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## A NEW SPECIES OF *PELECITUS* (FILARIOIDEA: ONCHOCERCIDAE) FROM THE ENDANGERED TEHUANTEPEC JACKRABBIT *LEPUS FLAVIGULARIS*

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**ABSTRACT:** *Pelecitus meridionaleporinus* n. sp. from the Tehuantepec jackrabbit is described. The new species differs from *Pelecitus helycinus* (Molin, 1860) in having delicate transverse striations, a salient vulva, and a readily apparent preesophageal ring; *P. helycinus* has teardrop cells around the vulva, which are lacking in the species presently described. The new species is different from *Pelecitus scapiceps* (Leidy, 1886) in having the vulva anterior to the esophageal–intestinal junction and wider lateral alae. *Pelecitus scapiceps* is found in the tarsal bursa of the hind feet of lagomorphs, whereas *P. helycinus* is found around tendons of legs and feet of birds. *Pelecitus meridionaleporinus* n. sp. occurs in the subcutaneous tissue at the base of both ears. This is the second species in *Pelecitus* Railliet and Henry, 1910 that occurs in New World lagomorphs, and the third found infecting mammals.

The cosmopolitan *Pelecitus* Railliet and Henry, 1910 includes 16 species, most of which are parasites of birds (Bartlett and Greiner, 1986). Two of those species, *Pelecitus scapiceps* (Leidy, 1886) and *Pelecitus roemeri* (Linstow, 1905) occur in mammals. The latter occurs in macropodids and the former is found in leporids from North America. The usual site of infection for these species is the subcutaneous tissue of the hind limbs. *Pelecitus scapiceps* occurs in the connective tissue around the ankle and in the intermuscular fascia associated to the knee, whereas *P. roemeri* occurs in the knee region of their hosts (Bartlett, 1983, 1984b; Bartlett and Greiner, 1986). The genus was reviewed by Bartlett and Greiner (1986), and previously Bartlett (1983, 1984a, 1984b, 1984c) examined the development and transmission patterns of *P. scapiceps*, as well as studied the geographic and host range of *P. scapiceps* across the United States and Canada; her results showed that this species is a common parasite of lagomorphs on the continent and that *P. scapiceps* originated through host capture from birds in a southern locality because the species seems to be more common in *Sylvilagus floridanus* (Allen, 1890) than in *Lepus* spp.

The Tehuantepec jackrabbit *Lepus flavigularis* Wagner, 1844 is an endangered species endemic to a small area in the state of Oaxaca in southern Mexico. This hare is nocturnal and inhabits sand dunes covered by shrubs and grasses close to the coastal shore. It occurs in sympatry with the cottontail *S. floridanus*. To our knowledge, there is no record of any parasite from this jackrabbit. In the present article, we propose a third species of *Pelecitus* (Nemata: Onchocercidae) from mammals, being the 17th species in the genus.

### MATERIALS AND METHODS

Specimens upon which this description is based were obtained from a scrotal male Tehuantepec jackrabbit that died after capture during a marking protocol on 5 February 2001. The jackrabbit was skinned and 5 capsules containing 2–4 nematodes were removed from the space between the subcutaneous and cartilaginous tissues at the base of both ears. The worms released from the capsules were stored in 70% ethanol,

and some complete capsules were preserved in the same fluid. Half of the specimens were cleared in lactophenol, whereas the remaining half were cleared in glycerin. Cleared specimens were measured with a SigmaScanPro™ Image Analyzer, San Rafael, California (Albinger et al., 1995), attached to a Zeiss Ultraphot™ microscope. Measurements provided throughout the text are in micrometers (μm), unless otherwise stated; the range, mean, and coefficient of variation indicated between parentheses are provided. Drawings were made with the aid of a Wild microscope equipped with a drawing tube. Specimens prepared for scanning electron microscopy (SEM) were dehydrated, dried by critical point drying using CO<sub>2</sub>, coated with gold palladium, and imaged using a beam of 15 kV in a Hitachi S-2460N.

Abbreviations for museums are as follows. Colección Nacional de Mamíferos, CNMA; Colección Nacional de Helminthos, CNHE, both in the Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City, Mexico; The Harold W. Manter Laboratory of Parasitology, HWML, University of Nebraska–Lincoln, Lincoln, Nebraska, and United States National Parasite Collection, USNPC, Beltsville, Maryland. We compared our material with *Dirofilaria scapiceps* USNPC 44754, 77344, 77863, and 77864, and *Pelecitus tubercauda* Vanderbilt, Anderson and Stock, 1984 USNPC 77836.

### DESCRIPTION

#### *Pelecitus meridionaleporinus* n. sp.

(Figs. 1–10)

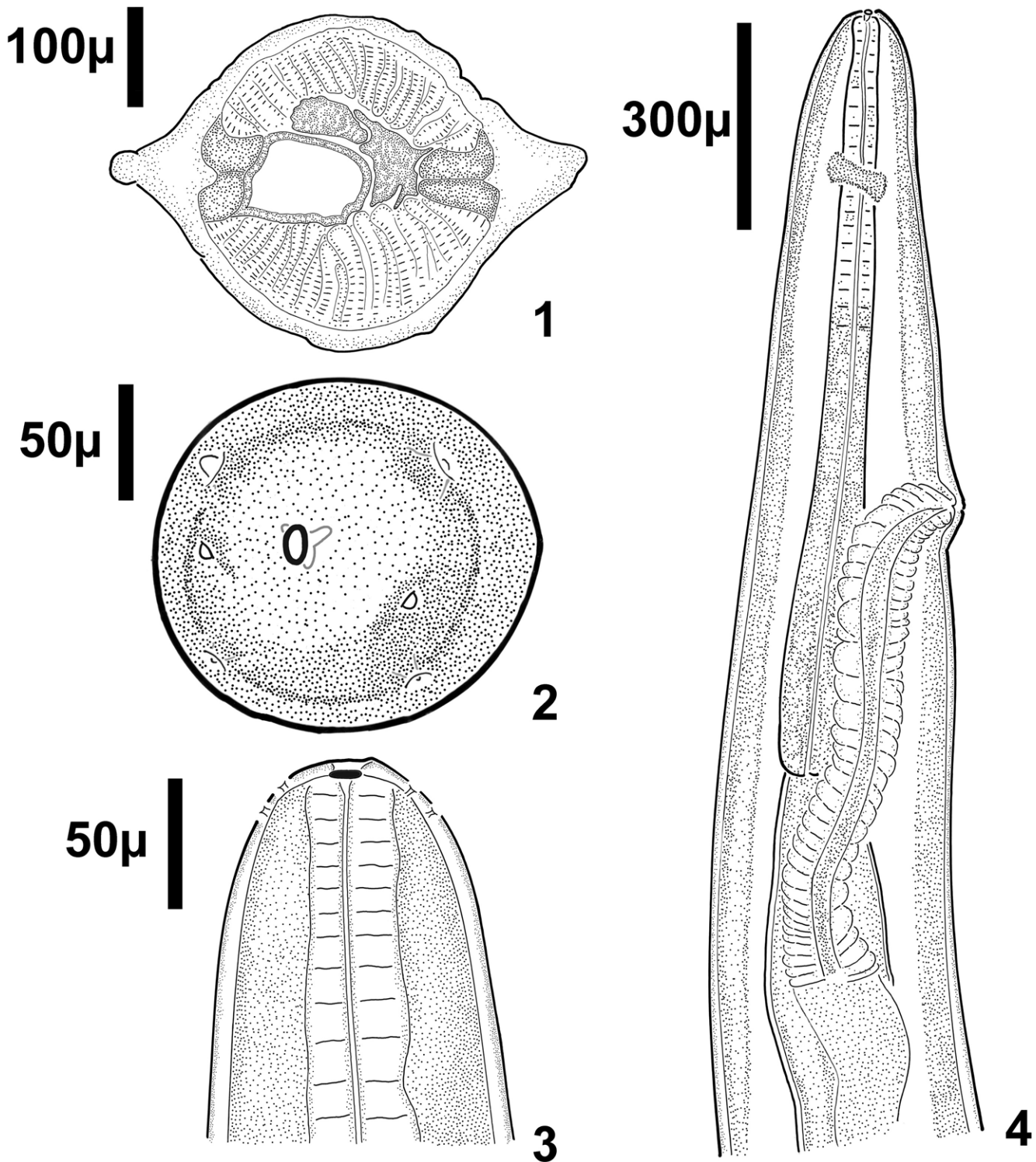
**General:** (Filarioidea: Onchocercidae). Body in dextral spiral. Body width uniform through most of length but tapering gradually at both ends. Lateral alae extending from cervical region to caudal end, asymmetrical both in size and shape; left larger than right; left ala with constriction (Fig. 1). Cuticle thick with delicate transversal striations. A pair of lateral amphids, 2 pairs of sessile submedial cephalic papillae (Fig. 2). Stoma small and circular (Fig. 2). Readily apparent preesophageal ring (Figs. 2, 3). Esophagus clearly divided behind nerve ring into muscular and glandular parts (Figs. 4, 5). Excretory pore not observed. Two asymmetrical postdeirids present in last third of body. Phasmids terminal (Fig. 6).

**Males:** Measurements on the basis of 5 specimens, unless otherwise stated. Body length 9.0–3.5 mm, 11.4 mm (18.8%), with 2.5 to 4 turns. Body width at level of nerve ring 128–169, 148 (11%); maximum width 284–362, 322 (11%), width at bases of caudal alae 106–117, 111 (5%). Transverse striations at midbody 2–5, 4 (31%) apart. Left ala 68–120, 101 (23%); right ala 65–115, 93 (24%), both at midbody. Nerve ring from anterior end 146–229, 178 (19%); excretory pore not seen. Total length of esophagus 821–1,007, 893 (11%); muscular esophagus 284–453, 382 (18%) long, 36–63, 45, (24%) wide; glan-

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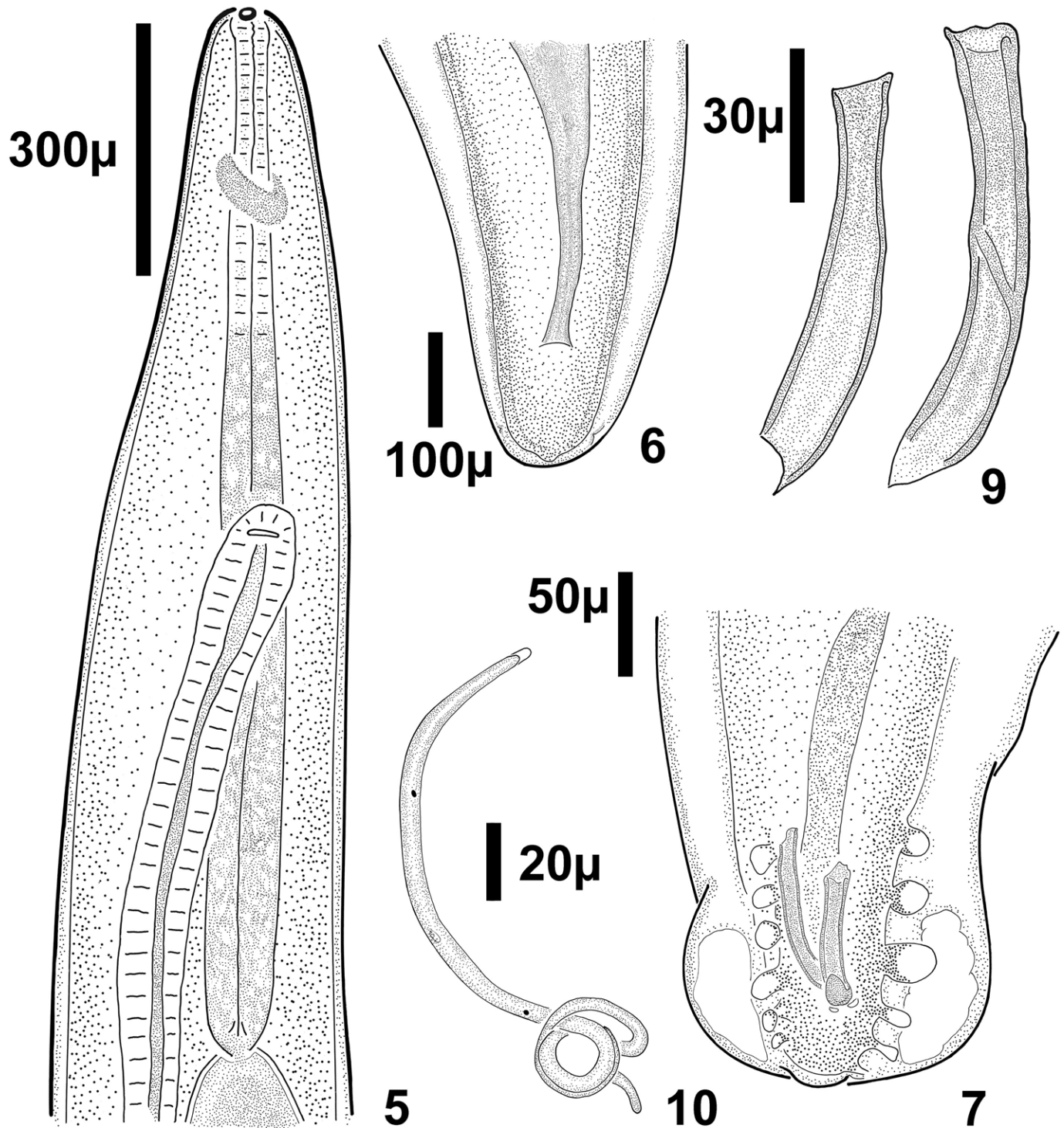
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FIGURES 1–4. *Pelecitus meridionaleporinus* n. sp. **1.** Cross section of a male at midbody, displaying the difference in size of alae. **2.** Face view of a male showing the stoma and submedial cephalic papillae, and amphids. **3.** Anterior end of a male showing papillae and the preesophageal ring. **4.** Anterior end in lateral view of a female, showing the salient vulva, esophagus, and vagina.

dular portion of esophagus 427–593, 512 (13%) long, 69–87, 81 (9%) wide. Four to 6 lateral left papillae; 4 to 6 right papillae (Fig. 7), embedded in expanded cuticle (Figs. 7, 8). One medial papilla anterior to anus; 2 medial papillae posterior to anus

(Figs. 7, 8). Spicules subequal (Fig. 9), left 75–102, 86 (n = 6; 12%) long, 10–12, 11 (n = 6; 7%) wide; right 102–119, 111 (n = 6; 6%) long, 10–14, 12 (n = 6; 15%) wide. Postdeirids n = 3, 774, 801, and 943 from posterior end. Tail 55–81, 64 (n



FIGURES 5–7,9–10. *Pelecitus meridionaleporinus* n. sp. 5. Anterior end in ventral view of a female. 6. Posterior end of a female showing the subterminal phasmids. 7. Tail of a male in ventral view showing the lateral papillae, hyaline lateral inclusions and lateral expansion of the cuticle. 8. Tail of a male in lateral view. 9. Spicules in lateral view. 10. Microfilaria extracted from the uterus of a gravid female.

= 7; 14%) long (Figs. 7, 8). Tail with symmetrical alae, each containing granular inclusions forming a single mass (Fig. 7).

*Females:* Measurements on the basis of 10 specimens, unless otherwise stated. Body length 12.5–28.0 mm, 19.6 mm (24.4%) with 3.5 to 6 turns, depending on size. Width at level of nerve ring 128–216, 166 (18%); maximum width 245–612, 417

(28%); width at anal level 106–214, 141 (n = 9, 32%). Transverse striations at midbody 5–8, 6 (21%). Width of left ala 83–168, 118 (n = 11, 22%); width of right ala 82–149, 108 (n = 11, 24%) both at midbody. Nerve ring 161–252, 214 (17%) from anterior end. Excretory pore not seen. Total length of esophagus 800–1,266, 1,065 (15%); muscular esophagus 266–

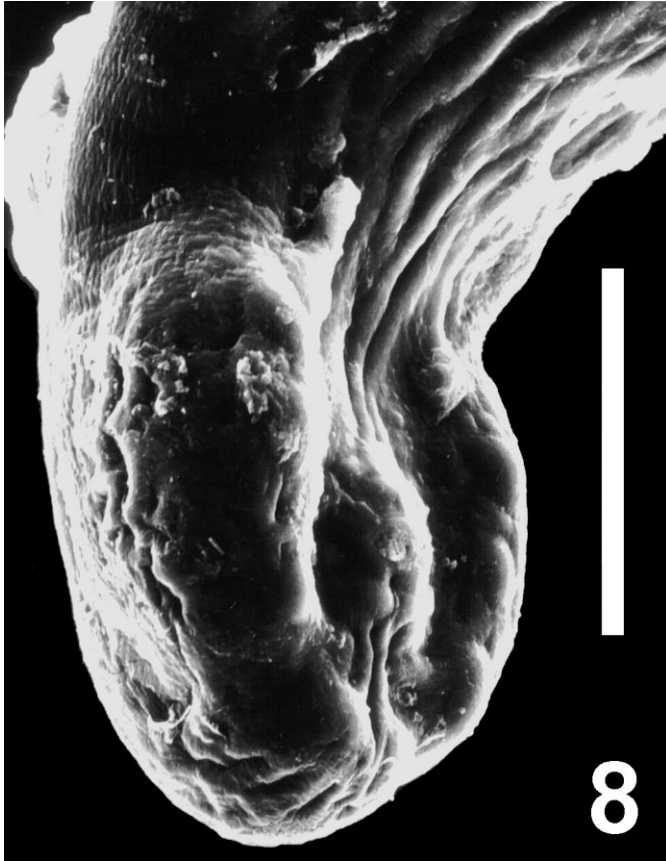


FIGURE 8. Scanning electron micrograph of the tail of *Pelecitus meridionaleporinus* n. sp. displaying the caudal ala and papillae. Bar = 50  $\mu$ .

499, 385 (20%) long, 39–66, 49 (15%) wide; glandular portion of esophagus 510–837, 679 (16%) long, 75–114, 88 (16%) wide (Figs. 4, 5). Vulva anterior to esophagointestinal junction and salient from body located 473–939, 677 (23%) from anterior end (Figs. 4, 5). Length of vagina 686–976, 799 (n = 8, 11%). Postdeirids were not seen. Tail 85–161, 111 (n = 9, 23%) (Fig. 6).

*Microfilaria*: (From uterus n = 4). Anterior end blunt, posterior end tapering gradually and ending in a narrow blunt tip. Total length 210–285, 255 (14%), maximum width 6–8, 7 (8%) (Fig. 10).

#### Taxonomic summary

*Type specimens*: Holotype male CNHE 4819, Allotype female CNHE 4820, Paratypes CNHE 4821, HWML 45825–HWML 45830.

*Symbiotype*: *Lepus flavigularis* Wagner, 1844. (liebre tropical, Tehuantepec jackrabbit, Isthmian jackrabbit), CNMA: 39696. Collected 5 February 2001.

*Type locality*: Llano San Lorenzo, 8.9 km northwest of Montecillo Santa Cruz, Municipio Santiago Niltepec, Oaxaca, Mexico, 16°26'26.3"N, 94°38'11.0"W, elevation 38 m.

*Site of infection*: Subcutaneous tissues at the base of ears.

*Etymology*: The species name *meridionaleporinus* is a blending of the Latin words “meridionalis” southern and “lepori-

nus” of hares. It makes reference to the finding of this species in the most southern hare in the New World.

#### Remarks

Individuals of *P. meridionaleporinus* n. sp. are different from all the other species in the genus in having a constriction along the left lateral ala. They also have asymmetrical lateral alae, fine transverse striations on the cuticle, a readily apparent preesophageal ring, females have a salient vulva anterior to the esophagointestinal junction, and males have just 1 pair of ventral postcloacal papillae and granular inclusions forming a unique mass on each side of the tail.

Three species most closely resemble *P. meridionaleporinus* n. sp., including *Pelecitus helicinus* (Molin, 1860) and *P. tubercauda* Vanderburgh, Anderson and Stock, 1984 (both parasites of birds) and *P. scapiceps* (Leidy, 1886), which also occurs in lagomorphs.

First, *P. meridionaleporinus* n. sp. is similar to *P. helicinus* (Molin, 1860) in the position of the vulva, asymmetry of lateral alae, and in the number of sublateral caudal papillae. They are different in that the latter has strong transversal striations, delicate or absent preesophageal ring, a nonsalient vulva with associated teardrop cells, and 2–5 sessile subterminal papillae. Second, the species presently described and *P. tubercauda* are similar in the position of the vulva, asymmetry of lateral alae, ornamentation of cuticle, and number of caudal papillae. They can be distinguished because *P. tubercauda* has a delicate preesophageal ring, esophagus inconspicuously divided into muscular and glandular portions, cuticle of the tail of males not laterally expanded, and the hyaline inclusions in the tail are conglomerated in 3–4 independent masses. Third, *P. meridionaleporinus* n. sp. and *P. scapiceps* share more similarities; however, specimens belonging to the latter can be distinguished by their symmetrical lateral alae, delicate preesophageal ring, esophagus inconspicuously divided in muscular and glandular portions; nonsalient vulva posterior to the esophageal–intestinal junction, and 2 pairs of postcloacal papillae.

Finally, *P. meridionaleporinus* n. sp. and *P. roemeri* (Linstow, 1905), parasites of macropodids, are different in the non-coiled body, symmetrical lateral alae, caudal papillae divided in an anterior set of prominent papillae, and a posterior set of smaller papillae that are characteristic of the Australian species.

#### DISCUSSION

The systematics of the Dirofiliariinae has been subject of several studies proposing the use of either adult morphology or the hosts infected as criteria to solve the relationships in the group (Eberhard and Orihel, 1984; Bartlett, 1986; Bartlett and Greiner, 1986; Omar, 1992). Among those proposals, Eberhard and Orihel (1984) named *Loaina* to include the 2 known species of filarioids from lagomorphs. However, Bartlett and Greiner (1986) proposed *Loaina* as monotypic, containing only *Loaina uniformis* (Price, 1957), and transferred *D. scapiceps* (Leidy, 1886) (= *Loaina scapiceps*) to *Pelecitus*. To date and including *P. meridionaleporinus* n. sp., there are 14 species in the genus recorded in birds and 3 in mammals; 2 of these species occur in lagomorphs of the New World.

Subsequently, a phylogenetic analysis of the taxa in Dirofiliariinae proposed by Omar (1992) shows that species of *Pele-*

*citus* are involved in a polytomy including species of both *Loaina* and *Folelleydes*. This clade includes the most derived taxa in the subfamily and supports the grouping previously proposed by Bartlett (1986) on the basis of her study of adult morphology of filarioids. In addition, the topology proposed by Omar (1992) does not reject the hypothesis that the presence of these nematodes in mammals was because of host switching from birds (Bartlett and Greiner, 1986); however, it does not reveal any sister-group relationship among any species of *Pelecitus* and *Dirofilaria*, as hypothesized by Bartlett and Greiner (1986).

In terms of biogeography, the presence of *P. meridionaleporinus* n. sp. in southern Mexico is congruent with a putative southern origin for the species of *Pelecitus* infecting lagomorphs ("the (host) capture probably occurred in the south"; Bartlett and Greiner, 1986); however, the mere presence of the new species in a southern locality is not evidence of the origin of the species because a phylogenetic hypothesis showing their relationships is missing.

The habitat of *P. meridionaleporinus* n. sp. is also unique in that adult and gravid individuals of this species form capsules in the subcutaneous tissues at the base of the ears, whereas all the others form capsules or live freely in the subcutaneous tissues around the articulations of the legs. In her experimental infections, Bartlett (1984b) highlighted that the occurrence of capsules in the hosts was an immunological reaction of the host, and that it was probably due to the little adaptation of the parasites to that host (particularly hares). It is possible that the capsules containing *P. meridionaleporinus* n. sp. resulted from a reaction of the host. However, the full development of the parasites at the base of both ears suggests that the base of the ears may be their normal site of infection. Intensive survey on lagomorphs in the area will provide elements to test this hypothesis.

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