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TRICHOSTRONGYLINA PARASITES OF DASYPODIDAE (XENARTHRA) FROM ARGENTINA; A NEW SPECIES OF *MACIELIA* (MOLINEIDAE: ANOPLOSTRONGYLINAE) IN *CHAETOPHRACTUS VELLEROSUS* AND REDESCRIPTION OF *TRICHOHELIX TUBERCULATA*

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ABSTRACT: *Macielia jorgei* n. sp. is described from *Chaetophractus vellerosus* from La Rioja, Argentina. Also *Trichohelix tuberculata* is redescribed in detail. The new species is characterized by parasitizing the small intestine, possessing a bursal membrane and telamon, having complex and sclerotized spicules distally divided into 2 processes, a simple, poorly sclerotized gubernaculum, and synlophe with bilateral symmetry and 12 cuticular ridges. This is the second report of a species of *Macielia* in Argentina. The synlophe of *Trichohelix tuberculata* is asymmetric and is characterized by 3 ventral ridges, oriented to the left. The size of these ridges decreases until they disappear at midbody.

The members of the family Molineidae are characterized by a symmetric caudal bursa, short and complex spicules, and a didelphic female (Chabaud, 1959). Within this family the subfamily Anoplostrongylinae is comprised of parasites of Neotropical Chiroptera, marsupials, and Xenarthra.

The genus *Macielia* is found in xenarthrans and marsupials from South America. Travassos (1935, 1937) revised the genus and distinguished 4 species, *Macielia macieli* (Travassos, 1915), *Macielia falsa* (Travassos, 1921), *Macielia chagasi* Travassos, 1935, and *Macielia flagellata* Travassos, 1937. Only 1 species, *Macielia peracchii* Grisi and Telles de Castro, 1973, is found in marsupials. To date the only species known in Argentina was described by Navone (1987), *Macielia elongata*, found in the stomach of *Tolypeutes matacus* (Desmarest, 1804).

Trichohelix Ortlepp, 1922 is a monospecific genus that parasitizes Euphractinae and Tolypeutinae from Argentina, Brazil, and Paraguay. It has been reported in *Chaetophractus villosus*, *Chaetophractus vellerosus*, *Cabassous unicinctus*, and *Euphractus sexcinctus* (Navone, 1987, 1990; Fujita et al., 1995; Hoppe et al., 2009). Although its geographical and host distribution is wide, and its morphology is well known, the synlophe was not studied until Hoppe et al. (2009) described it in part.

The aim of the present study is to describe a new species of *Macielia* parasitizing *Chaetophractus vellerosus* from La Rioja, Argentina and to redescribe *Trichohelix tuberculata*, a common species in most euphractines from Argentina.

MATERIALS AND METHODS

Forty-one specimens of *C. vellerosus* were collected from the provinces of Buenos Aires, Córdoba, La Rioja, Mendoza, San Juan, and San Luis, and 43 of *C. villosus* from Buenos Aires, Chubut, and Santiago del Estero (Argentina). The digestive tracts of the specimens were fixed in a 10% formaldehyde solution and dissected in the laboratory. The found nematodes were preserved in 70% ethanol, cleared in lactophenol, mounted on a slide under a coverslip, and studied with the use of a compound microscope. A cross section of the anterior end of both male and female was made to obtain an en face view. The synlophe was studied following Durette-Desset (1985), and the caudal bursa was described

following Durette-Desset and Digiani (2012). Drawings were made with the use of an Olympus BX 51 microscope (Olympus Corporation, Tokyo, Japan) equipped with drawing tube. Measurements are given in micrometers, unless otherwise stated, with the types, followed by the paratypes. These latter are expressed by the mean \pm SD in parentheses followed by range values. Nematodes were deposited in the Colección de Helmintos Museo de La Plata (CHMLP), and hosts in the Colección de Mastozoología Museo de La Plata (MLP), La Plata, Buenos Aires, Argentina.

DESCRIPTION

Macielia jorgei n. sp.

(Figs. 1–16)

General diagnosis: Small nematodes, uncoiled. Excretory pore situated anteriorly to deirids (Fig. 1). Cephalic vesicle present (Fig. 2). In apical view, the head has a rounded oral opening; 2 amphids and 4 externo-labial papillae (Fig. 3).

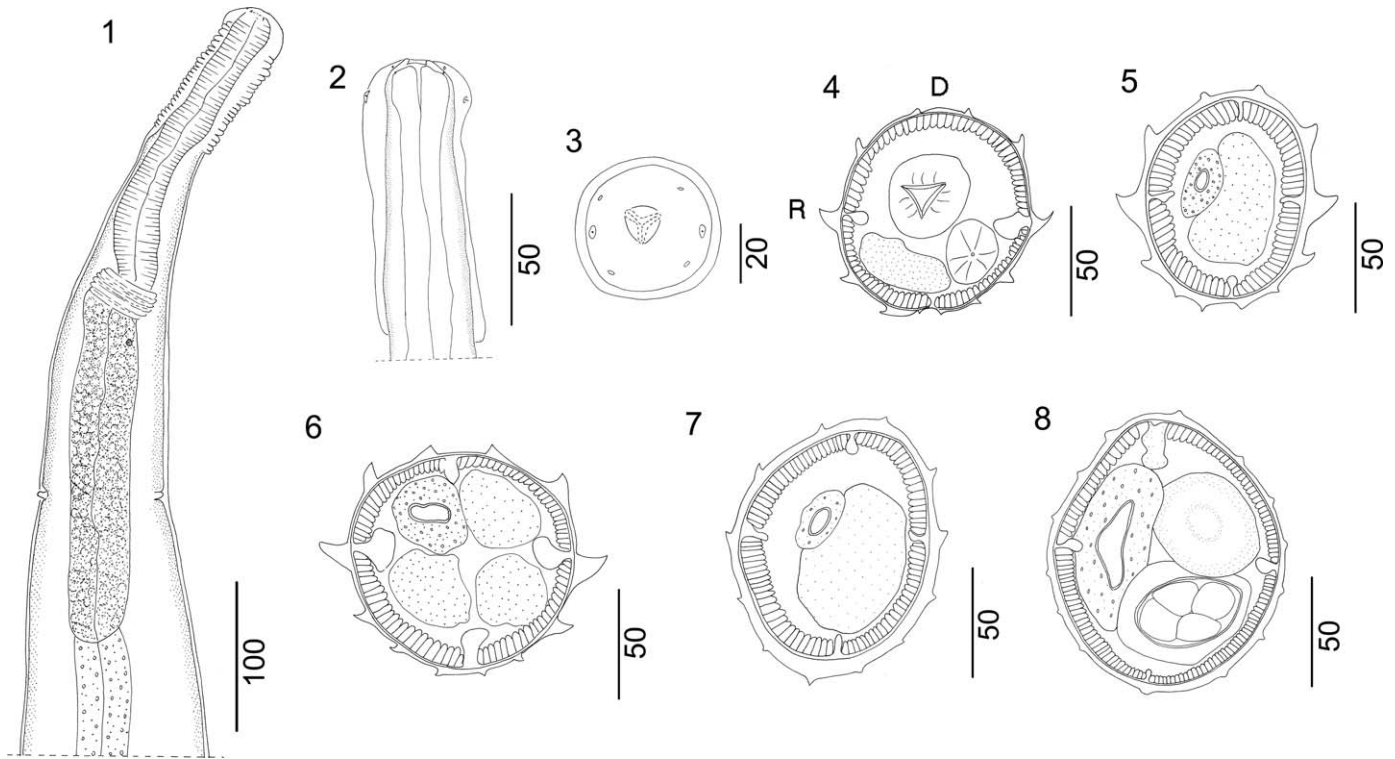
Synlophe (studied in 1 male and 1 female paratype): In both sexes, body bears continuous cuticular ridges, appearing just posterior to cephalic vesicle and extending just anterior to caudal bursa in male and to caudal extremity in female (Fig. 4). Synlophe with bilateral symmetry determined by number, size, and orientation of the ridges. Number of ridges: 12. Ridges with ventral–dorsal orientation, arranged as follows: 2 larger lateral ridges, 4 dorsal, and 6 ventral (Figs. 5, 6). Axis of orientation of the ridges coincident with sagittal axis.

In both sexes, size of ridges decreases gradually near posterior end (Figs. 7, 8); in females an extra pair of ridges appears in the postvulvar region.

Males (based on holotype and 5 paratypes unless otherwise indicated): Body length 7.20 (7.08 \pm 236, 6.72–7.30) mm, width at midbody 130 (121 \pm 14, 100–135). Cephalic vesicle 110 (113 \pm 13, 90–123) long and 40 (45 \pm 4, 40–50) wide. Nerve ring, deirids, and excretory pore situated at 285 (220 \pm 13, 210–240), 390 (382 \pm 46, 345–450), and 312 (316 \pm 34, 270–345) respectively, from apex. Esophagus 545 (532 \pm 29, 500–570) long. Caudal bursa subsymmetrical, with dorsal lobe distinct, with pattern of type 2-1-2. (Fig. 9). Rays 2 and 3 joined for about half of their length, with distal extremities directed anteriorly, reaching bursal margin. Rays 4 short, not reaching bursal margin. Rays 5 and 6 joined for about 2/3 of their length, both directed posteriorly, and distal extremity of rays 6 recurrent, but not convergent with extremity of rays 5. Rays 8 thick and blunt curved at right angle, not reaching the bursal margin. Dorsal ray bifurcated at distal third, each branch divided twice, and the external branch (ray 9) longer than the other 2 (rays 10 and phasmids). Telamon present, surrounding the gubernaculum. Accessory membrane supported by a pair of small rays bearing papillae 7 at its distal end (Fig. 10). Papilla zero not observed. Spicules subequal, complex, well sclerotized, 175 (181 \pm 9, 172–195) long, distally divided into 2 processes sharpened, 1 slightly longer than the other (Figs. 11, 12). Gubernaculum simple, poorly sclerotized, 70 (74 \pm 7, 67–80) (n = 4) (Figs. 13, 14).

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FIGURES 1–8. *Maciella jorgei* n. sp. (1) Female, anterior extremity, ventral view. (2) Male, cephalic vesicle. (3) Apical view. (4–8) Transverse sections of body: (4) female at level of esophagus, (5) male at midbody, (6) female at midbody, (7) male, near caudal bursa, (8) female, postvulvar region.

Females (based on allotype and 5 paratypes unless otherwise indicated): Body length 9.90 (9.97 ± 1.15 , 8.15–10.95) mm, width at midbody 110 (113 ± 18 , 100–135). Cephalic vesicle 120 (111 ± 12 , 90–120) long and 50 (48 ± 2 , 45–50) wide. Nerve ring, deirids and excretory pore situated at 265 (199 ± 31 , 155–230), 365 (366 ± 58 , 290–420) ($n = 4$), and 310 (290 ± 51 , 210–340), respectively from apex. Esophagus 600 (550 ± 39 , 480–575) long. Vulva situated at 1.57 (1.64 ± 160 , 1.35–1.75) mm from posterior extremity, with a vulvar cuticular dilatation. Vagina vera 60 (39 ± 6 , 35–47) ($n = 4$) long. Anterior branch of ovejector: vestibule 160 (135 ± 10 , 125–150) long, sphincter 60 (58 ± 5 , 50–65) long, infundibulum 90 (116 ± 13 , 100–130) long. Posterior branch of ovejector: vestibule 90 (133 ± 10 , 120–145) long, sphincter 60 (55 ± 6 , 45–60) long, infundibulum 120 (102 ± 9 , 90–115) long (Fig. 15). Anterior uterine branch 1.45 (1.35 ± 231 , 1.05–1.65) mm long with 38 (39 ± 4 , 36–45) eggs. Posterior uterine branch 0.96 (1.05 ± 173 , 0.9–1.3) mm long with 25 (33 ± 3 , 31–38) eggs. Eggs (52–70) by (30–44) ($n = 16$). Tail 140 (118 ± 6 , 110–125) (Fig. 16).

Taxonomic summary

Type host: *Chaetophractus vellerosus* Gray, 1865.

Type locality: Chemical, Province of La Rioja, Argentina ($30^{\circ}02'S$; $66^{\circ}03'W$).

Other localities: Estancia El Centenario ($34^{\circ}12'40''S$; $65^{\circ}49'30''W$), Province of San Luis.

Site of infection: Small intestine.

Specimens deposited: Holotype CHMLP 6677; allotype CHMLP 6678; paratypes CHMLP 6679. Deposited at Colección de Helminthos, Museo de la Plata, La Plata, Argentina.

Prevalence and mean intensity: 5%; 13.

Etymology: The species is named after a beloved uncle of the first author of this paper.

Remarks

Travassos (1935) defined the genus *Maciella* and included in this genus *Cooperia macieli* (Travassos, 1915) and *Cooperia falsa* (Travassos, 1921). He later added *M. chagasi* Travassos, 1935 and *M. flagellata* Travassos, 1937. *Maciella macieli* is a parasite of *Dasyypus novemcinctus* Linnaeus from Colombia; *M. falsa* is found in *C. unicinctus* (Linnaeus) from Brazil;

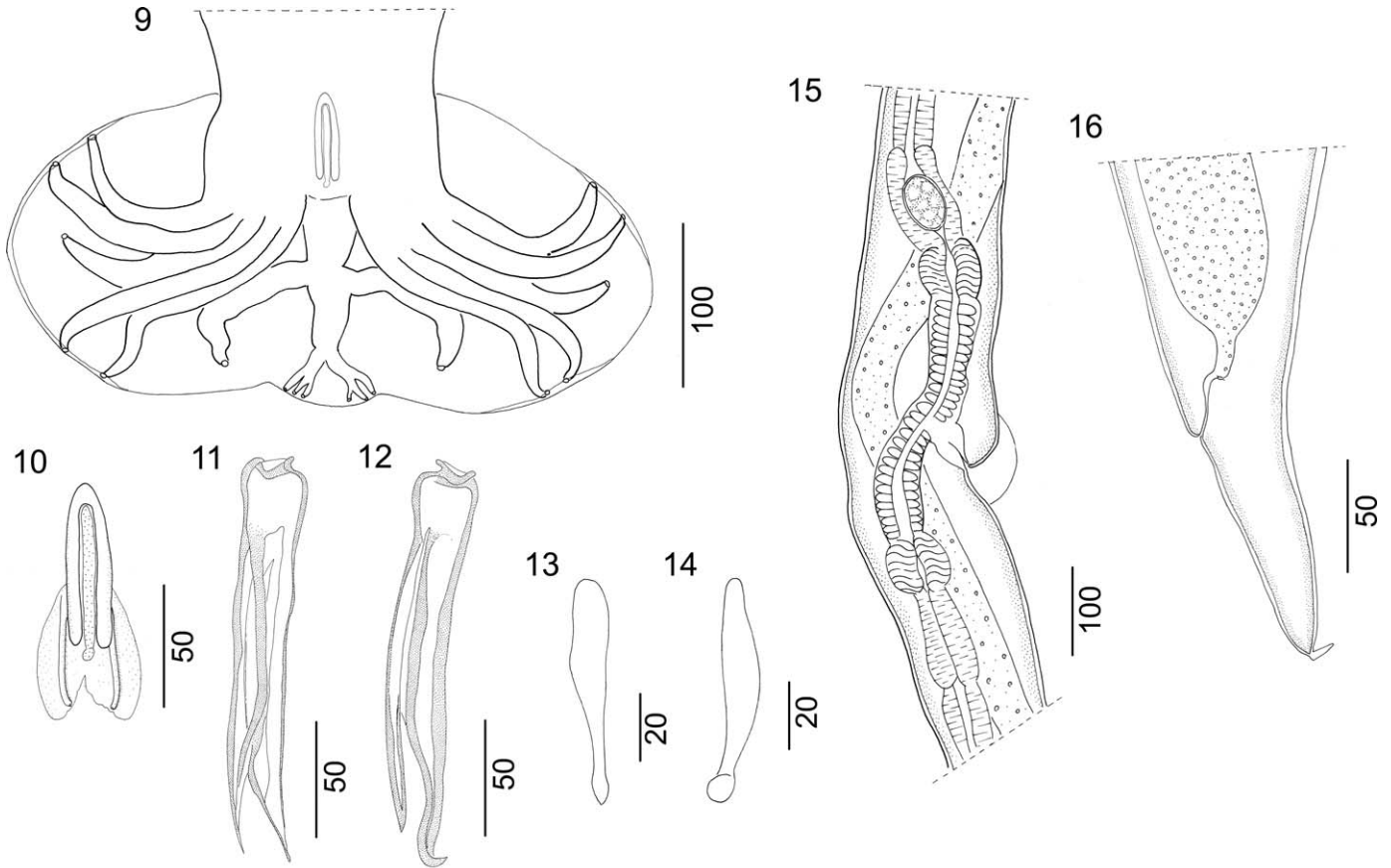
M. flagellata is a parasite of the stomach and intestine of *D. novemcinctus* from Brazil; *M. chagasi* is found in the stomach of *Es sexcinctus* Linnaeus from Brazil. Later, Durette-Desset (1970) described the synlophe of *M. macieli*, which was the first to be described for the genus *Maciella*. Grisi and Telles de Castro (1973) described *M. peracchii* parasitizing the marsupial *Philander frenatus* (Temminck) from Brazil, and Navone (1987) found *M. elongata* in the stomach of *Tolypeutes matacus* from Argentina. The species herein described resembles *M. elongata* by possessing a gubernaculum, equal number and disposition of ridges of the synlophe, and the morphology of the caudal bursa. However, it can be differentiated by the site of infection, the presence of a telamon, measurements of the body, and the morphology of the spicules, which possess 3 processes in *M. elongata* (2 filiform and recurved to ventral part, and the other thick, with the distal end expanded). The new species shares with *M. macieli* the number of ridges in the synlophe, spicules divided distally in 2 processes and the site of infection. However, *M. macieli* is smaller and has no gubernaculum. The species described here differs from *M. falsa* because the spicules are divided in 3 processes, 1 longer and ending in a triangular dilatation, the second shorter, wider and curved, and the third very narrow. Besides, *M. falsa* does not possess a gubernaculum. The new species shares with *M. chagasi* the measurements, presence of a gubernaculum and site of infection, but it is different because *M. chagasi* has spicules divided in 3 processes, 1 longer and the other 2 filiform. The synlophe of *M. chagasi* is unknown. *Maciella flagellata* possesses a gubernaculum, but it is smaller than the new species, the spicules are shorter, with 1 process very developed, and the other rudimentary. *Maciella peracchii* differs from the new species because it has a genital cone, is smaller, and its spicules are shorter. Taking into account the differences observed, *M. jorgei* is considered a new species.

REDESCRIPTION

Trichohelix tuberculata (Parona & Stossich, 1902)

(Figs. 17–33)

Diagnosis: Coiled nematodes, reddish in color in situ. Cephalic vesicle present. Excretory pore situated near to esophageal–intestinal junction



FIGURES 9–16. Male: (9) Caudal bursa, ventral view. (10) Telamon. (11) Left spicule, dorsal view. (12) Right spicule, laterodorsal view. (13) Gubernaculum, ventral view, (14) lateroventral view. Female: (15) Ovejector, right lateral view. (16) Caudal extremity, left lateral view.

(Fig. 17). In apical view, the head possesses a rounded oral opening; 2 amphids, 4 cephalic, and 4 externo-labial papillae observed (Fig. 18).

Synlophe: Asymmetric. In both sexes, cuticular ridges appear posterior to cephalic vesicle, and extend to the half of the body. At esophagus level a ventral ridge appears, oriented to the left (Fig. 19). Posterior to the beginning of the intestine, there are 3 ventral ridges, oriented to the left (Figs. 20, 21). A fourth small ridge appears near the midbody in some specimens (Fig. 23). The size of ridges gradually decreases (Figs. 22, 23) until they disappear at midbody (Figs. 24, 25). In both sexes the cuticle is swollen laterally and the swelling reaches the caudal end.

Males ($n=10$): Total length 6.62 (5.65–8.00) mm, maximum width 270 (230–300), nerve ring 193 (130–250) ($n=9$), excretory pore 367 (300–400) ($n=7$), esophagus length 418 (325–490), caudal bursa subsymmetrical, with pattern of type 2-1-2. Prebursal papillae present, very long and thin (Fig. 26). Rays 2 are bent forward, rays 3 longer than rays 2 and reaching the bursal margin. Rays 4 thicker, not reaching the bursal margin, rays 5 and 6 are separated at the base, rays 5 curved toward rays 6. Dorsal ray bifurcated, and each branch divided, simultaneously internal rays are bifurcated. Spicules complex, trifurcated on distal end, points united by a spicular membrane, 267 (250–290) (Figs. 27–30). Gubernaculum simple, 122 (100–150) ($n=9$) (Figs. 31, 32).

Females ($n=11$): Total length 8.46 (6.80–9.50), maximum width 336 (250–450), nerve ring 214 (150–300) ($n=7$), excretory pore 405 (350–460) ($n=6$), esophagus length 501 (450–550), distance vulva to posterior end 490 (370–770), vagina vera 80 (65–100) ($n=4$), vestibule 283 (250–330) ($n=6$), infundibulum 154 (125–200), sphincter 69 (50–100) \times 63 (50–80) ($n=5$) (Fig. 33). Eggs 64 (54–75) by 33 (29–37) ($n=10$).

Taxonomic summary

Hosts: *Chaetophractus villosus* (Desmarest, 1804); *Chaetophractus vellerosus* (Gray, 1865).

Localities: Carlos Tejedor, Castelli, Laprida, Villarino, Pellegrini, Punta Indio (province of Buenos Aires); Laguna La Blanca (province of Chubut); Cruz del Eje (province of Córdoba); Loventué, Santa Rosa (province of La Pampa); Chamental (province of La Rioja); Usno (province of San Juan); Estancia El Centenario (province of San Luis); Departamento de Copo (Santiago del Estero).

Site of infection: Small intestine.

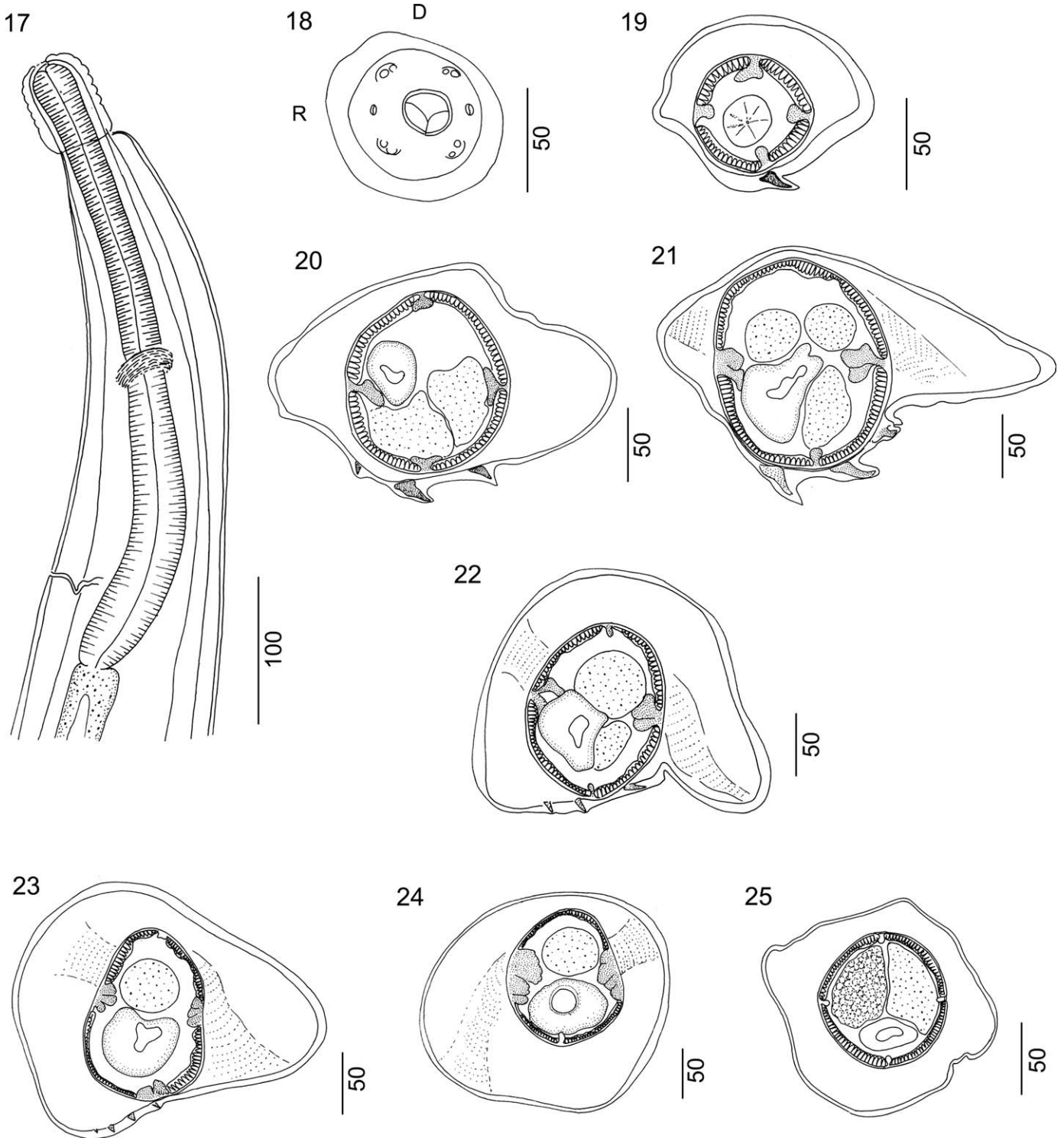
Specimens deposited: Voucher specimens from both hosts in the Helminthological Collection of Museo de La Plata (CHMLP 6605; CHMLP 6606).

Prevalence: 75% (*C. vellerosus*); 96% (*C. villosus*).

Mean intensity: 45 (*C. vellerosus*); 124 (*C. villosus*).

Remarks

Trichostrongylus tuberculatus was originally described as *Oesophagostomum tuberculatum* Parona and Stossich, 1901. Ortlepp (1922) redescribed the species and placed it in a new genus, *Trichostrongylus*, characterized by a coiled body, inflated cuticle, a trilobed caudal bursa, and a stout bifurcate dorsal ray, with tripartite tips. The tip of ray 5 is sharply recurved, and ray 2 is strongly arched forward and inward. The spicules are straight, tubular, equal, and branched at the distal end, and a gubernaculum is present. The vulva is situated near the anus, with a well-developed ovejector, and parallel uteri. Eggs are large, oval, and thin-shelled. Travassos (1937) redescribed this species and indicated the presence of prebursal papillae, not observed previously. In 1987, Navone provided data on the distribution and prevalence of *T. tuberculatus*, and noted the absence of synlophe, probably because this author used paraffin-embedded histological sections that made the observation of synlophe difficult. Recently, Hoppe et al. (2009) described for the first time the synlophe of specimens collected from *Euphractus sexcinctus* from Brazil, but only at midbody, without detailing the differences along the body. They indicated that the



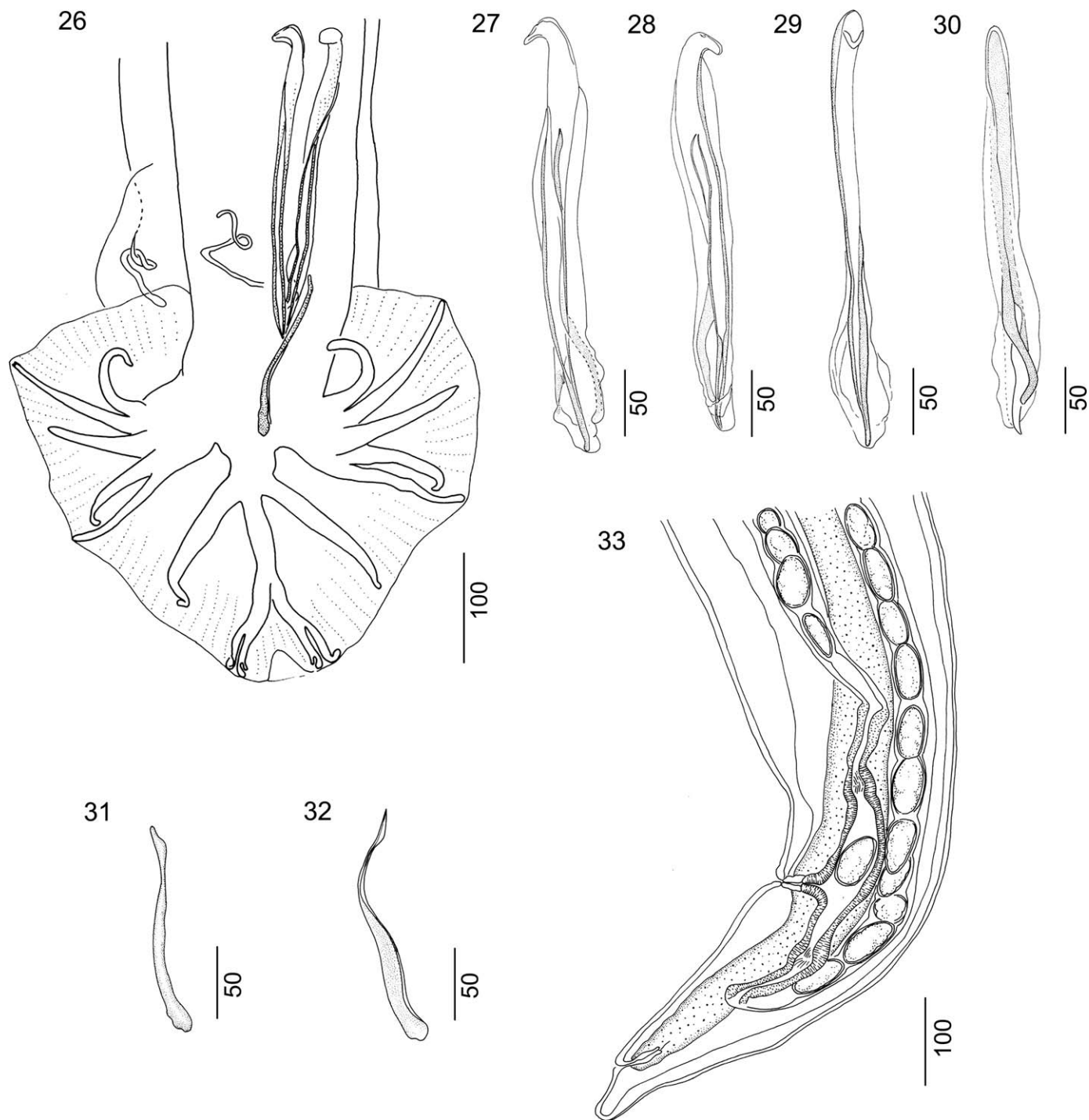
FIGURES 17–25. *Trichohelix tuberculata*. (17) Anterior extremity, left lateral view. (18) Apical view. (19–25) Transverse sections of body: (19) female, at level of esophagus; (20) male, immediately posterior the beginning of intestine; (21) female, immediately posterior the beginning of intestine; (22) female, at 2.8 mm from anterior end; (23) female, at 2.9 mm from anterior end; (24) female, at midbody; (25) male, near to distal end.

synlophes has many ridges of variable size; however, this appears to be because the cuticle was swollen and folded on itself.

Herein is indicated the presence of 3 ridges appearing behind the esophageal-intestinal junction that disappear at midbody. The remaining cuticle is transversely striated but without cuticular ridges, and it is inflated along the whole length of the body.

DISCUSSION

Species of *Macielia* parasitize dasypodids, with the exception of *M. peracchii*, a parasite of marsupials (Grisi and Telles de Castro, 1973). Previously, *M. elongata*, a parasite of *Tolypeutes matacus* from Chaco and Santiago del Estero provinces (Navone, 1987,



FIGURES 26–33. *Trichohelix tuberculata*. (26) Caudal bursa, ventral view. (27–30) Left spicule, (27) left lateral view, (28) right lateral view, (29) ventral view, (30) dorsal view. (31–32) Gubernaculum, (31) dorsal view, (32) right lateral view. (33) Ovejector, left lateral view. Abbreviations: D: dorsal; R: right. Sections oriented as Figure 4.

1990) was the only species reported from Argentina. The species herein described was found in *Chaetophractus vellerosus* from La Rioja and San Luis provinces. Although both host species belong to the Dasypodidae, they are representatives of different subfamilies (Tolypeutinae and Euphractinae). However, it is interesting to note that *M. jorgei* is the first species of *Macielia* described parasitizing the subfamily Euphractinae. This is the first

record of the genus *Macielia* in *C. vellerosus*, and the second species known of the genus from Argentina.

Travassos (1937) created the subfamily Trichohelicinae to include only *Trichohelix tuberculata*. However, Durette-Desset (1983) placed *Trichohelix* in Anoplostrongylinae. Recently, Hoppe et al. (2009) resurrected Trichohelicinae, which is characterized by spiraled nematodes with a cephalic vesicle;

synlophe formed by asymmetrical ridges with ventral–dorsal orientation; didelphic, prodelphic females, with vulva close to anus; males with a trilobed copulatory bursa with a symmetric, large dorsal lobe, and very long, thin, prebursal papillae; equal spicules, and a gubernaculum. These authors considered that the synlophe pattern and female reproductive system morphology represent an autapomorphy and relocated *T. tuberculata* in Trichohelicinae. Herein we observed a variable pattern of synlophe along the body. The rest of the features coincide with the genus *Trichohelix* and Trichohelicinae. This work describes in detail the synlophe of *T. tuberculata*, because the whole body of male and female specimens was cut transversely, allowing the precise observation of the beginning and the end of ridges.

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