

Redescription of *Desportesius brevicaudatus* (Spirurida, Acuariidae) based on nematodes from *Ixobrychus minutus* (Aves, Ciconiiformes) from Bulgaria

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Summary

Desportesius brevicaudatus (Dujardin, 1845) is redescribed on the basis of light-microscopy and SEM observations on specimens collected from the oesophagus and under the lining of the gizzard of *Ixobrychus minutus* (Ardeidae) from Bulgaria. New metrical data expand the known ranges of variation of the measurements of the body, tail, cordons, oesophagus and spicules. New information is provided on the variation of the shape of the deirids, the structure of the vagina, the complexity of the cordons, the pattern of the cuticular striation and the shape of the postdeirids. Cordons are described as consisting of a single row of serrate cuticular plates and a longitudinal cuticular ridge along the outer rims of the cuticular plates. The cuticular ridge is interpreted as homologous to the outer row of plates in the cordons of the genera *Acuaria*, *Cheilospirura* and *Echinuria*.

Keywords: Nematoda; Spirurida; *Desportesius brevicaudatus*; morphology; *Ixobrychus*; Bulgaria

Introduction

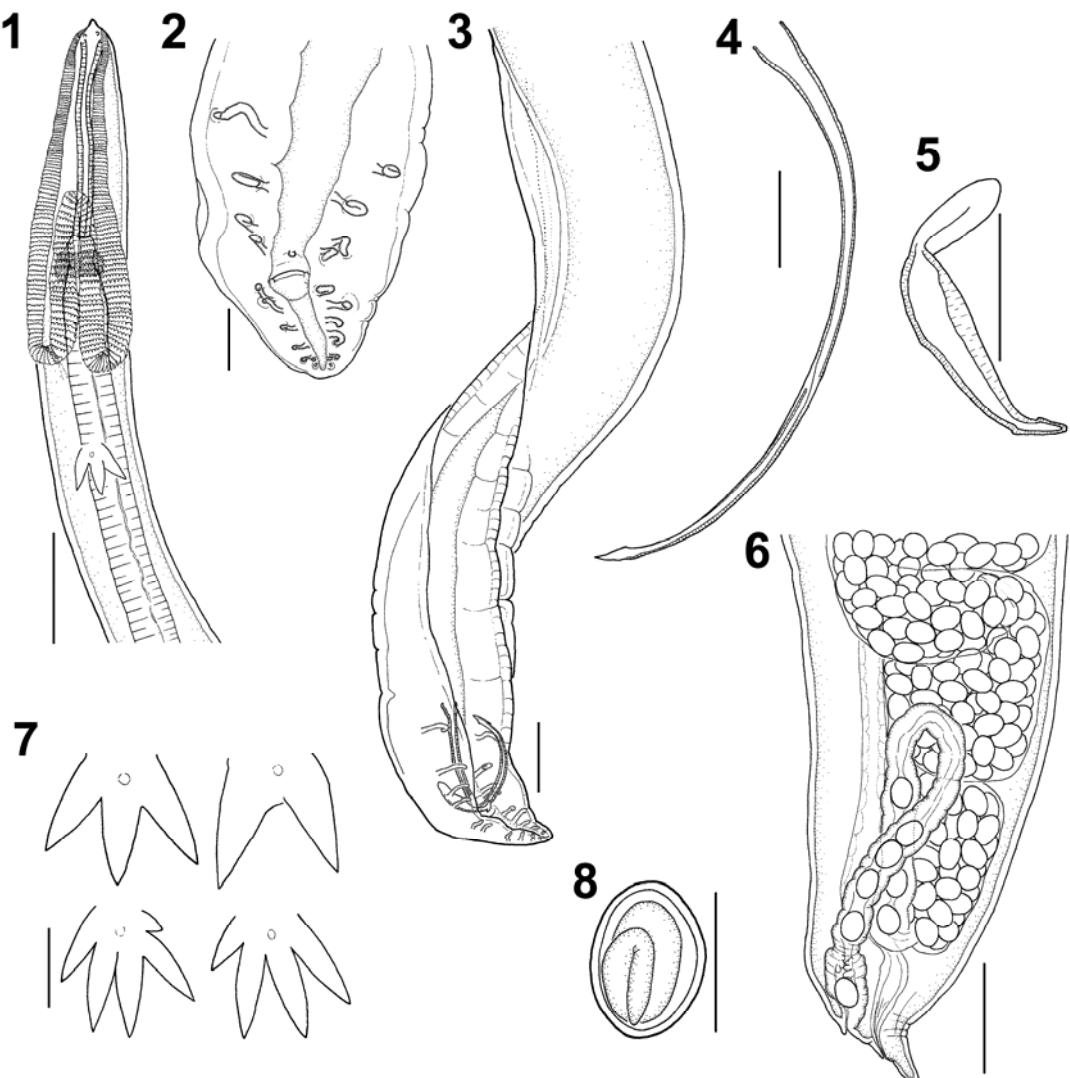
The morphology of *Desportesius brevicaudatus* (Dujardin, 1845) has been studied by several authors (Skrjabin, 1917; Sobolev in Skryabin *et al.*, 1965; Wong & Anderson, 1986; Smogorzhevskaya, 1990). The previous redescriptions contained information about a small number of characters and paid little attention to the metrical data and their variation. No ultrastructural studies of this species have been carried out. During a survey of the acuariid nematodes from Bulgaria, we found *D. brevicaudatus* collected from *Ixobrychus minutus* (L.) from the vicinity of Sofia. The examination of these specimens by light microscopy and SEM allowed expanding knowledge on the morphology of the species. The aim of the present article is to provide a detailed morphological description of *D. brevicaudatus*.

Material and Methods

A sample of 1 female and 2 male nematodes were found in the oesophagus and under the lining of the gizzard of one *Ixobrychus minutus* on 6 May 1983 at the village of Negovan. Another sample of 3 males and 8 females was obtained from a bird of the same species on 19 May 1983 at the village of Chelopechene (both localities near Sofia). The nematodes were fixed and preserved in 70 % ethanol. For light microscopy, specimens were cleared and examined as temporary mounts in glycerine. Specimens used for SEM observations were 1 male and 2 females. They were transferred from 70 % ethanol to 40 % ethanol (10 min), rinsed in 0.1 M cacodylate buffer (twice by 10 min), post-fixed in 1 % OsO₄ for 2 h, dehydrated in an ethanol series and critical-point dried with CO₂ by BAL-TEC CPD 030. Specimens were coated with gold-palladium in sputter coater Polaron SC7640 and examined using a LEO microscope at 10 kV.

Metrical data are presented as the range, with the mean and the number of measurements taken (n) in parentheses. Measurements are in micrometres except otherwise stated. The following indices were used: cordon length/body length = I_{CL/BL}; length of muscular oesophagus/length of glandular oesophagus = I_{mOE/gOE}; length of oesophagus/body length = I_{OE/BL}; length of caudal alae/body length = I_{CA/BL}; length of left spicule/length of right spicule = I_{LSP/RSP}; distance from vulva to posterior end/body length = I_{V/BL}.

Voucher specimens are deposited in the helminthological collections of the Museum für Naturkunde der Humboldt-Universität zu Berlin, no ZMB Vermes, Entozoa 7446, and the Central Laboratory of General Ecology, Bulgarian Academy of Sciences, Sofia (CLGE), nos N000.329; N000.846; N000.331; N000.850; N001.038 two female specimens, SEM stub; N001.039 one male specimen, SEM stub.



Figs. 1 – 8. *Desportesius brevicaudatus*. Fig. 1. Anterior end, male, lateral view. Fig. 2. Caudal end, male, ventral view. Fig. 3. Posterior end, male. Fig. 4. Left spicule, sinistral view. Fig. 5. Right spicule, dextral view. Fig. 6. Posterior end, female, lateral view. Fig. 7. Deirids. Fig. 8. Egg. Scale-bars = 100 µm (1, 3, 6); 50 µm (2, 4, 5); 25 µm (7, 8).

Results

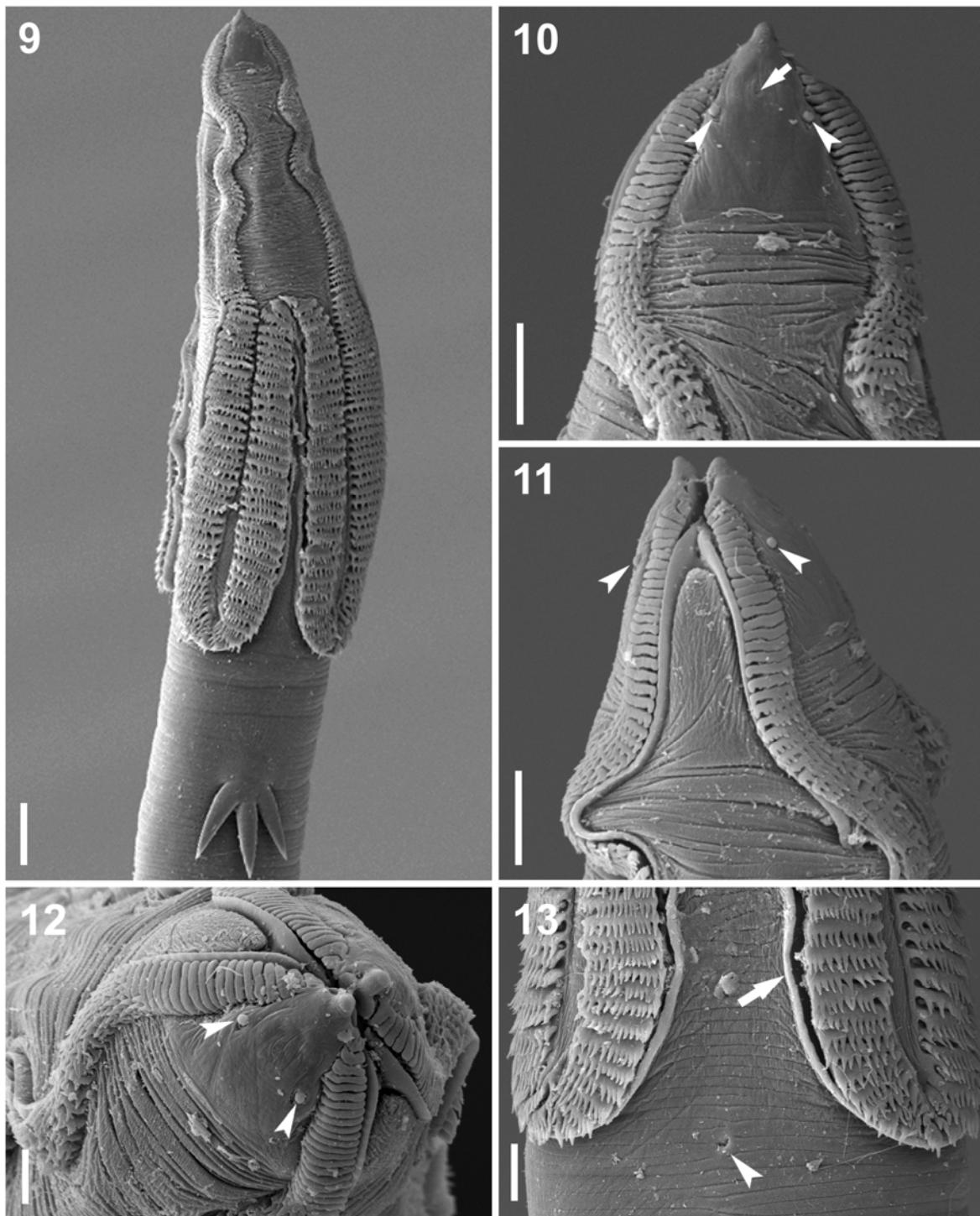
Desportesius brevicaudatus (Dujardin, 1845) Skryabin, Sobolev & Ivashkin, 1965 (Figs. 1 – 17)

Syns *Dispharagus brevicaudatus* Dujardin, 1845; *Histiocephalus brevicaudatus* (Dujardin, 1845) Diesing, 1851; *Acuaria (Synhimantus) brevicaudata* (Dujardin, 1845) Raiiillet, Henry & Sisoff, 1912; *Synhimantus brevicaudatus* (Dujardin, 1845) Gedoelst, 1919; *Synhimantus (Desportesius) brevicaudatus* (Dujardin, 1845) Gedoelst, 1919; Chabaud & Campana (1949); *Spiroptera triaenophora* Mehlis in Creplin, 1846.

General. Medium-sized acuariid nematode. Anterior end with 2 triangular pseudolabia, each bearing single amphid and pair of papillae (Figs. 10 – 12). Cordons arise dorsally and ventrally between pseudolabia, extending posteriorly

beyond nerve ring, recurrent in anterior direction and anastomosing laterally at level of posterior part of buccal cavity (Figs. 1, 9). Each cordon consisting of a single row of cuticular plates and longitudinal cuticular ridge along outer rims of plates; cuticular plates with width increasing in posterior direction and with serrate posterior rim bearing 10 – 12 spines in widest part of cordon (Fig. 13); cuticular plates and longitudinal ridge delimiting deep, almost closed longitudinal canal. Deirids very big, flat, usually tricuspid, sometimes with two, four or five cusps (Figs. 7, 9). Postdeirids small, c.3 long, bifurcate (Fig. 15). Cuticular striations present, interrupted along lateral sides of body (Fig. 14). Excretory pore situated close to posterior end of cordons (Fig. 13). Buccal cavity elongate. Nerve ring surrounding narrow anterior portion of muscular oesophagus (Fig. 1).

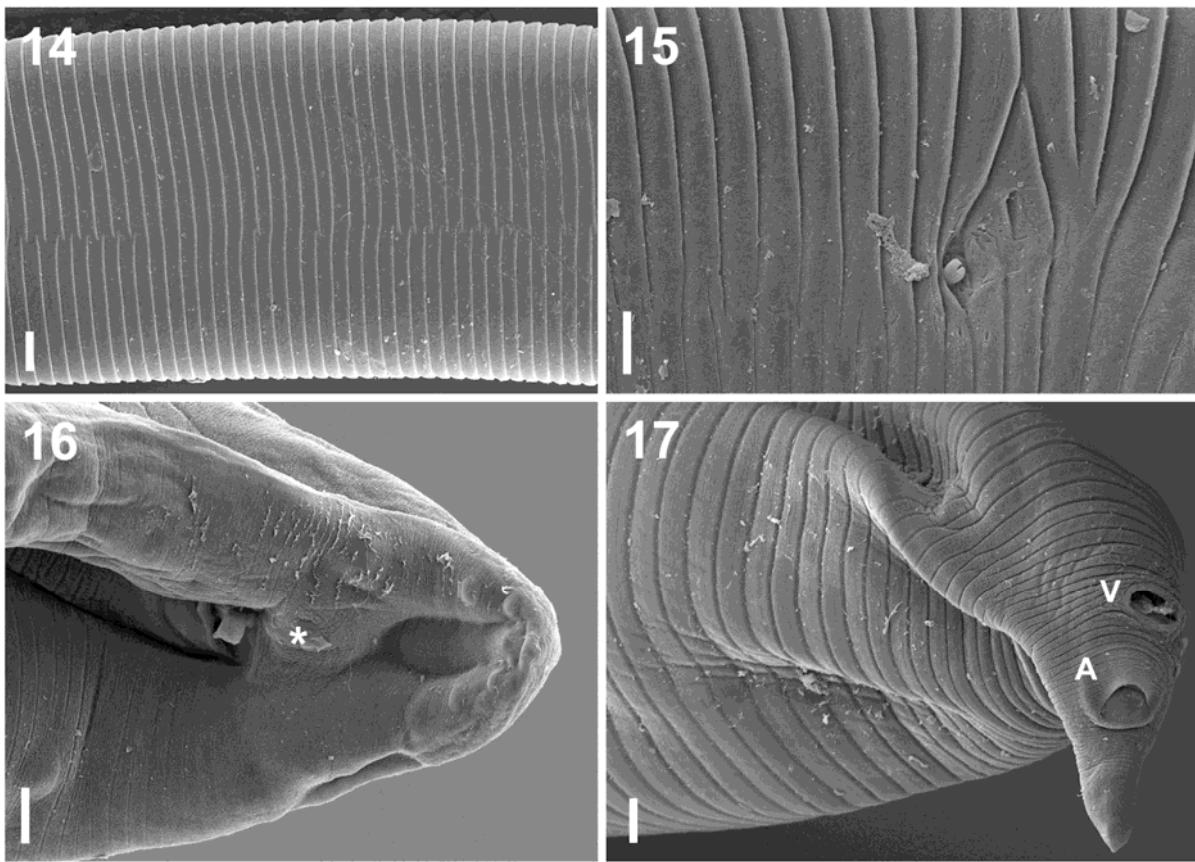
Male (n = 5, except otherwise stated). Body length 6.4 – 9.0 mm (7.6 mm). Maximum width 174 – 206 (191), about



Figs. 9 – 13 . *Desportesius brevicaudatus*, female, SEM. Fig. 9. Anterior end, lateral view. Fig. 10. Cephalic end, lateral view; note the cephalic papillae (arrowheads) and the amphid (arrow); Fig. 11. Cephalic end, ventral view; note the cephalic papillae (arrowheads). Fig. 12. Cephalic end, apical view; note the cephalic papillae (arrowheads). Fig. 13. Posterior region of the cordon, note the excretory pore (arrowhead) and the longitudinal ridge of the cordon (arrow). Scale-bars = 20 µm (9); 10 µm (10, 11, 13); 5 µm (12).

mid-body. Tail 88 – 99 (93) long. Body width at level of cloaca 45 – 63 (54). Cordons 215 – 282 (261) long, recurrent in anterior direction to 106 – 147 (134) from anterior body end, maximum 18 – 23 (20) wide. Deirids and excretory pore at 295 – 362 (330) and 259 – 295 (280), res-

pectively, from anterior end. Deirids 44 – 46 (45) long. Left postdeirid and right postdeirid at 2.7 – 3.4 mm (3.1 mm, n = 4) mm and 1.8 – 2.3 mm (2.0 mm, n = 4), respectively, from anterior end. Buccal cavity 167 – 204 (187) long (measured from anterior body end), 9 – 12 (10) wide.



Figs. 14-17. *Desportesius brevicaudatus*, SEM. Fig. 14. Cuticular striations at the level of the mid-body, lateral view. Fig. 15. Postdeirid. Fig. 16. Caudal end, male, ventral view; note the cupola situated posteriorly to cloaca (asterisk). Fig. 17. Posterior end, female, showing the anus (A) and the vulva (V). Scale-bars = 20 µm (14); 10 µm (15-17).

Muscular oesophagus 624 – 738 (696) long, 34 – 41 (37) wide. Glandular oesophagus 1 756 – 2 342 (2 013) long, 63 – 82 (70) wide. Nerve ring at 163 – 218 (199) from anterior end. Cuticle 11 – 16 thick. Distance between cuticular striations 9 – 13. Caudal alae 1 155 – 1 728 (1 455) long. Well-expressed cupola present ventrally, just posterior to cloaca (Figs. 2, 16). Single median sessile precloacal papilla present. Nine pairs of pedunculate caudal papillae, 4 precloacal and 5 postcloacal (Figs. 2, 3); postcloacal pairs of pedunculate papillae not grouped. Sixth pair of postcloacal papillae sessile, smaller, situated between bases of last pedunculate papillae. Left spicule 340 – 371 (355, n = 3) long, 7 – 9 (8) wide (Fig. 4). Right spicule 112 – 129 (118, n = 3) long, 19 – 24 (21, n = 3) wide (Fig. 5). $I_{CL/BL}$ 0.030 – 0.042 (0.035); $I_{mOE/gOE}$ 0.315 – 0.389 (0.349); $I_{OE/BL}$ 0.319 – 390 (0.357); $I_{CA/BL}$ 0.176 – 0.210 (0.191); $I_{LSP/RSP}$ 2.75 – 3.28 (3.02, n = 2).

Female (n = 8, except otherwise stated). Body length 7.6 – 9.3 (8.4) mm. Maximum width 255 – 335 (291), in posterior quarter of body. Tail 30 – 45 (37) long. Body width at anus 23 – 29 (26), at vulva 43 – 61 (52). Cordons 206 – 313 (253) long, recurrent in anterior direction to 88 – 156 (111) from anterior body end, maximum 21 – 27 (24) wide. Deirids and excretory pore at 228 – 398 (299) and 165 – 291 (236), respectively, from anterior extremity.

Deirids 36 – 47 (45) long. Left postdeirid and right postdeirid at 1.9 – 3.0 mm (2.5 mm) and 1.3 – 2.0 mm (1.6 mm), respectively, from anterior extremity. Buccal cavity 167 – 206 (181) long (measured from anterior body end), 11–16 (14) wide. Muscular oesophagus 675 – 825 (721) long, 36 – 48 (42) wide. Glandular oesophagus 1 705 – 2 215 (1 959) long, 63 – 88 (78) wide. Nerve ring at 159 – 224 (184) from anterior extremity. Cuticle 9 – 15 thick; distance between cuticular striations 13 – 15. Vulva at 59 – 71 (64) from posterior extremity; body sharply narrowing posterior to vulva (Figs. 6, 17). Uterus monodelphic. Vagina vera short, directed anteriorly, separated from vagina uterina by thick cuticular folds. Vagina uterina long, with well-developed circular musculature of walls. Eggs oval, 27 – 29 × 20 – 21 (28 × 21, n = 20), containing fully-developed embryo (Fig. 8). $I_{CL/BL}$ 0.025 – 0.045 (0.032); $I_{mOE/gOE}$ 0.324 – 0.433 (0.366); $I_{OE/BL}$ 0.287 – 0.421 (0.333); $I_{V/BL}$ 0.007 – 0.010 (0.008).

Discussion

The genus *Desportesius* Chabaud & Campana, 1949 was erected as a subgenus of *Synhimantus* Railliet, Henry & Sisoff, 1912; the authors placed 7 species in the new subgenus, mostly parasitic in ardeid birds (Chabaud & Cam-

pana, 1949). The subgenus was elevated to the generic level by Skryabin et al. (1965). Subsequent authors (Chabaud, 1975; Wong & Anderson, 1986; Smogorzhevskaya, 1990) also recognised *Desportesius* as a distinct genus.

Desportesius brevicaudatus (Dujardin, 1845) has been recorded as a parasite of birds of the family Ardeidae: *Botaurus stellaris* (L.) (type host), *Ixobrychus minutus*, *Egretta garzetta* (L.) and *Ardea cinerea* L.; all the records were from Palaearctic: France, Germany, Poland, Romania, Bulgaria, Ukraine, Russia (Black Sea coast) and Tajikistan (for surveys, see Wong and Anderson, 1986; Smogorzhevskaya, 1990). It has been reported from *Falco tinnunculus* L. (Accipitridae, Falconidae) and *B. stellaris* in Bulgaria (Petrova, 1984). The record from the former host is unusual, since the remaining findings of this nematode species were from ardeid birds only. Unfortunately, Petrova's (1984) material of this species was not available for revision for the purposes of the present study and we consider it doubtful. Therefore, the host range of *D. brevicaudatus* is considered here as restricted to ardeid

birds.

Wong and Anderson (1986) revised the genus *Desportesius* and redescribed *D. brevicaudatus* on the basis of one male specimen from the type material. The specimens from Bulgaria correspond well to their redescription in the body length, cordon length (data from the illustration), length of muscular and glandular oesophagus as well as the shape of the spicules and the arrangement of the caudal papillae. The male specimens from Bulgaria possess a longer tail (88 – 99 vs 55) and longer left and right spicules (340 – 371 vs 271 and 112 – 129 vs 95, respectively) but similar ratio, I_{LSP}/RSP 2.75 – 3.28 in our material vs 2.85 in the type specimen. On the basis of these comparisons, we identify the material from Bulgaria as *D. brevicaudatus*.

The samples from Bulgaria correspond well in their measurements (except for the length of the cords) with the material from *I. minutus* from Ukraine (Smogorzhevskaya, 1990) (Table 1).

Most of the previous descriptions of *D. brevicaudatus*

Table 1. Comparative metrical data of *Desportesius brevicaudatus* from various hosts and localities (in micrometres except otherwise stated).

Source	Wong and Anderson (1986)	Skrjabin (1917)	Sobolev in Skryabin et al. (1965)	Smogorzhevskaya (1990)	Present study
Host	<i>Botaurus stellaris</i>	<i>Botaurus stellaris</i>	Host not mentioned	<i>Ixobrychus minutus</i>	<i>Ixobrychus minutus</i>
Locality	France (?)	Russia	Russia	Ukraine	Bulgaria
Male	n = 1				n = 5
Body length (mm)	7.3	-	10.0	7.2-9.0	6.4-9.0 (7.6)
Maximum body width	130	-	160	130-172	174-206 (191)
Tail, length	55	-	63	-	88-99 (93)
Cordons, length	223****	-	228	292	215-282 (261)
Deirids from anterior end, distance	257	-	-	-	295-362 (330)
Excretory pore from anterior end, distance	212	-	-	-	259-295 (280)*
Buccal cavity, length	152	-	170	160-200	167-204 (187)
Muscular oesophagus, length	700	-	650	700-800	624-738 (696)
Glandular oesophagus, length (mm)	2.0	-	2.2	2.0-2.2	1.8-2.3 (2.0)
Left spicule, length	271	-	110	220-370	340-371 (355)**
Right spicule, length	95	-	60	72-100	112-129 (118)**
Female					n = 8
Body length (mm)	-	7.5-8.5	-	9.0-13.0	7.6-9.3 (8.4)
Maximum body width	-	290	-	304	255-335 (291)
Tail, length	-	68	-	-	30-45 (37)
Cordons, length	-	425	-	340-400	206-313 (253)
Deirids from anterior end, distance	-	560	-	-	228-398 (299)
Excretory pore from anterior end, distance	-	-	-	-	165-291 (236)
Buccal cavity, length	-	210	-	200-220	167-206 (181)
Muscular oesophagus, length	-	850	-	714-800	675-825 (721)
Glandular oesophagus, length (mm)	-	-	-	2.3	1.7-2.2 (2.0)
Vulva from posterior end, distance	-	600***	-	60-70	59-71 (64)

*n = 4; **n = 3; ***A possible misprint in Skrjabin's (1917) publication. ***Based on illustrations.

provided inadequate data about its metrical characters, obviously based on a small number of specimens (Table 1). The present study expanded the known ranges of variation of the body length and width, length of the tail and oesophagus, length and width of the cordons, size of the deirids and size of the spicules. In addition, we provide new data on the detailed structure of the cordons, the pattern of cuticular striation, the shape of the postdeirids, the variations in the shape of the deirids and the structure of the vagina.

The only previous SEM study of a species of the genus *Desportesius* is that on *D. invaginatus* (von Linstow, 1901) from *Bubulcus ibis* (L.) (=*Ardeola ibis*) from Egypt (Varjabedian, 2006). The published description and illustrations provide limited possibilities for comparisons. From the illustrations, it is seen that the widest cuticular plates of cordons in *D. invaginatus* bear c.20 posterior spines while, according to our observations, those in *D. brevicaudatus* have 10 – 12 spines only. In our material, we did not observe irregularly distributed cuticular bosses situated on the lateral sides of the posterior part of females and transverse annulations ("each annulus is striated") as described by Varjabedian (2006). Unfortunately, the illustrations do not allow us to judge whether these differences are specific characters of the species compared or if they are due to the processing of specimens of *D. invaginatus*.

Our SEM study revealed the particular structure of the cephalic cordons of *D. brevicaudatus* (see above). In some acuariid nematodes, each cordon consists of two longitudinal rows of similar plates, with a longitudinal canal situated between them; such an arrangement has been described in *Acuaria anthuris* (Rudolphi, 1819) (see Frantová, 2002), *Cheilospirura hamulosa* (Diesing, 1851) (see Gomes *et al.*, 2004) and *Echinuria uncinata* (Rudolphi, 1819) (see Kennedy *et al.*, 1973). There is no outer row of plates in *D. brevicaudatus*; it seems that the outer plates have merged to form a longitudinal ridge that externally delimits the longitudinal canal in this species. A similar structure of the cordons has been illustrated for *Syncuaria plegadisi* Digiani, 1999 and *Decorataria diacantha* (Petter, 1961) (see Digiani, 1999), *S. mackoi* Mutafchiev & Georgiev, 2008 (see Mutafchiev & Georgiev, 2008a), *Decorataria decorata* (Cram, 1927) (Mutafchiev & Georgiev, 2008b), *Skrjabinocerca canutus* Diaz, Cremonte, Navone & Laurenti, 2005 (see Diaz *et al.*, 2005). Chabaud & Campana (1949) commented on the differences in the structure of the cordons of the Echinuriinae and *Desportesius*; on the basis of light-microscopy observations on *Desportesius spinulatus* (Chabaud & Campana, 1949) Chabaud, 1950 (a junior synonym of *D. invaginatus*, see Wong & Anderson, 1986), they considered that the similar configurations of the cordons in these groups were results of convergent evolution. The homology of the outer longitudinal row of plates and the outer longitudinal ridge might be important in view of its application in phylogenetic studies of acuariids. Mawson (1982) emphasised the importance of the complexity of the cordon structure, in addition to their configuration, for the taxonomy of this family.

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