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Studies on *Pratylenchoides ivanovae* Ryss, 1980 and *P. magnicauda* (Thorne, 1935)

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Summary. The type material of *Pratylenchoides ivanovae* and populations from Germany and Russia (St. Petersburg region and Chukchi peninsula) was compared with *P. magnicauda* specimens from Spitsbergen and data from the literature. The synonymy *P. ivanovae* = *P. magnicauda* is established and males of *P. magnicauda* are described for the first time. The less developed stylet and oesophagus in males, presence of lateral flanges on the spicules and the dorsal curvature of the male tail are characters supporting the inclusion of the species in the genus *Pratylenchoides* rather than in *Amplimerlinius*.

Key words: *Pratylenchoides ivanovae, P. magnicauda*, morphology, distribution, Germany, Russia.

Pratylenchoides ivanovae Ryss, 1980 was described from the Pamir region in Tadjikistan and has been recorded also from Poland (M. Brzeski, pers. comm.). In this paper details on the morphology of populations collected in Bavaria, Germany, St.-Petersburg region and on Chukchi peninsula, Russia, and of specimens from the type locality are presented and the male is described. *P. ivanovae* resembles *P. magnicauda* (Thorne, 1935) Baldwin, Luc & Bell, 1983, a species considered to belong to the genus *Amplimerlinius* by Siddiqi (1976, 1986) and Ryss (1988). It is compared with published descriptions of this species and with specimens from Spitsbergen. The generic attribution of *P. ivanovae* and *P. magnicauda* is discussed and data on the known geographical distribution are compiled.

MATERIAL AND METHODS

Specimens of *P. ivanovae* of the following origin were available for study:

Tadjikistan. Holotype and 5 paratype females collected from roots of *Salix schugnanica* near lake Jashilkul in the Pamir mountains.

Germany. Specimens in soil samples collected from six different localities in Bavaria between 1973 and 1981: Spruce forest in the nature reserve «Hoellental» near Naila; spruce-pine forest at Amberg; river bank vegetation at Kastl near Amberg; willow groves along the Isar river at Landau and near Munchen; alder-birch-willow grove along the Lech river at Haunstetten near Augsburg. Males were found only in German populations, two specimens from «Hoellental» and two from Landau.

Russia. Specimens from soil of a spruce-pine forest in the nature reserve «Dontso» near Elizavetino in St.-Petersburg region, collected in September 1993 and from several native habitats of Chukchi peninsula collected in July 1982: Forest with predominance of *Salix udensis* in an inundation valley of the river Kovraljanskaja; forest consisting of *Salix krylovi* and *Betula exilis* with covering by the mosses *Hylocomium* spp. and *Aulocomium* spp.; forest of *Salix alexensis, S. udensis, S. krylovi* with covering of *Aulocomium palustris* in an inundation valley of the river Jablon; steppe with *Festuca* sp., *Polygonum* sp., *Parnassia* sp., *Artemisia* sp., *Saxifraga* sp., *Erytrichium* sp., *Carex* sp., *Rhododendron aureum*, *R. parvifolia, Salix* sp. in an inundation valley of the river Krestovaja which is an tributary of the river Jablon.

The specimens from Tadjikistan and Russia were

fixed in hot 4% formaldehyde, those from Germany in hot TAF, transferred to unhydrous glycerine and mounted on permanent slides.

Three female specimens of *P. magnicauda* from Spitzbergen were kindly supplied for the present study by P.A.A. Loof, who described nine females from four different sites in Spitsbergen (Loof, 1971).

Deposition. *P. ivanovae*: Tadjikistan - Zoological Institute of the Russian Academy of Sciences, St.-Petersburg (holotype and 4 paratypes) and Biologische Bundesanstalt, Munster (one paratype); Bavaria (Germany) - Biologische Bundesanstalt, Munster and Zoological Institute, St.-Petersburg; Russia: Zoological Institute, St.-Petersburg. *P. magnicauda*: Spitsbergen - Agricultural University, the Netherlands.

The stage of the juveniles was determinated by the structure of the genital primordium and developing genital tract as described previously by Ryss (1983, 1984).

RESULTS

Pratylenchoides ivanovae Ryss, 1980 (Tables 1 & 2; Figs. 1 & 2)

Female. Body straight or slightly curved ventrally behind vulva. Cuticle annuli 1.4 (1.0-2.0) μm wide at mid-body. Cephalic region prominent, continuous with body contour, hemispherical to conical, flattened anteriorly in lateral view. Cephalic framework strongly sclerotized, the height from posterior extensions to anterior end 6.5-8.5 μm. Posterior extensions of framework 2-3 annules long, its basal plate 1 μm thick. Stylet massive, the knobs directed laterally, with anterior surface slightly sloping. Anterior cephalids immediately behind cephalic framework, posterior cephalids at level of base of metenchium, 4-6 annules posterior to anterior cephalids. Oesophagus 169 (152-212) μm long. Median bulb oval with ratio length to width 1.6 (1.5-1.8). Subventral oesophageal gland nuclei posterior to dorsal nucleus, one located dorsally, the other ventrally; oesophago-intestinal valve behind oesophageal gland part which slightly overlaps intestine dorso-laterally. Ratio of distance from posterior end of the glandular part of oesophagus till anterior end of oesophago-intestinal valve to total length of the glandular part 0-0.15.

Lateral field usually areolated in the posterior third of the body. In specimens from Tadjikistan some incisures in lateral field so close together that they appear as five lines (Fig. 1, N). Females from Germany and Russia and have six distinct lateral lines well separated from each other.

Genital tract with oviduct consisting of 16 cells. Spermatheca 8.8 (7-11) μm long and 8.9 (6-11) μm wide, axial, pear-shaped with slit-like cavity to round with roundish cavity of 5.4 (4-10) μm diameter, empty or with rounded to slightly elongated sperm measuring 1.5-2 x 1-1.5 μm (observed in 6 females from localities in Germany only where males had been found). Sphincter of spermatheca with seven pairs of nuclei located at distal end. Uterus consisting of 18-20 cells arranged in three (rarely in two) rows. Vulval epiptygma absent.

Postrectal sac absent. Phasmids 22.0 (16.0-31.5) μm from tail terminus. Ratio of distance of phasmid to tail tip to body width at phasmid 1.36 (0.96-2.20). Tail cylindrical to clavate, terminus rounded, annulated. Ratio of body width at anterior margin of hyaline part to anal body width 0.75-0.80.

Male (Bavaria, Germany, n = 4). L = 596 (504-665) μm, a = 34 (28-41), b = 5.1 (4.5-6.3), c = 14.5 (13.0-16.1), c' = 2.7 (2.1-3.7), stylet = 22.1 (21-23) μm, spicules = 28 (27-29) μm, gubernaculum = 10.0-11.0 μm, MB = 49.5 (49-50).

Body straight or slightly curved ventrally. Cuticle annuli 1.0 μm wide at mid-body. Cephalic region with 5.8 (5-6) annules, high, continuous with body contour, hemispherical to conical, anteriorly flattened. Cephalic framework strongly sclerotized with basal plate 1 μm thick. Stylet well developed, its knobs directed laterally, with anterior surface slightly sloping, stylet base 4.0-4.5 μm wide. Anterior cephalids immediately behind cephalic framework, posterior cephalids at level of base of metenchium, 4-5 annules posterior to anterior cephalids. Oesophagus 120 (80-138) μm long. Median bulb 14.7 (14.5-15) x 7.2 (6.5-8.0) μm, oval, with ratio of length to width 1.9 (1.4-2.4). Glandular part of oesophagus less developed than in female but oesophago-intestinal valve distinct. Glandular overlap as in female. Nuclei of oesophageal glands seen only in one specimen, located at the same

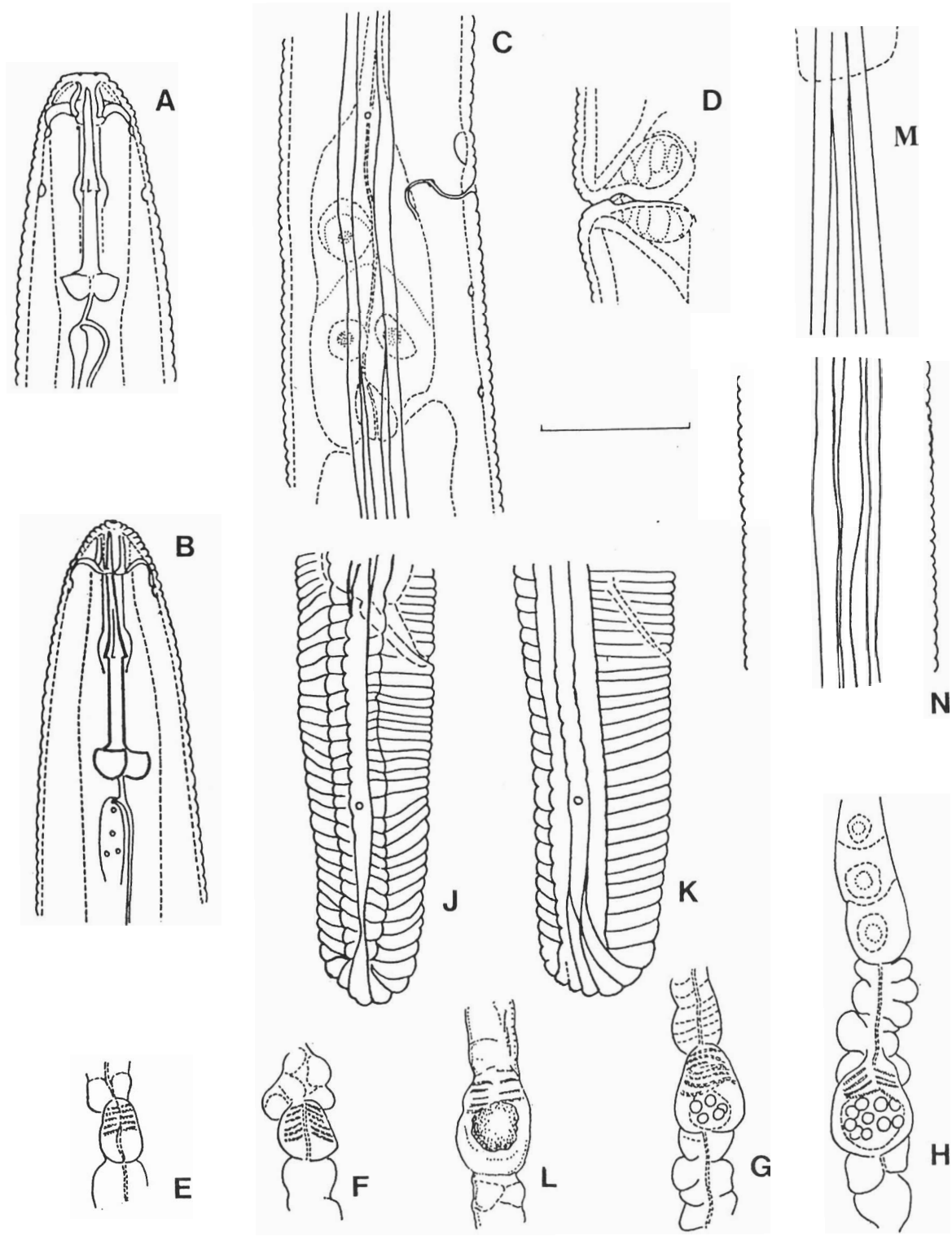

Fig. 1. *Pratylenchoides ivanovae* females from Germany (A-J) and holotype female from Tadjikistan (L-N). A: Head lateral; B: Head dorso-ventral; C: Oesophageal gland part and lateral field structure: D: Vagina and vulva; E-H, L: Shape of spermatheca; J, K: Tail; M, N: Lateral field of holotype (M - just behind oesophagus, which is marked by dotted line; N - at mid-body). Scale bar - 20 μm.

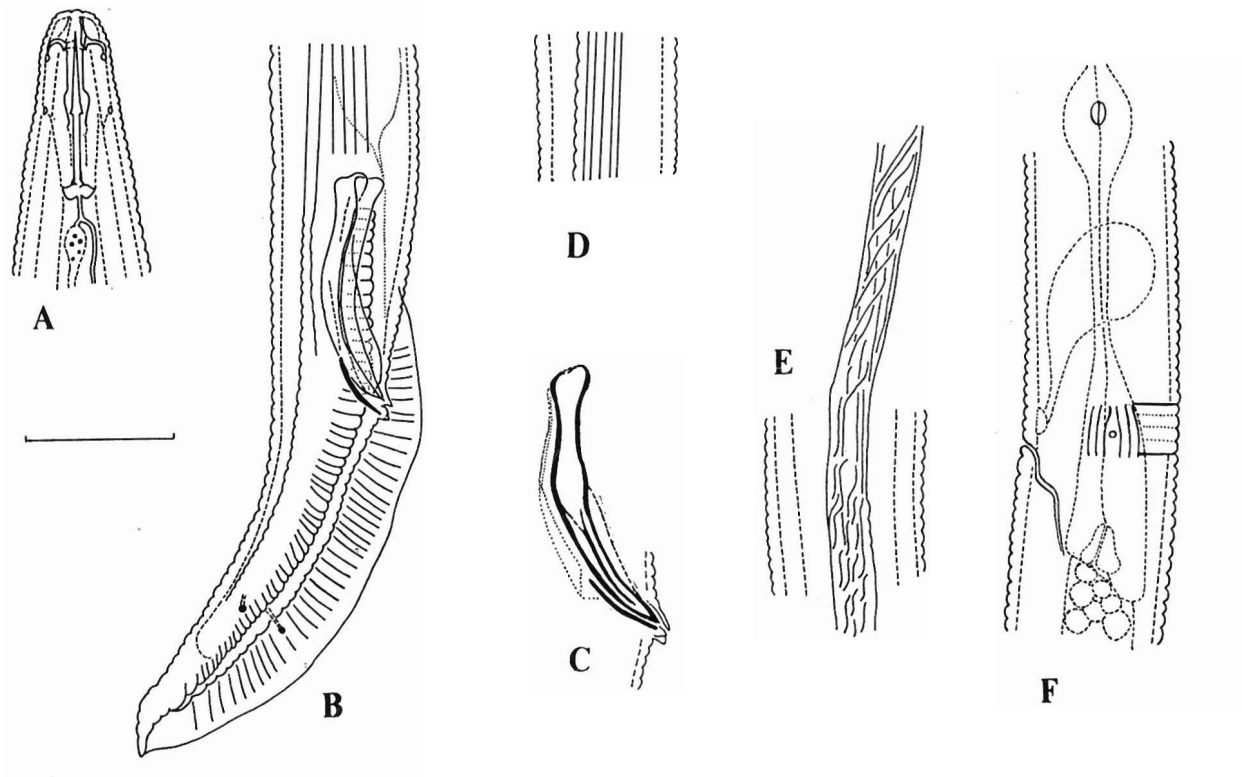

Fig. 2. *Pratylenchoides ivanovae* male from Germany. A: Head; B: Tail; C: Spicule; D, E: Lateral field (D - normal form, E - variation obseved in one specimen); F: Oesophageal gland part and lateral field structure at deirid. Scale bar: 13 μm for C, 15 μm for F, 20 μm for remainder.

positions as in female. Excretory pore 97 (76-112) μm from anterior end.

Spicules slender, slightly curved ventrally, with conical, pointed posterior part and lateral flanges. Gubernaculum not protrusible, simple. Tail 41.6 (35-50) μm long, slender, conical, curved dorsally. Caudal alae 59.5 (53-66) μm long, reaching acute tail terminus. Phasmids conspicuous, 20 (16-25) μm from tail terminus. Ratio of distance of phasmid to tail tip, to body width at phasmid 2.0 (1.3-2.7). Hyaline part of tail terminus 12.2 (10.5-14.5) μm long and 7.9 (7.0-9.5) μm wide at proximal end, ratio length to width 1.6 (1.2-2.1).

Juveniles. Female juveniles with morphological characters similar to adult females except for the structure of the genital primordium and developing reproductive system. Juveniles of 2nd, 3rd and 4th stage with 5-6 annules in head region, height of cephalic framework from anterior end to posterior extensions 5.0-6.0 μm, posterior extensions of framework 2-3 annules long. Ratio of distance from posterior end of the glandular part of oesophagus to anterior end of oesophago-intestinal valve, to total length of the glandular part 0-0.15 as in females. Cuticle annuli 1.0-1.5 μm wide at mid-body. Juveniles of these stages with four incisures in lateral field at mid-body, deirid, anus and between phasmid and tail terminus. Only one 3rd stage female juvenile and two 4th stage female juveniles (all from Chukchi peninsula) with six incisures at mid-body. Lateral field usually areolated in posterior third of the body as in adult females. Shape of tail tip as in females. Male juveniles were not found. Measurements for female juveniles are given in Table 2.

Pratylenchoides magnicauda (Thorne, 1935) (Table 1, Fig. 3)

Measurements, ratios and additional morphological characters for this species based on the

Table 1. Diagnostic measurements (μm) and morphometric ratios of *Pratylenchoides ivanovae* and *P. magnicauda* females.

Characters	*Pratylenchoides ivanovae*					*P. magnicauda*	
	Holotype	Tadjikistan,[1] Paratypes (n=5)	Germany,[2] Bavaria (n=21)	Russia,[2] St.-Petersburg (n=4)	Russia,[2] Chukchi peninsula (n=29)	USA,[3] Utah (n=20)	Spitsbergen[4] (n=9)
Length	1100	813 (728-896)	734 ± 96 (605-1024)	869 ± 54 (833-950)	697 ± 18 (560-879)	890 ± 40 (750-1070)	680-1070
a	29	32 (29-37)	29.2 ± 3.2 (24-36)	25.8 ± 1.3 (24-27)	23.9 ± 3.5 (19.4-31.0)	30.7 ± 1.2 (26.0-36.9)	25-30
b	4.3	4.5 (4.3-4.6)	4.4 ± 0.33 (4.2-4.5)	4.6 ± 0.25 (4.3-4.9)	4.3 ± 0.48 (3.1-5.3)	4.7 ± 0.2 (3.7-5.1)	4.0-4.7
c	18	20 (14-23)	17.9 ± 1.4 (15.7-20.2)	17.7 ± 0.7 (16.9-18.5)	15.0 ± 1.3 (13.0-17.9)	16.6 ± 0.8 (14.6-20.5)	15-18
c'	2.5	2.6 (2.3-3.1)	2.2 ± 0.26 (1.8-3.0)	2.4 ± 0.29 (2.2-2.7)	2.4 ± 0.32 (1.7-3.4)	2.4 ± 0.2 (1.8-3.1)	1.8-3.1
V	60	61 (59-63.6)	59.7 ± 2.1 (53.7-63.4)	63.3 ± 1.0 (62-64)	58.8 ± 3.2 (48-66)	61 ± 0.8 (56-64)	57-61
Stylet	31	29.2 (28-31)	28.6 ± 1.1 (27-31)	28.8 ± 1.4 (27-31)	28.2 ± 1.3 (25-31)	32.0 ± 0.6 (26.5-34)	25-34
Stylet base width	6.5	6.2 (6.0-6.5)	6.8 ± 0.5 (6.0-8.0)	6.8 ± 0.3 (6.5-7.0)	6.9 ± 0.8 (5.5-8.5)	-	6-7
DGO[5]	5	5	3.6 ± 0.4 (3.0-4.2)	4,5 ± 0.6 (4.0-5.0)	5.3 ± 0.5 (4.5-6.5)	4.4 ± 0.4 (3-6)	3.5-5
Lip annules	6	6	5-7	6.4 ± 0.9 (6-7)	6.2 ± 0.5 (5-7)	6	6-7
MB[6]	44	46.5 (44-50)	47.9 ± 2.1 (46-50)	48.0 ± 1.4 (47-50)	50 ± 2.8 (42-56)	49.5 ± 1.9 (35-53)	46-48
Median bulb length	19	18 (16-21)	19.1 ± 2.0 (16-26)	21 ± 1.8 (19-23)	17.7 ± 2.2 (14-23)	24.5	23-25
Median bulb width	12	11 (10-13)	11.9 ± 0.9 (10.5-14.0)	13.0 ± 1.2 (11.5-14.0)	13.4 ± 1.6 (10-16)	13	13-16
Excretory pore from anterior end	142	126 (102-146)	114.3 ± 8.0 (96-134)	146.8 ± 12.3 (135-164)	113.4 ± 14.9 (89-155)	158	-
Tail length	42	45.3 (35-56)	41.5 ± 4.2 (37-51)	49.4 ± 3.2 (46-53)	46.8 ± 7.5 (35-64)	54 ± 3.6 (40.5-71.0)	44-51
Hyaline part length	14	11.7 (9-14)	10.8 C 1.4 (8-13)	8.4 ± 1.1 (7-9.5)	9.5 ± 1.8 (6-12)	12.6 ± 1 (9-17)	10-13
Ratio: hyal. part length to width	0.8	0.7 (0.6-0.9)	0.71 ± 0.10 (0.48-0.94)	0.48 ± 0.05 (0.44-0.54)	0.60 ± 0.07 (0.41-0.73)	0.69	0.6-0.8
Number of tail annules	30	27 (26-30)	28.2 ± 4.4 (23-32)	31 ± 1.4 (30-33)	33 ± 7.1 (23-47)	32-41	32-42
Number of incisures:							
at mid-body	6	6	6	6	6	6	6
at deirid	4	4	4, 6	6	6, rarely 4	6	4
at anus	4	4	4, rarely 6	4	4, rarely 5 or 6	4	4
between phasmid and tail terminus	4	4	4	4	4	4	4

[1] Measurements by Ryss (1980) and original data.
[2] Original data.
[3] Summarized data given Thorne (1935), Allen (1955), Siddiqi (1976), Baldwin et al. (1983) and obtained by us from figures in these publications.
[4] Measurements by Loof (1971) and original data for 3 females.
[5] DGO - distance from the dorsal oesophageal gland orifice to stylet base.
[6] MB - distance from the anterior end to the center of the medial bulb expressed as a percentage of the total length of the oesophagus.

Table 2. Measurements (μm) , ratios and other morphological characters of *Pratylenchoides ivanovae* juveniles.

Characters	2nd stage juveniles, Germany (n = 3)	3rd stage juveniles, Chukchi peninsula (n = 5)	4th stage juveniles, Germany (n = 4)	4th stage juveniles, Chukchi peninsula (n = 13)
Length	368 ± 5 (364-371)	426 ± 35 (377-474)	514 ± 37 (476-553)	568 ± 54 (454-644)
a	24 ± 4.0 (21-27)	23.4 ± 3.5 (18.6-28.0)	24.8 ± 2.0 (22.7-27.0)	22.5 ± 2.5 (19.6-27.8)
b	3.0 ± 0.2 (2.8-3.1)	3.0 ± 0.24 (2.7-3.3)	3.46 ± 0.21 (3.2-3.7)	3.97 ± 0.49 (3.2-4.9)
c	14.0	13.2 ± 0.45 (13-14)	15.45 ± 1.0 (14.1-16.3)	13.72 ± 0.79 (12.4-15.0)
c'	2.3 ± 0.2 (2.1-2.4)	2.4 ± 0.08 (2.3-2.5)	2.05 ± 0.1 (2.0-2.2)	2.26 ± 0.23 (2.0-2.6)
V^1	62.2 ± 0.3 (60-62)	63.2 ± 0.8 (62-64)	59.0 ± 4.0 (53-63)	61.6 ± 4.8 (56-75)
Stylet	22.5	23.2 ± 0.8 (22.0-24.0)	26.2 ± 0.7 (25.5-27.0)	25.6 ± 0.6 (25.0-27.0)
Stylet base width	4.0	5.1 ± 0.8 (4.0-6.0)	6.2 ± 0.5 (5.5-6.5)	6.2 ± 0.4 (5.5-7.0)
DGO	3.5-4.0	4.7 ± 0.6 (3.5-5.5)	4.5	5.2 ± 0.7 (4.5-6.5)
Oesophagus length	123 ± 7 (118-128)	143 ± 13 (130-160)	140 ± 20 (112-158)	144 ± 10 (121-159)
MB	48.5 ± 0.7 (48.0-49.0)	47.6 ± 1.5 (45.0-49.0)	49.3 ± 2.3 (46.5-52.2)	49.5 ± 2.9 (42.0-55.0)
Median bulb width	9.5	10.3 ± 0.5 (10-11)	10.53 ± 0.48 (10-11)	12.0 ± 1.24 (8.5-13.5)
Ratio: median bulb length to width	1.53	1.35 ± 0.13 (1.2-1.5)	1.54 ± 0.11 (1.4-1.7)	1.31 ± 0.2 (1.1-1.9)
Excretory pore from anterior end	84.5 ± 2.1 (83-86)	90.6 ± 6.5 (80-96)	99.0 ± 9.0 (90-108)	96.0 ± 5.8 (88-107)
Genital primordium length	14	22.6 ± 2.3 (21.0-26.5)	101.4 ± 5.8 (97-108)	132.9 ± 34.1 (91-180)
Tail length	26.0-27.0	32.4 ± 2.6 (29.5-36.0)	33.2 ± 2.2 (30.0-35.0)	41.8 ± 5.5 (30.0-52.0)
Hyaline part length	5.7 ± 1.0 (5.0-6.5)	4.9 ± 0.65 (4.0-5.5)	6.6 ± 1.25 (5.0-8.0)	5.7 ± 5.14 (5.0-7.0)
Ratio: hyaline part length to width	0.68 ± 0.18 (0.6-0.8)	0.45 ± 0.09 (0.37-0.56)	0.51 ± 0.11 (0.36-0.60)	0.38 ± 0.07 (0.29-0.54)
Tail annules	26.0 ± 2.8 (24-28)	26.6 ± 1.1 (25-28)	26.3 ± 1.3 (25-28)	27.5 ± 4.1 (21-36)

V^1 - ratio of distance from anterior end to the place of attachment of the genital primordium or developing genital tube to the body wal

investigation of three females from Spitsbergen and literature data are given in Table 2. The morphometrics of *P. magnicauda* from USA was summarized from values and illustrations in Thorne (1935), Allen (1955), Siddiqi (1976), Baldwin et al. (1983).

Relationships. The only diagnostic character mentioned previously for differentiating *P. ivanovae* from *P. magnicauda* is the number of incisures in the lateral field: four (or sometimes five) in *P. ivanovae* and six in *P. magnicauda* (Loof, 1991). In the present study six incisures were also observed in the holotype, paratypes, German and Russian specimens of *P. ivanovae*. The glandular part of the oesophagus and the shape of the spermathecae, cephalic region and tail are all identical in both species. There is also a close agreement in morphometrics (Table 1).

Therefore it is proposed that *Pratylenchoides ivanovae* Ryss, 1980 = *Anguillulina magnicauda* Thorne, 1935 = *Pratylenchoides magnicauda* (Thorne, 1935) Baldwin, Luc & Bell, 1983, which constitutes a new synonymy.

Taxonomic position of *P. magnicauda*. *P. magnicauda* was originally described as *Anguillulina magnicauda* by Thorne in 1935, transferred to *Tylenchorhynchus* by Filipjev (1936), to *Amplimerlinius* by Siddiqi (1976) and to *Pratylenchoides* by Baldwin et al. (1983). In more recent publications this species can be found in either *Pratylenchoides* (Luc, 1987; Loof, 1991) or *Amplimerlinius* (Siddiqi, 1986; Ryss, 1988). The discovery of males of *P. magnicauda* in Germany has helped to clarify the taxonomic position of the species. As in other species of the genus the male of *P. magnicauda* has a stylet and an oesophagus less developed than in the female,

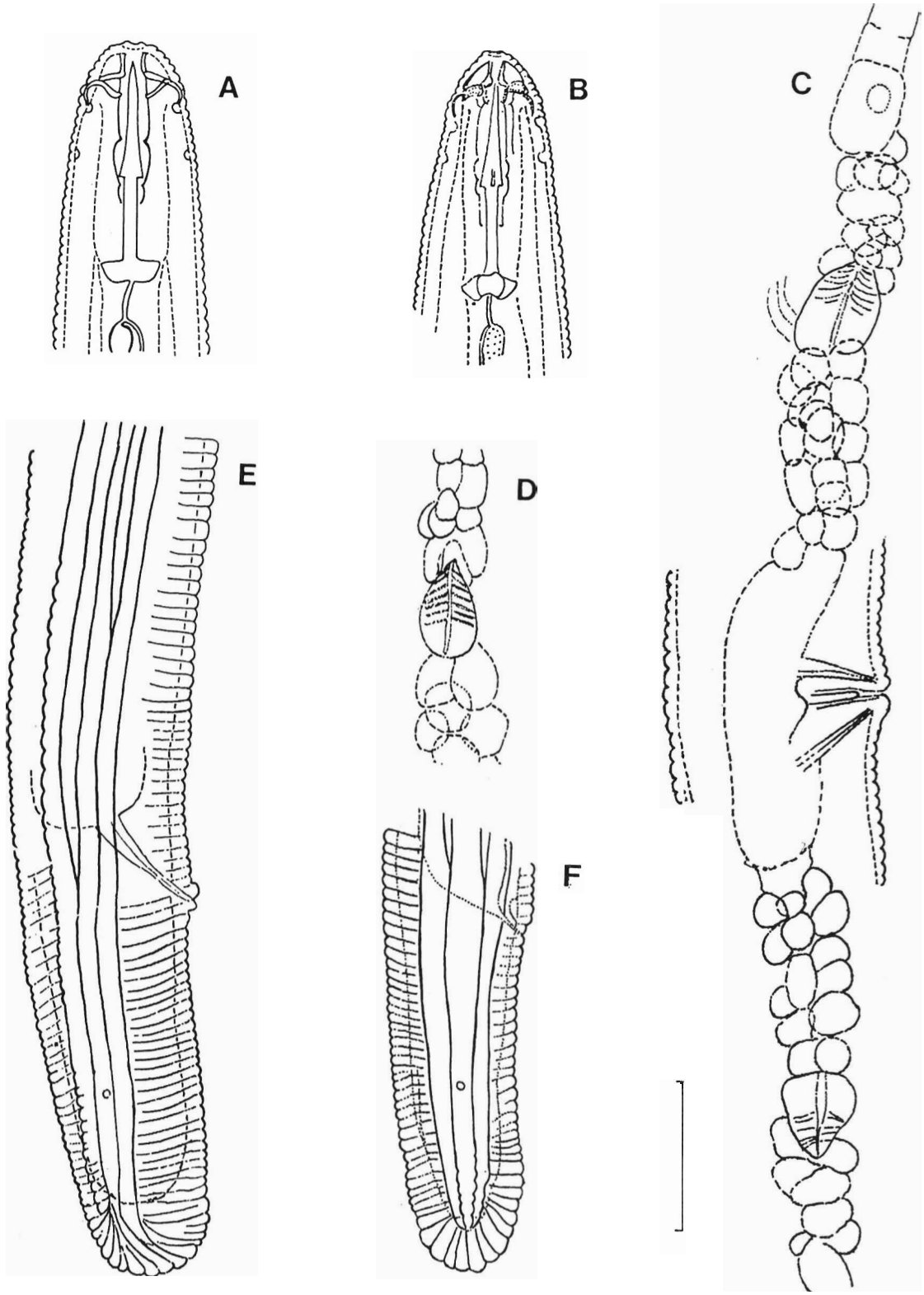

Fig. 3. *Pratylenchoides magnicauda* female from Spitsbergen. A, B: Head (A - lateral, B - dorso-ventral); C: Vulva and female genital tract; D: Spermatheca, dorso-ventral view; E, F: Posterior end with lateral field structure. Scale bar - 20 μm.

ventrally curved spicules with conical distal portion and distinct lateral flanges (vs. *Amplimerlinius* males with tubular spicules with bluntly pointed digitate distal portion and no lateral flanges), and a dorsally curved tail (vs. *Amplimerlinius* males with ventrally curved tails) justifying its inclusion in the genus *Pratylenchoides*.

Distribution of *P. magnicauda*. As a consequence of the proposed synonymy, *P. magnicauda* is a species of holarctic distribution, usually occurring in temperate to cool regions and at high altitude in biotopes with moderate to heavy rainfall or in inundation areas with ground moistening and plant communities ranging from grassland to broad leaved and coniferous forests with grass undergrowth. In North America it occurs in the western region from Alaska and British Columbia in the north to Utah, Colorado, Louisiana and New Mexico in the south (Thorne, 1935; Allen, 1955; Baker, 1957; Siddiqi, 1976; Baldwin et al., 1983; Donald, 1984). In the European-Asian continent this species is known from Spitsbergen (Loof, 1971), Germany, Poland (Brzeski, pers. comm.), Hungary (Andrassy, 1973), north-western Russia, Tadjikistan (Pamir mountains) (Ryss, 1980) and Chukchi peninsula which is the most eastern region of the continent located at the border of Alaska in North America.

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Резюме. Типовой материал *Pratylenchoides ivanovae* из Таджикистана , а также популяции того же вида из Германии и России (из Санкт-Петербургской обл. и Чукотского полуострова) сравнивали с нематодами *P. magnicauda* с острова Шпицберген и литературными данными. Установлена синонимия *P. ivanovae* = *P. magnicauda* и впервые произведено описание самцов этого вида. Менее развитые стилет и пищевод самцов, наличие латеральных гребней на спикулах и дорсальная изогнутость их хвоста дают основание отнести этот вид спорного таксономического положения к роду *Pratylenchoides*, а не к *Amplimerlinius*.