JOPAA2 98(6) 1055–1314 (2012)
(ISSN 0022-3395)

The Journal of

PARASITOLOGY

Founded by Henry Baldwin Ward

VOLUME 98 NUMBER 6
DECEMBER 2012

The Journal of the American Society of Parasitologists

J. Parasitol., 98(6), 2012, pp. 1176–1184

NEW RECORDS OF ACANTHOCEPHALANS FROM BIRDS IN THE PHILIPPINES WITH A DESCRIPTION OF A NEW *PORRORCHIS* SPECIES AND IDENTIFICATION KEYS FOR THE GENUS

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ABSTRACT: Three acanthocephalan species, *Sphaerirostris turdi* from the island thrush (*Turdus poliocephalus*), and *Porrorchis centropusi* and *Porrorchis kinsellai* n. sp., both from Philippine scops owls (Otus megalotis), are reported from Aurora Province, Luzon Island, Philippines. *Porrorchis kinsellai* n. sp. can be readily differentiated from previously known members of the genus by an almost perfectly spherical proboscis and presence of a characteristic finger-like process at the female posterior end, among other features. *Porrorchis centropusi* and *Porrorchis hylae* are regarded as synonyms by some authors, but based on several morphological features, they are considered separate species here. A key to the identification of all known species of *Porrorchis* (other than insufficiently described *Porrorchis brevicanthus*) is provided.

Acanthocephalans from birds in the Philippines were first reported by Tubangui (1933). One of the 6 species reported by Tubangui, namely, *Echinorhynchus centropusi* Tubangui, 1933, from the Philippine coucal (*Centropus viridis* [Scopoli, 1786]), was transferred by Joyeux and Baer (1935) into *Pseudoporrorchis* Joyeux and Baer, 1935. Later, Schmidt and Kuntz (1967) re-examined co-types of *E. centropusi* and synonymized this species with *Porrorchis hylae* Johnston, 1914. A discussion regarding the conspecificity of *P. hylae* and *Porrorchis centropusi* is provided here. Schmidt and Kuntz (1967) described *Porrorchis leibyi* Schmidt and Kuntz, 1967, from the collared scops owl (*Otus bakkamoena glabripes* [Swinhoe, 1870]), spotted scops owl (*Otus spilocephalus hambroecki* [Swinhoe, 1870]), Palawan scops owl (*Otus bakkamoena fuliginosus* [Sharpe, 1888]), and black-eared kite (*Milvus lineatus lineatus* [Gray, 1831]) from Taiwan and the Philippines (the holotype was collected in Taiwan). In addition, from Taiwan and the Philippines, Schmidt and Kuntz (1967) reported the type species of the genus, *Porrorchis elongatus* Fukui, 1929, initially described from Japan (Fukui, 1929). The type material of *P. elongatus* was destroyed during World War II; thus, Schmidt and Kuntz (1967) established a neotype for this species. Recently, Eduardo and Celis (2007) described *Pseudolueheia tongsoni* Eduardo and Celis, 2007, from Philippine scops owls (*Otus megalotis* [Walden, 1875]).

In the course of a biodiversity survey of terrestrial vertebrates and their parasites in the Philippines, we found acanthocephalans in 1 island thrush (*Turdus poliocephalus,* Latham, 1802) and 2 Philippine scops owls (*O. megalotis*). The thrush had the acanthocephalan *Sphaerirostris turdi*, and the owls harbored 2 species of *Porrorchis*, 1 of which is described herein as new to science. We also provide keys to identification of known species of *Porrorchis*.

MATERIALS AND METHODS

Acanthocephalans were found in 1 *T. poliocephalus* and 2 *O. megalotis* individuals trapped in May–June of 2009 by mist nets at 2 sites in the Aurora Province, Luzon Island, Philippines. Six specimens of the new species of *Porrorchis* were found in the intestine of 1 of 2 *O. megalotis*. Live acanthocephalans were relaxed in water and fixed in 70% ethanol. Morphology of the acanthocephalans was studied on temporary total mounts cleared in Berlese's medium using a compound Zeiss Axio Imager M1 microscope equipped with DIC optics. Drawings were made with aid of a drawing tube. All measurements in the text and table are in micrometers unless otherwise stated.

Porrorchis centropusi specimens used for scanning electron microscopy (SEM) were fixed in 70% ethanol, dehydrated in a graded series of ethanol, and dried with hexamethyldisilazane (Ted Pella Inc., Redding, California) as transition fluid. The specimens were mounted on aluminum stubs using conductive double-sided tape and silver paste, coated with gold-palladium, and examined with the use of a Hitachi 4700 scanning electron microscope (Hitachi U.S.A., Mountain View, California) at an accelerating voltage of 5–10 kV. Only 6 specimens of *Porrorchis kinsellai* n. sp. were available; thus, no specimens of these species were prepared for SEM, as this is a destructive procedure.

Type material was deposited in the parasite collection of the Harold W. Manter Laboratory (HWML) of the University of Nebraska, Lincoln, Nebraska. Types were deposited at HWML with the understanding that some will ultimately be repatriated to collections in the Philippines. Hosts were deposited at the University of Kansas Natural History Museum, Lawrence, Kansas (KUMNH).

RESULTS

Centrorhynchidae Van Cleave, 1916
Sphaerirostris Golvan, 1956
Sphaerirostris turdi (Yamaguti, 1939) Golvan, 1956

(Fig. 1)

General: Body thick-walled, smooth, elongated, spindle-shaped, narrowing toward posterior end. Trunk 4.56–4.70 mm long with maximum width 1.03–1.05 mm in middle portion. Females somewhat larger than males. Proboscis 350–480, divided into 2 parts by narrow groove. Proboscis maximum width 340, minimum width 290. Neck short, 100 in length. Proboscis size and armature in males and females about the same. Proboscis armed with 26–29 longitudinal hook rows of 10–12 hooks each. First 4–5 hooks large, with powerful roots directed posteriorly; rest of hooks spine-shaped with roots directed anteriorly. Proboscis narrowest at level of 8–9 hooks. Proboscis receptacle 880–1,010 in length and 270–280 in maximum width, with bi-layered muscular walls, attached to narrowest part of proboscis. Cerebral ganglion oval, in middle portion of proboscis receptacle, at level of border between proboscis and trunk. Lemnisci sac-like, 750–880 × 140–300, attached at level of border between proboscis and trunk, extending posteriorly beyond level of proboscis receptacle.

Male: Organs of male reproductive system occupy approximately two-thirds of trunk. Testes in middle portion of trunk, tandem, slightly overlapping each other. Anterior testis 550–710 × 270–500, posterior testis 500–750 × 360–480. Cement glands 3, of varying lengths; longest cement glands may reach posterior margin of posterior testis. Male genital pore slit-like, terminal.

Female: Trunk 12.9 mm long with maximum width 2.2 mm. Body filled with eggs. Fully formed eggs elongated with fertilization membrane lacking polar prolongations. Outer shell sculptured, especially towards

Received 12 February 2012; revised 16 May 2012; accepted 4 June 2012.

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DOI: 10.1645/GE-3116.1

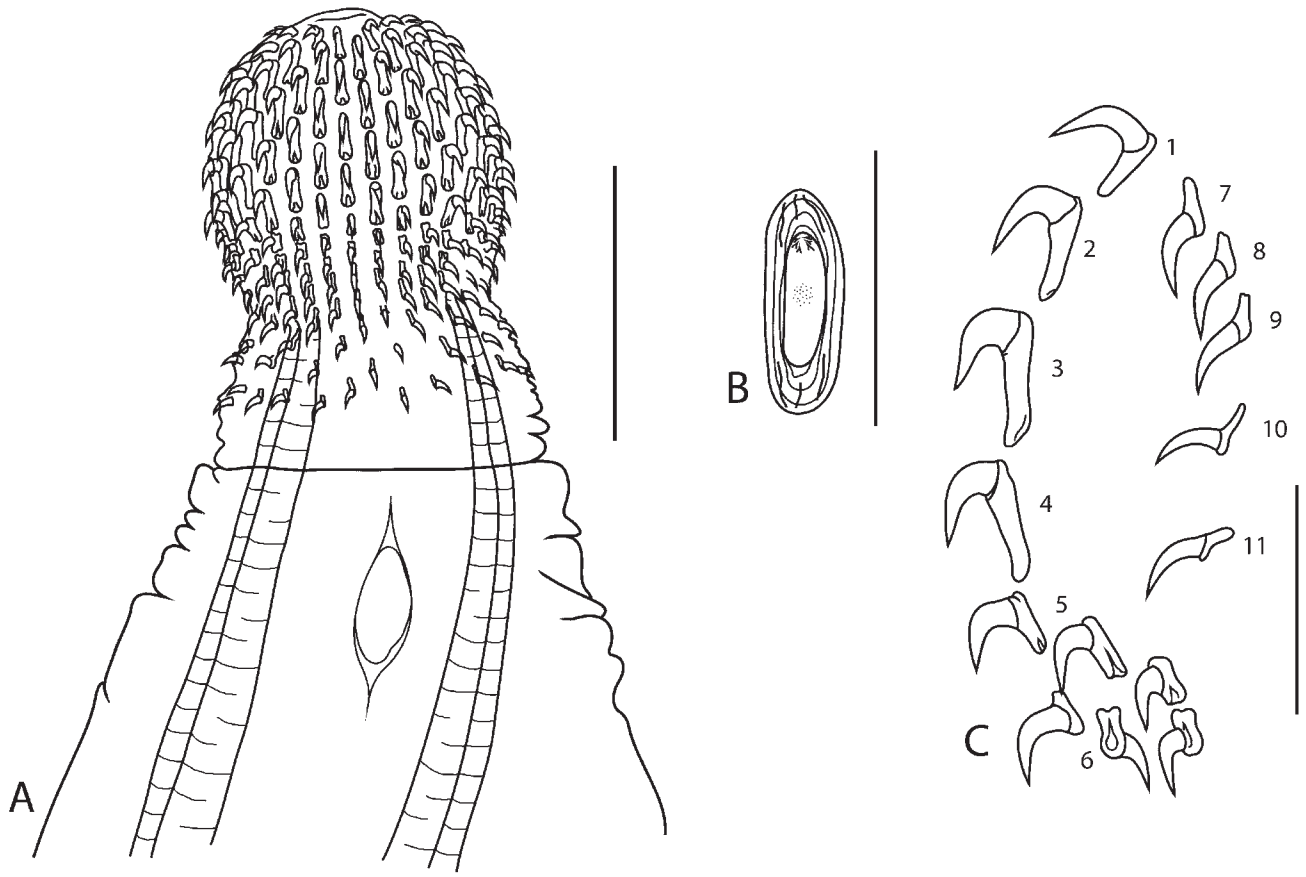

FIGURE 1. *Sphaerirostris turdi*. (**A**) Male, proboscis. (**B**) Egg. (**C**) Hooks. Scale bars: A = 300, B = 100; C =100.

poles. Fully formed eggs 80–85 × 23–25 in size. Genital pore subterminal. Posterior end rounded.

Taxonomic summary

Type host: Island thrush, *Turdus poliocephalus*.

Prevalence and intensity: Four males and 4 females found in 1 *T. poliocephalus* (host KUMNH 116450).

Locality: Aurora Memorial National Park, Aurora Province, Luzon Island, Philippines, 1,100 m, 15.667°N, 121.529°E.

Specimens deposited: HWML 67154 (labeled: ex. *Turdus poliocephalus*, Aurora Memorial National Park, Aurora Province, Luzon Island, Philippines, 2 June 2009, coll. V. Tkach).

Remarks

The specimens of *S. turdi* that we collected in the Philippines are morphologically consistent with the original description of the species by Yamaguti (1939).

Porrorchis centropusi Tubangui, 1933

(Figs. 2–4; Table I)

General: Body very elongated, females somewhat larger than males. Circular trunk muscles create impression of internal segmentation. Proboscis slightly widening from apical end towards posterior end forming conical structure rounded at posterior end. Narrow groove at level of last hook. Proboscis armed with 28–31 longitudinal hook rows of 9–10 hooks each. First 4–5 (usually 4) hooks with thick blades and simple massive roots directed posteriorly. Next hook (fifth or sixth) intermediate, its blade thinner than blades in previous hooks. Distal part of root widened, split, and directed posteriorly. Remaining hooks spine-like with 2 short roots directed anteriorly and reminiscent of horseshoe turned upside down. Proboscis receptacle sac-like, with bi-layered muscular walls, attached to narrowest part of proboscis. Neck conical, 200–300 long.

Cerebral ganglion 520 × 320, situated near bottom of proboscis receptacle. Lemnisci band-like, long, attached to proximal part of trunk and extending beyond bottom of proboscis receptacle. Lacunar system formed by 2 large longitudinal lateral canals connected by transverse anastomoses that give rise to numerous small, branching, blindly ending canals. Genital pore subterminal in both sexes.

Male (based on 6 specimens): Trunk 17.6–24.0 mm long, indistinctly separated into anterior part 1,640–2,100 mm wide at level of testes and longer and narrower posterior part, 1,100–1,510 mm wide. Proboscis length 480–560, maximum width 480–580, minimum width 320–390. Proboscis receptacle 1,120–1,340 × 430–560. Lemnisci 2,350–4,100 × 170–260. Proboscis with 26–31 longitudinal rows of 9–10 (regularly alternating) hooks or 10 hooks in each row. Thus, sizes of hooks with same number in neighboring rows differ substantially and are indicated here with "/" mark. Hook blade length: 1 = 45–60/55–68; 2 = 58–70/63–70; 3 = 60–68; 4 = 55–60/57–58; 5 = 50–63/55–65; 6 = 53–55/48–58; 7 = 50–57/50–55; 8 = 50–53/50; 9 = 43–53/48–50; 10 = 35–48/38–45. Hook root length: 1 = 38–53/48–68; 2 = 65–78/70–85; 3 = 83–88/83–90; 4 = 70–88/75–82; 5 = 33–70/25–65; 6 = 25–33/25–28; 7 = 25–35; 8 = 25–30; 9 = 25–28; 10 = 18–28.

Reproductive system organs occupy most of trunk. Anterior testis reaches posterior end of lemnisci. Testes elliptical, situated obliquely, and slightly overlapping each other. Anterior testis 990–1,400 × 580–970, posterior testis 950–1,380 × 580–670. Four cement glands of approximately equal length extend to posterior margin of posterior testis. Genital pore slit-like.

Female (based on 3 specimens): Trunk 23.0–35.0 mm long, widest in anterior part, with maximum width 1,740–2,050. Posterior end rounded. Proboscis 550–630 in length, 500–590 in maximum width, 370–400 at

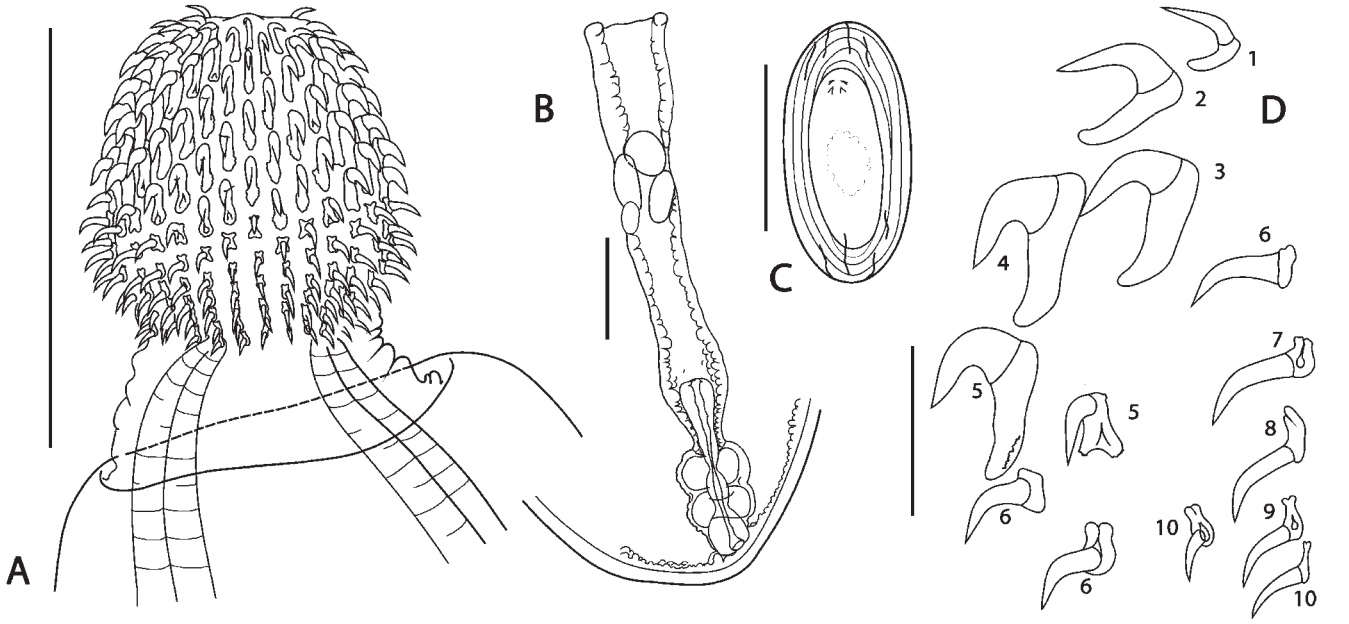

FIGURE 2. *Porrorchis centropusi*. (**A**) Female, proboscis. (**B**) Female, reproductive system. (**C**) Egg. (**D**) Hooks. Scale bars: A = 1,000, B = 200, C = 50, D = 100.

narrowest point. Proboscis receptacle 1,230–1,430 long and 500–600 wide in midsection. Neck 200–220 long. Proboscis armed with 29–30 longitudinal rows of 9–10 (regularly alternating) or 10 hooks in each row. Hook blades: 1 = 53–60; 2 = 60–70; 3 = 70–73; 4 = 58–67; 5 = 53–63; 6 = 58–63; 7 = 55–60; 8 = 48–53; 9 = 48–50; 10 = 40–48. Hook roots: 1 = 40–50/50–73; 2 = 70–83/80–83; 3 = 90–98/88–93; 4 = 90/68–80; 5 = 28–45; 6 = 25–30; 7 = 25–30; 8 = 25–33; 9 = 25–30; 10 = 25–28.

Female reproductive organ complex 1,100–1,600 long, consisting of vagina with 2 sphincters, uterus, and uterine bell, including selector apparatus. Eggs 70–78 × 36–38, outer shell sculptured.

Taxonomic summary

Type host: Philippine scops owls *Otus megalotis*.

Prevalence and intensity: Seven and 8 specimens found in 2 examined *O. megalotis* individuals (host KUMNH 114683 and 114684).

Locality: Aurora Memorial National Park, near Sitio Dimani, Barangay Villa Aurora, Municipality of Maria, Aurora Province, Luzon Island, Philippines (500 m; 15.685°N, 121.341°E).

Specimens deposited: HWML 67152–67153 (labeled: ex. *Otus megalotis*, Aurora Memorial National Park, Sitio Dimani, Barangay Villa Aurora, Aurora Province, Luzon Island, Philippines, 22 May 2009 and 25 May 2009, coll. V. Tkach).

Remarks

The specimens of *P. centropusi* in our material are morphologically consistent with the original species description by Tubangui (1933). Only the egg sizes of our specimens differ from the original description of *P. centropusi*, i.e., 70–78 × 36–38 in our material versus 29–37 × 14–18 in the original description. It is possible that Tubangui's (1933) original description contained measurements of eggs that were not fully developed.

The taxonomic status of *P. centropusi* was unstable. Golvan (1956) considered it to be a separate species, but Schmidt and Kuntz (1967) considered *P. centropusi* to be a synonym of *P. hylae* without providing any arguments for this taxonomic decision. Amin (1985) agreed with the opinion of Schmidt and Kuntz (1967), while more recently, Golvan (1994) and Salgado-Maldonado and Cruz-Reyes (2002) again considered *P. centropusi* to be an independent species. We agree with the viewpoint of the latter authors, because in our opinion, *P. centropusi* rather clearly differs from *P. hylae* in the position of testes in the anterior widened part of the trunk, so that lemnisci reach the anterior margin of anterior testis or even overlap it. In addition, testes in *P. centropusi* are situated very closely to or are overlapping each other. In *P. hylae*, either the posterior testis or both testes are situated in the narrow portion of the trunk part at a substantial distance from each other (Golvan, 1956; Schmidt and Kuntz, 1967).

DESCRIPTION

Porrorchis kinsellai n. sp.

(Figs. 4, 5; Table I)

General: Body very elongated, females larger than males. Tegument thick, unarmed. Circular trunk muscles create impression of internal segmentation. Distal part of proboscis spherical, separated from the base by narrow groove. Proboscis armed with 26–28 longitudinal hook rows of 8–10 hooks each. First 3–4 hooks with thick blades and simple massive roots directed posteriorly; roots longer than blades. Hook length and thickness increase from first to third hook. Fourth hook intermediate in shape, with complex root and arms directed sidewise. Hooks 5 to 10 spine-like, but also with complex roots: hooks 5–6 with short roots and 2 branches directed anteriorly, forming horseshoe-shaped structure. Roots of hooks 7–10 also directed anteriorly, but more elongated. Hook rows begin at different levels in alternating manner. Sizes of hooks with same number in neighboring rows differ substantially and are indicated here with "/" mark. Proboscis receptacle sac-like, with bi-layered muscular walls, attached to narrowest part of proboscis and extending through neck deep into trunk. Cerebral ganglion oval, 350–370 × 240–260, situated near bottom of proboscis receptacle. Lemnisci band-like, long, attached to proximal part of trunk and extending far beyond bottom of proboscis receptacle. Lacunar system formed by 2 large longitudinal lateral canals connected by transverse anastomoses that give rise to numerous small, branching, blindly ending canals. Genital pore subterminal in both sexes.

Male (based on 3 specimens): Very elongated acanthocephalans. Trunk 28.0–29.0 mm long. Anterior part of trunk 4.6–4.8 mm long and 1,120–1,310 wide at level of posterior margins of lemnisci. Longer posterior part of trunk narrows down to 730–760. Proboscis length 500–520, maximum width 470–500, minimum width 340–350. Neck conical, 180–190 long. Proboscis receptacle 1,020 × 470–500. Lemnisci 2,750–2,900 × 340–410. Proboscis with 26–27 longitudinal rows of 9–10 (regularly alternating) hooks or 9 hooks in each row. First 3 hooks largest, with powerful roots, fourth hook intermediate in shape, 5–9 hooks spine-shaped. Hook blade

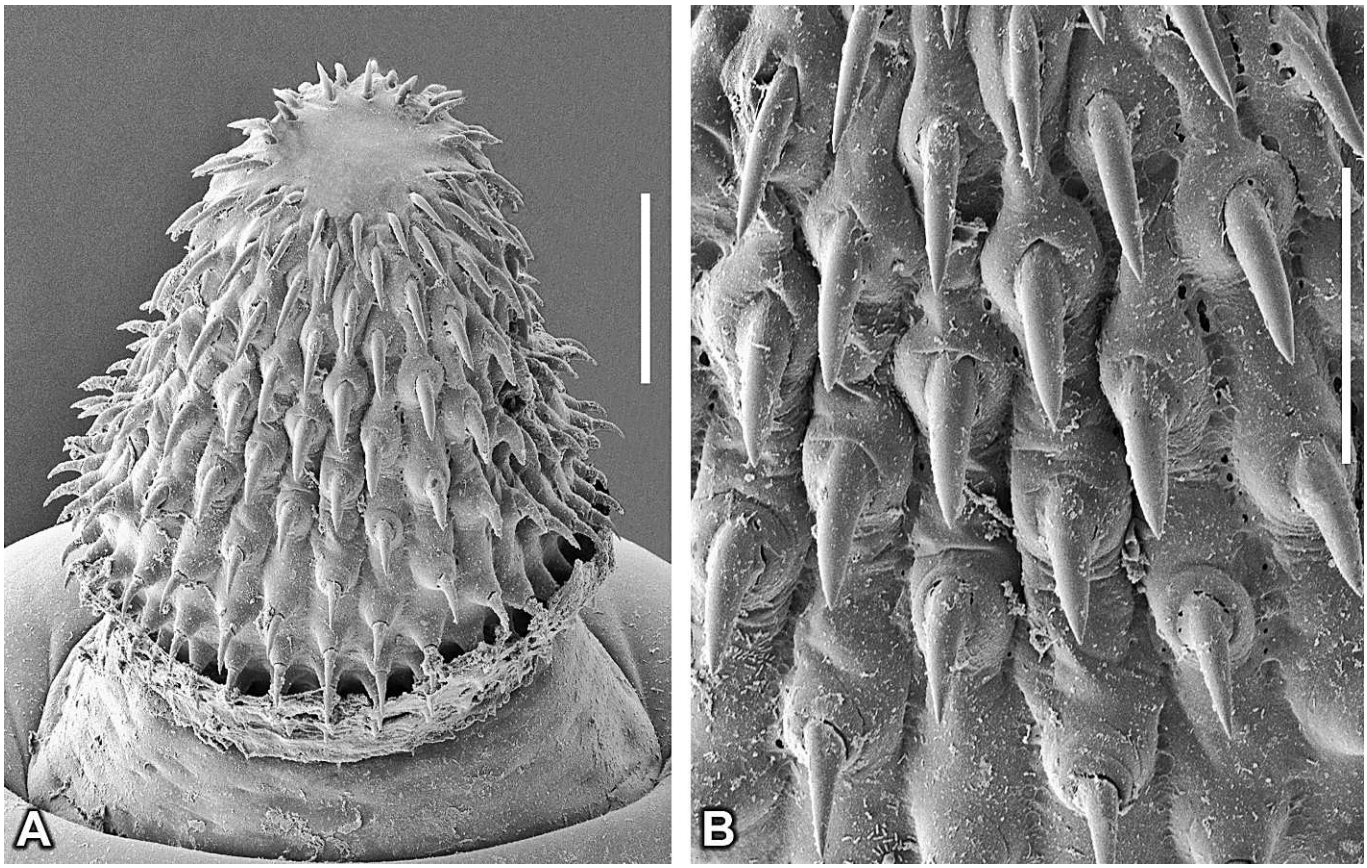

FIGURE 3. SEM images of *Porrorchis centropusi*. (**A**) Proboscis. (**B**) Hooks in the midsection of proboscis. Scale bars: A = 200, B = 100.

length: 1 = 39–42/50–58; 2 = 58; 3 = 58–60/54–58; 4 = 53–56/51–55; 5 = 49; 6 = 40–44; 7 = 37; 8 = 37; 9 = 35. Hook root length: 1 = 41–51/58; 2 = 72–79/79–81; 3 = 81–86/70–72; 4 = 35–41/26; 5 = 24–26/23–24; 6 = 24–26/23–24; 7 = 24–28/24–26; 8 = 24–26/23–26; 9 = 20–23.

Reproductive system organs occupy most of trunk. Testes oval, tandem, situated 290–600 from each other; anterior testis 800–950 from posterior margin of lemnisci. Anterior testis 800–870 × 420–480, posterior testis 820–910 × 430–470. Cement glands 5; 3 of them 15.6–16.5 mm long and reach posterior margin of posterior testis, fourth cement gland 4.2–5.7 mm long, fifth gland 3.5–5.3 mm long. Total length of cement gland complex, including ducts, 16.5–19.1 mm. All males with invaginated bursa, 2.2–3.0 mm long. Genital pore slit-like, subterminal, surrounded by lip-like thickening of body wall supported by well-defined circular muscles.

Female (based on 3 specimens): Very elongated acanthocephalans, 35.0–45.0 mm long. Trunk widest (1,150–1,500) at level of posterior end of lemnisci, then narrows to 840–1,030 in middle portion, and somewhat widens again to 1,220–1,560 at level of reproductive system ducts. Posterior end with distinctive finger-like process (Figs. 4C, 5F), 420–450 long. Proboscis 530–560 long, spherical part 500–510 long and 490–580 wide. Narrowest part of proboscis 350–430 wide. Neck conical, 190–220 long. Proboscis receptacle 1,050–1,160 × 460–600. Lemnisci 3.15–3.55 mm long and 380–430 wide. Proboscis with 27–28 longitudinal rows of 8–9 or 9–10 hooks or 9 hooks. In 2 specimens, hook number regularly alternating, while in 1 specimen, 4 rows of 9 hooks followed by 1 row of 10 hooks. First 3–4 hooks largest, with powerful roots, 4–5 hooks (depending on row) intermediate in shape, 5–9 hooks spine-shaped. Hook blade length: 1 = 45–52/48–65; 2 = 65/68–69; 3 = 68/61–65; 4 = 60/58–60; 5 = 55–60/50–55; 6 = 43–48/45–48; 7 = 40–45; 8 = 35–40/38–42; 9 = 35–40/35–38; 10 = 35. Hook root length: 1 = 48–65/55–73; 2 = 73–100/73–95; 3 = 98–100/98; 4 = 25–52/30–73; 5 = 25–33/30–35; 6 = 28–33/30–35; 7 = 28–30/28–33; 8 = 22–38/28–33; 9 = 25/25–28; 10 = 25.

Reproductive system ducts 1,380–2,000 in length, situated in posterior, widened part of body and consist of vagina with 2 muscular sphincters, uterus, and uterine bell with muscular walls. Eggs oval, 45–55 × 18–22, fertilization membrane without polar prolongations. Genital pore opens ventrally at base of terminal process at posterior body end.

Taxonomic summary

Type host: Philippine scops owls *Otus megalotis* (host KUMNH 114684).

Site of infection: Intestine.

Prevalence and intensity: Three males and 3 females found in 1 of 2 examined *Otus megalotis* individuals.

Locality: Aurora Memorial National Park, near Sitio Dimani, Barangay Villa Aurora, Municipality of Maria, Aurora Province, Luzon Island, Philippines (500 m, 15.685°N, 121.341°E).

Type specimens deposited: Holotype (male) and allotype (female): HWML 67150 (labeled: ex. *Otus megalotis*, Aurora Memorial National Park, Sitio Dimani, Barangay Villa Aurora, Aurora Province, Luzon Island, Philippines, 22 May 2009, coll. V. Tkach). Four paratypes (2 males and 2 females): HWML 67151 (labeled identically).

Etymology: This species is named in honor of Dr. John M. Kinsella in recognition of his significant contributions to helminthology.

Remarks

The arrangement and number of proboscis hooks in the new species are somewhat similar to those in *P. hylae*, *Porrorchis rotundatus* (Linstow, 1897), *P. centropusi* Tubangui, 1933, and *Porrorchis tyto* Amin et al., 2008 (Table I). However, *P. kinsellai* n. sp. can be reliably differentiated from all other species of the genus by the almost perfectly spherical proboscis in both sexes and by the structure of the female posterior end, which has a characteristic finger-like tip (Figs. 4C, 5F) that is not found in other

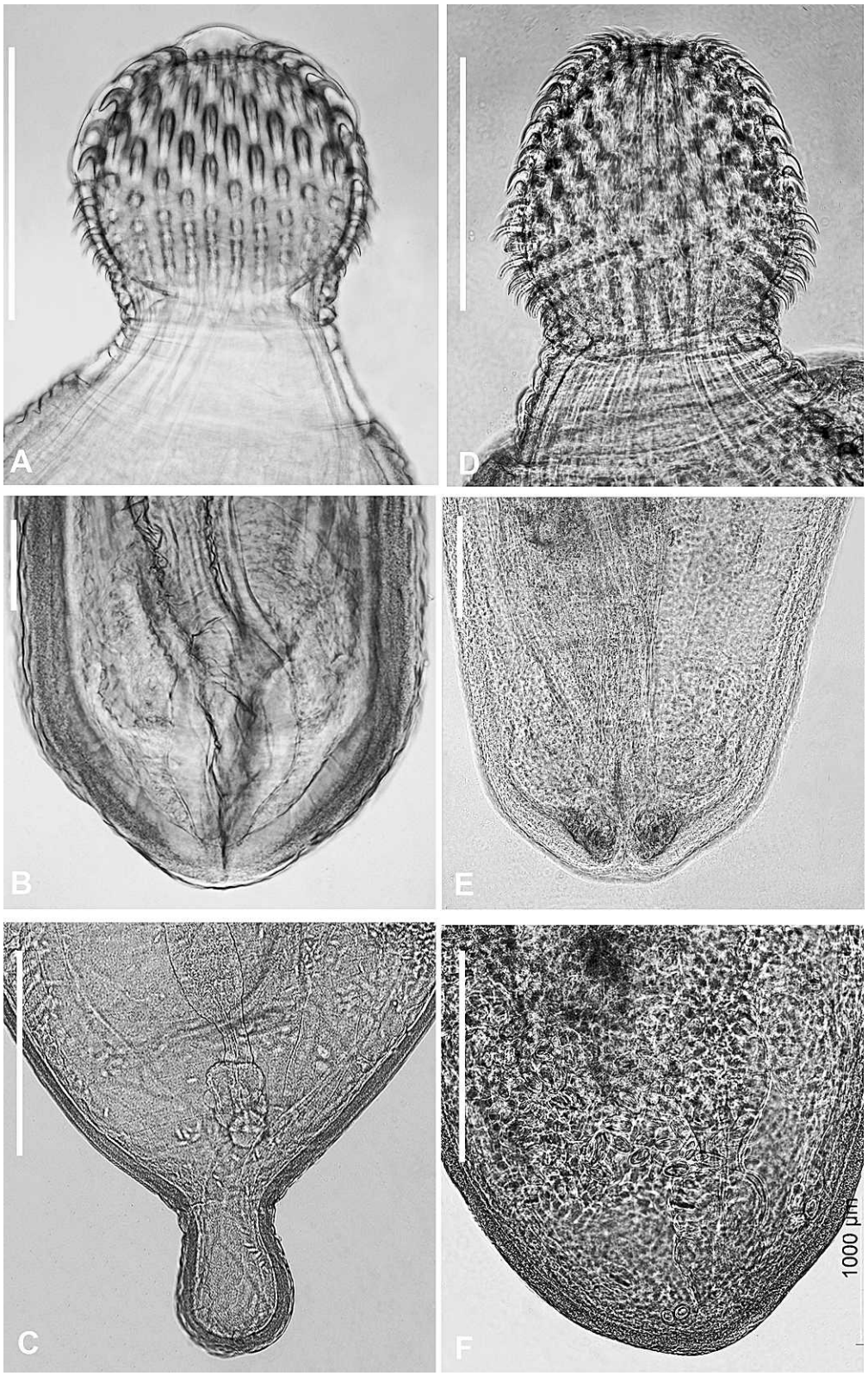

FIGURE 4. **(A–C)** *Porrorchis kinsellai* n. sp. (A) Proboscis. (B) Male, posterior end. (C) Female, posterior end. **(D–F)** *Porrorchis centropusi*. (D) Proboscis. (E) Male, posterior end. (F) Female, posterior end. Scale bars: A, D = 500; B, E = 200; C = 500; F = 1,000.

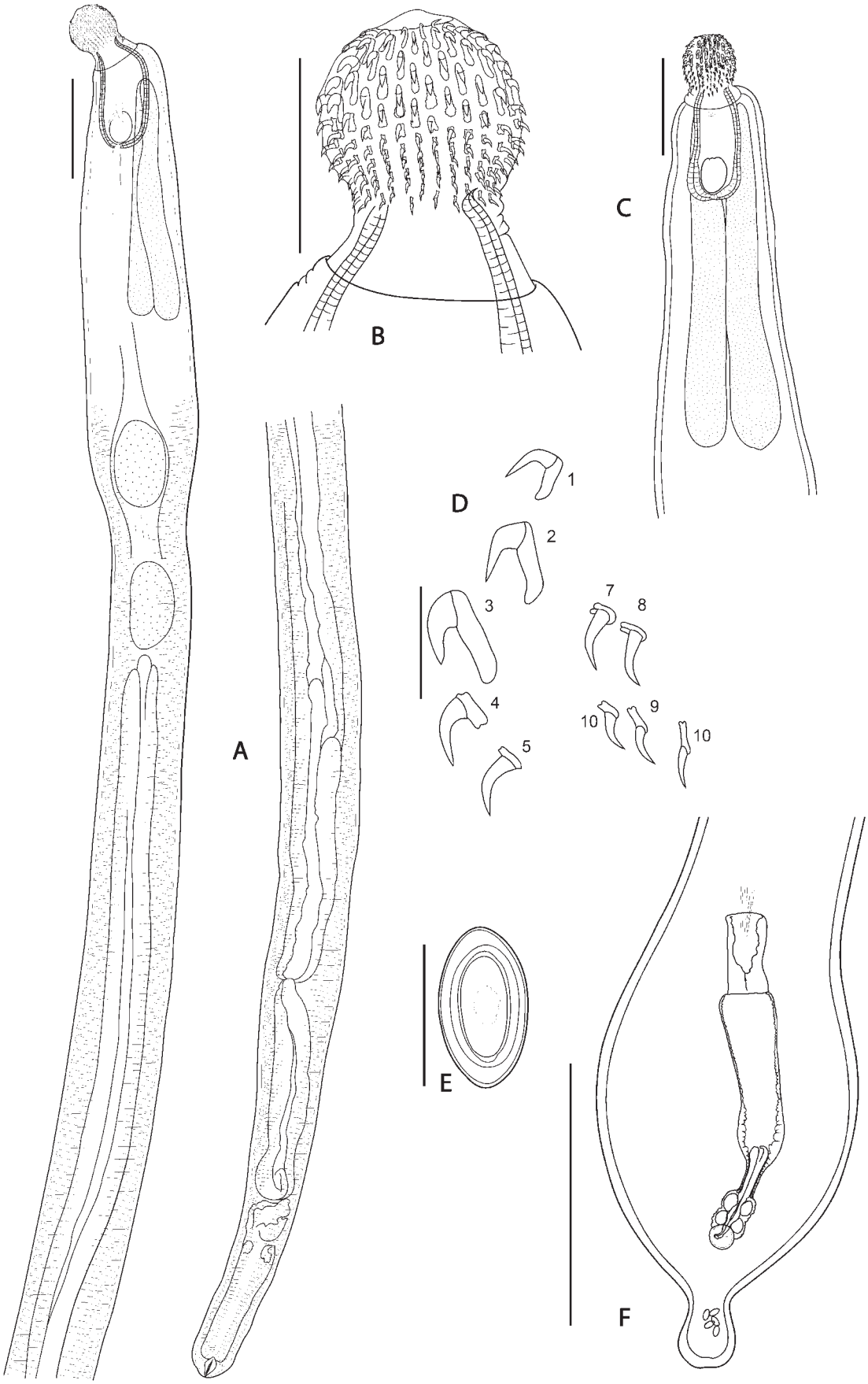

FIGURE 5. *Porrorchis kinsellai* n. sp. (**A**) Male, holotype. (**B**) Male, holotype, anterior end. (**C**) Female, allotype, anterior part of body. (**D**) Hooks. (**E**) Egg. (**F**) Female, allotype, reproductive system. Scale bars: A, C, F = 1,000; B = 500; D = 100; E = 50.

TABLE I. Comparisons among *Porrorchis kinsellai* n. sp. and *Porrorchis centropusi* (Tubangui, 1933), *Porrorchis hylae* (Johnston, 1914), *Porrorchis rotundatus* (Linstow, 1897), and *Porrorchis tyto* Amin, Van Ha, and Heckmann, 2008.

	P. centropusi (Tubangui, 1933)		*P. centropusi* (Tubangui, 1933)		*P. hylae* (Johnston, 1914)	
Reference:	Tubangui (1933)		This paper		Golvan and Brygoo (1965)	
Sex:	Males	Females	Males	Females	Males	Females
Trunk L (mm)	11.50–14.50	20.00–30.00	17.58–24.00	23.00–35.00	48.00–52.00	56.00–81.00
Trunk W (mm)	0.80–1.00	0.90–1.25	1.64–2.10	1.74–2.05	1.10–1.30	1.40–1.80
Proboscis shape	Subspherical to ovoid		Subspherical to ovoid		Ovoid	
Hook rows/no. per row	26 × 8–10		26–31 × 9–10	29–30 × 9–10	24–28 × 8–10	24–28 × 8–10
No. of largest hooks with roots	—		4–5 in both sexes		4 in both sexes	
Number of cement glands	—		4		4	
Testes position	Overlap each other		Overlap each other		At a distance from each other	
Egg		29–37 × 14–18		70–78 × 36–38		54–60 × 24–28
Genital pore	Subterminal	Subterminal	Subterminal	Subterminal	Subterminal	Subterminal

species of the genus. Moreover, the males of the new species have 5 cement glands, while other species have only 4 glands. The new species differs from *P. tyto* in having a subterminal male genital pore (terminal in *P. tyto*). The eggs in the new species are 45–55 × 18–22; in contrast, the eggs of both *P. hylae* (59–65 × 27–29) and *P. tyto* (57–72 × 27–32) are substantially larger. The new species has 3–4 large hooks possessing well-pronounced roots versus 4–6 such hooks in *P. hylae* and 5–7 in *P. tyto*. The testes in the new species are situated at a substantial distance from each other, while in *P. rotundatus P. centropusi*, testes are situated at a very short distance from each other or overlap.

DISCUSSION

Our finding of *Sphaerirostis turdi* is the first record of this species in the Philippines. It was originally described from Japan and is widely distributed in Eurasia; therefore, its discovery in the Philippines is not surprising.

We also found 2 *Porrorchis* species in the Philippines. The number of species in this genus has increased considerably since the 1980s. Schmidt and Kuntz (1967) included 11 species in *Porrorchis*. In the next 18 yr, the situation did not change, and Amin (1985) also listed 11 species in the genus. More recently, however, the number of recognized species has grown steadily. Golvan (1994) added 5 additional species to the genus, namely, *Porrorchis brevicanthus* (Das, 1949) Golvan, 1994, *P. centropusi*, *Porrorchis chauchani* Gupta and Fatma, 1986, *Porrorchis crocidurai* Gupta and Fatma, 1986, and *Porrorchis keralensis* George and Nadakal, 1984. Since then, 5 more species have been described, i.e., *Porrorchis nickoli* Salgado-Maldonado et Cruz-Reyes, 2002, *Porrorchis heckmanni* Bilqees, Khan, Khatoon, et Khatoon, 2007, *P. tyto* Amin, Van Ha, and Heckmann, 2008, *Porrorchis aruensis* Smales, 2010, and *Porrorchis jonesae* Rahman, Khan, Khatoon, and Bilqees, 2010 (Salgado-Maldonado and Cruz-Reyes, 2002; Bilqees et al., 2007; Amin et al., 2008; Smales, 2010; Rahman et al., 2010).

The description of *P. kinsellai* n. sp. brings the number of valid species in the genus up to 22 and adds a fifth species to the list of *Porrorchis* species known from the Philippines. The key to their identification is provided below, with the exception *P. brevicanthus* (Das, 1949) Golvan, 1994, which was described very insufficiently. *Porrorchis jonesae* is included in the keys, although we have some doubts regarding the systematic position of this species, which was rather superficially described and illustrated by Rahman et al. (2010). The number of the hook rows in *P. jonesae* is only 12–14, while the rest of the members of the genus have 20 or more hook rows. At the same time, Figure 1e in Rahman et al. (2010) suggests a greater number of hook rows than provided in the description. The information used in the key was obtained from the original descriptions and subsequent redescriptions (Tubangui, 1933; Das, 1957; Golvan and Brygoo, 1965; Schmidt and Kuntz, 1967; Gupta and Jain, 1975; George and Nadakal, 1984; Salgado-Maldonado and Cruz-Reyes, 2002; Bilqees et al., 2007; Amin et al., 2008).

Key to species of the genus *Porrorchis*

1a Proboscis with 12–37 longitudinal hook rows 4
1b Proboscis with 38–50 longitudinal hook rows 2
2a Proboscis with 46–50 longitudinal hook rows. Known from Japan ..... *Porrorchis oti* Yamaguti, 1939
2b Proboscis with 38–44 longitudinal hook rows 3
3a Proboscis with 38–41 rows of 12–13 hooks. Eggs 78 × 41. Known from Australia ..... *Porrorchis bazae* (Southwell and Macfie, 1925) Schmidt and Kuntz, 1967
3b Proboscis with 40–44 rows of 8–10 hooks. Eggs 60 × 30. Known from Madagascar ..... *Porrorchis maxvachoni* (Golvan and Brygoo, 1965) Schmidt and Kuntz, 1967
4a Parasites of mammals 5
4b Parasites of birds. 9
5a Proboscis with 30 longitudinal hook rows. Known from Indonesia ..... *P. aruensis* Smales, 2010
5b Proboscis with 20–28 longitudinal hook rows 6
6a Proboscis with 20–24 longitudinal hook rows 7
6b Proboscis with 26–28 longitudinal hook rows 8
7a Proboscis 550–600 × 400–500. Eggs 40–42 × 26–30. Known from India ..... *P. crocidurai* Gupta and Fatma, 1986
7b Proboscis 290–430 × 550–600. Eggs 65–75 × 23–26. Known from Mexico ..... *P. nickoli* Salgado-Maldonado et Cruz-Reyes, 2002

TABLE I Extended.

P. rotundatus (Linstow, 1897)		*P. tyto* Amin, Van Ha, and Heckmann, 2008		*P. kinsellai* n. sp.	
Golvan and Brygoo (1965)		Amin et al. (2008)		This paper	
Males	Females	Males	Females	Males	Females
30.00–35.00	32.00–48.00	24.10–26.80	21.75–46.75	28.00–29.00	35.00–45.00
1.5	2	1.07–1.10	1.02–1.30	1.29–1.31	1.15–1.50
Subspherical to ovoid		Ovoid		Spherical	
28–32 ×10	26–28 × 10	25–27 × 10–11	25–29 × 10–11	26–27 × 8–9	27–28 × 8–10
3–4 in both sexes		5–7 in both sexes		3–4 in both sexes	
4		4		5	
Overlap each other		At a distance from each other		At a distance from each other	
	60–65 × 30		50–72 × 27–32		45–55 × 18–22
Subterminal	Subterminal	Terminal	Subterminal	Subterminal	Subterminal

8a 7–8 hooks in each row. Known from Australia .... *Porrorchis hydromuris* (Edmonds, 1957) Schmidt and Kuntz, 1967
8b 10–12 hooks in each row. Known from India..... ..... *P. chauchani* Gupta and Fatma, 1986
9a Proboscis with 12–14 longitudinal hook rows. Known from Pakistan.... *P. jonesae* Rahman, Khan, Bilqees, 2010
9b Proboscis with 20–37 longitudinal hook rows..... 0.10
10a Lemnisci relatively short, extending only slightly beyond the bottom of proboscis receptacle 0.11
10b Lemnisci relatively long, extending well beyond the bottom of proboscis receptacle 0.12
11a Proboscis with 22–26 hook rows. Proboscis 600–800 × 200–390. Known from India .... *P. keralensis* George and Nadakal, 1984
11b Proboscis with 20 longitudinal hook rows. Proboscis 420–430 × 550–600. Known from Pakistan .... *P. heckmanni* Bilqees, Khan, Khatoon N., and Khatoon Sh., 2007
12a Proboscis 800-1200 long..... 13
12b Proboscis 400–750 long 15
13a Proboscis with 20–24 rows of 10–12 hooks.
13b Proboscis with 28–34 rows of 11–14 hooks. Known from Japan, Taiwan, and Philippines..... ..... *P. elongatus* Fukui, 1929
14a Blades of apical hooks longer than blades of hooks in the middle of proboscis. Eggs 70 × 31. Known from Vietnam ..... *Porrorchis haudemeri* (Joyeux et Baer, 1935) Schmidt and Kuntz, 1967
14b Blades of apical hooks shorter than blades of hooks in the middle of proboscis. Eggs 60 × 25. Known from Guinea and Madagascar..... *Porrorchis centropi* (Porta, 1910) Schmidt and Kuntz, 1967
15a Testes at some distance from each other..... 0.18
15b Testes very close to each other, frequently touching or overlapping..... 0.16
16a Proboscis with 26–32 rows of 8–11 hooks 17
16b Proboscis with 20–24 rows of 8–9 hooks. Known from India..... *Porrorchis indicus* (Das, 1957) Schmidt and Kuntz, 1967
17a Eggs 60–65×30. Known from Japan and Madagascar ... *P. rotundatus* (Linstow, 1897) Schmidt and Kuntz, 1967
17b Eggs 70–78 × 36–38. Known from Philippines..... .... *P. centropusi* (Tubangui, 1933) Joyeux and Baer, 1935
18a Proboscis with 24–29 hook rows 19
18b Proboscis with 30–37 hook rows. Known from Taiwan and Philippines .... *P. leibyi* Schmidt and Kuntz, 1967
19a Proboscis oval. Posterior end of female lacks finger-like process 0.20
19b Proboscis spherical. Posterior end of female with a 420–450 long finger-like process. Known from Philippines..... *P. kinsellai* sp. n.
20a Each longitudinal hook row contains 5–7 large hooks with powerful roots. Known from Vietnam..... ..... *P. tyto* Amin, Van Ha, and Heckmann, 2008
20b Each longitudinal hook row contains no more than 4 large hooks with powerful roots. Known from India, Taiwan, Philippines, and Australia .... *P. hylae* (Johnston, 1914) Schmidt and Kuntz, 1967

ACKNOWLEDGMENTS

We thank the Protected Areas and Wildlife Bureau (PAWB) of the Philippine Department of Environment and Natural Resources (DENR), our field counterparts and collaborators, especially Dr. Rob Moyle (University of Kansas), and the local government units and community members of Aurora Province who have supported our field research. Dr. Arvin Diesmos (National Museum of the Philippines) was instrumental in organization and logistic support of the expedition. This study was supported by the National Science Foundation BS&I grant DEB 0743491 to R. M. Brown, S. E. Bush, D. H. Clayton, and R. G. Moyle.

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