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Cucolepis cincta gen. n. et sp. n. (Cestoda: Cyclophyllidea) from the squirrel cuckoo *Piaya cayana* Lesson (Aves: Cuculiformes) from Paraguay

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Abstract: *Cucolepis* gen. n. is erected as monotypic for *Cucolepis cincta* sp. n., a new species of cyclophyllidean cestode of the family Paruterinidae. The new species is described from the squirrel cuckoo, *Piaya cayana* Lesson (Aves: Cuculiformes), taken from two localities in Paraguay in 1984 and 1985. This new genus is most similar to the genus *Triaenorhina* Spasskii et Shumilo, 1965 in terms of the hook morphology and large epiphyseal structures extending from both the handle and guard, but differs in several aspects of the strobilar morphology, such as the shape of the cirrus sac, genital atrium, uterus and paruterine organ. The strobilar morphology of the new genus strongly resembles that of the genus *Francobona* Georgiev et Kornyushin, 1994, especially the shape of the cirrus sac and genital atrium, yet *Francobona* spp. lack the developed epiphyseal structures observed in species of *Cucolepis* and *Triaenorhina*. Previous records and the nature of parasite-host associations between cuculiform birds and their cestode parasites are discussed.

Keywords: Cestoda, Paruterinidae, Neotropical, *Piaya*, new genus, cuckoo

The examination of unidentified avian cestode material from the Muséum d'Histoire Naturelle, Geneva, Switzerland (MHNG), collected from two localities in Paraguay in 1984 and 1985 by either Carlos Dlouhy or Claude Vaucher, revealed the presence of an undescribed genus and species from two squirrel cuckoos, *Piaya cayana* Lesson. This new genus and its only known species are described below.

MATERIALS AND METHODS

The material studied consisted of five specimens with scoleces and five fragments of strobila from the squirrel cuckoo, *Piaya cayana*, collected from Road Stroesner (Road #7), 230 km from Asunción, Caaguazú, Paraguay, on 13 August 1984, and from near the stream Tagatjia Guazu, 4 km south of the ranch Santa Maria, Concepción, Paraguay, on 20 October 1985. Specimens were deposited in the collections of invertebrates of the Muséum d'Histoire Naturelle, Geneva, Switzerland (MHNG). All specimens were stained with hydrochloric carmine and mounted in Canada balsam. Measurements were taken using an optical retical or a SPOT Diagnostic Instrument digital camera system mounted on a Zeiss Axioskop 2 (Zeiss, Thornwood, NY) and SPOT software (version 4.5; http://www.diaginc.com/software/). Measurements of the testes, cirrus sac, vitellarium, ovary, vagina and seminal receptacle were taken only from fully developed mature proglottides. Metrical and meristic data are presented as the range (min–max), with the mean, standard deviation and the number of measurements or counts taken (n) in parentheses. The measurements given are in micrometres (μm) unless otherwise stated. The terms used for the developmental stages of proglottides follow Georgiev and Vaucher (2001). Avian nomenclature follows the IOC World Bird Names (Gill and Donsker 2012).

RESULTS

Cucolepis gen. n.

Diagnosis. Scolex with cup-shaped, sucker-like rostellum and double crown of numerous rostellar hooks. Epiphysis of rostellar hooks strongly developed, larger or comparable in size with refractive particle ("true hook"), extending from both handle and guard of refractive particle, i.e. rostellar hooks of the rectanguloid type as defined by Spasskii and Shumilo (1965) and Bona and Maffi (1987). Epiphyses of anterior row longer than those of posterior row. Proglottides craspedote, wider than long except gravid (with almost equal length and width or longer than wide). Genital pores alternating. Genital atrium consists of two parts separated by muscular bundles forming a sphincter; its bottom forming thick-walled circular protrusion. Genital ducts pass between osmoregulatory canals. Testes lateral, posterior and dorsal to vitellarium, also sometimes overlapping posterior or lateral margin of ovary. Cirrus sac pyriform, with very thick

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muscular walls, sometimes reaching osmoregulatory canals. Cirrus unarmed. Vas deferens highly coiled; external vas deferens and encircling tissue forming elongate dense agglomerate situated obliquely. Vitellarium median, compact. Ovary fan-shaped. Seminal receptacle fusiform. Vagina opens dorsally to male pore; vaginal copulatory and conductive parts clearly distinguished. Uterus forming one sac. Paruterine organ anterior to uterus, almost conical. Eggs and onchospheres oval. In Cuculiformes of South America.

Type species: *Cucolepis cincta* sp. n.

Etymology: The generic name is derived from the Spanish "cuco" (cuckoo in English), for the host of the new genus, and the Latin suffix *-lepis*, which means "scale" and is frequently used as a suffix in names of cyclophyllidean genera. The grammatical gender of *Cucolepis* is feminine.

Remarks. In its possession of a paruterine organ, a scolex with an armed sucker-like rostellum and rectanguloid hooks in two rows with epiphyseal thickenings of the handle and guard, *Cucolepis* gen. n. is a member of the family Paruterinidae Fuhrmann, 1907 (for the family diagnosis, see Georgiev and Kornyushin 1994). The new genus belongs to the group of 15 genera, which are characterized by armed scoleces. Among them, only *Cucolepis* and *Triaenorhina* Spasskii et Shumilo, 1965 are characterized by the presence of rostellar hooks of rectanguloid type (Spasskii and Shumilo 1965, Bona and Maffi 1984a, 1987, Georgiev and Kornyushin 1994).

Currently, *Triaenorhina* includes seven species parasitic in birds of the families Coraciidae, Bucorvidae, Bucerotidae and Trogonidae in the Old World (Georgiev and Gibson 2006), all characterized by strongly developed epiphyseal structures of rostellar hooks comprising both handle and guard. However, the species of *Triaenorhina* exhibit different strobilar morphology, especially their highly elongate and thin-walled cirrus sac (versus pyriform and thick-walled cirrus sac in the new genus), simple genital atrium (versus genital atrium thick-walled circular protrusion at its base in the new species of *Cucolepis*) and longitudinally elongate lobate uterus associated with almost conical and short paruterine organ (versus compact and rather globular uterus and almost tubular paruterine organ in most of *Triaenorhina* spp.; see Georgiev and Kornyushin 1994, Georgiev and Gibson 2006).

The new species of *Cucolepis* is similar to the two species of the genus *Francobona* Georgiev et Kornyushin, 1994, which are also parasites of cuculiform birds in the New World (Bona and Mafi 1984b, 1985, Georgiev and Kornyushin 1994). The main difference between species of *Cucolepis* and *Francobona* spp. is the presence of rectanguloid rostellar hooks in the former and simple triangular hooks with small rounded epiphyses of the handle in the latter.

The presence of large epiphyses on rostellar hooks is a highly adaptive character allowing the growth of rostellar hooks in the intestine of the definitive host; it allows small rostellar hooks developed in metacestodes to achieve much greater size in the definitive host in order to provide more reliable attachment of mature cestodes (Spasskii and Shumilo 1965). The phenomenon of postlarval growth of rostellar hooks is not frequent across the order Cyclophyllidea and is to occur in members of the paruterinid genera *Triaenorhina* (see Spasskii and Shumilo 1965) and *Cucolepis* (present study) as well as for the hymenolepidid genus *Confluaria* Ablasov in Spasskaya, 1966 (e.g., Vasileva et al. 2000) and for some gryporhynchids (e.g., Scholz et al. 2002). Therefore, it should be regarded as an independently developed characteristic in several cestode families. In view of the substantial similarity of the strobilar morphology of *Cucolepis* and *Francobona* and the obvious differences with that of *Trianorhina*, it can be concluded that the presence of huge ephiphyses of the rostellar hooks of the paruterinid genera *Cucolepis* and *Trianorhina* should be regarded as a result of convergent evolution.

In addition to its rectanguloid rostellar hooks, *Cucolepis* can be distinguished from the remaining armed paruterinid genera by several characters. Its rostellar hooks are arranged in two rows rather than in four rows as in *Neyraia* Joyeux et Timon-David, 1934; genital ducts passing between osmoregulatory canals rather than ventrally as in *Notopentorchis* Burt, 1938; genital pores alternating rather than unilateral as in *Troguterina* Spasskii, 1991; testes posterior or lateral to the female gonads rather than situated in two groups lateral to and over-reaching the female glands as in *Cladotaenia* Cohn, 1901 and *Paruterina* Fuhrmann, 1906; a fan-shaped ovary rather than a bi-winged ovary as in *Cladotaenia* and *Paruterina*, *Sphaeruterina* Johnston, 1914 and *Neyraia*, or compact as in the genera *Notopentorchis* and *Triaenorhina*; a developing uterus that forms one sac rather than two sacs as in *Biuterina* Fuhrmann, 1902, with posterior diverticula as in *Spasskyterina* Kornyushin, 1989, or reticular as in the genera *Parvirostrum* Fuhrmann, 1908 or *Dictyterina* Spasskii in Spasskaya and Spasskii, 1971; a longitudinally elongate paruterine organ approaching a conical shape rather than being transversely elongate at the anterior proglottis margin as in *Laterotaenia* Fuhrmann, 1906, *Culcitella* Fuhrmann, 1906, or *Matabelea* Mettrick, 1963, a thick-walled longitudinal curved tube terminating in a spherical body at the anterior proglottis margin as in *Sphaeruterina*, or being wider than long as in *Notopentorchis*; a unicameral paruterine organ rather than bicameral as in *Neyraia* (for characteristics of the paruterinid genera, see Georgiev and Kornyushin 1994).

On the basis of these comparisons, we believe that none of the known paruterinid genera can harbour the newly-discovered species and therefore propose the new genus *Cucolepis*.

Cucolepis cincta sp. n. Figs. 1, 2

Description. Body ribbon-shaped (Fig. 1A), gradually widening posteriorly, 61 mm (n = 1) long, consisting of 200 proglottides, maximum width at level of post-mature or pre-gravid proglottides, 703–1 072 (890 ± 137, n = 10). Proglottides craspedote; mature and post-mature proglottides wider than long; pre-gravid and gravid proglottides longer than wide. Scolex rounded (Fig. 1B), with cylindrical apical portion bearing rostellum; maximum width of scolex at mid-level of suckers, 264–360 (305 ± 41, n = 5).

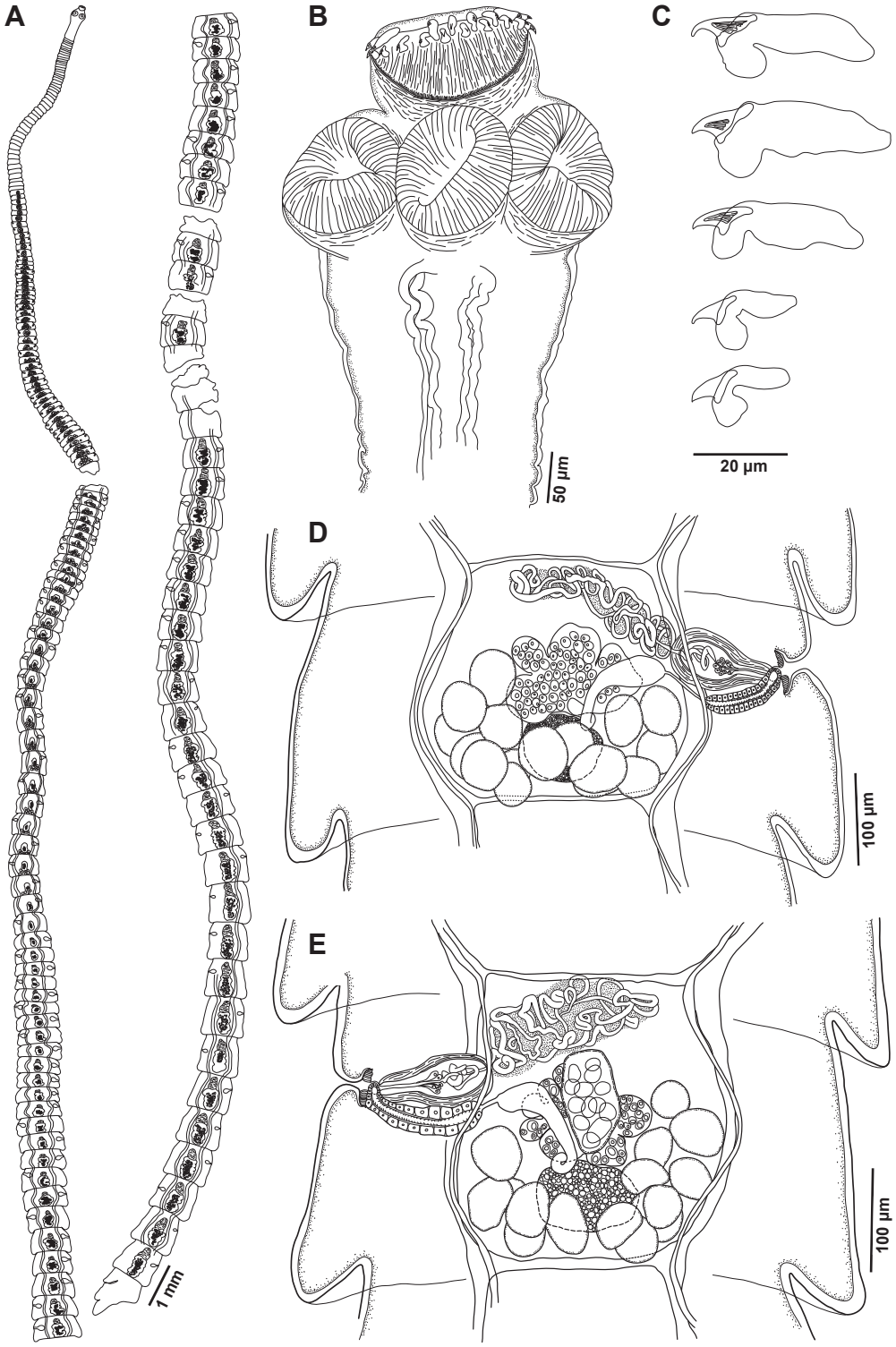

Fig. 1. *Cucolepis cincta* gen. n. et sp. n. **A** – whole worm; **B** – scolex; **C** – anterior and posterior rostellar hooks; **D** – mature proglottis; **E** – mature proglottis with developing uterus.

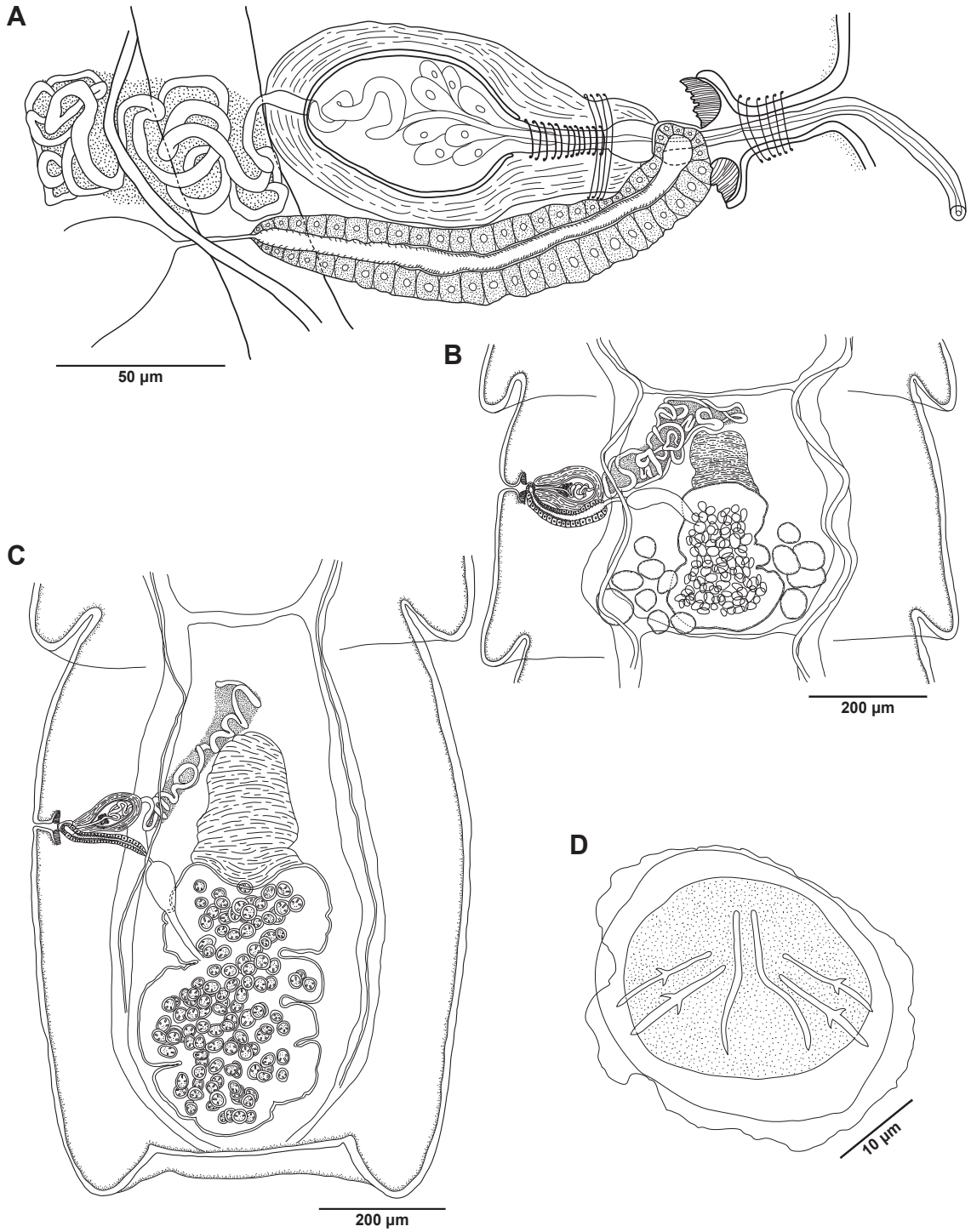

Fig. 2. *Cucolepis cincta* gen. n., sp. n. **A** – genital ducts; **B** – pre-gravid proglottis; **C** – gravid proglottis; **D** – egg.

Suckers round, with well-developed musculature, 111–150 (129 ± 11, n = 19) in diameter. Rostellum 129–168 (145 ± 16, n = 5) in diameter, sucker-like, highly muscular; glandular cells not observed within or around rostellum; well-expressed layer of radial musculature separating rostellum from surrounding parenchyma. Rostellar hooks 37–42 (40 ± 2, n = 4) in number, arranged in one anterior and one posterior regular row, blades directed anteriorly when rostellum retracted; each hook consisting of refractive particle ("true hook") and long epiphysis comprising both handle and guard (Fig. 1C); refractive particle with short curved blade, short guard and short handle;

epiphyses of hooks of anterior row longer than those of hooks of posterior row. Anterior rostellar hooks 36–45 (40 ± 3, n = 10) long, total length of hook base including epiphyseal thickening 30–38 (34 ± 3, n = 10); refractive particle 6–14 (12 ± 3, n = 10) long, base 9–11 (10 ± 1, n = 10) long, blade 6–10 (7 ± 2, n = 10) long. Posterior rostellar hooks 16–30 (20 ± 5, n = 8) long, total length of hook base including epiphyseal thickening 13–23 (17 ± 3, n = 8); refractive particle 7–10 (9 ± 1, n = 8) long; base 4–7 (6 ± 1, n = 8) long; blade 6–7 (6 ± 0.4, n = 8) long. Neck short, 168–238 (198 ± 25, n = 5) wide. First proglottides appear at distance of 117–320 (194 ± 81, n = 5) from posterior margin of suckers. Genital pores irregularly alternating in short series (e.g. 1, 1, 1, 2, 1, 5, 1, . . . 2, 2, 4, 1, 1, 1, 2 . . .). Genital atrium with infundibular orifice and tubular middle part (Fig. 2A), thick-walled, surrounded by muscular bundles forming sphincter; basal part of atrium wider, its bottom forming thick-walled circular protrusion; short hermaphroditic canal present, containing orifices of vagina and cirrus sac. Genital ducts pass between dorsal and ventral osmoregulatory canals. Dorsal osmoregulatory canals 3–12 (6 ± 2, n = 43) wide. Ventral osmoregulatory canals 10–30 (19 ± 5, n = 40) wide; transverse anastomoses along posterior margin of each proglottis.

Testes spherical or slightly oval, 14–16 (15 ± 1, n = 9) in number, 30–57 × 28–50 (42 ± 8 × 34 ± 5, n = 41 from 14 proglottides), forming compact group situated laterally, dorsally and posteriorly to vitellarium, often slightly overlapping posterior and lateral margin of ovary (Fig. 1D). External vas deferens convoluted, surrounded by intensely staining cells, in combination forming dense body occupying anterior part of antero-medial field of proglottis. Cirrus sac pyriform (Fig. 2A), 78–152 × 35–60 (124 ± 19 × 51 ± 8, n = 19) in mature proglottides (Figs. 1D, 2A), 118–143 × 51–62 (128 ± 6 × 55 ± 3, n = 18) in post-mature and pre-gravid proglottides (Fig. 2B, C), tapering porally, rounded antiporally, thick-walled, reaching or just crossing poral osmoregulatory canals. Internal vas deferens forming several coils in antiporal part of cirrus sac (Fig. 2A). Ejaculatory duct surrounded by intensely staining cells. Evaginated cirrus cylindrical, unarmed, 42–60 × 3–5 (49 ± 6 × 4 ± 1, n = 6).

Ovary fan-shaped, medial, its width about half of median field, 80–177 (124 ± 24, n = 16) wide (Fig. 1D, E). Vitellarium oval, compact, medial, at some distance from posterior proglottis margin, 48–102 (78 ± 18, n = 16) in diameter. Mehlis' gland not distinct. Seminal receptacle fusiform, poral portion rounded when filled, dorsal to ovary. Vagina opening dorsal to male pore (Fig. 2A), clearly separated into copulatory and conductive parts, passing posteriorly to cirrus sac; copulatory part surrounded by thick cellular sleeve; vaginal lumen thick-walled, lined with microtriches (sometimes not distinct); conductive part short. Uterus in mature proglottides dorsal to ovary, sac-like, thick-walled, longitudinally elongate-oval. With further development in mature proglottides (Fig. 1E), uterus longitudinally elongate sac, compact or slightly lobed, occupying central part of posterior median field; primordium of paruterine organ visible as consolidation of medullary parenchyma anteriorly to uterus. Uterus in pregravid (Fig. 2B) and gravid proglottides (Fig. 2C) longitudinally elongate sac, 125–768 × 85–343 (384 ± 193 × 237 ± 96, n = 30); slightly lobed, occupying posterior half of median field. Paruterine organ anterior to uterus (Fig. 2B, C), almost conical, consisting of uniform fibrilar tissue. Fully gravid proglottides with eggs in paruterine organ were not observed. Eggs oval, with thin outer shell closely enveloping embryophore (Fig. 2D), 32–44 × 28–42 (39 ± 4 × 33 ± 4, n = 15). Embryophore oval, 29–34 × 24–31 (32 ± 1 × 26 ± 2, n = 20), thin-walled. Oncosphere oval, 25–32 × 18–27 (28 ± 2 × 23 ± 2, n = 20). Embryonic hooks: central pair thin, 14–21 (19 ± 2, n = 20) long; intra-lateral hooks thick, 11–16 (14 ± 1, n = 20) long; extra-lateral hooks thin, 12–16 (14 ± 1, n = 20) long.

Type host: *Piaya cayana* Lesson (Aves: Cuculiformes).

Type locality: Road Stroesner (Road #7), 230 km from Asunción, Caaguazú, Paraguay (25°28'11"S, 56°02'59W; altitude 300 m).

Additional locality: Stream Tagatjia Guazu, 4 km south of the ranch Santa Maria, Concepción, Paraguay (22°45'36"S, 57°26'24"W; altitude 131 m).

Site: Small intestine.

Type material: Holotype circled in blue, MHNG-PLAT-39576, collected on 13 August 1984 by C. Dlouhy; paratypes: MHNG-PLAT-82106, two specimens with scoleces and one fragment of incomplete strobila on one slide, one entire specimen with scolex and two fragments of incomplete strobila on one slide (same collection data as holotype); MHNG-PLAT-37786, three specimens with scoleces and one fragment of incomplete strobila on one slide, collected on 20 October 1985 by C. Vaucher as part of the Expeditions of the Geneva Museum in Paraguay.

Etymology: The meaning of "*cincta*" (Latin) is "surrounded". This species is named for the muscular bundles that surround and bind the genital atrium, thus forming a sphincter.

Remarks: *Cucolepis cincta* sp. n. is the only species within the genus.

DISCUSSION

Cucolepis cincta is only the fourth species of the family Paruterinidae to be described from the Cuculiformes, or cuckoos, a very diverse order in terms of habitat, social behaviour and geographic distribution. Given that paruterinids parasitize a wide diversity of avian orders, from Accipitriformes (hawks, eagles, kites and their allies) and Caprimulgiformes (nightjars), to several families of Passeriformes (perching birds), cuckoos host a relatively small portion of paruterinid diversity. Several studies have attempted to formally define the phylogenetic relationships among cuckoos using molecular, morphological, ecological and behavioural data (Hughes 1996, 2000, 2006,

Table 1. Species of the family Paruterinidae recorded from South America.

Cestode species	Host order	Host species	Locality	Source
Anonchotaenia brasiliensis Fuhrmann, 1908	Passeriformes	*Cacicus haemorrhous* (L.)	Brazil	Fuhrmann (1908), Rausch and Morgan (1947)
Anonchotaenia globata (von Linstow, 1879) Cohn, 1900	Passeriformes	*Zonotrichia capensis* (Mueller)	South America	Rausch and Morgan (1947)
Anonchotaenia globata	Passeriformes	*Sporophila caerulescens* (Vieillot)	South America	Rausch and Morgan (1947)
Anonchotaenia macrocephala Fuhrmann, 1908	Passeriformes	*Progne chalybea* (Gmelin)	South America	Rausch and Morgan (1947)
Anonchotaenia macrocephala	Passeriformes	*Hirundo* sp.	South America	Rausch and Morgan (1947)
Anonchotaenia macrocephala	Passeriformes	*Progne tapera* (L.)	South America	Rausch and Morgan (1947)
Anonchotaenia macrocephala	Passeriformes	*Progne subis* (L.)	South America	Rausch and Morgan (1947)
Anonchotaenia trochili Fuhrmann, 1908	Apodiformes	*Eupetomena macroura* (Gmelin)	Brazil	Rausch and Morgan (1947)
Biuterina campanulata (Rudolphi, 1819) Fuhrmann, 1908	Passeriformes	"*Thamnophilus sulfuratus*"	Brazil	Fuhrmann (1908)
Biuterina campanulata	Passeriformes	*Aphanotriccus audax* (Nelson)	Brazil	Fuhrmann (1908)
Biuterina cylindrica Fuhrmann, 1908	Passeriformes	*Tachyphonus cristatus* (L.)	Brazil	Fuhrmann (1908)
Biuterina cylindrica	Passeriformes	"*Tachyphonus melanoleucus*" = *Lampros-piza melanoleuca* (Vieillot)	Brazil	Fuhrmann (1908)
Biuterina distincta Fuhrmann, 1908	Passeriformes	*Gracula* sp.	Brazil	Fuhrmann (1908)
Biuterina globosa Fuhrmann, 1908	Passeriformes	*Tityra semifasciata* (Spix)	Brazil	Fuhrmann (1908)
Biuterina motacillacayanae (Rudolphi, 1819) Fuhrmann, 1908	Passeriformes	*Dacnis cayana* (L.)	Brazil	Fuhrmann (1908)
Biuterina trapezoides Fuhrmann, 1908	Passeriformes	*Emberiza* sp.	Brazil	Fuhrmann (1908)
Biuterina trapezoides	Passeriformes	"*Molothrus peconis*" = *Molothrus ater* (Boddaert)	Brazil	Fuhrmann (1908)
Biuterina trapezoides	Caprimulgiformes	*Caprimulgus* sp.	Brazil	Fuhrmann (1908)
Biuterina trigonacantha Fuhrmann, 1908	Passeriformes	*Schoeniophylax phryganophilus* (Vieillot)	Brazil	Fuhrmann (1908)
***Cucolepis cincta* gen. n. et sp. n. Phillips, Georgiev et Mariaux, 2012**	**Cuculiformes**	***Piaya cayana* (L.)**	**Paraguay**	**Present study**
Culcitella bresslaui Fuhrmann, 1927	Accipitriformes	*Buteo leucorrhoea* (Quoy et Gaimard)	Brazil	Fuhrmann (1927)
Culcitella crassa Fuhrmann, 1906	Accipitriformes	*Spizaetus ornatus* (Daudin)	Brazil	Fuhrmann (1906)
Culcitella rapacicola Fuhrmann, 1906	Accipitriformes	*Ictinia plumbea* Gmelin	Brazil	Fuhrmann (1906)
Culcitella rapacicola	Accipitriformes	*Geranospiza caerulescens* (Vieillot)	Brazil	Fuhrmann (1906)
Culcitella rapacicola	Accipitriformes	*Buteo nitidus* (Latham)	Brazil	Fuhrmann (1906)
Francobona similis (Ransom, 1909) Georgiev et Kornyushin, 1994	Cuculiformes	*Coccyzus melacoryphus* Vieillot	Argentina	Bona and Maffi (1985)
Francobona similita (Bona et Maffi, 1984) Georgiev et Kornyushin, 1994	Cuculiformes	*Coccyzus melacoryphus*	Argentina	Bona and Maffi (1984a)
Francobona similita	Cuculiformes	*Coccyzus merlini* D'Orbigny	Argentina	Bona and Maffi (1984a)
Francobona similita	Cuculiformes	*Piaya cayana*	Argentina	Bona and Maffi (1984a)
Laterotaenia natteri Fuhrmann, 1906	Accipitriformes	*Sarcoramphus papa* (L.)	Brazil	Fuhrmann (1906)
Orthoskrjabinia sp.	Passeriformes	*Paroaria coronata* (Miller)	Brazil	Mascarenhas et al. (2009)
Paruterina angustata Fuhrmann, 1906	Strigiformes	"*Scotopelia brasilianus*"	Brazil	von Linstow (1906)
Paruterina otidis Baczynska, 1914	Strigiformes	*Asio flammeus* (Pontoppidan)	Brazil	Baczynska (1914)
Paruterina trogoni Bona, Bosco et Maffi, 1986	Trogoniformes	*Trogon rufus* Gmelin	Peru	Bona et al. (1986)
Parvirostrum linusi Georgiev et Vaucher, 2001	Passeriformes	*Dendrocolaptes platyrostris* Spix	Paraguay	Georgiev and Vaucher (2001)
Parvirostrum recticulatum Fuhrmann, 1908	Passeriformes	*Lepidocolaptes albolineatus* (Lafresnaye)	Brazil	Fuhrmann (1908)
Parvirostrum reticulatum	Passeriformes	*Xiphorhynchus elegans* (Pelzeln)	Brazil	Fuhrmann (1908)
Parvirostrum reticulatum	Passeriformes	*Xiphorhynchus guttatus* Lichtenstein	Brazil	Fuhrmann (1908)
Parvirostrum sp.	Passeriformes	*Lepidocolaptes angustirostris* (Vieillot)	Paraguay	Georgiev and Vaucher (2001)
Parvirostrum synallaxis (Mahon, 1957) Georgiev et Vaucher, 2001	Passeriformes	*Synallaxis rutilans* Temminck	Brazil	Mahon (1957)
Sphaeruterina fuhrmanni (Baczyncka, 1914) Fuhrmann, 1932	Piciformes	*Bucco* sp.	Brazil	Baczynska (1914)
Sphaeruterina longiceps (Rudolphi, 1819) Fuhrmann, 1932	Passeriformes	*Cacicus haemorrhous* (L.)	Brazil	Rudolphi (1819)
Sphaeruterina longiceps	Passeriformes	*Psarocolius decumanus* (Pallas)	Brazil	Rudolphi (1819)
Troguterina disparhamulis (Bona, Bosco et Maffi, 1986) Spasskii, 1991	Trogoniformes	*Trogon violaceus* Gmelin	Peru	Bona et al. (1986)
Troguterina disparuncinata (Bona, Bosco et Maffi, 1986) Spasskii, 1991	Trogoniformes	*Trogon curucui* (L.)	Argentina	Bona et al. (1986)

Johnson et al. 2000, Posso and Donatelli 2006, 2010). The most robust available phylogeny for the cuckoos is that of Sorenson and Payne (2005), which was based on an exhaustive sampling of extant cuckoo species and an extensive mitochondrial dataset. Their analysis confirmed the monophyly of the Cuculiformes and its organization into five subfamilies: Crotophaginae (anis), Neomorphinae (New World ground cuckoos), Centropodinae (coucals), Couinae (Malagasy couas and Southeast Asian ground cuckoos), and Cuculinae (arboreal cuckoos). Over half of known cuckoo species fall within the Cuculinae, the only subfamily to be further divided into tribes: Cuculini (Old World brood parasitic cuckoos) and Phaenicophaeni (malkhoas of the Old World and New World "coccyzine cuckoos"). Recent molecular phylogenetic work supports the "coccyzine cuckoos" as monophyletic and to include the three genera *Coccycua* Lesson, *Coccyzus* Vieillot and *Piaya*, with *Coccycua* being the basal lineage of the clade (Sorenson and Payne 2005, Hughes 2006).

In addition to *C. cincta*, five species (including three undescribed) of the cestode family Paruterinidae have been reported from "coccyzine cuckoos": *Francobona similis* (Ransom, 1909) Georgiev et Kornyushin, 1994, *Francobona similita* (Bona et Maffi, 1984) Georgiev et Kornyushin, 1994, two undescribed species within the "*rectangula*" group of *Paruterina* Fuhrmann, 1906 (*sensu* Bona and Maffi 1984a) and an unidentified species (see Bona and Maffi 1984a, b) of *Triaenorhina*. *Coccycua* is the only genus of the group for which members have not been examined yet for cestodes. To our knowledge, paruterinids are mostly stenoxenous, i.e. they do not exhibit strict host specificity of one cestode species parasitizing a single host species, but rather paruterinid species can be found in several phylogenetically related species of hosts. Given that the morphology of *C. cincta* is most similar to that of *Francobona* spp. and the phylogenetic relationships of the hosts of these species, it would not be surprising to find paruterinid species, including species of *Cucolepis* or *Francobona*, parasitizing individuals of *Coccycua.*

Cuckoos also host cestodes of two other cyclophyllidean families. At least three species of dilepidids have been reported from two species of Crotophaginae and three species representing both tribes of the Cuculinae (see Fuhrmann 1907, Macko and Rysavy 1982, Mariaux and Vaucher, 1990). At least five species of davaineids have been reported from Centropodinae (see Southwell 1922). However, each of these cestode families contains more than 300 species and cuckoos host a remarkably small proportion of that diversity. Neomorphinae and Couinae are the only subfamilies remaining of Cuculiformes that currently lack cestode records.

It is tempting to look for a pattern in the absence of cestode records from these two cuculiform subfamilies. For example, it may appear to be connected to host habitat given that species of these two subfamilies are predominately ground-dwelling, although both subfamilies include some arboreal species (Sorenson and Payne 2005). That having been said, there are records of members of other cestode families parasitizing ground-dwelling birds, such as davaineids in tinamous (Fuhrmann 1909). It is critical to determine if the relative scarcity, or complete lack, of cestode records from members of the Cuculiformes speaks to inadequate sampling throughout the host order, to any resulting cestode diversity not having been recognized or studied, or possibly to the actual absence of cestodes from those potential hosts.

In general, the records of paruterinids from South America are spotty and scattered across several orders of birds (Table 1). The bulk of paruterinid species reported from South America derives from descriptions published between 1906 and 1947, often with imprecise localities, such as simply "South America" or "Brazil" (Fuhrmann 1906, 1908, 1927, Rausch and Morgan 1947). This makes new collections of paruterinids in South America interesting because of the high potential to be either new locality or host records or to provide new material for comparative analyses based on morphological or molecular data.

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