Syst Parasitol (2016) 93:451–465
DOI 10.1007/s11230-016-9639-7

Revision of the genus *Soricinia* Spassky & Spasskaja, 1954 (Cestoda: Cyclophyllidea: Hymenolepididae) with redescriptions of three species, an amended generic diagnosis and an identification key to species

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Received: 28 September 2015 / Accepted: 19 March 2016

Abstract Redescriptions of three species of *Soricinia* Spassky & Spasskaja, 1954 are provided. The type-species of the genus, *Soricinia soricis* (Baer, 1925), is redescribed on the basis of the holotype from the Alpine shrew *Sorex alpinus* Schinz collected in Salève Mountain, France. Since the type-material of *Soricinia infirma* (Żarnowski, 1955) has apparently been lost, a neotype from the type-host *Sorex araneus* L. and from a region reasonably close to the type-locality (Poltavska Oblast' in the Ukraine), is designated. The type-material of *Soricinia quarta* (Karpenko, 1983) Karpenko, 1999 from *Sorex isodon* Turov in Khabarovsk Kray (Russia) is redescribed. A taxonomic revision and an overview of the geographical distribution of species of the genus *Soricinia* are presented. An amended generic diagnosis and a key to identification of *Soricinia* spp. are also presented.

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Introduction

Cestodes of the genus *Soricinia* Spassky & Spasskaja, 1954 are among the smallest hymenolepidids with unarmed scoleces, parasitic in shrews. The original diagnosis of *Soricinia* describes serial development of the strobila and formation of a syncapsule uniting several gravid proglottides. As a result, Spassky (1954) placed the genus within the tribe Ditestolepidini. Spassky (1954) chose *Soricinia soricis* (Baer, 1925) Spassky, 1954 (syn. *Hymenolepis minuta* Baer, 1925) as the type-species of *Soricinia*. The original description of the type-species based on a single specimen collected from an Alpine shrew *Sorex alpinus* Schinz in Salève Mountain (France) was brief and superficial (Baer, 1925). Gulyaev (1991) stated that the original description of *Hymenolepis soricis* Baer, 1925 lacks clear morphological differentiating characters and proposed to consider it a *species inquirenda* thus questioning the validity of the genus *Soricinia*. Vaucher (in Czaplinski & Vaucher, 1994) retained *Soricinia* as a separate genus. Moreover, he considered *Insectivorolepis* Zarnowski, 1955 a synonym of *Soricinia*. Žarnowski (1955) chose *Hymenolepis globosa* Baer, 1931 from the Eurasian water shrew (*Neomys fodiens* Pennant) in Switzerland (Baer, 1931) as the type-species of the genus *Insectivorolepis* and provided a detailed generic diagnosis of *Insectivorolepis* that differed substantially from the generic diagnosis of *Soricinia* (see Vaucher in Czaplinski & Vaucher, 1994). As a result, Irzhavsky et al. (2005) considered

Insectivorolepis as a valid genus while suggesting that *Soricinia* should be a *genus inquirenda*.

Upon re-examination of the type-specimens of *H. soricis* and *H. globosa*, Zubova et al. (2010) concurred with the opinion of Vaucher (in Czaplinski & Vaucher 1994) who considered *Insectivorolepis* a junior synonym of *Soricinia*. However, the paper by Zubova et al. (2010) did not contain a redescription of the type-species and detailed diagnosis of the genus. Recently, Binkienė et al. (2015) provided a detailed redescription of *Soricinia globosa*, but did not amend the generic diagnosis.

Comparative sequence analysis of the nuclear ribosomal 28S and mitochondrial *nad*1 genes of *Soricinia infirma* (Zarnowski, 1955), *Soricinia quarta* (Karpenko, 1983), *Soricinia genovi* Binkienė, Kornienko & Tkach, 2015 and *Soricinia bargusinica* (Eltyschev, 1975) revealed that despite the high morphological similarity among species of *Soricinia*, their sequences exhibit great interspecific divergence levels in both genes, from 0.9 to 4.2% in the 28S gene and from 9.6 to 17.2% in the *nad*1 gene (Binkienė et al., 2015). In both phylogenetic trees resulting from analyses of the two genes, sequences of specimens identified as *S. infirma* formed an independent clade that appeared as a sister group to the clade comprising the remaining *Soricinia* spp. Overall, the members of the "*S. infirma*" clade differed most significantly from the remaining species. Pairwise comparisons of partial 28S and *nad*1 sequences have indicated that the two forms of *S. infirma* (from Altai and the Carpathians) sequenced by Binkienė et al. (2015) and *S. infirma* sequenced by Haukisalmi et al. (2010) most likely represent three different species. Additional studies including all current members of *Soricinia* are necessary in order to verify their congeneric status (Binkienė et al., 2015).

The aim of this study is to revise the content of the genus *Soricinia* using results of morphological and genetic analyses and provide an amended diagnosis of the genus. We provide redescriptions of the type-species *S. soricis* and two other insufficiently described species, *S. infirma* and *S. quarta*.

Materials and methods

The holotype of *S. soricis* deposited at the Museum of Natural History of Geneva (MHNG; accession numbers C7/11, MHNG-PLAT-15531) and the holotype of *S. quarta* deposited at the Museum of Zoology of the Institute of Systematics and Ecology of Animals, Novosibirsk, Russian Federation (ISEA) (accession number 3589) were used for re-descriptions of these species.

Live cestodes were rinsed in saline, killed with hot water and fixed in 70% ethanol. For morphological study, four complete specimens were stained with Ehrlich's haematoxylin, dehydrated in a graded ethanol series, cleared in clove oil and mounted in Canada balsam; two specimens were mounted in Berlese's medium to facilitate examination of the copulatory apparatus. The specimens were deposited in the Natural History Museum, Geneva, Switzerland (MHNG) and the Museum of Zoology of the Institute of Systematic and Ecology of Animals, Novosibirsk, Russian Federation (ISEA).

Measurements are given in micrometres unless otherwise stated and are presented as the range followed by the mean and the number of measurements taken (n) in parentheses. The terminology used in the description of different stages of proglottis development follows Mas-Coma & Puchades (1991).

Soricinia soricis (Baer, 1925) Spassky & Spasskaja, 1954

Syn. *Hymenolepis minuta* Baer, 1925

Type-host: *Sorex alpinus* Schinz (Soricomorpha: Soricidae).
Type-locality: Region of Salève, France (see Baer, 1925).
Site in host: Intestine.
Type-material: Deposited in MHNG. Holotype: slide C7/11, *Sorex alpinus*, MHNG-PLAT-15531, coll. Dr. E. Andre.

Redescription (Fig. 1)

[Based on the holotype.] Small cestode with total length 360 (Fig. 1A). Strobilation gradual. Strobila consisting of 9 proglottides: 2 juvenile, 3 hermaphroditic (1 mature), 3 pregravid and 1 gravid, latter containing fully-formed eggs. Mature proglottis acraspedote, transversely elongate, 20 × 90 (Fig. 1B). Single gravid proglottis 48 × 70. Male and female gonads appearing

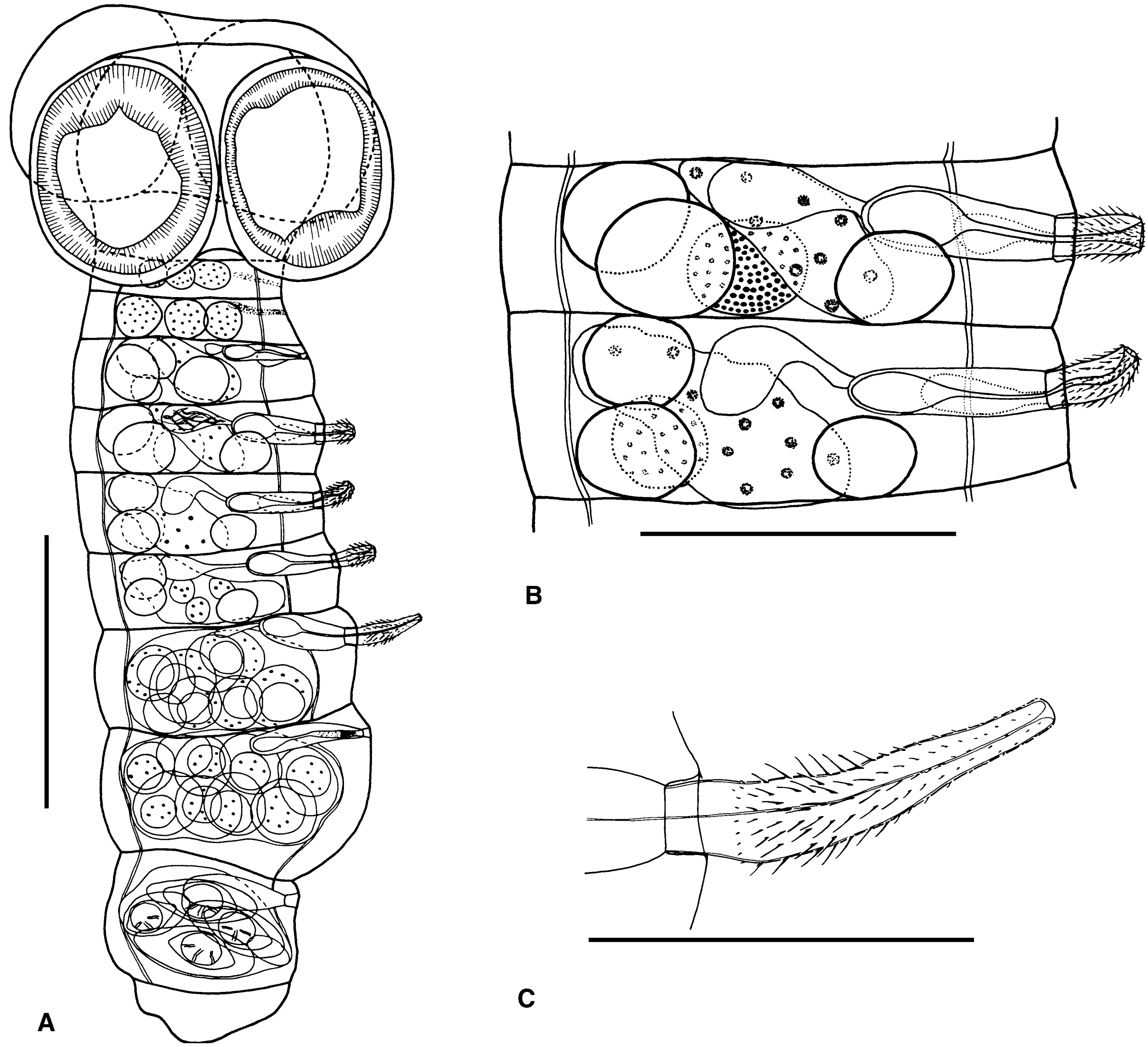

Fig. 1 *Soricinia soricis* (Baer, 1925) ex *Sorex alpinus* Schinz. Holotype. A, Total view; B, Mature proglottides; C, Evaginated cirrus. *Scale-bars*: A, 100 µm; B, 50 µm; C, 30 µm

simultaneously, subsequent maturation following functional protandry pattern. Osmoregulatory canals without transverse anastomoses. Genital pore unilateral, dextral. Genital atrium cylindrical, immediately pre-equatorial.

Scolex relatively large, slightly compressed dorso-ventrally, 90 wide. Suckers 75–76 × 60–61 (n = 2), with well-developed muscular rim. Rhynchus and rostellar apparatus absent. Neck distinct, 68 wide.

Testes 3, oval, 15–18 × 18–22 (16 × 20; n = 3), arranged in triangle, 1 poral and 2 antiporal, in median field of proglottis (Fig. 1B). Diminishing testes visible in first pregravid proglottis. Cirrus-sac cigar-shaped, elongate, thin-walled, 30–33 × 10, crossing poral osmoregulatory canals, not reaching midline of proglottis (Fig. 1B). Internal seminal vesicle small, 15 × 9, ovoid; external seminal vesicle elongate, 19 × 10, median, ventral. Cirrus conical, 30–32 × 7, covered with heteromorphic spines: basal part unarmed, parabasal part covered with long, thin, needle-shaped spines decreasing in size towards end of cirrus (Fig. 1C).

Copulatory part of vagina pear-shaped, opening ventral to cirrus-sac. Ovary large, entire or slightly lobed, 48 × 22, ventral to testes, occupying large part of middle field. Vitellarium compact, oval, 18 × 15, aporal, ventral to testes, postovarian (Fig. 2B). Uterus sac-like, ventral to testes, occupying almost entire median field, containing 8–9 large eggs. Eggs oval, 38–44 × 16–18 (41 × 17; n = 3); oncospheres 13–15 (14; n = 3) in diameter; embryophore fusiform, with straight polar projections, 25–27 × 13–14 (26 × 14; n = 3); embryonic hooks small, 8–10 (9; n = 2).

Remarks

The original description of *S. soricis* by Baer (1925) was incomplete and did not provide information on the number and/or size of the proglottides, eggs, ovary and vitellarium. Besides, it contained erroneous information on the cirrus-sac and cirrus length. The cirrus-sac length reported in the original description was 240–300 µm with the cirrus being only 8 µm long. Our re-examination showed that the cirrus-sac of the holotype is 30–33 µm long and the cirrus is 30–32 µm long. It is obvious that Baer (1925) measured only the evaginated part of the cirrus. The poor original description hindered the proper systematic placement of this cestode for a long time.

Karpenko (1999) identified as *S. soricis* a small cestode found in *Sorex caecutiens* Laxmann in the Russian Far East (Khabarovsk Kray), revised the genus *Soricinia* and amended its diagnosis. He placed *Insectivorolepis infirma*, *Insectivorolepis globosa* (syn. *Hymenolepis globosa*), *Ditestolepis secunda* Schaldybin, 1964 and *Sinuterilepis spasskyi* Sadowskaja, 1965 among the synonyms of *S. soricis*. However, the cestode from the Far East collected by Karpenko (1999) differs from the holotype of *S. soricis* in the length of the cirrus sac (40–45 *vs* 30–33 µm) and the cirrus armature. According to Karpenko the cirrus is evenly covered with small spines, whereas the spines of the type-specimen of *S. soricis* are heteromorphic. Additionally, the study by Binkienė et al. (2015) demonstrated substantial morphological differences between *S. infirma* and *S. globosa*. Therefore, the taxonomic status of the species from Khabarovsk Kray identified by Karpenko (1999) as *S. soricis* remains unclear.

***Soricinia infirma* (Zarnowski, 1955) Czaplinski & Vaucher, 1994**

Type-host: *Sorex araneus* L. (Soricomorpha: Soricidae).
Type-locality: Near village Vishnyaki, Khorolsky District, Poltavska Oblast, Ukraine (54°07′59″N, 24°01′05″E).
Site in host: Intestine.
Type-material: Neotype, *Sorex araneus*, MNHG-PLAT-91139. Voucher specimens from the same individual of *S. araneus* are deposited in the ISEA (No. 18.6.2.2-18.6.2.5).

Description (Fig. 2)

[Based on five specimens; measurements of the holotype are followed by the range, mean and number of measurements in parentheses.] Small cestodes, 600 (300–600; 420; n = 5) long. Strobila consisting of 13 (10–13; 12; n = 5) proglottides: 2–3 juvenile, 2–3 hermaphroditic (1 mature), 3–4 postmature and 2–3 gravid. Strobilation gradual. Proglottides acraspedote, transversely elongate (Fig. 2C). Mature proglottis 29 × 120 (28–36 × 110–120; 31 × 117; n = 5), pregravid proglottides 55 × 160 (55–73 × 150–170; 66 × 162; n = 5). Primordia of male and female gonads appearing simultaneously, subsequent maturation following functional protandry pattern. Scolex relatively large, slightly compressed dorso-ventrally, 120 (110–120; 113; n = 5) wide. Neck 86 (79–91; 86; n = 5) wide, clearly differentiated from scolex. Suckers subspherical, cup-shaped, 74 × 70 (68–85 × 58–80; 76 × 70; n = 5), with well-developed muscular rim (Fig. 2B). Rhynchus and rostellar apparatus absent.

Osmoregulatory canals without transverse anastomoses. Ventral osmoregulatory canals 2 (2–3; 2.4; n = 5) in diameter, dorsal canals 1 (1–2; 1.3; n = 5) in diameter. Genital pores unilateral, dextral, opening in middle of proglottis margin. Genital atrium simple, cylindrical 12 (11–15; 14; n = 7) deep.

Testes 3, oval, 33–36 × 22–23 (28–36 × 19–29; 32 × 25; n = 10), 1 poral and 2 antiporal, arranged in almost right-angled triangle in median field of proglottis (Fig. 2C). Cirrus-sac cigar-shaped, elongate, thin-walled, 60–62 × 9–10 (57–65 × 8–10; 61 × 8; n = 6), crossing poral osmoregulatory canals, reaching midline of proglottis. Cirrus

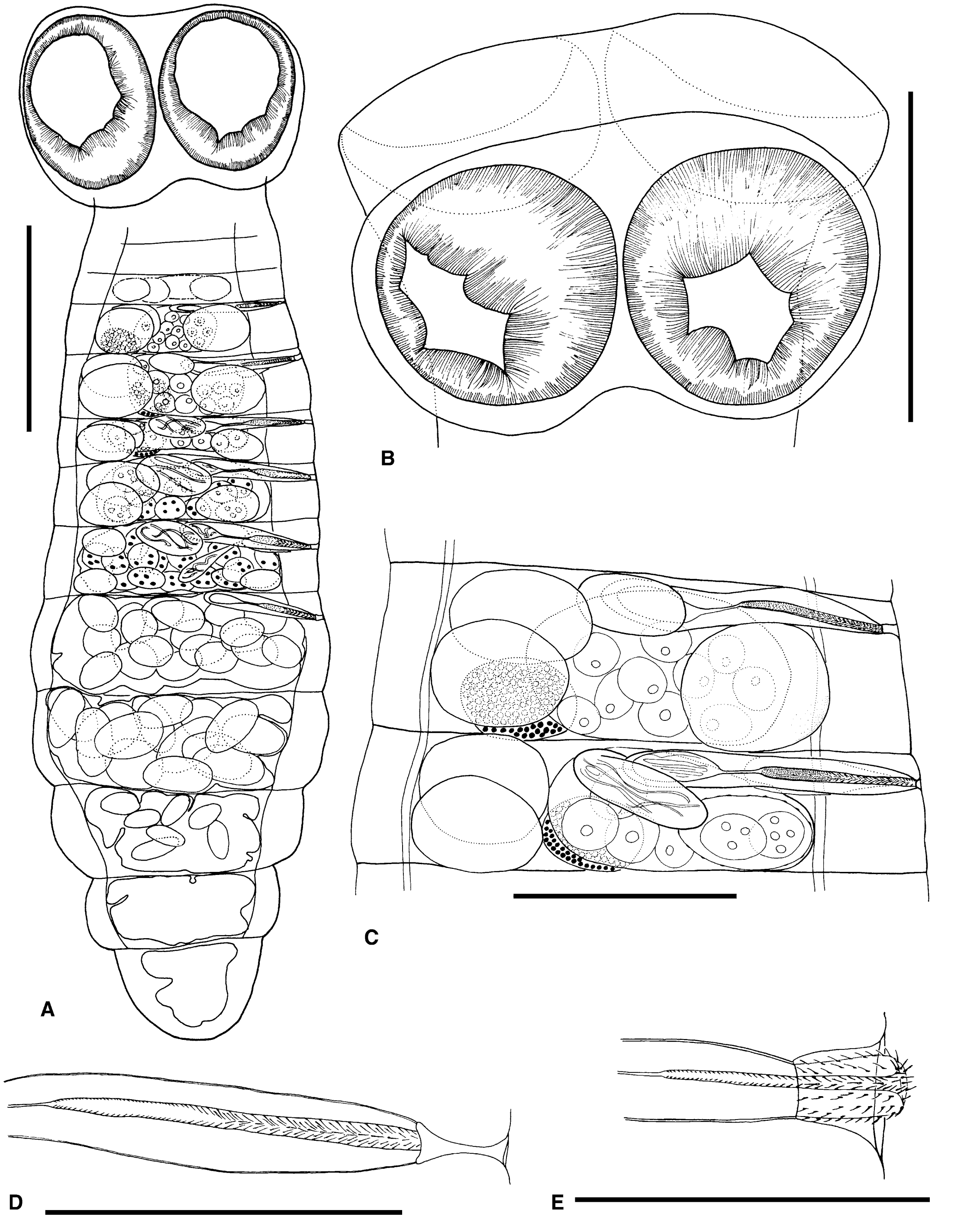

Fig. 2 *Soricinia infirma* (Zarnowski, 1955) ex *Sorex araneus* L. Neotype and voucher specimens from the same host individual. A, Total view (neotype); B, Scolex (voucher specimen); C, Mature proglottides (neotype); D, Invaginated cirrus (voucher specimen); E, Evaginated cirrus (voucher specimen). *Scale-bars*: A, B, 100 μm; C, 50 μm; D, E, 40 μm

cylindrical, large, 30 (30–38; 33; n = 5), armed. Parabasal portion of cirrus covered with numerous, long, needle-shaped spines, 2–3 (2–3; 2.5; n = 10) long, decreasing in size towards end of cirrus (Fig. 2D, E). Internal seminal vesicle oval, 18 × 6 (14–21 × 6–10; 19 × 8; n = 6); external seminal vesicle elongated, 30 × 15 (30–36 × 14–19; 31 × 16; n = 6), positioned along anterior margin of proglottis.

Ovary compact, 63 × 35 (61–66 × 28–36; 64 × 32; n = 5), in middle of proglottis, anterior and ventral to testes. Vitellarium compact, oval, 30 × 16 (22–30 × 16–19; 26 × 18; n = 5), aporal, ventral to testes, posterior to ovary. Vagina thin-walled, opening ventral to cirrus-sac. Copulatory part of vagina 28 × 9 (27–33 × 7–9; 29 × 9; n = 5), pin-shaped, leading to small oval seminal receptacle, 17 × 8 (15–17× 7–8; 16 × 8; n = 5) in middle of proglottis. Uterus sac-like, occupying almost entire median field, not extending beyond osmoregulatory canals. Uterus in gravid proglottides containing 16–20 (18; n = 7) eggs (Fig 2A). Embryonic hooks small, 6–7 (6.4; n = 8).

Remarks

The holotype of *S. infirma*, described from *S. araneus* in the vicinities of Puławy, Lublin District, eastern Poland (Žarnowski, 1955), could not be located in any collection in Poland despite the effort undertaken by Pojmańska et al. (2012). It appears, therefore, that the holotype of this species as well as any other specimens that could be considered as belonging to the type-series, are not extant. The ongoing research on *Soricinia* spp. throughout the Holarctic and the use of molecular tools for differentiation among morphologically similar species of the genus (Binkienė et al., 2015; our unpublished data) require clarification of the identity of *S. infirma* to preserve the taxonomic stability of the species and avoid confusion in the future. We have found several specimens of *S. infirma* from the type-host *S. araneus* in Poltavska Oblast', Ukraine, within a reasonable proximity to the type-locality. These specimens corresponded very closely to the original description of the species by Žarnowski (1955) and possessed the main features differentiating *S. infirma* from the morphologically closest species *S. soricis* (see below). Therefore, a complete specimen collected from *S. araneus* in the Ukraine, was designated as the neotype and deposited in the collection of the Natural History Museum, Geneva, Switzerland.

Soricinia infirma is morphologically most similar to *S. soricis*. The two species are similar in scolex morphology and the number of proglottides (10–13 *vs* 9). Nevertheless, *S. infirma* can be distinguished from *S. soricis* by having a longer cirrus-sac (57–65 µm, reaching midline of proglottis *vs* 30–33 µm, not reaching midline of proglottis), a larger ovary (61–66 × 28–36 *vs* 48 × 22 µm) and a larger number of eggs in gravid proglottides (16–20 *vs* 8–9). In addition, the cirrus of *S. infirma* is cylindrical, while in *S. soricis* it is conical.

Soricinia quarta (Karpenko, 1983) Karpenko, 1999

Syn. *Ditestolepis quarta* Karpenko, 1983

Type-host: *Sorex isodon* Turov (Soricomorpha: Soricidae).
Type-locality: Solnechny District of Khabarovsk Kray, Russian Federation (see Karpenko, 1983).
Site in host: Intestine.
Type-material: Holotype (ISEA 3589, *S. isodon*, village Beryosovka, Solnechny District of Khabarovsk Kray, Russian Federation, coll. 16.viii.1979; host field number 3589). The holotype and five paratypes of the same species are on the same slide. The holotype is clearly indicated.

Redescription (Fig. 3)

[Based on the holotype and four paratypes; measurements of the holotype are followed by the range, mean and number of measurements in parentheses.] Small tapeworms, 500 (400–500; 450; n = 5) long. Strobilation gradual. Strobila consisting of 17 (15–20; 17; n = 5) proglottides: 3–4 juvenile, 3–4 hermaphroditic (1 mature), 7–8 postmature and 1–4 gravid. Proglottides acraspedote, transversely elongate (Fig. 3B). Mature proglottis 35 × 87 (29–35 × 85–87; 31 × 86; n = 5), pregravid proglottides 59–62 × 101–102 (54–62 × 101–105; 57 × 103; n = 5). Primordia of male and female gonads appearing simultaneously subsequent maturation following functional protandry pattern.

Osmoregulatory canals without transverse anastomoses. Ventral osmoregulatory canals 2–3 (2–3; 2.4; n = 5) in diameter, dorsal canals 1–2 (1–2; 1.6;

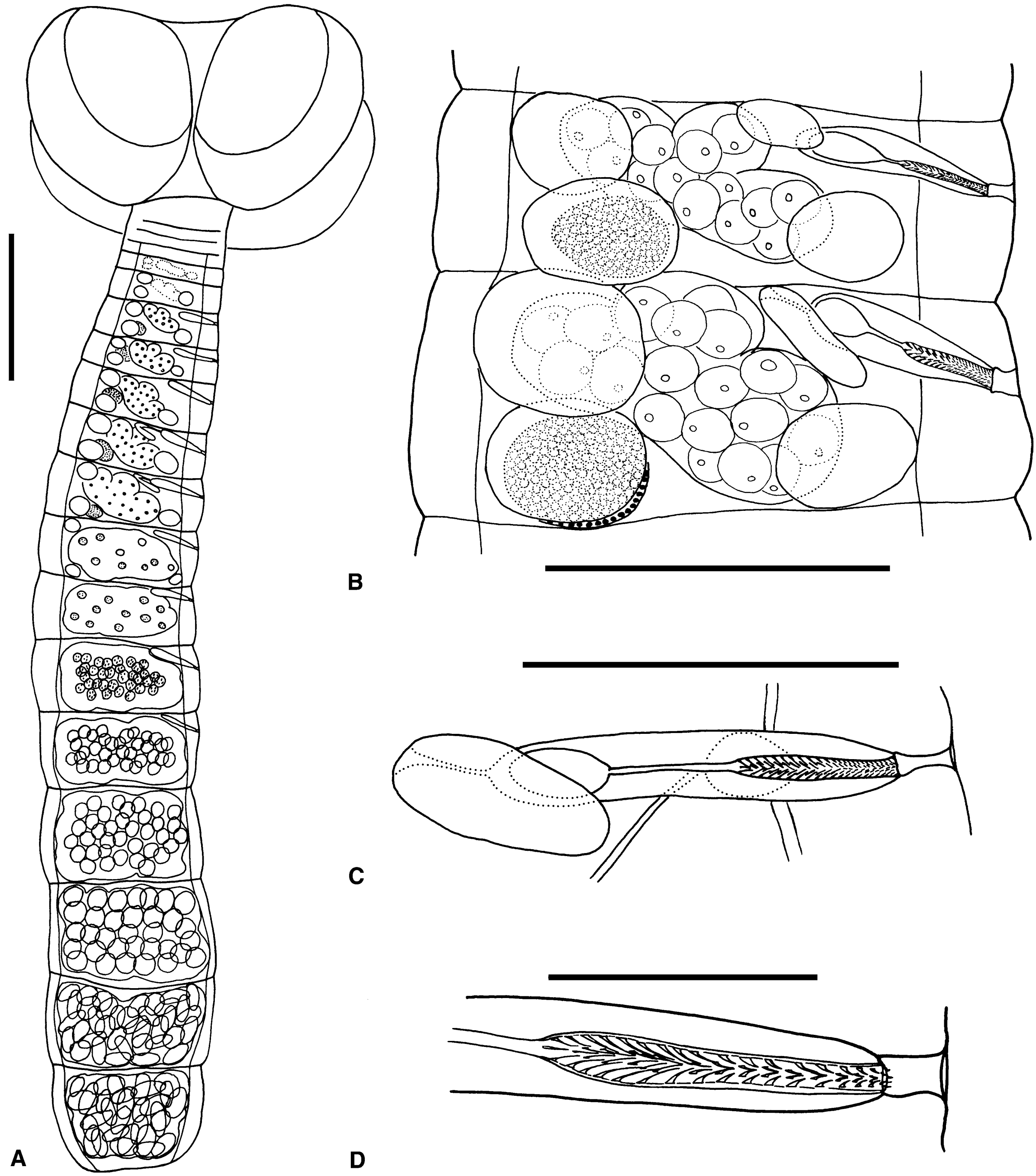

Fig. 3 *Soricinia quarta* Karpenko, 1983 ex *Sorex isodon* Turov. Holotype. A, Total view; B, Mature proglottides; C, Cirrus-sac; D, Invaginated cirrus. *Scale-bars:* A, 100 µm; B, 50 µm; C, 40 µm; D, 20 µm

n = 5) in diameter. Genital pores unilateral, dextral, opening in middle of proglottis margin. Genital atrium cylindrical, simple, 3–4 (3–4; 3.6; n = 5) deep.

Scolex relatively large, slightly compressed dorso-ventrally, 155 (155–160; 157; n = 5) wide. Neck 52 (52–62; 57; n = 5) wide, clearly differentiated from scolex. Suckers elongate, bothrium-like, 97–98 × 81–83 (89–98 × 81–87; 93 × 85; n = 5), with muscular thickening along edges. Rhynchus and rostellar apparatus absent.

Testes 3, oval, 14–21 × 11–13 (13–21 × 10–14; 16 × 12; n = 10), 1 poral and 2 antiporal, arranged in almost right-angled triangle in median field of proglottis (Fig. 2B). Cirrus-sac cigar-shaped, elongated, thin-walled, 35 × 7 (35–40 × 7–9; 37 × 8; n = 5), crossing poral osmoregulatory canals, not reaching midline of proglottis (Fig. 2B, C). Cirrus cylindrical, large, 15–17 (15–18; 17; n = 5), armed. Parabasal portion of cirrus covered with numerous small spines; longest spines in apical part of cirrus (Fig. D). Internal seminal vesicle oval, 11 × 6 (10–13 × 6–7; 11 × 6; n = 5); external seminal vesicle elongated, 23 × 8 (22–24 × 8–11; 23 × 9; n = 6), positioned along anterior margin of proglottis, may be bent toward centre of proglottis.

Ovary tri-lobed, 54 × 23 (45–60 × 23–30; 50 × 24; n = 5), in middle of proglottis, anterior and ventral to testes. Vitellarium compact, oval, 20 × 13 (15–22 × 12–16; 19 × 14; n = 5), antiporal, ventral to testes, posterior to ovary. Vagina thin-walled, opening ventral to cirrus-sac. Copulatory part of vagina 21 × 7 (19–21 × 6–7; 20 × 7; n = 5). Uterus sac-like, occupying almost entire median field, not extending laterally beyond osmoregulatory canals. Uterus in pregravid proglottides containing 32–35 (30–35; 33; n = 7) eggs. No gravid proglottides were observed.

Remarks

This species has been described as *Ditestolepis quarta* Karpenko, 1983 from *S. isodon* collected in the Khabarovsk Kray (Russian Federation) (Karpenko, 1983). Later, he (Karpenko, 1999) re-described the species from *S. unguiculatus* Dobson collected on Kunashir Island (Kuril Archipelago, Russian Federation), transferred it to *Soricinia* and proposed an amended generic diagnosis of *Soricinia*. However, Karpenko's generic diagnosis contained several inaccuracies. Among other characters, he listed the cirrus-sac as not extending to the midline of the proglottis, a slightly lobate ovary and the possibility of gravid proglottides detaching from the strobila in groups. However, according to Korneva & Kornienko (2014), eggs of *Soricinia* possess sclerotised outer envelope and are dispersed in the environment individually through ruptures in the uterine and proglottis walls.

Our reexamination of the type-material of *S. quarta* revealed inaccuracies in the original description by Karpenko (1983) who described the suckers in this species as cup-shaped (bothrium-like according to our observations) and the strobilation as serial (in reality it is gradual). These errors were later incorporated by Karpenko (1999) in the generic diagnosis of *Soricinia*. Moreover, the holotype appears to be morphologically different from the remaining specimens in the type-series. In addition, some features provided in the re-description by Karpenko (1999) from Kunashir Island differed significantly from those in the original description (see Karpenko, 1983; Table 1). In part, the cirrus-sac and cirrus in the specimens from Kunashir Island are almost twice as long as the cirrus-sac and cirrus in *S. quarta* from the Khabarovsk Kray (60–72 and 45–52 *vs* 37–42 and 21–22 µm). In the original description, the ovary is tri-lobed while in the text of the redescription it is referred to as slightly lobed, but illustrated as entire (figure 2 in Karpenko, 1999). The number of proglottides in the two forms is also different (22–23 in specimens from Kunashir *vs* 11–21 in the original description). Karpenko (1999) explained these differences by the poor condition of his specimens from Kunashir Island (i.e. upon which the redescription was based). Our morphological examination of both the type-specimen and the specimens from Kunashir Island collected by Karpenko (1999) has confirmed that Karpenko's (1999) description of specimens from Kunashir was accurate. However, his identification was erroneous because the specimens from Kunashir certainly belong to a different, yet undescribed species.

Soricinia quarta is morphologically most similar to *S. aurita* Irzhavsky, Gulyaev & Kornienko, 2005 from the Caucasian shrew *S. satunini* Ognev and *S. sawadai* Zubova, Gulyaev & Kornienko, 2010 from *S. unguiculatus* from Sakhalin Island (Far East of Russian Federation). In these three species, the suckers are located in dorsal and ventral bothrium-like depressions. *Soricinia quarta* can be distinguished from the other two species by the shape of the ovary, the length of the cirrus-sac and cirrus, and the number of eggs per proglottis (Irzhavsky et al., 2005; Zubova et al., 2010). The cirrus-sac of *S. quarta* is more than 2–3 times

Table 1 Morphological variation in different descriptions of *Soricinia quarta*

Character Source	Holotype (original description) Karpenko (1983)	Paratypes (original description) Karpenko (1983)	Holotype Present study	Specimens from Kunashir Island Karpenko (1999)
Shape of suckers	cup-shaped	cup-shaped	bothrium-like	cup-shaped
Number of proglottides	16	11–21	17	22–23
Cirrus-sac length	37–42	30–38	36–40	60–72
Cirrus length	20–30	21–22	15–17	45–52
Number of eggs	–	–	32–35	30–40
Shape of ovary	tri-lobed	tri-lobed	tri-lobed	compact, slightly indented

shorter than in *S. aurita* and *S. sawadai* and not reaching the midline of proglottis whereas it crosses the midline in the latter two species. The ovary of *S. quarta* is tri-lobed, whereas the ovary in *S. aurita* and *S. sawadai* is compact. The number of eggs in the gravid proglottides of *S. quarta* is much greater than in *S. sawadai* (30–45 *vs* 15–22). Although the cirrus armature is overall similar in the three species, *S. quarta* has long needle-shaped spines on the apical part of the cirrus whereas in *S. aurita* and *S. sawadai* spines are located on the parabasal part of the cirrus.

Genus *Soricinia* Spassky & Spasskaja, 1954

Amended diagnosis (modified after Vaucher in Czaplinski & Vaucher, 1994)
Small Hymenolepididae. Strobila consisting of few proglottides. Development of proglottides gradual. Proglottides transversely elongate, acraspedote. Scolex relatively large, unarmed, without rostellar apparatus; suckers cup-shaped. Osmoregulatory canals without transverse anastomoses. Testes three, one poral and two antiporal, situated in a triangle or in a row. Cirrus-sac crossing poral osmoregulatory canals, sometimes extending beyond midline of proglottis. Cirrus armed. Internal and external seminal vesicle both present; internal seminal vesicle small. Ovary entire or tri-lobed. Vitellarium subspherical, postovarian, compact. Uterus median, sac-like. Eggs relatively few. Parasites of shrews of the genera *Sorex* L. and *Neomys* Kaup in the Holarctic.
Type-species: *Soricinia soricis* (Baer, 1925) Spassky & Spasskaja, 1954 (syn. *Hymenolepis minuta* Baer, 1925) ex *S. alpinus* from France.

Other species:

- *Soricinia aurita* (Irzhavsky, Gulyaev & Kornienko, 2005) Zubova, Gulyaev & Kornienko, 2010 (syn. *Insectivorolepis aurita* Irzhavsky, Gulyaev & Kornienko, 2005) ex *S. raddei* Satunin and *S. volnuchini* Ognev from Central Caucasus (the Kabardino-Balkar Republic, Russian Federation) (Irzhavsky et al., 2005; Zubova et al., 2010);
- *Soricinia bargusinica* Eltyschev, 1975 [syn. *Insectivorolepis bargusinica* (Eltyschev, 1975) Afanasjeva, 1993)] ex *S. araneus* and *S. caecutiens* from East Siberia (Russian Federation) (Eltyschev, 1975; Afanasjeva, 1993);
- *Soricinia genovi* Binkiene, Kornienko & Tkach, 2015 ex *Neomys fodiens* from the Rhodope Mountains (Bulgaria) (Binkienė et al., 2015);
- *Soricinia globosa* (Baer, 1931) Vaucher in Czaplinski & Vaucher, 1994 [syns *Hymenolepis globosa* Baer, 1931; *Insectivorolepis globosa* (Baer, 1931) Zarnowski, 1955; *Dicranotaenia globosa* (Baer, 1931) López-Neyra, 1942)] ex *Neomys anomalus* Cabrera and *N. fodiens* from Switzerland (Baer, 1931; López-Neyra, 1942; Žarnowski, 1955; Vaucher in Czaplinski & Vaucher, 1994);
- *Soricinia infirma* (Zarnowski, 1955) Vaucher in Czaplinski & Vaucher, 1994 [syns *Insectivorolepis infirma* Zarnowski, 1955; *Ditestolepis secunda* Schaldybin, 1964] ex *S. araneus* and *S. minutus* L. from Białowieża Forest (Poland) (Žarnowski, 1955; Schaldybin, 1964);
- *Soricinia kenki* (Locker & Rausch, 1952) Vaucher in Czaplinski & Vaucher, 1994 [syns *Hymenolepis kenki* Locker & Rausch, 1952; *Insectivorolepis kenki* (Locker & Rausch, 1952) Zarnowski, 1955] ex *S. vagrans vagrans* Baird from North America

(Oregon, USA) (Locker & Rausch, 1952; Žarnowski, 1955; Vaucher in Czaplinski & Vaucher, 1994; Locker & Rausch, 1952);

- *Soricinia quarta* (Karpenko, 1983) Karpenko, 1999 [syns *Ditestolepis quarta* Karpenko, 1983; *Insectivorolepis macracetabulosa* Sawada & Koyasu, 1991)] ex *S. isodon, S. unguiculatus* and *S. caecutiens* from Khabarovsk Kray (Russian Federation) (Karpenko, 1983; Karpenko, 1999; Sawada & Koyasu, 1991);
- *Soricinia sawadai* Zubova, Gulyaev & Kornienko, 2010 ex *S. unguiculatus* from Sakhalin Island (Russian Federation) (Zubova et al., 2010).

Key to the species of *Soricinia*

1a Number of proglottides < 15 2
1b Number of proglottides > 15 3
2a Number of proglottides 10–13; cirrus-sac 57–65 µm long, reaching midline of proglottis; cirrus cylindrical; number of eggs 16–20 .... *S. infirma* (Zarnowski, 1955)
2b Number of proglottides 9; cirrus-sac 30 µm long, not reaching midline of proglottis; cirrus conical; number of eggs 8–9 ...... *S. soricis* (Baer, 1925)
3a Cirrus-sac reaching midline of proglottis; ovary entire 4
3b Cirrus-sac not reaching midline of proglottis; ovary tri-lobed 7
4a Number of proglottides 55–60; cirrus-sac 108–115 µm long; number of eggs 100–110, parasite of Nearctic shrews .... *S. kenki* (Locker & Rausch, 1952)
4b Number of proglottides 19–30, parasites of Palaearctic shrews 5
5a Copulatory part of vagina with well-developed vaginal sphincter; number of proglottides 30; number of eggs 10–16 ...... *S. globosa* (Baer, 1931)
5b Copulatory part of vagina without distinct vaginal sphincter; number of proglottides 19–26; number of eggs 15–30 6
6a Entire cirrus covered with needle-shaped spines decreasing towards the apical part of cirrus; cirrus 52–55 µm long; number of proglottides 19–22; number of eggs *c.*30 .... *S. aurita* (Irzhavskii, Gulyaev & Kornienko, 2005)
6b Parabasal portion of cirrus covered with long needle-shaped spines, apical part of cirrus unarmed; cirrus 65–70 µm long; number of proglottides 23–26; number of eggs 15–22 .... *S. sawadai* Zubova, Gulyaev & Kornienko, 2010
7a Number of proglottides *c.*90; cirrus-sac 90 µm long; number of eggs 85–100 .... *S. bargusinica* Eltyschev, 1975
7b Number of proglottides < 25; cirrus-sac shorter than 60 µm; number of eggs < 60 8
8a Number of proglottides 15–20; cirrus-sac 37–40 µm long; number of eggs 32–35 .... *S. quarta* Karpenko, 1983
8b Number of proglottides 19–25; cirrus-sac 47–60 µm long; number of eggs 40–52 .... *S. genovi* Binkienė, Kornienko & Tkach, 2015

Discussion

Representatives of *Soricinia* are broadly distributed in the Holarctic and parasitise a number of shrew species belonging to *Sorex* and *Neomys* (Table 2). Despite several attempts to revise the genus (Gulyaev, 1991; Vaucher in Czaplinski & Vaucher, 1994; Karpenko, 1999; Irzhavsky et al., 2005; Zubova et al., 2010), the systematic position and species composition of the genus remains controversial. Spassky (1954) erected *Soricinia* as monotypic. However, due to the incompleteness of the first description of the type-species *S. soricis* and several inaccuracies in the original generic diagnosis (presence of serial metamerism, fusion of gravid segments into syncapsule), the boundaries of the genus were blurred. This resulted in the inclusion in *Soricinia* of numerous species that later proved to belong to other genera, e.g. *Soricinia collaris* Karpenko, 1984, transferred to *Ecrinolepis* Spassky & Karpenko, 1983 by Gulyaev (1991); *Soricinia macrospina* Karpenko, 1984, transferred to *Ecrinolepis* by Gulyaev (1991); *Soricinia aporalis* Karpenko, 1984, transferred to *Ecrinolepis* by Gulyaev (1991); *Soricinia cirravaginata* Eltyshev, 1975, synonymised with *Ecrinolepis longibursata* (Morozov, 1957) by Gulyaev (1991); *Soricinia japonica* Sawada & Koyasu, 1991, synonymised with *Mathevolepis skrjabini* (Sadovskaja, 1965) by Gulyaev & Karpenko (1998); and *Soricinia tripartita* Zarnowski, 1955, transferred

Table 2 List of the species of *Soricinia* Spassky & Spasskaja, 1954, their hosts and geographical distribution

Species	Host	Geographical region and source
Soricinia soricis (Baer, 1925) Spassky & Spasskaja, 1954	*Sorex alpinus* Schinz	*Europe*: France (Baer, 1925)
	Sorex araneus L.	*Europe*: Lithuania (present study), Moldova (Andreiko, 1973), Belarus (Merkusheva & Bobkova, 1981), Russian Federation: Samara Oblast (Kirillova & Kirillov, 2007); *Asia*: Georgia (Prokopič & Matsaberidze, 1972)
	Sorex minutus L.	*Europe*: Moldova (Andreiko, 1973), Lithuania (Binkienė, 2006), former Czechoslovakia (Prokopič et al., 1974)
	Sorex raddei Satunin	*Asia*: Georgia (Prokopič & Matsaberidze, 1972)
S. globosa (Baer, 1931) Czaplinski & Vaucher, 1994	*Neomys anomalus* Cabrera	*Europe*: Bulgaria (Genov, 1984), former Czechoslovakia (Prokopič et al., 1974)
	Neomys fodiens Pennant	*Europe*: Bulgaria (Genov, 1984), former Czechoslovakia (Prokopič, 1959, Prokopič et al., 1974; Mituch, 1968), Slovakia (Hanzelova & Ryšavy, 1996); *Asia*: Georgia (Prokopič & Matsaberidze, 1972)
S. kenki (Locker & Rausch, 1952) Czaplinski & Vaucher, 1994	*Sorex vagrans* Baird	*North America*: USA: States Oregon (Locker & Rausch, 1952), Montana (Kinsella, 2007)
	Sorex bendirii Merriam	*North America*: USA: State Oregon (Neiland, 1953)
	Sorex cinereus Kerr	*North America*: USA: States Montana (Senger, 1955), Pennsylvania (Kinsella et al., 2008)
	Sorex pacificus Coues	*North America*: USA: State California (Voge, 1955)
S. infirma (Zarnowski, 1955) Czaplinski & Vaucher, 1994	*Sorex araneus* L.	*Europe*: France, Switzerland (Vaucher, 1971), Poland (Žarnowski, 1955), Finland (Haukisalmi, 1989, 2015; Haukisalmi & Heikki, 1994; Haukisalmi & Henttonen, 1998), Bulgaria (Genov, 1984), former Czechoslovakia (Prokopič et al., 1974), Russian Federation: Republic of Mordovia (Schaldybin, 1964), Republic of Karelia (Anikanova et al., 2002), Republic of Komi (Yushkov, 1995); *Asia*: Russian Federation: Republic of Altai (Kornienko, 2001), Republic of Buryatia (Eltyschev, 1975)
	Sorex minutus L.	*Europe*: Poland (Žarnowski, 1955), Bulgaria (Genov, 1984), Lithuania (Binkienė, 2006), former Czechoslovakia (Prokopič et al., 1974), Russian Federation: Republic of Mordovia (Schaldybin, 1964); *Asia*: Russian Federation: Republic of Altai (Kornienko, 2001), Republic of Buryatia (Eltyschev, 1975)
	Sorex caecutiens Laxmann	*Europe*: Finland (Haukisalmi, 1989; Haukisalmi & Heikki, 1994), Lithuania (Binkienė, 2006), former Czechoslovakia (Prokopič et al., 1974), Russian Federation: Republic of Karelia (Anikanova et al., 2002); *Asia*: Russian Federation: Republic of Altai (Kornienko, 2001), Republic of Buryatia (Eltyschev, 1975), Khabarovsk Kray (Kornienko et al., 2014), Republic of Sakha (Yakutia) (Kornienko & Dokuchaev, 2015)
	Sorex tundrensis Merriam	*Asia*: Russian Federation: Republic of Altai (Kornienko, 2001), Republic of Buryatia (Eltyschev, 1975), Republic of Sakha (Yakutia) (Dokuchaev & Kornienko, 2013; Kornienko & Dokuchaev, 2015)
	Sorex gracillimus Thomas	*Asia*: Russian Federation: Khabarovsk Kray (Kornienko et al., 2014), Republic of Sakha (Yakutia) (Kornienko & Dokuchaev, 2015)

Table 2 continued

Species	Host	Geographical region and source
	Sorex isodon Turov	*Europe*: Russian Federation: Republic of Komi (Yushkov, 1995); *Asia*: Russian Federation: Republic of Altai (Kornienko, 2001), Republic of Buryatia (Eltyschev, 1975), Republic of Sakha (Yakutia) (Kornienko & Dokuchaev, 2015)
S. bargusinica Eltyschev, 1975	*Sorex araneus* L.	*Asia*: Russian Federation: Republic of Buryatia (Eltyschev, 1975), Republic of Altai (Kornienko, 2001)
	Sorex caecutiens Laxmann	*Asia*: Russian Federation: Republic of Buryatia (Eltyschev, 1975), Republic of Sakha (Yakutia) (Odnokurtsev & Karpenko, 1993; Kornienko & Dokuchaev, 2015), Khabarovsk Kray (Kornienko et al., 2014)
	Sorex isodon Turov	*Asia*: Russian Federation: Republic of Sakha (Yakutia) (Odnokurtsev & Karpenko, 1993), Khabarovsk Kray (Kornienko et al., 2014)
	Sorex tundrensis Merriam	*Asia*: Russian Federation: Republic of Sakha (Yakutia) (Odnokurtsev & Karpenko, 1993; Dokuchaev & Kornienko, 2013; Kornienko & Dokuchaev, 2015)
S. quarta (Karpenko, 1983) Karpenko, 1999	*Sorex araneus* L.	*Asia*: Russian Federation: Khabarovsk Kray (Karpenko, 1983; Kornienko et al., 2014), Novosibirsk Oblast (Kornienko, 2001; Panov & Karpenko, 2004)
	Sorex caecutiens Laxmann	*Asia*: Japan (Kornienko et al., 2014), Russian Federation: Khabarovsk Kray (Karpenko, 1983; Kornienko et al., 2014), Republic of Sakha (Yakutia) (Odnokurtsev & Karpenko, 1993; Kornienko et al., 2014), Novosibirsk Oblast (Kornienko, 2001; Panov & Karpenko, 2004)
	Sorex isodon Turov	*Asia*: Japan (Kornienko et al., 2014), Russian Federation: Khabarovsk Kray (Karpenko, 1983; Kornienko et al., 2014), Republic of Sakha (Yakutia) (Dokuchaev & Kornienko, 2013; Kornienko et al., 2014), Novosibirsk Oblast (Kornienko, 2001; Panov & Karpenko, 2004)
	Sorex unguiculatus Dobson	*Asia*: Japan (Sawada & Koyasu, 1991; Kornienko et al., 2014), Russian Federation: Khabarovsk Kray (Karpenko, 1983; Kornienko et al., 2014)
	Sorex tundrensis Merriam	*Asia*: Japan (Kornienko et al., 2014), Russian Federation: Khabarovsk Kray (Karpenko, 1983; Kornienko et al., 2014), Republic of Sakha (Yakutia) (Dokuchaev & Kornienko, 2013)
S. aurita (Irzhavsky, Gulyaev & Kornienko, 2005) Zubova, Gulyaev & Kornienko, 2010	*Sorex satunini* Ognev	*Asia*: Russian Federation: the Kabardino-Balkar Republic (Irzhavsky et al., 2005)
	Sorex raddei Satunin	*Asia*: Russian Federation: the Kabardino-Balkar Republic (Irzhavsky et al., 2005)
	Sorex volnuchini Ognev	*Asia*: Russian Federation: the Kabardino-Balkar Republic (Irzhavsky et al., 2005)
S. sawadai Zubova, Gulyaev & Kornienko, 2010	*Sorex unguiculatus* Dobson	*Asia*: Russian Federation: Sakhalin Island, Japan: Hokkaido Island (Zubova et al., 2010)
	Sorex caecutiens Laxmann	*Asia*: Russian Federation: Sakhalin Island, Japan: Hokkaido Island (Zubova et al., 2010)
S. genovi Binkienė, Kornienko & Tkach, 2015	*Neomys fodiens* Pennant	*Europe*: Bulgaria (Binkienė et al., 2015)

to *Gulyaevilepis* Kornienko & Binkiene 2014 by Kornienko & Binkiene (2014). In addition, *Soricinia longisegmentalis* Sawada & Kobayashi, 1994 should be removed from *Soricinia* due to the presence of serial metamerism in this species (see Sawada & Kobayashi, 1994). Likewise, *Soricinia syncapsulata* Nanda & Malholtra, 1991 does not belong to *Soricinia* because of the presence of a rudimentary rostellum and uterine syncapsules (see Nanda & Malholtra, 1991).

Zubova et al. (2010) compared the descriptions of *I. macracetabulosa* published by Sawada & Harada (1993) and Sawada & Koyasu (1991) and concluded that *I. macracetabulosa* of Sawada & Koyasu (1991) is a synonym of *S. quarta*, whereas *I. macracetabulosa* of Sawada & Harada (1993) is a distinct species, which they named *Soricinia haradai* Zubova, Gulyaev & Kornienko, 2010. Zubova et al. (2010) mentioned the differences in the number of proglottides, the size of the scolex and the length of the cirrus and cirrus-sac as distinguishing characters. However, our comparison of the two descriptions of *I. macracetabulosa* did not show any significant differences between the two forms. Therefore, we consider the *S. haradai* a junior synonym of *S. quarta*.

In conclusion, the re-examination of type-materials and/or freshly collected specimens of several species of *Soricinia* (*S. soricis*, *S. infirma*, *S. quarta*, *S. globosa*, *S. genovi*, *S. bargusinica*, *S. aurita, S. sawadai*) allowed us to confirm their congeneric status and to amend the diagnosis of *Soricinia* incorporating important morphological characteristics of the genus. Remarkably, in contrast to the high diversity of *Soricinia* spp. in the Palaearctic species of the genera *Sorex* and *Neomys*, only a single species of *Soricinia* is known from North American shrews, namely *S. kenki*. Considering the diverse fauna and broad distribution of *Sorex* spp. in North America, we anticipate that additional species of *Soricinia* may be discovered from shrews in the Nearctic.

Acknowledgements We thank one of the anonymous reviewers and the editor for their useful comments and suggestions and Dr. Mike Kinsella for some English corrections.

Funding This study was funded in part by the Federal Fundamental Scientific Research Program for 2013-2020 (VI.51.1.7.), the Russian Fund for Fundamental Research (Projects No. 14–04–00871 and 15–04–03785) and the U.S. National Science Foundation grant DEB 0818696.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All applicable institutional, national and international guidelines for the care and use of animals were followed. Hosts were collected in the Ukraine under a collecting permit from the Ministry of Ecology and Natural Resources of the Ukraine.

References

Afanasieva, S. A. (1993). [Redescription of *Soricinia bargusinica* Eltyschev, 1975 (Cestoda: Hymenolepididae) - an endemic parasite of shrews of East Siberia.] *Sibirskii Biologicheskii Zhurnal, 4*, 50–54 (In Russian).

Andreiko, O. F. (1973). [Review of helminths of insectivorous mammals (Insectivora) of the USSR the neighbouring countries.] *Parazity Zhivotnykh i Rastenii, 9*, 3–33 (In Russian).

Anikanova,V. S, Bugmyrin, S. B., & Ieshko, E. P. (2002). [Cestodes of small mammals in Karelia.] In: Alimov, A. F., Galkin, A. K. & Dubinina, H. V. (Eds) *Problemy Cestodologii,* II. Sankt-Petersburg: Izdatel'stvo SPBGU, pp. 18–33 (In Russian).

Baer, J. G. (1925). Sur quelques Cestodes du Congo Belge. *Revue Suisse de Zoologie, 32*, 239–251.

Baer, J. G. (1931). Helminthes nouveaux parasites de la musaraigne d'eau, *Neomys fodiens* Pall. (Note préliminaire). *Verhandlungen Der Schweizerischen Naturforschenden Gesellschaft, 112*, 338–340.

Binkienė, R. (2006). Helminth fauna of shrews (*Sorex* spp.) in Lithuania. *Acta Zoologica Lituanica, 16*, 241–245.

Binkienė, R., Kornienko, S. A., & Tkach, V. V. (2015). *Soricinia genovi* n. sp. from *Neomys fodiens* in Bulgaria, with redescription of *Soricinia globosa* (Baer, 1931) (Cyclophyllidea: Hymenolepididae). *Parasitology Research*, *114,* 1, 209–218.

Czaplinski, B., & Vaucher, C. (1994). Family Hymenolepididae Ariola, 1899. In: Khalil, L. F., Jones, A. & Bray, R. (Eds) *Keys to the Cestode Parasites of Vertebrates*. Wallingford: CAB International, pp. 595–663.

Dokuchaev, N. E., & Kornienko, S. A. (2013). [Shrew cestodes in the basin of the lower Anabar River (north-western Yakutia).] *Bulletin of the Northeast Scientific Centre, Russian Academy of Sciences Far East Branch, 4*, 16–21 (In Russian).

Eltyschev, Y. A. (1975). [Fauna of helminths of mammals from Barguzin basin and its geographic analysis. I. The systematic review.] In: Kontrimavichius, V. L. (Ed.) *Paraziticheskiye organizmy severo-vostoka Azii*. Vladivostok: Academy of Sciences of the USSR, pp. 135–167 (In Russian).

Genov, T. (1984). [*Helminths of insectivorous mammals and rodents in Bulgaria.*] Sofia: Publishing House of the Bulgarian Academy of Sciences, 348 pp (In Bulgarian).

Gulyaev, V. D. (1991). [Morphology and taxonomy of ditestolepidinid cestodes (Cyclophyllidea) parasitic in shrews, with serial metamerism of the strobila.] *Zoologicheskii Zhurnal, 70*, 44–53 (in Russian).

Gulyaev, V. D., & Karpenko, S. V. (1998). [Cestodes of the genus *Mathevolepis* (Cestoda: Cyclophyllidea, Hymenolepididae) from the Common shrews of the Holarctic region.] *Parazitologiya, 32*, 507–518 (In Russian).

Hanzelova, V., & Ryšavy, B. (1996). Synopsis of cestodes in Slovakia IV. Hymenolepididae (continiued). *Helminthologia, 33*, 213–222.

Haukisalmi, V. (1989). Intestinal helminth communities of *Sorex* shrews in Finland. *Annales Zoologici Fennici, 26*, 401–409.

Haukisalmi, V. (2015). Checklist of tapeworms (Platyhelminthes, Cestoda) of vertebrates in Finland. *ZooKeys, 533*, 1–61.

Haukisalmi, V., & Heikki, H. (1994). Distribution patterns and microhabitat segregation in gastrointestinal helminths of *Sorex* shrews. *Oecologia, 97*, 236–242.

Haukisalmi, V., & Henttonen, H. (1998). Analysing interspecific associations in parasites: alternative methods and effects of sampling heterogeneity. *Oecologia, 116*, 565–574.

Haukisalmi, V., Hardman, L. M., Foronda, P., Feliu, C., Laakkonen, J., et al. (2010). Systematic relationships of hymenolepidid cestodes of rodents and shrews inferred from sequences of 28S ribosomal RNA. *Zoologica Scripta, 39*, 631–641.

Irzhavsky, S. V., Gulyaev, V. D., & Kornienko, S. A. (2005). [*Insectivorolepis auritus* sp. n. (Cyclophyllidea, Hymenolepididae) – a new species of a cestode from shrews of Central Caucasus.] In: Alimov, A. F., Galkin, A. K., Gulyaev, V. D., & Dubinina E. V. (Eds) *Problems of Cestodology, III*. Sankt-Petersburg: Zoological institute RAS, pp. 160–169 (In Russian).

Karpenko, S. V. (1983). [Two new species of hymenolepidid cestodes from shrews from Baical-Amur zone.] *Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR. Seriya Biologicheskikh Nauk, 10*, 125–133 (In Russian).

Karpenko, S. V. (1999). [Cestodes of the genus *Soricinia* from shrews in Holarctic region.] *Zoologicheskii Zhurnal, 78*, 922–928 (In Russian).

Kinsella, J. M. (2007). Helminths of the vagrant shrew, *Sorex vagrans*, from western Montana, USA. *Acta Parasitologica, 52*, 151–155.

Kinsella, J. M., Vandegrift, K. J., Grant, L. K., Bozick, B. A., & Hudson, P. J. (2008). Gastrointestinal helminths of the masked shrew, *Sorex cinereus*, from Pennsylvania. *Comparative Parasitology, 75*, 141–144.

Kirillova, N. J., & Kirillov, A. A. (2007). [Helminth fauna of the common shrew *Sorex araneus* L. (Soricidae) from Samarskaya Luka.] *Parazitologiya, 41*, 392–398 (In Russian).

Korneva, Z. V., & Kornienko, S. A. (2014). [Morphology and fine structure of the uterus in *Ecrinolepis collaris* and *Soricinia infirma* (Cestoda, Cyclophyllidea) and their correlation with strobilae fecundity.] *Zoologicheskii Zhurnal, 93*, 11, 1305–1315 (in Russian).

Kornienko, S. A. (2001). [*Cestodes of shrews from North-Eastern Altai (systematics, ecology)*.] Abstract of PhD thesis. Novosibirsk: Institute of systematic and ecology of animals of Siberian Branch RAS, 23 pp (In Russian).

Kornienko, S. A., & Binkienė, R. (2014). Redescription and systematic position of *Soricinia tripartita* Żarnowski, 1955 (Cestoda: Cyclophyllidea), a cestode species parasitic in shrews of the genus *Sorex*, including erection of *Gulyaevilepis* gen. n. *Folia Parasytologica, 61*, 141–147.

Kornienko, S. A., & Dokuchaev, N. E. (2015). [Shrew cestodes of the basin of Indigirka River.] *Bulletin of the North-East Scientific Centre, Far East Branch of the Russian Academy of Sciences, 1*, 42–48 (In Russian).

Kornienko, S. A., Makarikov, A. A., & Dokuchaev, N. E. (2014). [Cestodes of small mammals on Bolshoy Shantar Island (western part of Okhotsk Sea).] *Bulletin of the North-East Scientific Centre, Far East Branch of the Russian Academy of Sciences, 24*, 64–69 (In Russian).

Locker, B., & Rausch, R. (1952). Some cestodes from Oregon shrews, with descriptions of four new species of *Hymenolepis* Weinland, 1858. *Journal of the Washington Academy of Sciences, 42*, 26–31.

López-Neyra, C. R. (1942). División del generó *Hymenolepis* Weinland (s.l.) en otros mas naturales. *Revista Ibérica de Parasitología, 2*, 46–93.

Mas-Coma, S., & Puchades, M. T. (1991). A methodology for the morphoanatomic and systematic study of the species of the family Hymenolepididae Railliet et Henry, 1909 (Cestoda: Cyclophyllidea). *Research and Reviews in Parasitology, 51*, 139–173.

Merkusheva, I. V. & Bobkova, A. F. (1981). [Helminths of domestic and wild animals in Belarus: catalogue.] Minsk: Science and technology, 120 pp (in Russian).

Mituch, J. (1968). *Index helminthum. Studia Helminthologica, 2*, 220–341.

Nanda, S., & Malholtra, S. K. (1991). A hymenolepidid cestode *Soricinia syncapsulata* sp.n. infecting *Rattus rattus* in Garhwal Himalaya. *India. Acta Parasitologica Polonica, 36*, 31–33.

Neiland, K. A. (1953). Helminths of northwestern mammals, Part V. Observations on cestodes of shrews with the descriptions of new species of *Liga* Weinland, 1857, and *Hymenolepis* Weinland, 1858. *Journal of Parasitology, 39*, 487–494.

Odnokurtsev, V. A., & Karpenko, S. V. (1993). [Structure of the helminthes fauna of shrews from Yakutiya.] In: Spassky, A. A., & Nesterov, P. I. (Eds) *Fauna, ecologiya i prakticheskoe znachenye fito- i zooparaziticheskikh organizmov*. Kishinev: Stinitsa, pp 65–76 (In Russian).

Panov, V. V., & Karpenko. S. V. (2004). [The population dynamics of the water shrew *Neomys fodiens* (Mammalia: Soricidae) and its helminth fauna in the northern Baraba.] *Parazitologiya*, *38,* 440–456 (In Russian).

Pojmańska, T., Salamatin, R., Sulgostowska, T., Cielecka, D., Okulewicz, A., et al. (2012). The Polish collection of parasitic helminths (a report on realization of works concerning fusion of parasitic collections dispersed among different scientific institutions). *Annals of Parasitology, 58*, 2, 75–86.

Prokopič, J. (1959). The parasitic helminths of insectivora in ČSR. *Československa Parasitologie, 6*, 87–134.

Prokopič, J., Karapchanski, I., Genov, T., & Janchev, J. (1974). [Ecological analysis of the helminth fauna of small mammals in different biotopes and different regions of Europe.]

Izvestiya na Tsentralnata Khelmintologichna Laboratoriya, 17, 119–144 (In Bulgarian).

Prokopič, J., & Matsaberidze, G. V. (1972). Cestodes species new for the parasite fauna of micromammalians from Georgia. *Věstník Československé Společnosti Zoologické, 36*, 214–220.

Sawada, I., & Harada, M. (1993). Cestode parasites of shinto shrew, *Sorex shinto shinto* from Chino City, Nagano Prefecture, Japan. *Bulletin of Nara Sangyo University, 9*, 147–155.

Sawada, I., & Kobayashi, S. (1994). Cestode parasites of some micromammalians (Insectivora) from the adjacent area of Akademgorodok City, Southern Central Siberia and Northern Teletskoye Lake, Altai Region, Russia. *Proceedings of the Japanese Society of Systematic Zoology, 52*, 14–33.

Sawada, I., & Koyasu, K. (1991). Cestodes of some micromammalians (Insectivora) from Hokkaido, Japan. *Japanese Journal of Parasitology, 40*, 567–575.

Schaldybin, L. S. (1964). [Fauna of helminths of mammals in Mordovian state reserve.] *Uchenye Zapiski Gor'kovskogo Pedagogicheskogo Instituta*, *48*, 52–81 (In Russian).

Senger, C. M. (1955). Observations on cestodes of the genus *Hymenolepis* in North American shrews. *Journal of Parasitology, 41*, 167–170.

Spassky, A. A. (1954). [Classification of hymenolepidids of mammals.] *Trudy Gel'mintologcheskoy Laboratorii*, *7*, 120–167 (In Russian).

Vaucher, C. (1971). Les cestodes parasites es Soricidae d'Europe: étude anatomique, révision taxonomique et biologie. *Revue Suisse de Zoologie, 78*, 1–113.

Voge, M. (1955). A list of cestode parasites from California mammals. *American Midland Naturalist, 54*, 413–417.

Yushkov, V. F. (1995). [*Helminths of mammals. Fauna of the European Western North of Russia.* Vol. III.] Sankt-Petersburg, Russia: Nauka, 201 pp (In Russian).

Žarnowski, E. (1955). Robaki pasożytnicze drobnych ssaków leśnych (Rodentia i Insectivora) okolicy Puław (woj. lubelskie). I. Cestoda. *Acta Parasitologica Polonica, 3*, 279–368 (in Polish).

Zubova, O. A., Gulyaev, V. D., & Kornienko, S. A. (2010). [*Soricinia sawadai* sp. n. (Cyclophyllidea: Hymenolepididae), a new cestode species from the shrews of Sakhalin Island.] *Parazitologiya, 44*, 3, 232–239 (in Russian).