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Revision of the species *Psyllotylenchus pawlowskyi* (Kurochkin, 1960) Poinar & Nelson, 1973. III. Description of *Spilotylenchus ivashkini* sp. n.

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Summary. A description of the morphology and life cycle of the nematode *Spilotylenchus ivashkini* sp. n. is given. The species is established as a result of a revision of *Psyllotylenchus pawlowskyi* (Kurochkin, 1960) Poinar & Nelson, 1973, a parasite of *Coptopsylla lamellifer* and *Nosopsyllus laeviceps* fleas, which was described from specimens representing three separate species (*Spilotylenchus pawlowskyi* (Kurochkin, 1960) *partim* Slobodyanyuk, 1997 that parasitises only *Coptopsylla lamellifer* fleas and *Kurochkinitylenchus laevicepsi* (Slobodyanyuk, 1999) and *Spilotylenchus ivashkini* sp. n., each of which parasitise *Nosopsyllus laeviceps* fleas). The new species can be distinguished from *S. pawlowskyi* by body length and the position of the excretory pore in the parasitic female, by body shape and tail shape in juveniles from the host coelom and from the environment, and by the host insect. From all other spilotylenchs, including *S. pawlowskyi,* the new species differs by the shape of the parasitic female stylet.
Key words: biology, fleas, morphology, *Spilotylenchus ivashkini* sp. n.

Kurochkin (1960) described a tylenchid nematode, *Heterotylenchus pawlowskyi* (= *Psyllotylenchus pawlowskyi*) from the haemocoel of *Coptopsylla lamellifer* Wagn. and *Nosopsyllus laeviceps* Wagn. Fleas collected from around the Astrakhan Station of Plague Control in the Kharabali and Krasnyi Yar districts of the Astrakhan region in the Lower Volga. Also, he reported the alternation of heterosexual and parthenogenetic generations in the nematode life cycle. The author visited the type locality of the species and collected parasitic tylenchid nematodes associated with *C. lamellifer* and *N. laeviceps* fleas. Investigation of the morphology and life cycle of the newly collected nematodes revealed that Kurochkin's description included representatives of three parasitic nematode species, none of which belonged to the heterogonic genus *Psyllotylenchus*. One of these species, that only parasitizes *C. lamellifer* fleas was redescribed as *Spilotylenchus pawlowskyi* (Kurochkin, 1960) *partim* Slobodyanyuk, 1997 in the first part of a revision of *Psyllotylenchus pawlowskyi* species (Slobodyanyuk, 1997a). Another species that only parasitises *N. laeviceps* fleas was redescribed as *Kurochkinitylenchus laevicepsi* Slobodyanyuk, 1999 in a second part of the revision of *Psyllotylenchus pawlowskyi* species (Slobodyanyuk, 1999). Further results from this revision are reported here, which include a re-evaluation of the morphology and biology of a third nematode species of the group described as *Psyllotylenchus pawlowskyi sensu* (Kurochkin, 1960). This species develops without alternation of generations and belongs to the genus *Spilotylenchus*.

Materials and methods were described in the first part of this investigation (Slobodyanyuk, 1997a).

DESCRIPTION
Spilotylenchus ivashkini sp. n.
(Figs. 1-5)

Synonymy:

Heterotylenchus pawlowskyi Kurochkin, 1960 *ex parte*: p. 1282 ("parthenogenetic generation juveniles originating from the body of mature heterosexual parasitic female with length up to 800 μm);

Psyllotylenchus pawlowskyi (Kurochkin, 1960) Poinar & Nelson, 1973 *ex parte*.

Morphometrics. Tables 1-3.

Parasitic female. Sausage-shaped or coiled spirally with ventral side always turned outward. Young adults colourless, a bright yellow colouration develops in mature specimens. Colouration disappears after formalin fixation. Body walls very thick, with prominent transverse folds in some mature speci-

mens. Cephalic end not offset from body contour. Tail short, conically tapered with sharp terminus, or with mucro 2-23 μm long, rarely tail rounded without mucro. Stylet divided into two parts: a strongly sclerotized, narrowed based conical blade; and a less sclerotized abruptly widened shaft ending with slightly thickened and asymmetrical base. Total stylet length 18-22 μm, conus length 5-6 μm, stylet diameter at base of blade 1.5-2 μm, shaft diameter at blade base junction 2-2.5 μm, basal thickening diameter 3-3.5 μm. Stylet lumen narrow, with opening on ventral side of conus. Oesophagus short, almost cylindrical, without isthmus. Oesophageal lumen narrow, with slightly sclerotized lining. Dorsal gland orifice 2-5 μm behind basal thickening of stylet, orifices of subventral glands about 1.5 stylet lengths posterior. Nerve ring 40-70 μm from anterior end, always posterior to excretory pore. Excretory duct narrow and slightly sclerotized, excretory cell not visible. Intestine narrow, without lumen, rectum thin-walled. Ovary and oviduct forming from one to sixflexures in anterior body region, with tip directed anterior or posterior. Spermatheca rounded or oval, filled with numerous small spermatozoa. Narrow and short part of oviduct present behind spermatheca. Sac-like uterus occupying about one third of body volume in young specimens, up to two thirds of body volume in mature specimens, filled with numerous eggs and juveniles. Eggs from uterus 49 (45-55) μm x22 (18-25) μm. Juveniles in uterus 253 (235-270) μm long, 7.5 (7-8) μm wide. Vagina short, thick-walled, vulval lips not protruding (Fig. 1D). Ovoviviparous.

Juveniles from host coelom. First stage juvenile - body thread-like, short and thin. Cephalic end not offset from body contour. Tail short, conically tapered with rounded terminus. Stylet fine, 4-5 μm long, without basal thickening; protractors undeveloped, stylet appearing as if embedded in a transparent capsule. Excretory pore located just anterior to nerve ring. Excretory duct thin, not sclerotized, difficult to distinguish. Oesophagus with weak contours. Oesophageal glands and their orifices not observed. Intestine without lumen, rectum thin. Gonad primordium ovoid, with one sexual cell, located at about mid-body. In first moulting juveniles stylet and gonad primordium without prominent changes, no sexual dimorphism.

Second stage juvenile - body length and width increased as compared to J1. Stylet fine, 6-7 μm long, with very small distal conus and knob-like basal thickening; protractors undeveloped. Oesophagus short, nearly cylindrical. Excretory duct more expressed. Orifice of dorsal oesophageal gland just behind stylet base, orifices of subventral glands not visible. Gonad primordium ovoid, slightly more developed than in J1, located at mid-body. In second moulting male juveniles spicular primordium present.

Third stage juvenile - two types of J3, "common" and "large", present. Body size increases substantially, especially in the "large" form (up to 842 μm long and 30 μm in dia.). Cephalic end with six lips, not offset from body contour. A more robust stylet 8-9 μm long, with small distal conus and three distinct basal knobs, protractors still weak. Excretory duct thin and slightly sclerotized, excretory cell not visible. Contours of oesophagus more marked, lumen very thin, not sclerotized, dorsal gland orifice 1-2 μm behind stylet base, subventral gland orifices not visible. Gonad primordium with development initiated after second moult. Male juveniles distinguished by developing spicular apparatus; female juveniles by large hollow cell in place of vagina. Gonad primordium located in posterior body third in juveniles of both sexes, extending for 35-55 μm and 77-83 μm in "common" and "large" female forms, respectively; 62-105 μm and 90-140 μm in "common" and "large" male forms, respectively. Double cuticle along entire body, with shed cuticle on the tail in some juveniles from the host coelom as an additional sheath. Upper cuticle smooth, lower one striated. In juveniles from the rectal section of host intestine the stylet, oesophagus, excretory duct and gonad primordium are as in juveniles from the host coelom just before migration to intestine. Also, gemizonid and large intestine cells become obvious. Additional sheath of cuticle and third moulting not observed in specimens in the host intestine. A third moulting observed only in "large" forms from the host coelom.

Free-living juveniles. Free-living J3 - similar to "common" forms from the host coelom. Cuticle smooth. Lateral field indiscernible. Gemizonid expressed. Sexual dimorphism more prominent in the extent and structure of gonad primordium that is situated in the posterior third of the body in both sexes.

Free-living J4 - cephalic end, with six lips, not off-set. Cuticle with thin annulation. Lateral field 4-5 μm wide, with seven lines. Stylet 9-10 μm long, more robust, with small knobs. Oesophagus cylindrical, with three glands, in female juveniles glands more developed. Dorsal gland orifice 1-2 μm posterior to stylet base, subventral gland orifices at about 1.5 stylet lengths posterior to dorsal gland orifice. Excretory canal short, not strongly sclerotized, excretory cell indiscernible. Hemizonid located well

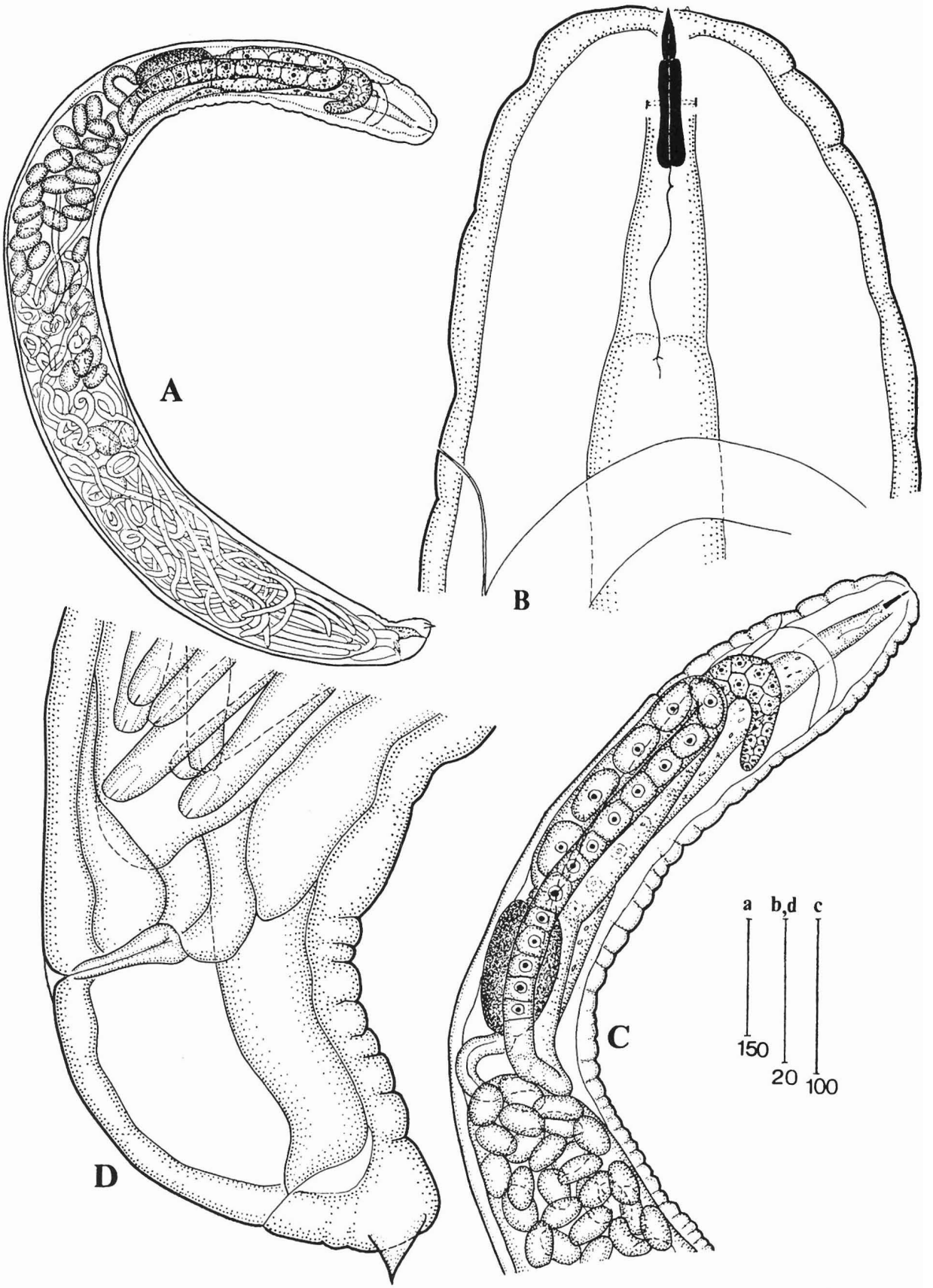

Fig. 1. *Spilotylenchus ivashkini* sp. n. parasitic female. A: Lateral view; B & C: Anterior end; D: Posterior end. Scale bars in μm.

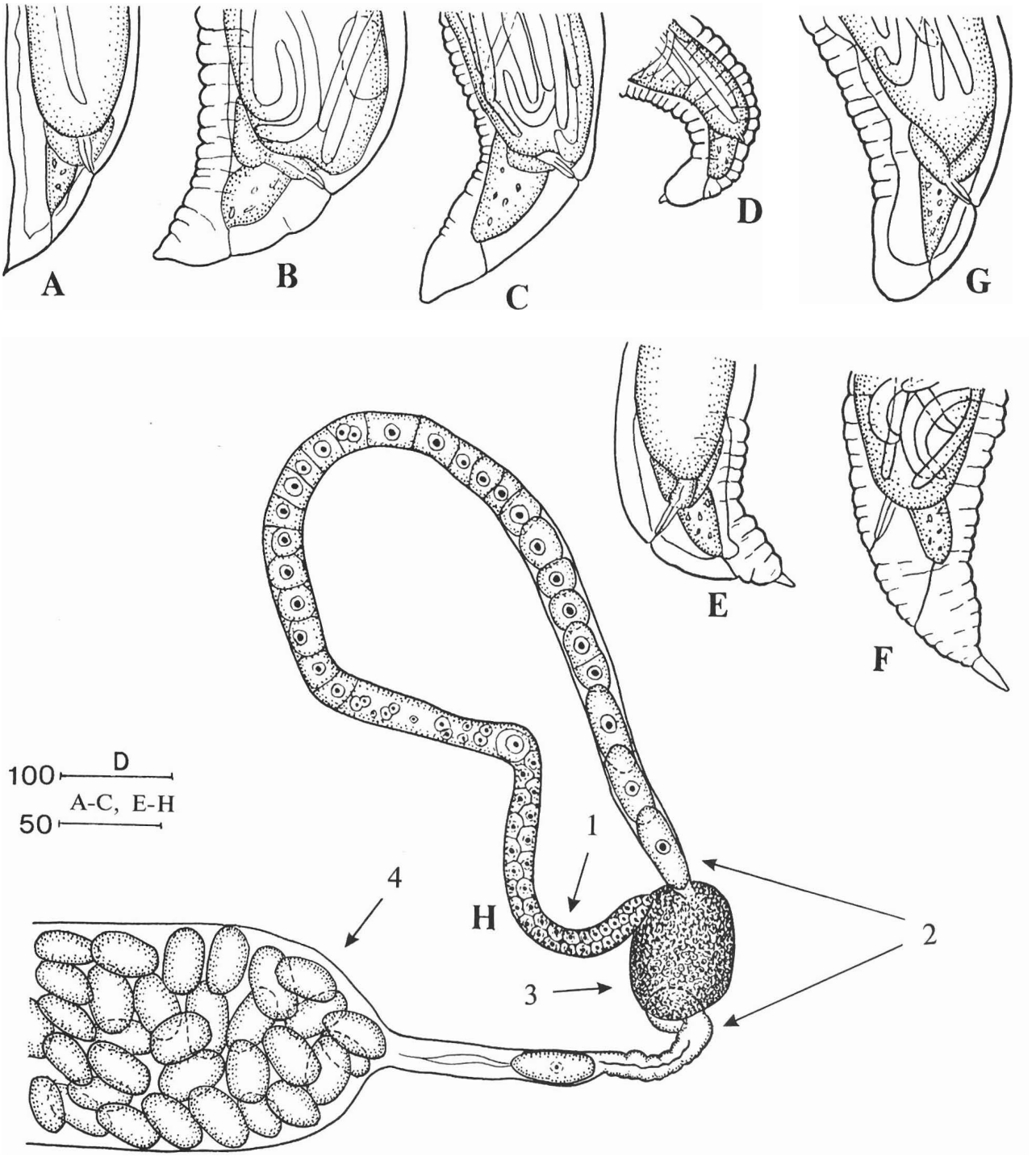

Fig. 2. *Spilotylenchus ivashkini* sp.n. parasitic females. A-G: Variations in posterior end; H: Genital tube excised from a female (1 - ovary; 2 - oviduct; 3 - spermatheca; 4 - uterus filled with eggs). Scale bars in μm.

posterior of the nerve ring. Female genital primordium more differentiated.

Biology. A total of 1924 specimens of *Nosopsylla laeviceps* fleas were dissected of which 363 (18.9%) were found to be infected with *S. ivashkini* sp. n., the latter being encountered in fleas from the type locality in the Astrakhan region, and from the Stavropol region, Russia, and the Guriev and the northern Uralsk regions, Kazakhstan, the habitat of the host. *Spilotylenchus ivashkini* sp. n. were not found in fleas from Azerbaijan (Table 4).

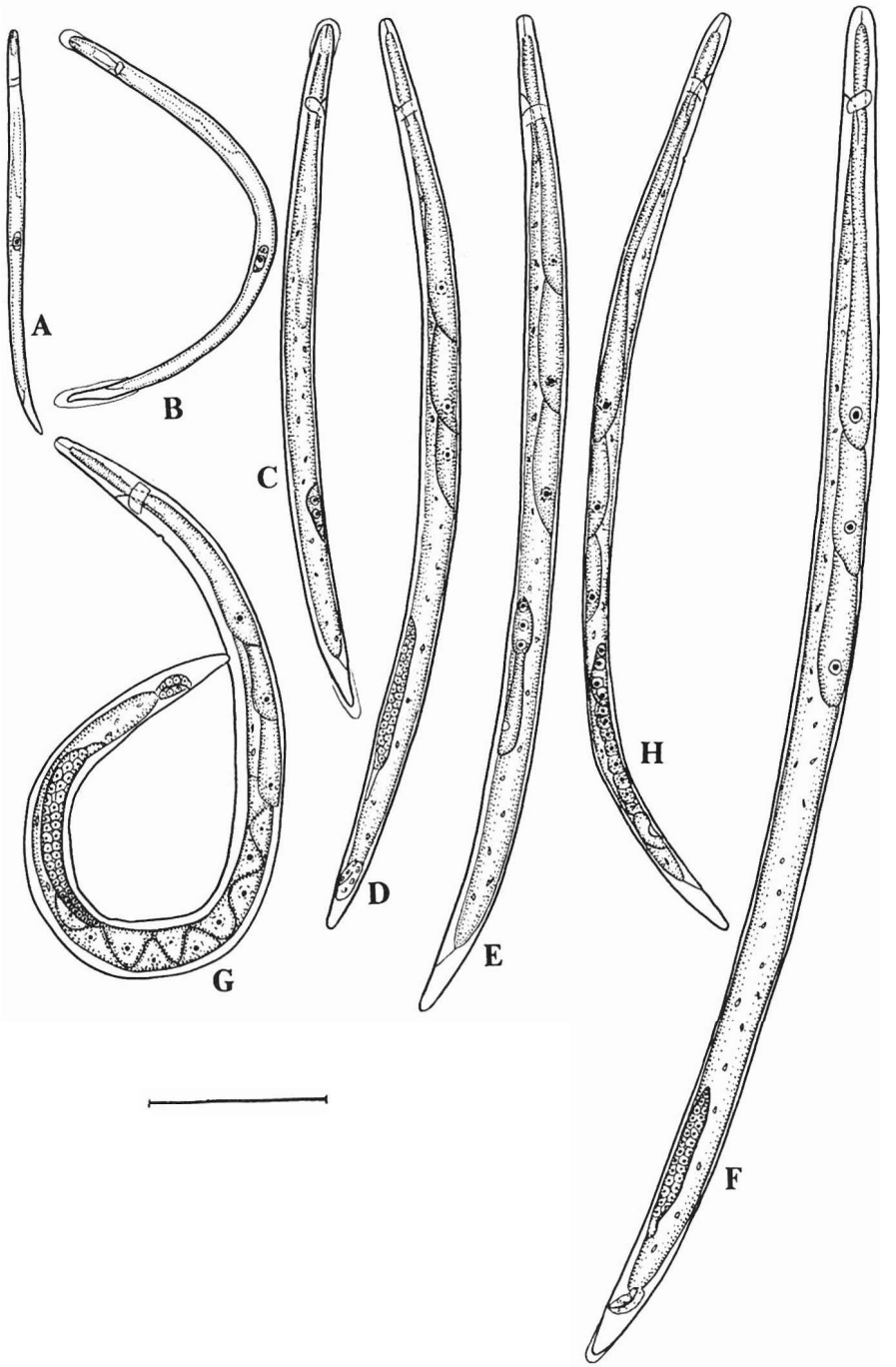

Fig. 3. *Spilotylenchus ivashkini* sp. n. juveniles. A: First stage juvenile; B: Juvenile during first moult; C: Juvenile during second moult; D & E: "Common" third stage male and female juveniles from the host coelom; G: Third stage juvenile from the host intestine; F: "Large" third stage male juvenile from the host coelom; H: Free-living fourth stage female juvenile. Scale bar - 100 μm.

Spilotylenchus ivashkini sp. n. is characterized by having a life cycle without alternation of generations. The partially free-living stages of *S. ivashkini* sp. n. occur under the nest of the flea host. Fertilized female nematodes with underdeveloped genital system make contact with flea larvae and enter their body cavities, probably by penetrating through the cuticle, as do other sphaerularioids. The process of sexual maturation of these females is synchronized with the host's morphogenesis. The penetrated females develop into mature heterosexual parasitic females in the hemocoel only of the host imago.

From 1 to15 (mean=3.0) parasitic *S. ivashkini* sp. n. females were observed in the host's coelom at

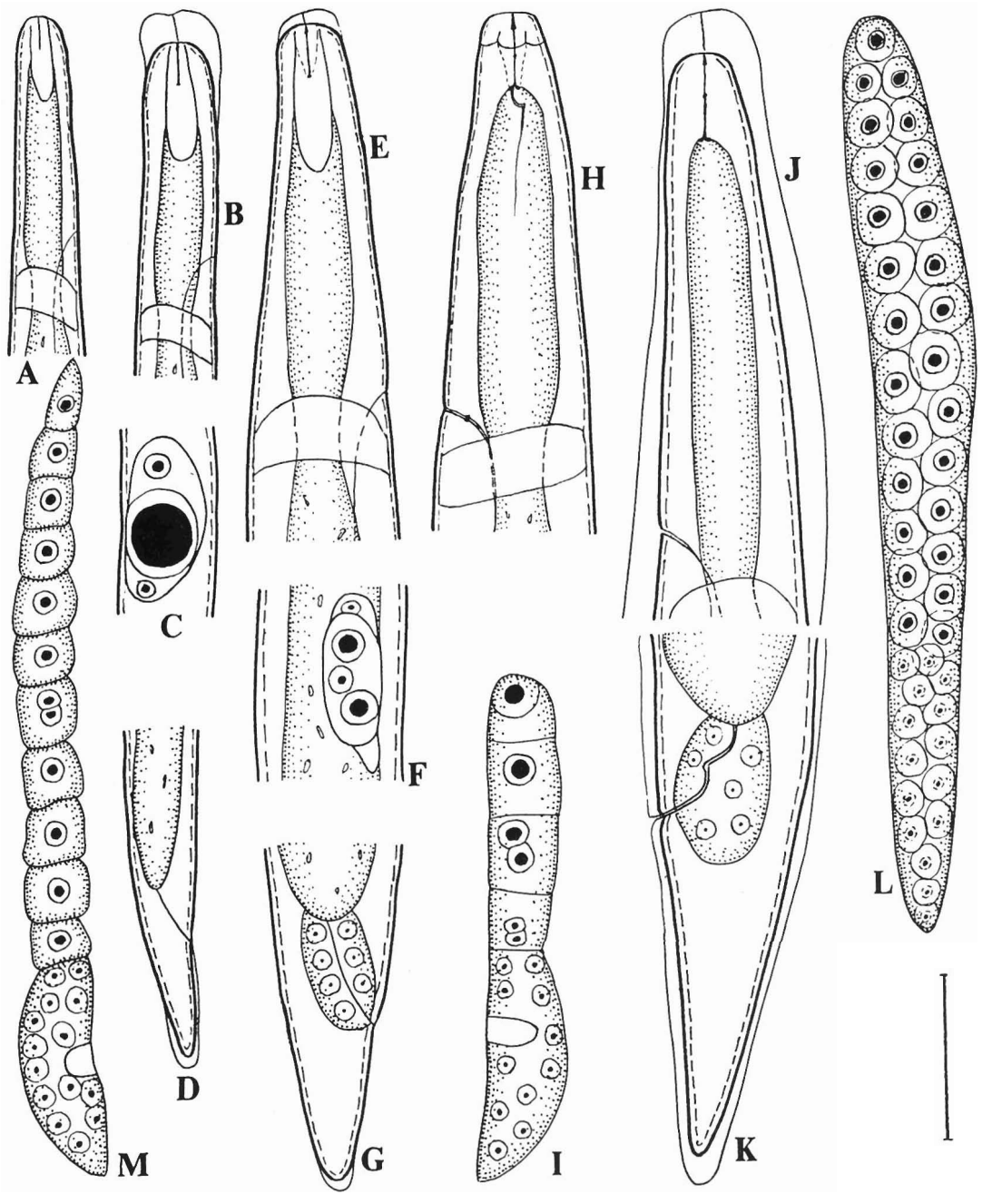

Fig. 4. *Spilotylenchus ivashkini* sp.n. juveniles from host coelom. A: Anterior end of first stage juvenile; B, C & D: Anterior end, genital primordium, and posterior end of juvenile during first moult; E, F & G: Anterior end, genital primordium, and posterior end of juvenile during second moult; H & I: Anterior end and female genital primordium of J3; J, K & L: Anterior and posterior ends and genital primordium of male "large" J3 during third moult; M: Genital primordium of female "large" J3 during third moult. Scale bar - 20 μm.

the moment of the young flea's exsheathment from the pupa envelope. When numerous parasitic females penetrated the host these were localised in the abdominal cavity and in the thorax and head segments of the host's body. Females produce up to 1000 J1 juveniles that develop into the bisexual forms in the host's body cavity. Unlike with *S. pawlowskyi*, no penetration of juveniles into the host's femur muscles was observed. Up to 5000 juveniles of different size were extracted from the coelom of individual infected fleas penetrated by seven female nematodes.

Moulting juveniles were not observed in the female uterus, and as occurs with other species in

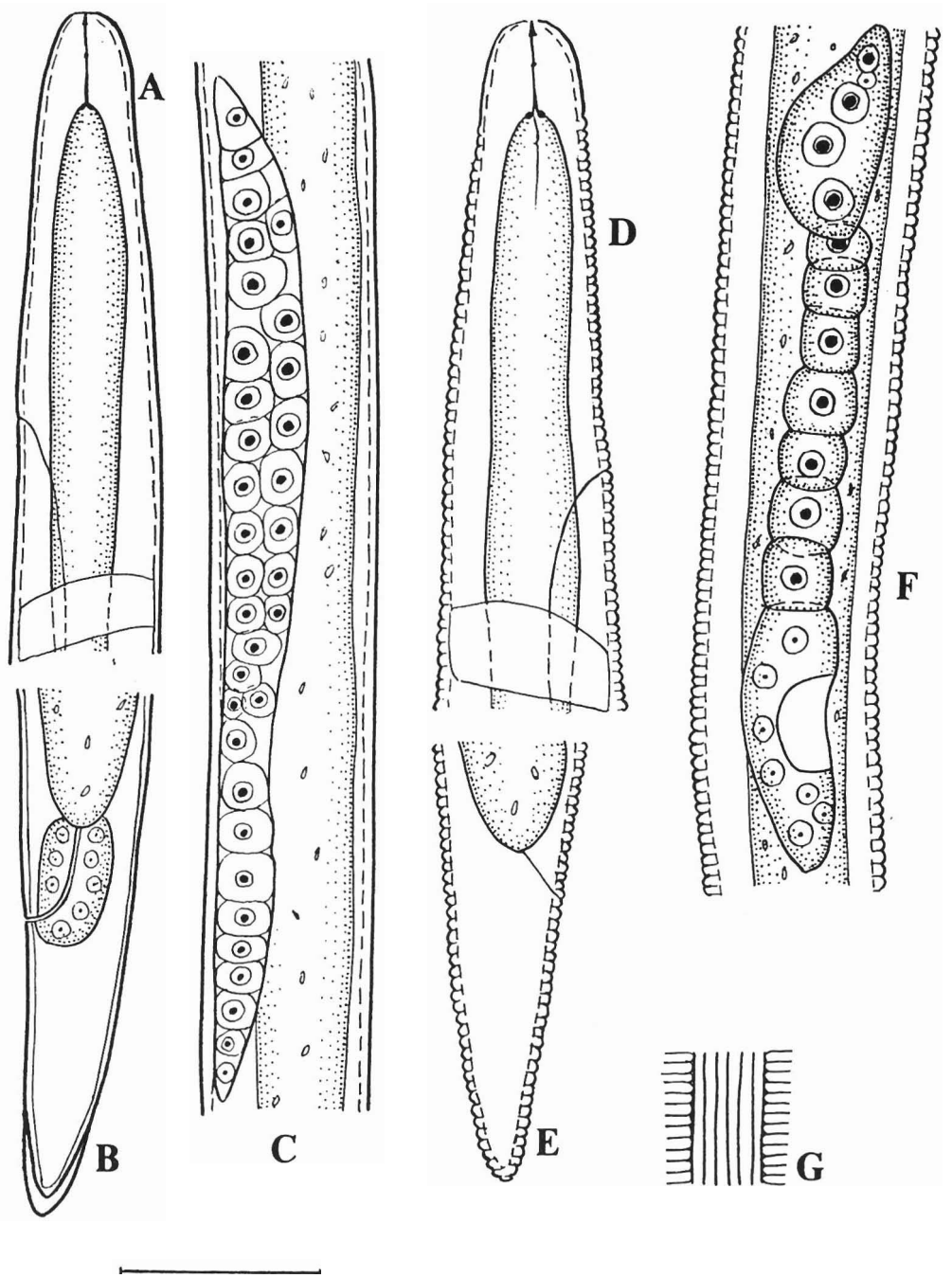

Fig. 5. *Spilotylenchus ivashkini* sp.n. free-living juveniles. A, B & C: Anterior and posterior ends and genital primordium of third stage male juvenile in double cuticle, additional sheath visible on the tail; D-G: Anterior and posterior ends,genital primordium and lateral field of fourth stage female juvenile. Scale bar - 20 μm.

the genus two moults take place in the host's coelom. *Spilotylenchus ivashkini* sp. n. J3 juveniles penetrated the host's intestine. Up to 140 juveniles were observed in the rectal section of a host intestine, and thereafter migrated to the environment without additional development or moult. The third moult was observed only in free-living juveniles, and not in juveniles from the host intestine.

Development of some *S. ivashkini* sp. n. juveniles differed from that described above. Some J3s from the host coelom carry the unshed cuticle from the previous stage, as occurs with all *S. pawlowskyi* J3s (Slobodyanyuk, 1997a).

Some *S. ivashkini* sp. n. J3s in the body cavity of some flea specimens develop without penetrating the host's intestine. These juveniles enlarge consid-

erably, up to 842 μm in length and 32 μm in width, as compared to 587 μm and 25 μm, respectively in "common" J3s from the host coelom. Thus, two groups of J3s from the host coelom can be distinguished, "common" and "large" forms (Table 3). The penetration of "large" J3s into the host intestine and their subsequent emergence into the environment from the host coelom were not observed. The third moult of "large" J3s occurs in the host coelom, unlike that of the "common" J3s that moult only in the environment. Further development of "large" J3s was not observed, therefore it is not known if these juveniles can migrate from the host, *e.g.*, through the damaged cover of the flea cadaver. Similarly, it is not known if "large" J3s develop in the environment, or simply represent a dead-end in the parasite life cycle.

Free-living "common" J3s were reared for more than two months, during which time only the third moult was observed. The late juvenile moult and the formation of free-living males and females were not observed. Presumably, as occurs with other species of the genus *Spilotylenchus*, after the fourth moult of nematodes in the environment the female *S. ivashkini* sp. n. invades the host larvae after fertilisation by free-living males, with the males dying after copulation.

Type material. Holotype parasitic heterosexual female and paratype heterosexual females deposited in the Institute of Parasitology, Russian Academy of Sciences, Moscow, Russia.

Type host and locality. All type specimens were collected from *Nosopsyllus laeviceps* fleas in the Kharabali district of the Astrakhan region. This insect was indicated by Kurochkin (1960) as one of two type hosts and he also indicated this region as the type locality of *Psyllotylenchus pawlowskyi* (*sensu lato*). *Spilotylenchus ivashkini* sp. n. holotype parasitic female was collected from the coelomic cavity of a female *Nosopsyllus laeviceps* flea, collected from a mid-day gerbil *Meriones meridianus* on October 25th, 1985, captured in the village of Tchapchachi (*leg.* O.V. Slobodyanyuk). The paratype parasitic females of *S. ivashkini* sp. n. were collected from the coelomic cavities of 3 female and 2 male *Nosopsyllus laeviceps* collected from tamarisk and mid-day gerbils *Meriones tamariscinus* and *M. meridianus* between October 19th to November 4th, 1985, captured in the Kharabali district of the Astrakhan region in the Lower Volga.

Diagnosis and relationships. *Spilotylenchus ivashkini* sp. n. can be distinguished from other species in the genus by the structure and shape of the parasitic female stylet. The stylet shape of *S. ivashkini* sp. n. is similar to that of *S. pawlowskyi sensu stricto*, but differs in the stylet being 18-22 μm long, the stylet distal blade is symmetrically tapered, with a narrowing, never thickened base, the stylet shaft widens abruptly at the junction of the blade, and has asymmetrical basal thickening. In *S. pawlowskyi* the stylet is 22-28 μm long, the stylet distal blade base has a little thickening as a protruding ring at the junction of the stylet shaft, and there is not an abrupt widening of the stylet shaft at the junction of the blade. Also, *S. ivashkini* sp. n. differs from *S. pawlowskyi* by its smaller parasitic female body, shorter distance from the excretory pore to the anterior end, and by much larger juveniles of all stages. The maximal body length of juveniles from the host coelom in *S. ivashkini* sp. n. is 906 μm, and in *S. pawlowskyi* is 498 μm. In juveniles of *S. ivashkini* sp. n. from the host and free-living juveniles the body is not curved ventrally when relaxed, and the tail is conically tapering and relatively narrow at the end. In *S. pawlowskyi* juveniles, the body curves ventrally, the tail has a broad rounded terminus.

The stylet and body length of *S. ivashkini* sp. n. is similar to that of *S. megabothridis* and *S. ussuriensis*, but the stylet shaft of *S. megabothridis* is much narrower than its blade, and in *S. ussuriensis* the distal tip of the blade terminates with an oblique ventral cut.

Also, *S. ivashkini* sp. n. differs from all species in the genus *Spilotylenchus* by having "large" J3s in the host coelom, and by its host species.

When describing *Psyllotylenchus* (=*Heterotylenchus*) *pawlowskyi* Kurochkin (1960) did not provide details of a parasitic female with morphology corresponding to that of *S. ivashkini* sp. n. Also, the maximum length of juveniles reported from the host body cavity of "mature female of heterosexual generation", was given as 800 μm. However, juveniles of *S. ivashkini* sp. n. from the host body cavity are characterised by a length of up to 906 μm. Specimens of the species described by Kurochkin (1960) were collected in the Kharabali district of the Astrakhan region. Kurochkin (1960) reported two flea species as type hosts for *P. pawlowskyi*: *Coptopsylla lamellifer* and *Nosopsyllus laeviceps*. However, Slobodyanyuk (1997a, 1999) in a revision of the species described by Kurochkin (1960) reported two other tylenchid species from this type locality that parasitise the two fleas: *S. pawlowskyi* (*sensu stricto*) and *Kurochkinitylenchus laevicepsi*. The juveniles of these species collected from their hosts body cavities do not exceed 500 μm. Therefore, it may be assumed that juveniles found by Kurochkin (1960) represent the species *S. ivashkini* sp. n., and that Kurochkin's

Table 1. Morphometrics of *Spilotylenchus ivashkini* sp. n. parasitic females (All measurements in μm).

Characters	Holotype	Paratypes
n	1	28
L	1480	1224±41.2 (925-1880)
a	11	12.9±0.7 (7.5-23.2)
c	74	45.1±4.5 (26.0-129.4)
D	135	102±6.6 (67-207)
Cd	20	30.8±1.7 (11-45)
V%	95.9	93.9±0.3 (90.6-97.3)
Vulva-anus distance	40	42.6±2.0 (12-62)
Vulva to tail tip	60	72.8±2.3 (37-100)
Anterior to excretory pore	51	40.8±1.6 (26-57)
Anterior to uterus	420	504±40.6 (277-840)
Uterus length	1000	704±59.9 (341-1026)
Ratio uterus length/body length	0.68	0.54±0.03 (0.37-0.76)
Stylet length	20	19.7±0.2 (18-22)

Table 2. Morphometrics of *Spilotylenchus ivashkini* sp. n. juveniles from the host (All measurements in μm).

Characters	J1	J1 moulting	J2	J2 moulting	"common" J3 from host coelom	"large" J3 from host coelom	J3 moulting from host coelom	J3 from host intestine
n	11	9	10	8	37	17	10	25
L	266±10.5 (217-315)	328±8.9 (288-362)	424±10.2 (372-410)	445±8.7 (392-470)	517±5.5 (450-587)	725±17.2 (615-842)	820±14.4 (775-906)	591±5.0 (550-650)
a	23.0±0.9 (19.7-27.2)	30.0±0.8 (25.9-33.7)	21.3±0.2 (20-22.5)	21.6±0.6 (19.6-24.7)	23.3±0.3 (20-25)	26.9±0.8 (20.8-32.4)	31.8±0.9 (29.7-37.2)	22.0±0.4 (20.5-24.8)
b	2.8±0.1 (2.5-3.0)	2.7±0.2 (2.3-3.0)	2.5±0.1 (2.2-2.9)	2.7±0.2 (2.0-3.6)	2.0±0.07 (1.6-2.6)	2.5±0.3 (1.7-5.1)	4.6±0.1 (4.2-4.9)	2.1±0.007 (1.7-2.5)
c	14.3±0.7 (12.4-18.6)	14.8±0.3 (12.8-16.7)	18.2±0.4 (16.2-20.3)	19.9±1.0 (17.5-20.4)	18.8±0.3 (14.5-20.6)	23.0±0.5 (19.5-25.3)	21.9±0.4 (20.1-24.0)	20.5±0.3 (18.3-22.7)
D	11.0±0.5 (8-14)	11.0±0.5 (9-13)	19.9±0.5 (17-22)	20.6±0.4 (19-21)	22.2±0.3 (20-24)	27.1±0.3 (25-30)	26.5±0.6 (23-30)	26.8±0.6 (23-31)
Oes	97.6±7.7 (77-114)	128.2±9.2 (100-152)	166.6±7.1 (140-190)	171.9±12.1 (122-205)	273±10.1 (150-377)	334+26.4 (160-450)	211±32.8 (160-460)	283±8.4 (170-340)
Cd	18.9±0.4 (17-20)	22.1±0.5 (20-23)	23.4±0.6 (20-25)	22.4±0.8 (22-25)	27.6±0.4 (25-30)	31.4±0.7 (29-38)	38.3±0.8 (35-42)	28.8±0.4 (25-31)
Anterior to excretory pore	26.2±1.8 (23-31)	25.9±1.0 (22-28)	34.7±1.4 (28-42)	37.0±0.7 (33-40)	45.0±0.6 (37-51)	47.5±2.4 (40-68)	62.1±0.8 (56-66)	48.1±0.5 (45-52)
Anterior to nerve ring	29.7±1.3 (27-33)	31.0±0.9 (27-32)	38.7±1.4 (34-44)	42.1±0.6 (40-45)	48.2±0.9 (40-57)	55.5±3.9 (42-85)	68.4±2.1 (61-77)	59.2±2.1 (50-70)
Anterior to hemizonid	–	–	–	–	–	–	–	83.8±1.0 (82-88)
Anterior to genital primordium	139.8±6.5 (115-180)	173.7±5.6 (151-198)	215.4±4.9 (195-230)	229.3±9.8 (185-280)	342±7.0 (220-400)	504±15.0 (400-605)	593±13.4 (504-665)	392.6±11.8 (287-480)
Ratio anterior to genital primordium/body length	0.52±0.001 (0.48-0.57)	0.53±0.005 (0.51-0.55)	0.50±0.01 (0.46-0.58)	0.51±0.02 (0.47-0.64)	0.66±0.01 (0.52-0.71)	0.69±0.007 (0.63-0.73)	0.72±0.01 (0.68-0.82)	0.67±0.02 (0.51-0.74)
Genital primordium	12.3±0.2 (11-13)	11.9±0.2 (11-13)	23.3±1.2 (18-28	28.4±0.8 (25-30)	64.7±3.4 (35-110)	105.6±5.0 (77-140)	92.0±5.6 (62-125)	68.2±5.7 (40-100)
Stylet length	4.3±0.1 (4-5)	4.9±0.2 (4-6)	6.4±0.2 (6-7)	8.4±0.2 (8-9)	9.7±0.08 (9-10)	10.1±0.08 (10-11)	9.4±0.2 (9-11)	10.1±0.08 (10-11)

Table 3. Morphometrics of *Spilotylenchus ivashkini* sp. n. juveniles after migration to the environment (All measurements in μm).

Characters	after 3 days	after 24 days	after 30 days	after 43-45days	after 69 days
n	10	26	17	12	11
L	556±8.4 (525-579)	485±12.2 (390-616)	676±11.1 (580-735)	490±14.5 (385-590)	504±15.9 (435-590)
a	27.2±0.9 (24.5-30.9)	28.8±0.7 (22.7-36.1)	23.6±0.7 (19.2-27.7)	29.2±1.4 (25.7-33.7)	30.3±0.9 (26.8-33.3)
b	2.3±0.2 (1.8-3.0)	2.6±0.2 (1.8-3.7)	2.3±0.3 (1.9-3.2)	2.0±0.1 (1.7-2.1)	2.0±0.08 (1.9-2.3)
c	20.3±0.5 (18.1-22.2)	19.6±0.6 (16.6-25.7)	21.7±0.5 (18.4-22.8)	17.9±0.6 (15.5-19.6)	17.7±0.8 (15.5-20.3)
D	20.6±0.8 (17-23)	17.1±0.7 (15-22)	28.6±0.8 (25-30)	17.4±1.4 (15-29)	16.7±0.6 (14-19)
Oes	256.4±24.1 (175-320)	206±14.5 (125-325)	296.3±27.5 (220-350)	250±9.3 (185-282)	262±11.6 (205-280)
Cd	27.4±0.7 (24-29)	24.9±0.4 (22-27)	31.0±0.7 (29-35)	27.4±0.6 (25-32)	29.2±0.6 (26-31)
Anterior to excretory pore	42.4±1.5 (38-46)	41±1.6 (33-54)	56.9±1.0 (53-62)	42.9±2.3 (34-52)	44.2±0.9 (41-46)
Anterior to nerve ring	62.3±1.1 (59-65)	52.7±1.2 (43-59)	61.0±1.1 (58-65)	50.1±2.2 (45-65)	51.7±1.3 (43-58)
Anterior to hemizonid	82.0±1.7 (74-85)	79.3±0.9 (75-84)	82.0±1.7 (74-85)	81±1.2 (72-83)	81.0±1.7 (71-83)
Anterior to genital primordium	365.4±9.1 (333-391)	310±7.7 (244-413)	421.4±18.4 (285-500)	317±8.5 (278-375)	365±15.0 (318-408)
Ratio anterior to genital primordium length/ body length	0.66±0.01 (0.62-0.70)	0.65±0.007 (0.63-0.75)	0.65±0.04 (0.46-0.84)	0.66+0.02 (0.57-0.79)	0.67±0.02 (0.61-0.69)
Genital primordium	81.1±4.1 (68-100)	78.9±3.5 (60-110)	93.8±5.0 (70-125)	87.0±3.6 (75-100)	94.5±3.5 (75-117)
Stylet length	9.9±0.1 (9-10)	9.9±0.1 (9-11)	10.6±0.1 (10-11)	10.4±0.2 (10-12)	10.3±0.1 (10-11)

Table 4. Proportion of *Nosopsyllus laeviceps* fleas infected with *Spilotylenchus ivashkini* sp. n.

Locality	Females*	Males	Total
Astrakhan	8/111 (7%)	3/40 (8%)	11/151 (7%)
Stavropol	11/86 (13 %)	5/56 (9%)	16/142 (11%)
Guriev	15/172 (9%)	14/90 (16%)	29/262 (11%)
Uralsk	230/914 (25%)	77/376 (21%)	307/1290 (24%)
Azerbaijan	0/50 (0)	0/29 (0)	0/79 (0)
Total	264/1333 (20%)	99/591 (17%)	363/1924 (19%)

*- numerator, number of fleas infected; denominator, number examined.

interpretation of their origin was erroneous. Also,he assumed that these juveniles develop into parthenogenetic females.

Spilotylenchus ivashkini sp. n. nematodes were found in *Nosopsyllus laeviceps* fleas from the Astrakhan region, the Stavropol region, and the Gurjev and Ural'sk regions of Kazakhstan. In each of these areas the nematode was the only species of entomoparasitic tylenchids with juveniles from the host's body cavity reaching 800 μm, or longer, in length. This new species, together with *Kurochkinitylenchus laevicepsi*, was also found during an examination of a collection of slides with nematodes from *N. laeviceps* fleas, prepared by the late Prof. Rubtsov at the Zoological Institute of the Russian Academy of Sciences, St. Petersburg. It may be concluded that only two species of tylenchids, *i.e.*, *S. ivashkini* sp. n. and *K. laevicepsi*, parasitize *N. laeviceps* fleas.

Etymology. The name of new species commemorates the late Prof. V.M. Ivashkin.

CONCLUSIONS

Revision of *Psyllotylenchus pawlowskyi* (Kurochkin, 1960) Poinar *et* Nelson, 1973, a species described from specimens collected from *Coptopsylla lamellifer* and *Nosopsyllus laeviseps* fleas, revealed that it comprises three different nematode species:

1) *Spilotylenchus pawlowskyi* (Kurochkin, 1960) *partim* Slobodyanyuk, 1997. Insect host *Coptopsylla lamellifer.*

Synonyms:

Heterotylenchus pawlowskyi Kurochkin, 1960 *ex parte*: p. 1281-1282, Fig. 1A ("mature female of sexual generation"); *Psyllotylenchus pawlowskyi* (Kurochkin, 1960) Poinar & Nelson, 1973 *ex parte*.

2) *Spilotylenchus ivashkini* sp. n. Insect host *Nosopsyllus laeviceps*.

Synonyms:

Heterotylenchus pawlowskyi Kurochkin, 1960 *ex parte*: p. 1282 ("parthenogenetic generation juveniles originating from the body of mature female of heterosexual generation" up to 800 μm long); *Psyllotylenchus pawlowskyi* (Kurochkin, 1960) Poinar & Nelson, 1973 *ex parte*.

3) *Kurochkinitylenchus laevicepsi* Slobodyanyuk, 1999. Insect host *Nosopsyllus laeviceps*.

Synonyms:

Heterotylenchus pawlowskyi Kurochkin, 1960 *ex parte*: p. 1282, Fig. 1B, D ("mature parthenogenetic generation females, producing juveniles"), p. 1281, Fig. 1E, K (male); *Psyllotylenchus pawlowskyi* (Kurochkin, 1960) Poinar & Nelson, 1973 *ex parte*.

In the regions investigated the only tylenchid found in *C. lamellifer* fleas was *S. pawlowskyi*. Similarly, *S. ivashkini* sp. n. and *K. laevicepsi* were found in *N. laeviceps* fleas collected from these regions (Slobodyanyuk, 1997a, 1997b, 1999).

These nematodes develop without alternation of heterosexual and parthenogenetic generations, which contradicts the report by Kurochkin (1960). The life cycles of *S. pawlowskyi* and *S. ivashkini* sp. n. are simple, without alternations of generations, but the life cycle of *K. laevicepsi* has an alternation of two parasitic heterosexual generations.

The revision of *Heterotylenchus pawlowskyi* (= *Psyllotylenchus pawlowskyi*) resulted in the establishment of the new genus *Kurochkinitylenchus* Slobodyanyuk, 1999, and together with the genera *Spilotylenchus*, *Psyllotylenchus*, *Incurvinema*, and *Rubzovinema* this new genus is included in the family Spilotylenchidae Slobodyanyuk, 1999. Four subfamilies: Spilotylenchinae Slobodyanyuk, 1999, Kurochkinitylenchinae Slobodyanyuk, 1999, Psyllotylenchinae Slobodyanyuk, 1999, and Rubzovinematinae Slobodyanyuk, 1999 are distinguished in this family based on their type of life cycle.

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Слободянюк О.В. Ревизия вида *Psyllotylenchus pawlowskyi* (Kurochkin, 1960) Poinar & Nelson, 1973. III. Описание *Spilotylenchus ivashkini* sp. n.

Резюме. Дано описание морфологии и жизненного цикла нематоды *Spilotylenchus ivashkini* sp. n. (Tylenchida: Sphaerularioidea), специфичного паразита блохи *Nosopsyllus laeviceps*. Новый вид описан в результате проведенной ревизии сборного вида нематод *Psyllotylenchus pawlowskyi* (Kurochkin, 1960) Poinar & Nelson, 1973. *Spilotylenchus ivashkini* sp. n. наиболее близок по своей морфологии к *S. pawlowskyi*, но отличается от него значительно меньшими размерами тела и хвоста у полостных и свободноживущих личинок. От всех других представителей рода новый вид отличается строением стилета паразитических самок.