

PORRORCHIS NICKOLI N. SP. (ACANTHOCEPHALA: PLAGIORHYNCHIDAE) FROM MAMMALS IN SOUTHEASTERN MEXICO, FIRST KNOWN OCCURRENCE OF PORRORCHIS IN THE WESTERN HEMISPHERE

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ABSTRACT: *Porrorchis nickoli* n. sp. is described from the intestine of the gray four-eyed opossum *Philander opossum* (type host), the Virginia opossum *Didelphis virginiana*, the common opossum *Didelphis marsupialis*, and the white-nosed coati *Nasua narica*. Hosts were collected in southeastern Mexico in the Los Tuxtlas region of the state of Veracruz (type locality) and in the states of Tabasco and Chiapas. This new species is distinguished from other *Porrorchis* species by its small proboscis (0.286–0.428 mm long × 0.273–0.438 mm wide), a proboscis armature consisting of 22–24 vertical rows of 7 or 8 hooks per row, and the male reproductive system extending postequatorially and occupying only half of the trunk. This is the first known occurrence of a *Porrorchis* species in the Western Hemisphere.

The acanthocephalan genus *Porrorchis* Fukui, 1929 (Plagiorhynchidae: Porrorchinae) was revised by Schmidt and Kuntz (1967), who also provided a historical review of the group. Since this revision, 5 species have been added to the genus (Golvan, 1994), although the general view of the group as being parasites in birds and mammals in southeast Asia, India, Australia–New Zealand, and Africa has not changed. Three *Porrorchis* species are known to use a mammal as a definitive host: *Porrorchis chauhani* Gupta and Fatma, 1985 and *Porrorchis crocidurii* Gupta and Fatma, 1985, both described from the Indian musk rat *Crocidura perrotetti*; and *Porrorchis hydromuris* (Edmonds, 1957) described from the Australian water rat, *Hydromys chrysogaster*. In addition, *Porrorchis hylae* (Johnston, 1914) and *Porrorchis leiblyi* Schmidt and Kuntz, 1967 have been reported to occur incidentally in mammals in southeast Asia (Schmidt and Kuntz, 1967). Both these acanthocephalan species have avian definitive hosts, although it has not been reported whether the incidental infections in mammals included mature worms (Schmidt and Kuntz, 1967).

In the present study, acanthocephalans belonging to the genus *Porrorchis* Fukui, 1929 were found in 4 mammal species in southeastern Mexico, the first time species of this genus has been identified in the Western Hemisphere. These 4 hosts include 3 opossum species, i.e., the gray four-eyed opossum *Philander opossum* (Linnaeus, 1758), the Virginia opossum *Didelphis virginiana* Kerr, 1792, and the common opossum *Didelphis marsupialis* (Linnaeus, 1758) (Marsupialia: Didelphidae), and the white-nosed coati *Nasua narica* (Linnaeus, 1766) (Carnivora: Procyonidae). The identified *Porrorchis* species differs from congeners and is described as a new species.

MATERIALS AND METHODS

Animals were collected between 1978 and 1998 at Laguna Escondida village, the Sierra de Santa Martha, Catemaco Lake, Sontecomapan Lagoon, Balzapote, Playa Escondida, and Cárdenas at San Andrés Tuxtla, all in the Los Tuxtlas area of Veracruz (18°10'–18°45'N, 94°42'–95°27'W), at Martínez de la Torre, Veracruz, the Río Oxolotan in Tabasco, and at the Cascadas Agua Azul, Chiapas (no coordinates available). Live traps baited with canned fish were placed in the late afternoon and checked the following morning. The trapped animals were immediately taken to the laboratory for parasitological examination. Here they were euthanized with an overdose of pentobarbital, the body

cavity was opened, and the gastrointestinal tract and other viscera were examined using a dissecting microscope.

Acanthocephalans were removed alive from the host intestines and allowed to extend in tap water placed in a refrigerator. They were fixed in Bouin's fluid or AFA. Some specimens were fixed under slight pressure in Bouin's fluid. The parasites were stained in Mayer's paracarmine or Ehrlich's haematoxylin, dehydrated in an ascending ethanol series, cleared in a graded series of Terpinol–100% ethanol, and mounted in Canada balsam. Line drawings were made with the aid of a camera lucida. All measurements are in millimeters; the range is followed by the mean in parentheses. Width refers to maximum width. Hooks were measured only in lateral view. Trunk length excludes the proboscis and neck. Mature eggs were measured within the female body cavity.

DESCRIPTION

***Porrorchis nickoli* n. sp.**

(Figs. 1–3)

Based on 14 specimens (9 males, 5 females). Adults of medium size, pale yellow to white. Trunk cylindrical, slender elongate, thin walled, spinose, slightly swollen dorsally near anterior end in both sexes. Mature females larger than males. Main lacunar canals lateral, branching into reticular anastomosing ducts. Body wall containing small round to ovoid hypodermal nuclei, moderately numerous, evenly distributed. Proboscis subglobular, slightly swollen (Fig. 1), with 22–24 rows of 7 or 8 hooks each. Anterior hooks with posteriorly directed, well-developed, posteriorly enlarged simple root; fourth hook of each row the largest and strongest; basal hooks slender, with anteriorly directed manubria. Each hook surrounded at its base by definite theca of proboscis cuticle. Armature similar in both sexes. Neck well developed, robust, conical. Proboscis receptacle cylindrical, double walled, inserted at base of proboscis. Brain at about middle third of receptacle. Lemnisci approximately equal in length, flat, tongue shaped, broadest near posterior ends, much longer than proboscis receptacle. Testes oval, tandem, postequatorial. Cement glands 4, elongate. Male genital pore nearly terminal. Female genital pore subterminal. Eggs elliptical, without polar swellings.

Males (Fig. 3A, C) (measurements based on 9 specimens): Trunk 23.790–54.000 (39.895) long, 1.040–1.907 (1.511) greatest width. Proboscis 0.286–0.428 (0.373) long by 0.273–0.438 (0.357) wide. Anterior proboscis hooks 0.033–0.051 (0.041) long by 0.007–0.020 (0.010) wide at base; middle hooks 0.036–0.054 (0.043) long by 0.010–0.015 (0.012) wide at base; basal hooks 0.026–0.039 (0.029) long by 0.005–0.007 (0.006) wide at base. Neck 0.357–0.979 (0.721) long by 0.316–0.530 (0.423) wide. Proboscis receptacle 0.816–1.387 (1.131) long by 0.132–0.336 (0.267) wide. Lemnisci 1.740–3.386 (2.811) long by 0.360–0.867 (0.663) wide. Reproductive system (Fig. 3A,C) in posterior half of trunk, 7.650–18.150 (11.315) long. Testes oval, tandem. Anterior testis 0.999–2.610 (1.951) long by 0.489–1.050 (0.800) wide; posterior testis 0.958–2.100 (1.702) long by 0.306–1.050 (0.700) wide. Four cement glands, tubular, 5.040–12.900 (8.470) long by 0.112–0.387 (0.238) wide each. Saefftingen's pouch claviform in shape, 0.836–2.244 (1.744) long by 0.255–0.900 (0.501) wide. Male genital pore almost terminal.

Received 8 March 2001; revised 11 July 2001; accepted 11 July 2001.

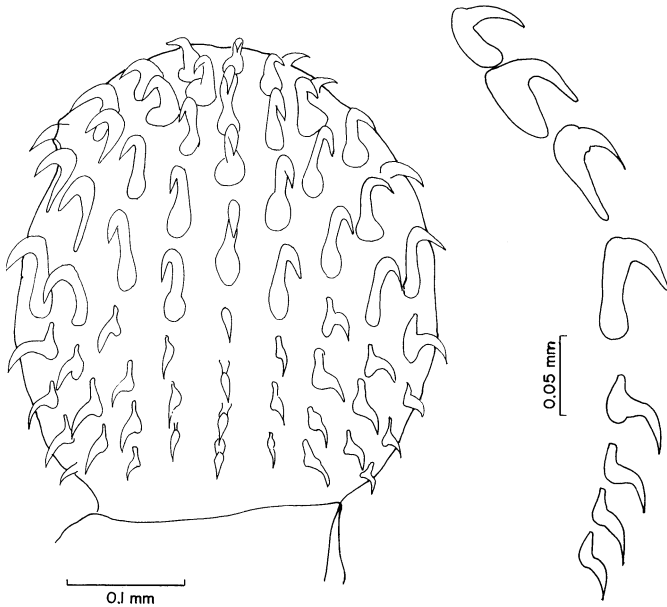


FIGURE 1. *Porrorchis nickoli* n. sp. Proboscis and complete row of hooks of holotype male.

Females (Fig. 3A, D) (measurements based on 4 mature and 1 gravid specimen): Trunk 23.370–60.000 (49.770) long by 0.960–3.000 (1.806) greatest width. Proboscis 0.416–0.436 (0.409) long by 0.275–0.488 (0.388) wide. Anterior proboscis hooks 0.044–0.054 (0.048) long by 0.007–0.015 (0.012) wide at base; middle hooks 0.039–0.054 (0.045) long by 0.013–0.015 (0.013) wide at base; basal hooks 0.018–0.039 (0.028) long by 0.005–0.010 (0.006) wide at base. Neck 0.408–0.816 (0.596) long by 0.408–0.581 (0.487) wide. Proboscis receptacle 0.816–1.122 (0.966) long by 0.183–0.387 (0.328) wide. Lemnisci 1.989–3.468 (2.794) long by 0.448–0.960 (0.721) wide. Anterior edge of uterine bell 2.907–3.300 (3.103) from genital pore. Uterine bell 0.510–0.612 (0.578) long. Eggs (Fig. 3E) fusiform, without polar swellings, 0.065–0.075 (0.069) long by 0.023–0.026 (0.023) wide.

Taxonomic summary

Type host: Gray four-eyed opossum, *Philander opossum* (Linnaeus, 1758) (Marsupialia: Didelphidae).

Other hosts: Common opossum, *Didelphis marsupialis* (Linnaeus, 1758), and Virginia opossum, *Didelphis virginiana* Kerr, 1792 (Marsupialia: Didelphidae); white-nosed coati, *Nasua narica* (Linnaeus, 1766) (Carnivora: Procyonidae).

Site of infection: Small intestine.

Type locality: Laguna Escondida village, Los Tuxtlas, Veracruz, Mexico (18°10'–18°45'N, 94°42'–95°27'W).

Other hosts and localities: *Philander opossum* Playa Escondida, Los Tuxtlas, Veracruz, June 1980; Río Oxolotán, Tabasco, March 1981; Laguna Escondida lake, Los Tuxtlas, Veracruz, April 1998. *Didelphis marsupialis* Martínez de la Torre, Veracruz, March 1987. *Didelphis virginiana* Cascadas Agua Azul, Chiapas, March 1981; Cárdenas, San Andrés Tuxtla, Veracruz, June 1991; Balzapote, Veracruz, June 1991; Sontecomapan, Veracruz, April 1997; Catemaco Lake, Veracruz, April 1997. *Nasua narica* Sierra Santa Martha, Los Tuxtlas, Veracruz, May 1978.

Specimens deposited: Type specimens deposited in the Colección Nacional de Helmintos (CNHE), Instituto de Biología, Universidad Nacional Autónoma de México, holotype male catalog no. 4377, allotype female no. 4378, paratypes nos. 4379, 4380 and 4381.

Prevalence and intensity: For *Philander opossum* from Laguna Escondida village, 2 animals were infected with 4 and 5 acanthocephalans each; from Playa Escondida, 1 of 5 animals examined was infected with 1 acanthocephalan; from Río Oxolotán, Tabasco, the single opossum examined was infected with 1 acanthocephalan. For *Didelphis marsupialis* from Martínez de la Torre, Veracruz, the single animal examined

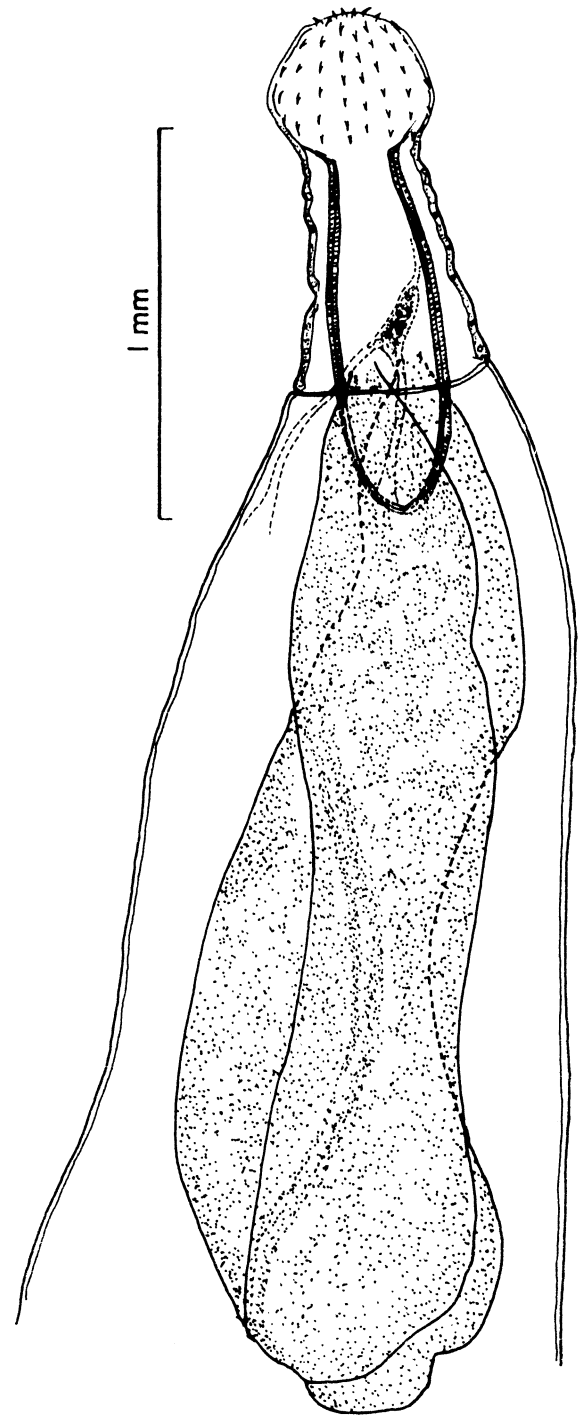


FIGURE 2. *Porrorchis nickoli* n. sp. Praesoma and anterior region of trunk of a paratype.

was infected with 2 acanthocephalans. For *Didelphis virginiana* from Cascadas Agua Azul, Chiapas, the single specimen examined was infected with 3 acanthocephalans; from Cárdenas, San Andrés Tuxtla, Veracruz, the single opossum examined was infected with 4 acanthocephalans; from Balzapote, Veracruz, the single opossum examined was infected with 6 acanthocephalans; from Catemaco Lake the single opossum examined was infected with 1 acanthocephalan; from Sontecomapan, Veracruz, 2 animals examined were each infected with 2 acanthocephalans.

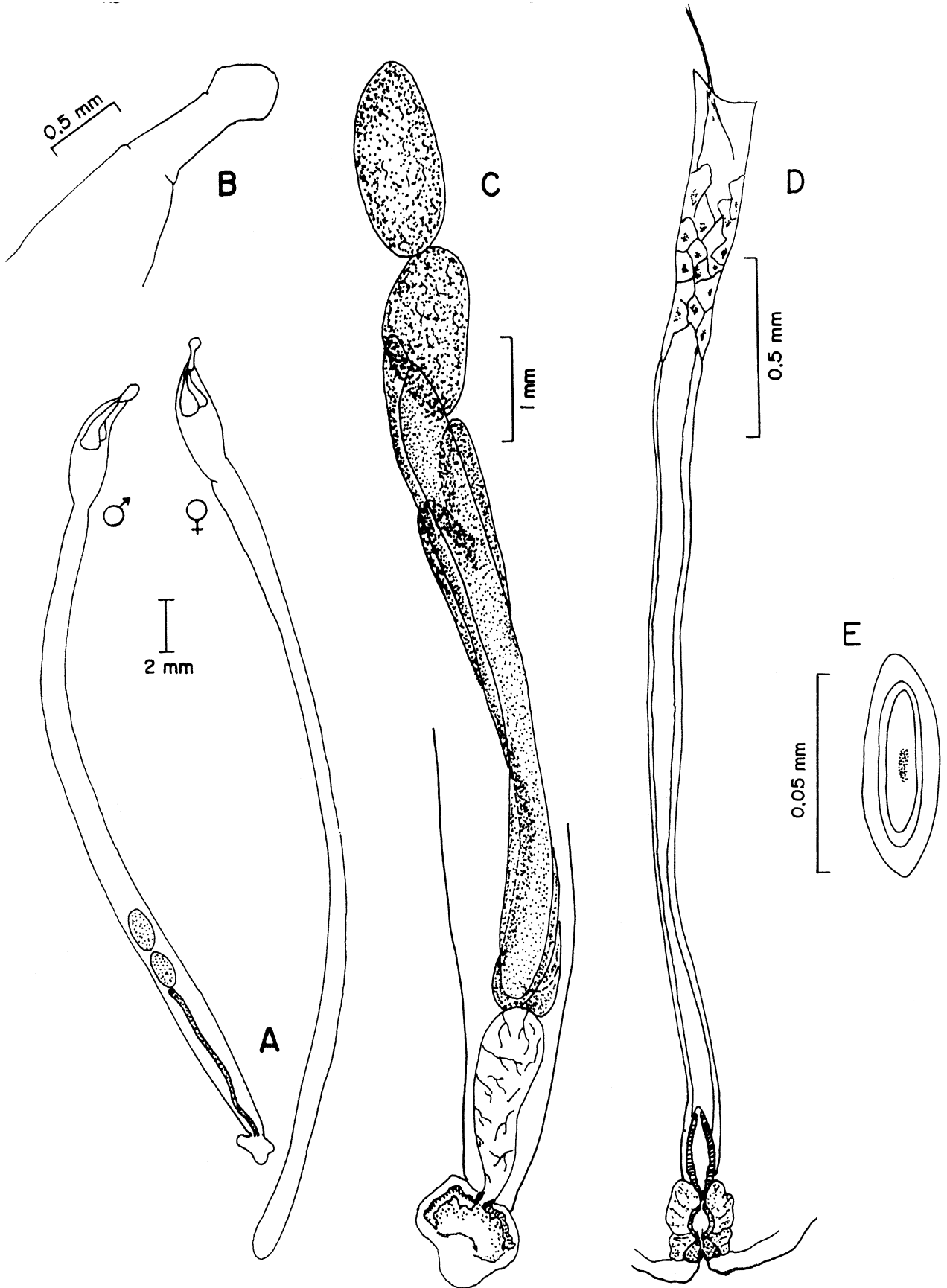
TABLE I. Known species of *Porrorchis* Fukui, 1929.*

Species	Total length (mm)	Proboscis armature	Proboscis length × width (mm)	Length of hooks (mm)		
				Apical	Middle	Basal
<i>P. elongatus</i> Fukui, 1929	11–38 M 30–55 F 33–40 M 35–55 F	32–34 rows × 13 or 14 hooks/row 28–34 × 11–14	0.830–0.900 × 0.580–0.710 0.825–0.900 × 0.520–0.700	0.070–0.072 0.090	0.078–0.088	0.055–0.078
<i>P. bazae</i> (Southwell and Macfie 1925) Schmidt and Kuntz, 1967	33 M 50 F (fragment)	38–41 × 12 or 13 30–32 × 11 or 12	0.900 × 0.640			
<i>P. brevicanthus</i> (Das, 1949) Golvan, 1994						
<i>P. centropi</i> (Porta, 1910) Schmidt and Kuntz, 1967	30–35 M 50 F	20–24 × 10–12	1.200 × 1.000	0.030	0.060	0.038–0.042
<i>P. centropusi</i> (Tubangui, 1933) Petrochenko, 1958	11.5–14.5 M 20–30 F	26 × 8–10	0.400–0.500 × 0.400–0.460	0.087–0.102		0.042–0.048
<i>P. chauhani</i> Gupta and Fatma, 1986	14 M 10.9–15.0 F	26–28 × 10–12	0.700 M 0.550–0.600 F	0.058–0.060		0.050–0.055
<i>P. crocidurai</i> Gupta and Fatma, 1986	8.5–9 M 10–12.85 F	20–24 × 8 or 9	0.550–0.600 × 0.400–0.500	0.060–0.062		
<i>P. hoidemeri</i> (Joyeux and Baer 1935) Schmidt and Kuntz, 1967	36 M 50–55 F	22–24 × 11 or 12	0.800–1.000 × 0.380–0.500	0.054	0.050	
<i>P. hydromuris</i> (Edmons, 1957) Schmidt and Kuntz, 1967	14–17 M 12–19 F	26 × 7 or 8	0.600–0.660 × 0.380 0.400–0.460	0.040–0.050		
<i>P. hylae</i> (Johnston, 1914) Schmidt and Kuntz, 1967	20–30 M 33–58 F 48–52 M 56–81 F	24–28 × 8–10 26–28 × 10	0.500 × 0.390–0.440 0.550–0.650 × 0.370–0.430	0.040–0.050 M 0.038–0.053 F	0.056–0.059 M 0.065–0.071 F	0.030–0.044 M 0.055–0.059 F
<i>P. indicus</i> (Das, 1957) Schmidt and Kuntz, 1967	28 M 46 F	20–24 × 8 or 9	0.400 × 0.300	0.040–0.060		0.025–0.030
<i>P. keratensis</i> George and Nadakal, 1984	30–35 M 32–42 F	22–26 × 8 or 10	0.600–0.800 × 0.200–0.390	0.020–0.030	0.047–0.050	0.034–0.038
<i>P. leihi</i> Schmidt and Kuntz, 1967	35–42 M 42–60 F	30–37 × 8 or 12	0.490–0.535 × 0.410–0.535	0.390–0.590	0.079–0.093	0.059–0.072
<i>P. maxvachoni</i> (Golvan and Brygoo, 1965) Schmidt and Kuntz, 1967	41 M 55 F	40–44 × 8 or 10	0.850 × 0.700 M 1.00 × 0.800 F	0.055	0.050	0.035
<i>P. oti</i> Yamaguti, 1939	51–62 F	46–50 × 10	0.800 × 0.920	0.048–0.600		0.060–0.066
<i>P. rotundatus</i> (Von Linstow, 1897) Schmidt and Kuntz, 1967	30–35 M 32–48 F	28–32 × 10 or 11	0.650–0.750 × 0.550–0.600	0.025	0.040	
<i>P. nickoli</i> n. sp.	23.8–54.0 M 23.4–60.0 F	22–24 × 7 or 8	0.286–0.428 × 0.273–0.438	0.033–0.051 M 0.044–0.054 F	0.036–0.054 M 0.039–0.054 F	0.026–0.039 M 0.018–0.039 F

* M = males; F = females

TABLE I. Continued.

Species	Egg length × width (mm)	Hosts	Geographic distribution	Reference
<i>P. elongatus</i> Fukui, 1929	0.035–0.060 × 0.018–0.028	Birds	Japan	Fukui, 1929
<i>P. bazae</i> (Southwell and Macfie 1925) Schmidt and Kuntz, 1967	0.060–0.065 × 0.026–0.028	Birds	Japan, Taiwan, Philippines	Schmidt and Kuntz, 1967
<i>P. brevicanthus</i> (Das, 1949) Golvan, 1994	0.078 × 0.041		Australia (Queensland)	George and Nadakal, 1984
<i>P. centropi</i> (Porta, 1910) Schmidt and Kuntz, 1967	0.060 × 0.025	Birds	India	Yamaguti, 1968
<i>P. centropusi</i> (Tubangui, 1933) Petrochenko, 1958	0.029–0.037 × 0.014–0.018	Birds	Africa	Golvan, 1956a; Golvan and Brygoo, 1965
<i>P. chauhanii</i> Gupta and Fatma, 1986	0.040–0.042 × 0.026–0.030	Mammals	Philippines	Golvan and Brygoo, 1965; Tubangui, 1933
<i>P. crocidurii</i> Gupta and Fatma, 1986	0.070 × 0.031	Mammals	India	Gupta and Fatma, 1985
<i>P. houdemeri</i> (Joyeux and Baer 1935) Schmidt and Kuntz, 1967	0.068–0.075 × 0.032–0.036	Birds	Indochina	Joyeux and Baer, 1935; Golvan and Brygoo, 1965
<i>P. hydromuris</i> (Edmonds, 1957) Schmidt and Kuntz, 1967	0.059–0.065 × 0.027–0.029	Mammals	Australia	Edmonds, 1957
<i>P. hylae</i> (Johnston, 1914) Schmidt and Kuntz, 1967	0.540–0.060 × 0.024–0.028	Birds, amphibians, reptiles	Australia, Philippines, India, Taiwan	Schmidt and Kuntz, 1967; Edmonds, 1957
<i>P. indicus</i> (Das, 1957) Schmidt and Kuntz, 1967	0.032–0.050 × 0.011–0.020	Amphibians	Australia	Golvan and Brygoo, 1965
<i>P. keralensis</i> George and Nadakal, 1984	0.050–0.060 × 0.025–0.035	Birds	India	George and Nadakal, 1984
<i>P. leibyi</i> Schmidt and Kuntz, 1967	0.065–0.070 × 0.029–0.034	Birds, mammals, amphibians, reptiles	Taiwan, Philippines	Schmidt and Kuntz, 1967
<i>P. maxvachoni</i> (Golvan and Brygoo, 1965) Schmidt and Kuntz, 1967	0.060 × 0.030	Birds	Madagascar	Golvan and Brygoo, 1965
<i>P. oti</i> Yamaguti, 1939	0.060–0.065 × 0.030–0.033	Birds	Japan	Yamaguti, 1968
<i>P. rotundatus</i> (Von Linstow, 1897) Schmidt and Kuntz, 1967	0.065–0.075 × 0.023–0.026	Birds	Madagascar	Golvan, 1956b; Golvan and Brygoo, 1965
<i>P. nickoli</i> n. sp.		Mammals	Mexico	Present work



Etymology: The species is named after Dr. Brent B. Nickol, a well-known specialist on Acanthocephala.

DISCUSSION

The new species clearly fits within the characteristics of *Porrorchis* Fukui, 1929 as presented by Schmidt and Kuntz (1967) based on the presence of anterior swelling of the cylindrical trunk in both sexes. It also has numerous small hypodermal nuclei, lateral main lacunar canals, and a subglobular-ovoid proboscis bearing numerous longitudinal rows of hooks. The first 4 hooks in each row are strong, with well-developed simple roots, and the remaining spines are rootless but with a simple anteriorly directed manubrium. A double-walled proboscis sheath inserts at the base of the proboscis, and the brain is located at approximately the middle of the sheath. Other characteristics include long, flat lemnisci; tandem, oval testes; and long, tubular cement glands.

Porrorchis currently includes 16 species (Amin, 1985; Golvan, 1994) (Table I) distributed throughout southeast Asia, India, the Philippines, Australia, Madagascar, and Africa. Most species are parasites in birds, although 3 species, *P. chauhani* Gupta and Fatma, 1985, *P. crocidurai* Gupta and Fatma, 1985, and *P. hydromuris* (Edmonds, 1957) have been recorded in mammals. Two additional species, *P. hylae* (Johnston, 1914) and *P. leiblyi* Schmidt and Kuntz, 1967, have been reported as incidental in mammals.

Morphologically, 3 major characteristics separate *P. nickoli* n. sp. from all other species of this genus: (1) a smaller proboscis, (2) the armature of proboscis bearing few rows and few hooks per row compared with other species, and (3) the male reproductive system occupying only the posterior half of trunk.

Species of *Porrorchis* are characterized by an ovoid proboscis bearing numerous longitudinal rows of hooks (Schmidt and Kuntz, 1967). Length of the proboscis ranges from 0.400–0.500 in *P. centropusi* Tubangui, 1933 to 1.200 in *P. centropi* (Porta, 1910) (Table I); *P. nickoli* n. sp. can be distinguished from all other *Porrorchis* species by its much smaller proboscis (0.286–0.428). The new species is further distinguished from all other species of the genus by its proboscis armature having only 22–24 rows of 7 or 8 hooks per row as compared with armatures ranging from 20–24 rows of 8 or 9 hooks per row in *P. crocidurai* Gupta and Fatma, 1986 and *P. indicus* (Das, 1957) to 46–50 rows of 10 hooks per row in *P. oti* Yamaguti, 1939 (Table I).

Porrorchis centropusi (Tubangui, 1933) and *P. hydromuris* (Edmonds, 1957) also have a small proboscis. However they can be distinguished from *P. nickoli* based on the number of rows on the proboscis armature; *P. centropusi* has 26 rows of 8–10 hooks each, and *P. hydromuris* has 26 rows of 7 or 8 hooks each.

Porrorchis nickoli n. sp. is also similar to *P. indicus* (Das, 1957), a parasite of the mammal *Crocidura perrotteti* from India, in trunk size and proboscis size and armature. These 2 species can be distinguished by the size of middle proboscis

hooks (*P. indicus* 0.07–0.09 vs. *P. nickoli* 0.036–0.054 in males and 0.039–0.054 in females) and by egg size (*P. indicus* 0.032–0.050 × 0.011–0.020 vs. *P. nickoli* 0.065–0.070 × 0.023–0.026).

A very distinct feature of *P. nickoli* n. sp. is the position of the male reproductive system, which occupies only the posterior half of trunk. This character differs from other known *Porrorchis* species, which have a pre-equatorial male reproductive system, often beginning near the proboscis sheath and occupying most of the trunk.

The helminth parasite fauna of American marsupials is well known in both North America and South America (e.g., Potkay, 1970; Blumenthal and Kirkland, 1976; Correa-Gomes, 1979; Alden, 1995), but there are no reports of a species matching the characteristics of *P. nickoli* n. sp. Therefore, it seems *P. nickoli* n. sp. is a Middle American Neotropical species. This characterization is congruent with the fact that *P. nickoli* has not been identified in the opossum species *Didelphis virginiana* from the states of Durango (n = 1 host examined), Sinaloa (n = 2), Jalisco (n = 6), Colima (n = 43), Michoacán (n = 4), and the State of México (n = 1), all in more northerly regions of Mexico.

ACKNOWLEDGMENTS

The authors are indebted to Fernando A. Cervantes Reza, Curator of the National Mammals Collection of Mexico, for the identification of the hosts. We also thank Isabel Cristina Cañeda-Guzmán and Daniel Prado Ancona for their assistance in field and laboratory and 2 anonymous reviewers for their helpful comments.

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FIGURE 3. *Porrorchis nickoli* n. sp.; drawn from specimens placed in a Petri dish with 70% ethyl alcohol. **A.** Male and female. **B.** Typical form of the proboscis and anterior region of trunk. Internal organs and hooks on the proboscis were omitted for clarity. **C.** Reproductive system of holotype male. **D.** Reproductive system of allotype female. **E.** Egg in the uterus.

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