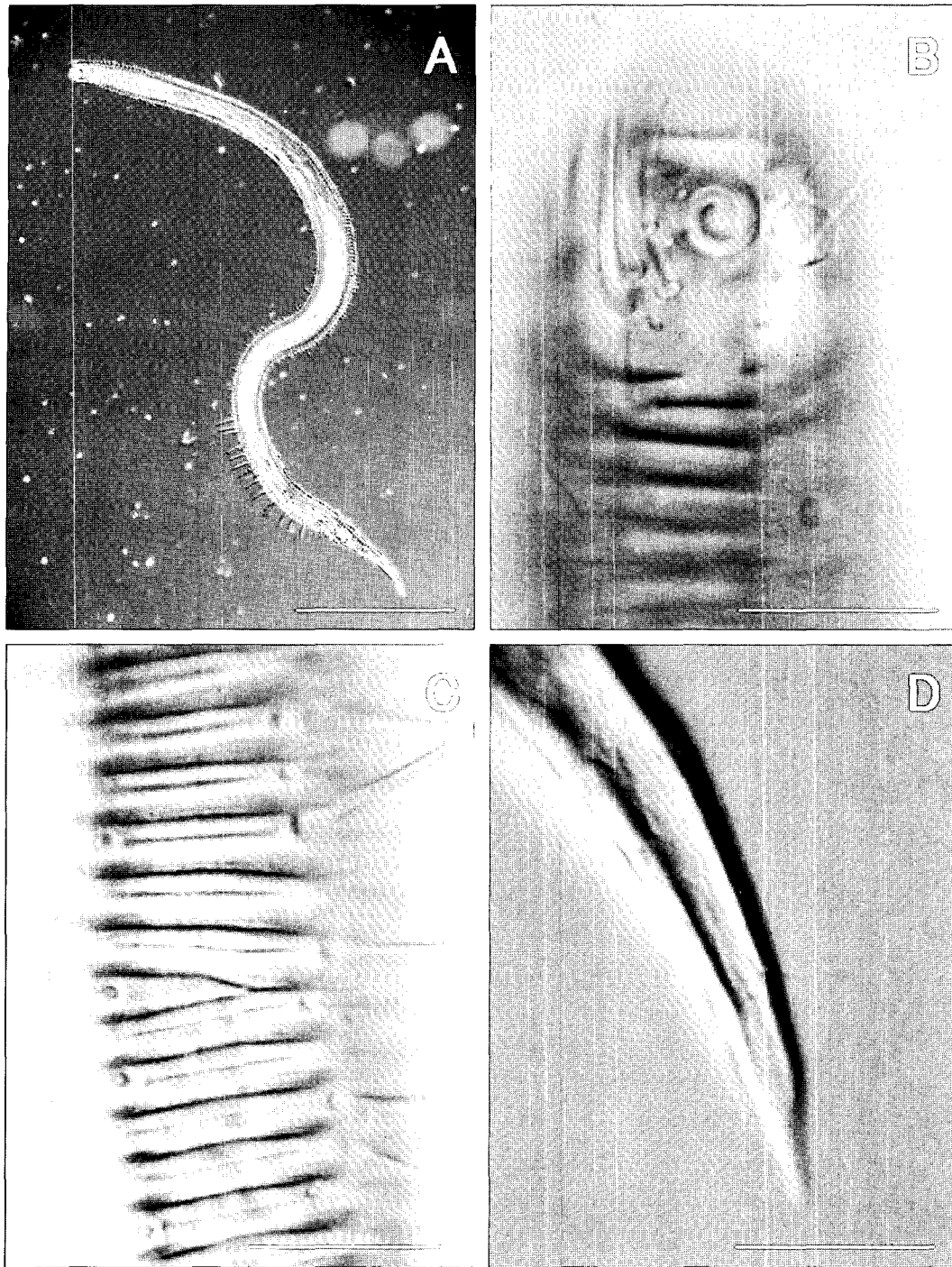


Fig. 3. *Dracogalerus koreanus* n. sp., male (paratype). A, Habitus, lateral view. B, Head region and amphidial fovea, lateral view. C, Body annulation of posterior sublateral adhesion region, lateral view. D, Tail region, lateral view. A-D, DIC micrographs. Scale bars = 300 μ m (A) and 30 μ m (B-D).

to broadly flattened border with withdrawn lip region. Lip region usually retracted in fixed specimens, bearing inner crown of 6 fine short labial setae. Cephalic setae, 4, short, 10 μ m long. Posterior head region with 6 fine long (26 μ m) subcephalic setae, 2 sublateral and 4 subventral. Amphidial fovea spiral, lying laterally on rostrum in between cephalic

and subcephalic setae. Cephalic adhesion tubes (CAT) 8, inserted on mid-rostrum (Figs. 2B, 3B). Buccal cavity weakly developed, collapsed, unarmed. Pharyngeal region cylindrical, slightly developed terminal swelling without cuticularized valve. Cardia not observed. Intestine narrow cylindrical anteriorly, widening posteriorly and located

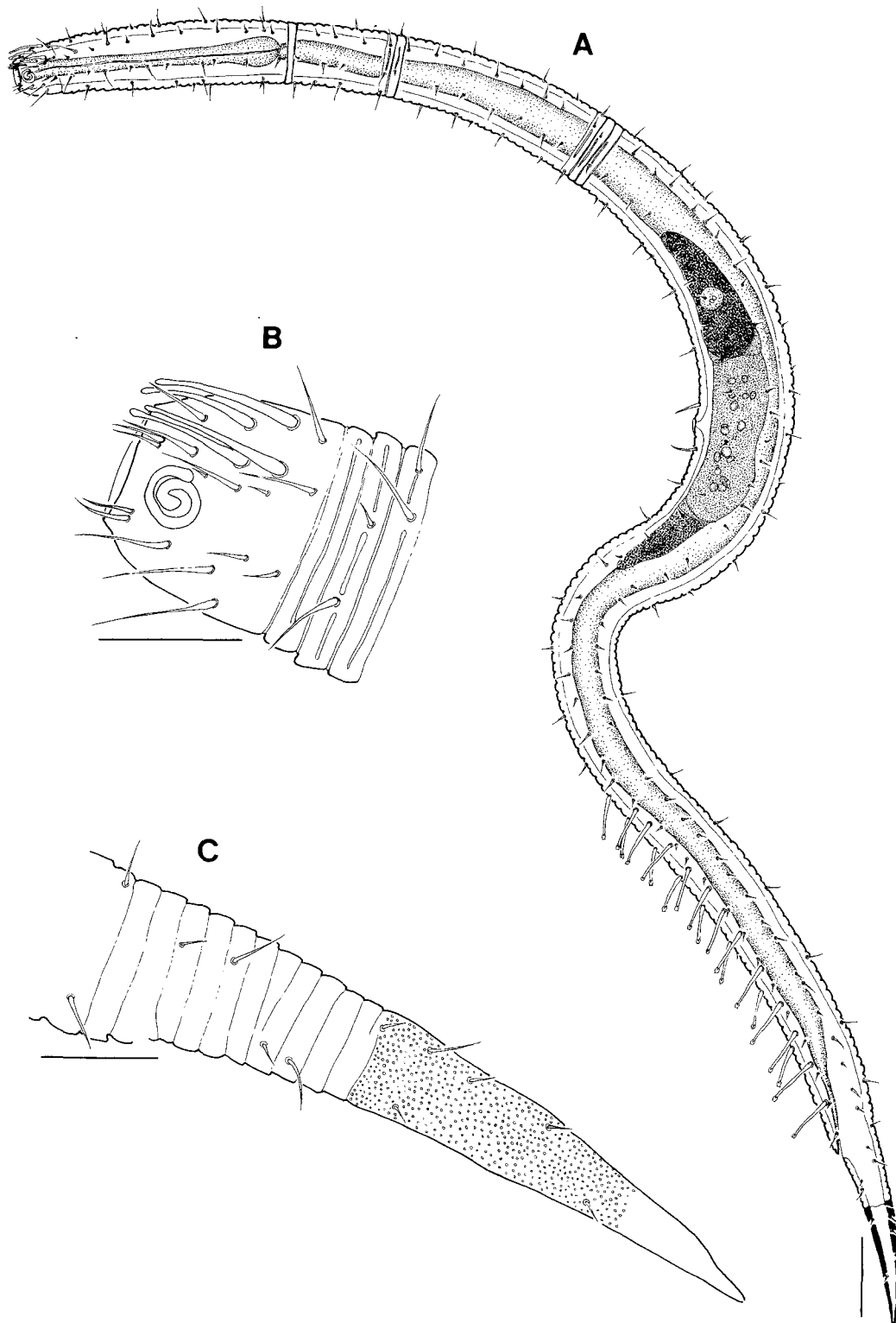


Fig. 4. *Dracogalerus koreanus* n. sp., female (paratype). A, Habitus, lateral view. B, Head region, lateral view. C, Tail region, lateral view. Scale bars = 50 μm (A) and 20 μm (B, C).

dorsally to genital system. Reproductive system typical of Draconematidae, extending to beginning of swollen mid-body region. Spicules 83 μm long, thick, slightly curved,

with large offset capitulum (Fig. 2C). Gubernaculum 12 μm long. Ventral corniform setae absent. Posterior adhesion tubes very short and stout, with slightly developed

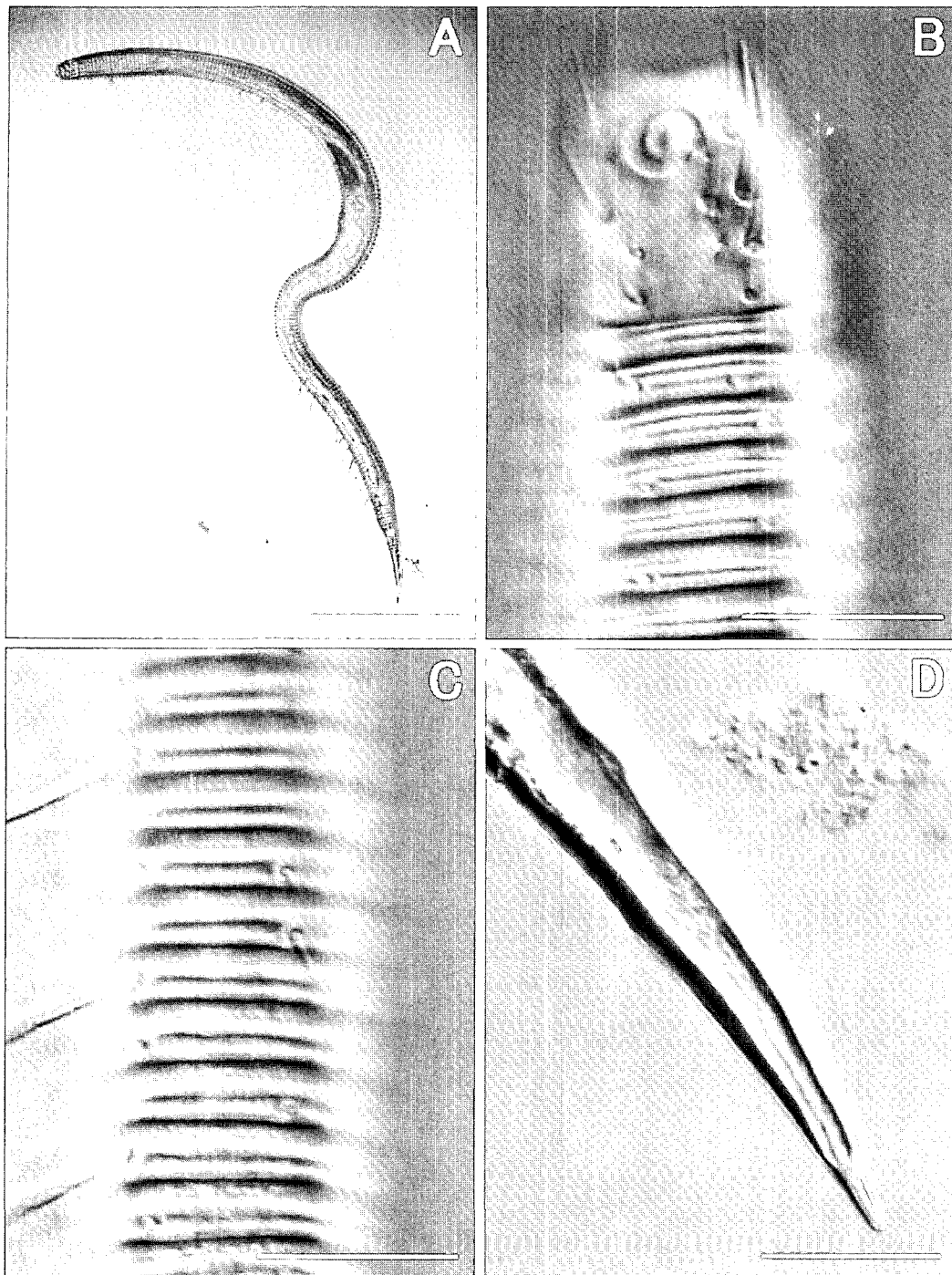


Fig. 5. *Dracogalerus koreanus* n. sp., female (paratype). A, Habitus, lateral view. B, Head region and amphidial fovea, lateral view. C, Body annulation of posterior sublateral adhesion region, lateral view. D, Tail region, lateral view. A-D, DIC micrographs. Scale bars = 300 μ m (A) and 30 μ m (B-D).

bell-shaped end containing tong-like extension of inner canal, widened at insertion site. PAT slightly shortening posteriorly. PAT arranged on 4 longitudinal rows; 2 sublateral rows each consisting of 8 adhesion tubes including 5 or 6 intermingled somatic setae, and 2 subventral rows each consisting of 5 (left side) and 6 (right side) adhesion tubes, without intermingled somatic setae. Sublateral adhesion

tubes intermingled with short glandular somatic setae. All PAT anterior to cloacal opening/anus. Tail cylindro-conoid. Non-annulated tail end relatively long (57% of total tail); its cuticle perforated mediodorsally; with 5 ventrally rounded protuberances, 3 pairs of subventral setae and 2 pairs of subdorsal setae (Figs. 2D, 3D).

Female: Similar to male in most respects. Body cuticle with

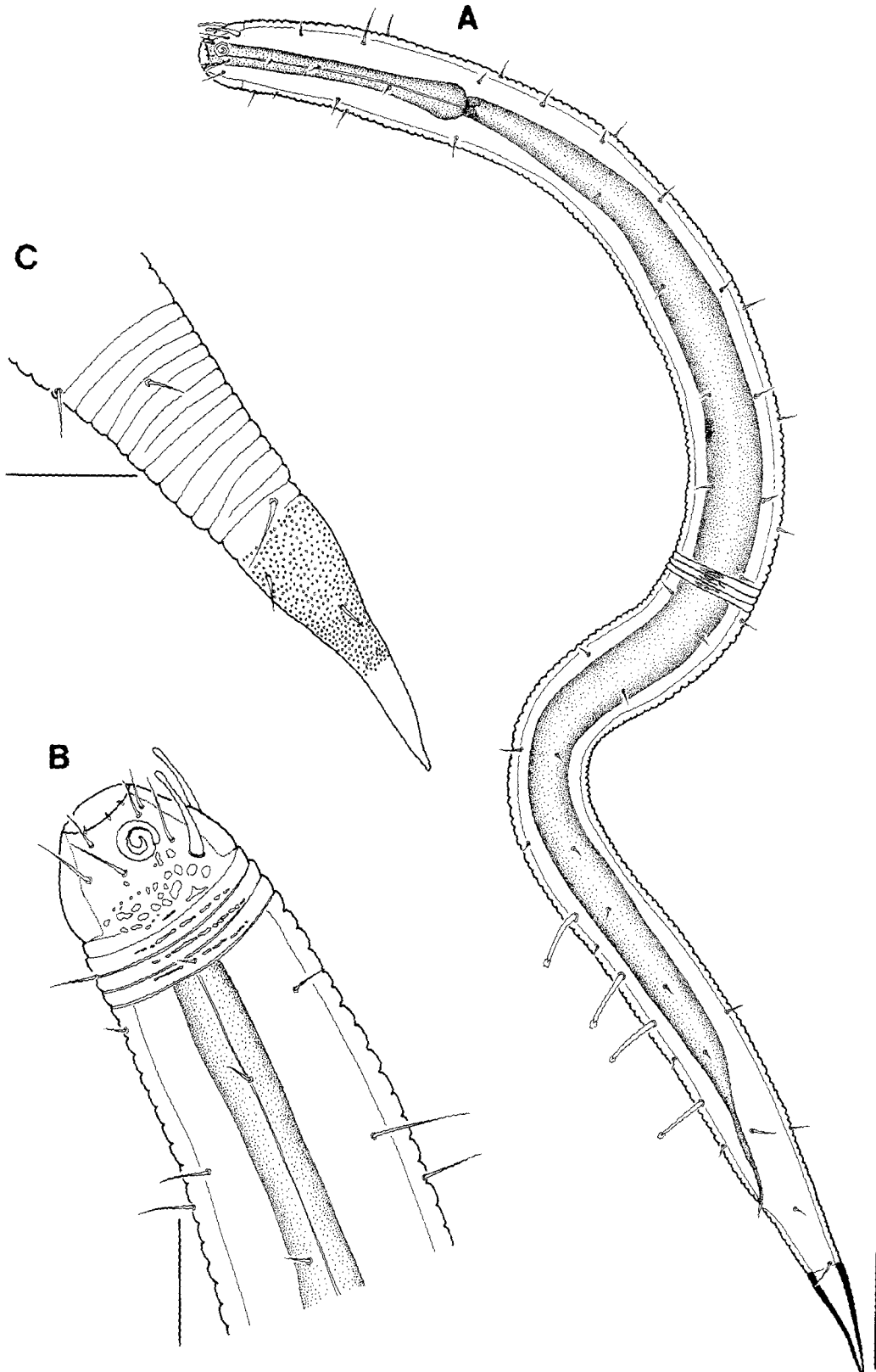


Fig. 6. *Dracogalerus koreanus* n. sp., second stage juvenile (paratype). A, Habitus, lateral view. B, Head region, lateral view. C, Tail region, lateral view. Scale bars = 50 μm (A) and 20 μm (B, C).

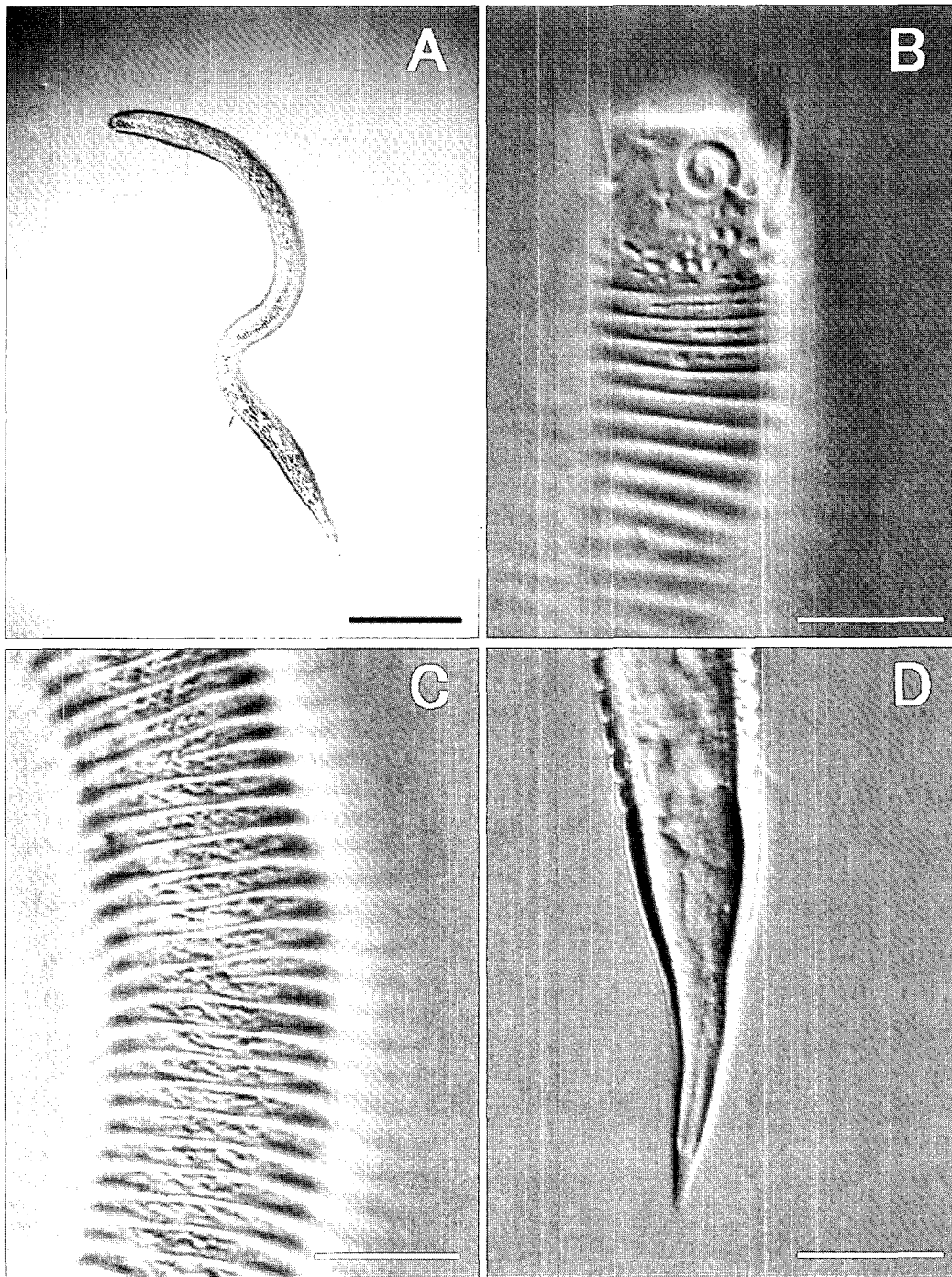


Fig. 7. *Dracogalerus koreanus* n. sp., second stage juvenile (paratype). A, Habitus, lateral view. B, Head region, lateral view. C, Body annulation of posterior sublateral region, lateral view. D, Tail region, lateral view. A-D, DIC micrographs. Scale bars = 200 µm (A) and 20 µm (B-D).

thick annulation and well-developed transverse groove (Fig. 5C). Body width greatest at level of vulva (Figs. 4A, 5A). Pharyngeal region 13.2% of total body length. Lip region usually retracted in fixed specimens, bearing inner crown of 6 fine short labial setae. Cephalic setae, 4, short, 8 µm long (Fig. 4B). Posterior head region with 6 fine long (18 µm) subcephalic setae. Amphidial fovea spiral, lying

laterally on rostrum between cephalic and subcephalic setae (Fig. 5B). Eight CAT inserted on mid-rostrum. Posterior adhesion tubes short, with slightly developed bell-shaped end. PAT slightly shortening posteriorly. PAT arranged on 4 longitudinal rows; 2 sublateral rows each consisting of 12 (left side) and 10 (right side) adhesion tubes, and 2 subventral rows each consisting of 8 adhesion tubes. Intermingled

somatic setae absent. Sublateral adhesion tubes intermingled with short glandular somatic setae. All PAT anterior to cloacal opening/anus. Ovaries paired, opposed and reflexed. Vulva near mid-body, not encircled by projections, one pair of paravulval setae present. Ventral corniform setae absent. Tail cylindro-conoid. Non-annulated tail end very long (68% of total tail); its cuticle perforated, with 4 pairs of subdorsal setae and 2 pairs of subventral setae. Ventral protuberances absent (Figs. 4C, 5D).

Juvenile (second stage juvenile; paratype): Habitus similar to adult (Figs. 6A, 7A). Rostrum ornamented with minute punctations (Figs. 6B, 7B). Body cuticle irregularly ornamented (Fig. 7C). Pharyngeal region 14% of total body length. Lip region usually retracted in fixed specimens, bears inner crown of 6 fine short labial setae. Cephalic setae, 4, short, 6.5 μm long. Posterior head region with 3 fine long (11 μm) subcephalic setae (Fig. 6B). Amphidial fovea spiral, lying laterally on rostrum between cephalic and subcephalic setae (Fig. 7B). Three CAT inserted on rostrum posteriorly. Posterior adhesion tubes short, with slightly developed bell-shaped end. PAT arranged on 2 longitudinal rows; 2 sublateral rows each consisting of 4 adhesion tubes. Intermingled somatic setae absent. Sublateral adhesion tubes intermingled with short glandular somatic setae. All PAT anterior to cloacal opening/anus. Reproductive system not formed. Tail cylindro-conoid; non-annulated tail end 59% of total tail length, with 1 pair of subdorsal and 1 pair of subventral somatic setae. Ventral protuberances absent (Figs. 6C, 7D).

The first, third, and fourth stage juveniles not found.

Etymology: The specific name is taken from Korea, the type locality.

DISCUSSION

Currently, the members of the genus *Dracogalerus* are distinguished morphologically from all the other genera of the family Draconematidae Filipjev (1918) by the following diagnostic characteristics: anterior body region hardly swollen, all cephalic adhesion tubes inserted on anterior half of rostrum, buccal cavity collapsed or weakly developed, esophagus with inconspicuous terminal swelling, and cuticle very thick (thickness may obscure internal structures). According to the taxonomic key characters of the genus *Dracogalerus* in Allen and Noffsinger (1978), the genus can be divided artificially into two groups on the basis of the shape of rostrum. The first group is characterized by having broadly rounded rostrum, and comprises *D. bastiani*, *D. cryptocephalus*, and the new species described here. This species group can be also subdivided into two subgroups based on the number of cephalic adhesion tubes

on rostrum as follows: the first subgroup (*D. cryptocephalus* and *D. koreanus* n. sp.) has eight cephalic adhesion tubes, while another subgroup (*D. bastiani*) has 10 cephalic adhesion tubes. The second group is characterized by having conoid shaped rostrum and comprises *D. afrikaanus* (Allen and Noffsinger, 1978).

The new species, *D. koreanus*, is mainly characterized by (1) rostrum broadly rounded anteriorly, (2) body annulation thick, with well developed grooves, (3) eight CAT inserted on mid-rostrum, (4) the number of PAT (8 sublateral and 5-6 subventral PAT in male, and 10-12 and 7-8 in female), (5) PAT intermingled with five or six somatic setae, and (6) non-annulated tail end with ventrally developed five rounded protuberances.

Dracogalerus koreanus is most closely related to *D. cryptocephalus* mainly by possessing a similar head shape and eight cephalic adhesion tubes. As shown in Table 1, however, the new species differs from *D. cryptocephalus* by the following distinctive characteristics: transverse annulation of the body cuticle strongly grooved in both sexes (vs smooth); spicules slightly curved and relatively thick (vs strongly curved and very slender); non-annulated tail end with five rounded protuberances (vs six rounded protuberances); eight sublateral and five or six subventral PAT in male (vs seven sublateral and eight subventral PAT in male); five or six intermingling somatic setae present (vs absent); higher ratio "a" value of 20.8 (vs 16), ratio "c" value of 8.8 (vs 7.5), and ratio "c'" value of 4.0 (vs 3.5) in male.

The new species also shares the character combination of a similar broadly rounded rostrum and spiral shaped amphidial fovea in female with *D. bastiani*. However, it is clearly distinguished from the latter species by the following diagnostic features: (1) the number of cephalic adhesion tubes (the present new species has 8 CAT in 2 transverse rows on rostrum, whereas *D. bastiani* has 10 CAT in 3 transverse rows on rostrum), (2) the number of PAT in female (10-12 sublateral PAT and 7-8 subventral PAT in the new species compared to 28 sublateral PAT and 15 subventral PAT in *D. bastiani*), (3) the number of rounded protuberances on the ventral side of non-annulated tail end (5 rounded protuberances in *D. koreanus* n. sp. vs absent in *D. bastiani*), and (4) lower ratio "c" value (10.3 vs 12.2) and higher ratio "c'" value (4.7 vs 2.7).

A key to the species of the genus *Dracogalerus*

1. Rostrum broadly rounded anteriorly; base of rostrum not rounded -----2
Rostrum conoid shaped; base of rostrum expanded, wider than succeeding body width ----- *D. afrikaanus*
2. Ten CAT, in 3 transverse rows on rostrum -- *D. bastiani*
Eight CAT, in 2 transverse rows on rostrum ----- 3
3. Male with 7 SIAT and 8 SvAT ----- *D. cryptocephalus*

Table 1. Character comparisons of *Dracogalerus koreanus* n. sp. with its congeners.

Character	<i>D. koreanus</i> n. sp.	<i>D. afrikaanus</i>	<i>D. bastiani</i>	<i>D. cryptocephalus</i>
Transverse annulation	Strongly grooved	Obscurely marked	Obscurely marked	Smooth
Rostrum	Broadly rounded	Conoid shaped	Broadly rounded	Broadly rounded
CAT	8	8	10	8
Spicule	Slightly curved and relatively thick	Slightly curved and slender	Not observed	Strongly curved and very slender
Non-annulated tail end in male	With 5 rounded protuberances	With 3 rounded protuberances	Not observed	With 6 rounded protuberances
SIATn	8 in male, 10-12 in female	14 in male, 19 in female	28 in female	7 in male
SvATn	5-6 in male, 7-8 in female	9 in male, 10 in female	15 in female	8 in male
Intermingled setae in male	5-6	8	Not observed	Absent
Ratio a	20.8 in male, 19.8 in female	18.3 in male	Not observed	16 in male
Ratio c	8.8 in male, 10.3 in female	10.0 in male, 11.4 in female	12.2 in female	7.5 in male
Ratio c'	4.0 in male, 4.7 in female	2.7 in male, 2.8 in female	2.7 in female	3.5 in male
Habitat	Shallow subtidal coarse sediments and various invertebrates (sponges and bryozoans)	Associated with algae	Associated with algae	High and low tidal zones
Locality	Korea (Jeju Is.)	South Africa (East London and Hout Bay)	South Africa (East London and Hout Bay)	Australia (Vaucluse, Port Jackson)

Male with 8 SIAT and 5 to 6 SvAT -- *D. koreanus* n. sp.

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