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Research article

[urn:lsid:zoobank.org/pub:144F0449-7736-44A0-8D75-FA5B95A04E23](https://zoobank.org/pub:144F0449-7736-44A0-8D75-FA5B95A04E23)

Cestode parasites (Neodermata, Platyhelminthes) from Malaysian birds, with description of five new species

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Abstract. We studied the cestode fauna (Platyhelminthes) of forest birds in Malaysia (Selangor) collected during a field trip in 2010. Ninety birds of 37 species were examined and global prevalence of cestodes was 15.3%. Five new taxa are described: *Emberizotaenia aeschlii* sp. nov. (Dilepididae) from *Tricholestes criniger* (Blyth, 1845) (Pycnonotidae); *Anonchotaenia kornyushini* sp. nov. (Paruterinidae) from *Trichastoma malaccense* (Hartlaub, 1844) (Pellorneidae); *Biuterina jensenae* sp. nov. (Paruterinidae) from *Chloropsis cochinchinensis* (Gmelin, 1789) (Irenidae); *Raillietina hymenolepidoides* sp. nov. (Davaineidae) and *R. mahnerti* sp. nov. (Davaineidae) from *Chalcophaps indica* (Linnaeus, 1758) (Columbidae). *Ophryocotyloides dasi* Tandan & Singh, 1964 is reported from *Psilopogon henricii* (Temminck, 1831) (Rampastidae). Several other taxa in Dilepididae, Davaineidae, Paruterinidae, Hymenolepididae and Mesocestoididae, either potentially new or poorly known, are also reported. The richness described from this small collection hints at the potentially huge unknown parasite diversity from wild hosts in this part of the world.

Keywords. Avian hosts, Asia, Dilepididae, Davaineidae, Paruterinidae, Hymenolepididae, *Mesocestoides*.

Mariaux J. & Georgiev B.B. 2020. Cestode parasites (Neodermata, Platyhelminthes) from Malaysian birds, with description of five new species. *European Journal of Taxonomy* 616: 1–35.
<https://doi.org/10.5852/ejt.2020.616>

Introduction

Between 2008 and 2017, a worldwide concerted effort was made to document the diversity of cestodes in their vertebrate hosts (Caira & Jensen 2017). In this context, a team of taxonomists led by the present authors focused on avian parasites, with a particular focus on Cyclophyllidea of terrestrial birds (Mariaux *et al.* 2017). This resulted in various expeditions targeting particularly understudied hosts and regions (for previously published results, see Dimitrova *et al.* 2013, 2017, 2019; Widmer *et al.*

2013; Phillips *et al.* 2014; Mariaux & Georgiev 2018a, 2018b). The present contribution reports on the parasite fauna of a small collection of terrestrial birds examined in a well-conserved area of secondary and primary forest in Selangor State, North of Kuala Lumpur, Malaysia. Data for cestode parasites in this part of the world are scarce and most hosts examined were investigated for the first time. As expected, an important proportion of their parasitic fauna was unknown, leading us to describe five new species herein. An additional new hymenolepidid species from a kingfisher (Alcedinidae) will be treated elsewhere.

Material and methods

Hosts were collected with mist nets by the authors during a field expedition in Malaysia from July 27 to August 12, 2010. All collections were made at, or in the vicinity of, University of Malaya's Gombak Field Station, Selangor, Malaysia (3.32° N, 101.77° E), altitude 280–350 m. Birds were sorted at mist net side and those not necessary for the study were released on the spot. Selected birds were transported to the lab in fabric bags, euthanized as soon as possible with an excess of chloroform, photographed and identified. Dissections were made under a stereo microscope. The digestive tract was removed (possibly cut in sections depending on its size) and cut open. Cestodes were collected and preliminarily identified as far as possible. Specimens for morphological analysis were fixed with hot 4% formalin and transferred to 70% ethanol. When practicable, a piece of a voucher specimen was kept in molecular grade 99% ethanol and the corresponding specimen was fixed as above in a separate vial. Specimens were prepared using Mayer's hydrochloric carmine staining, dehydration in an ethanol series, clearing in eugenol (clove oil) and mounting in Canada balsam. Some scoleces were squashed in Berlese's medium to facilitate examination of rostellar hooks. When necessary, pieces of worms were embedded in paraffin and cross-sections (12–15 µm thick) were prepared. Sections were stained with Weigert's haematoxylin and counterstained with eosin. Except for tetrathyridia, all material discussed herein was collected in the host small intestine.

All measurements are given in micrometers (if not indicated otherwise) as the range, with the mean and the number (n) of measurements or counts in parentheses. Standard conventions for Dilepididae descriptions follow Bona (1994: 446). All specimens are deposited in the Platyhelminthes Collections of the Museum of Natural History (MHNG-PLAT) in Geneva, Switzerland. Partial COI (cox1) sequences were generated according to the methodology described in Scholz *et al.* (2013). These sequences are deposited in GenBank under accession numbers MN590285 to MN590294 (data by A. Waeschenbach and D.T.J Littlewood, Natural History Museum, London, UK).

Due to the use of bird bodies for other studies by the staff of the University of Malaya, Kuala Lumpur, only about half of the examined host individuals were prepared for preservation in museum collections; these were registered in the bird collections of the MHNG. The nomenclature of birds follows the last available edition of Avibase (Lepage 2019).

Repositories

MHNG-PLAT = Platyhelminthes Collections, Museum of Natural History, Geneva, Switzerland
NHM = Natural History Museum, London, UK
SAM-AHC = South Australian Museum, Australian Helminthological Collection, Adelaide, Australia

Results

Our fieldwork included the examination of 90 hosts specimens distributed in 14 families (mostly of Passeriformes) and 37 species. Seventeen birds (15.3%), belonging to 11 species in the Columbidae, Halcyonidae, Irenidae, Malaconotidae, Motacillidae, Muscicapidae, Pycnonotidae, Sylviidae and

Timaliidae harboured cestodes, in line with expected prevalences for terrestrial birds (Mariaux *et al.* 2017). All identified cestodes belong to the Cyclophyllidea. Here we report on 13 taxa, including five new species.

The hosts examined have also been used to characterize the diversity of other parasite groups, resulting in a diversity survey of their haemosporidian parasites (Ivanova *et al.* 2015) and the description of two new acuariid nematode species (Mutafchiev *et al.* 2014).

Class Cestoda van Beneden, 1848
Order Cyclophyllidea van Beneden in Braun, 1900
Family Dilepididae Fuhrmann, 1907
Genus *Emberizotaenia* Spasskaya, 1970

Emberizotaenia aeschlii sp. nov.

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Figs 1–3, Table 1

Etymology

The species is dedicated to the late Prof. André Aeschlimann, parasitologist and mentor of the senior author, who was familiarly known as “Aeschli” to his colleagues and students.

Material examined

Holotype

MALAYSIA • Selangor, University of Malaya’s Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 31 Jul. 2010; no molecular voucher; MHNG-PLAT-120682.

Comparative material

AUSTRALIA • transverse sections of syntypes of *Emberizotaenia chlamyderae* (Krefft, 1871) Bona, 1994 from *Chlamydera maculata* (Gould, 1837) (Passeriformes, Ptilonorhynchidae); SAM-AHC 20445.

Type host

Tricholestes criniger (Blyth, 1845) (Passeriformes, Pycnonotidae).

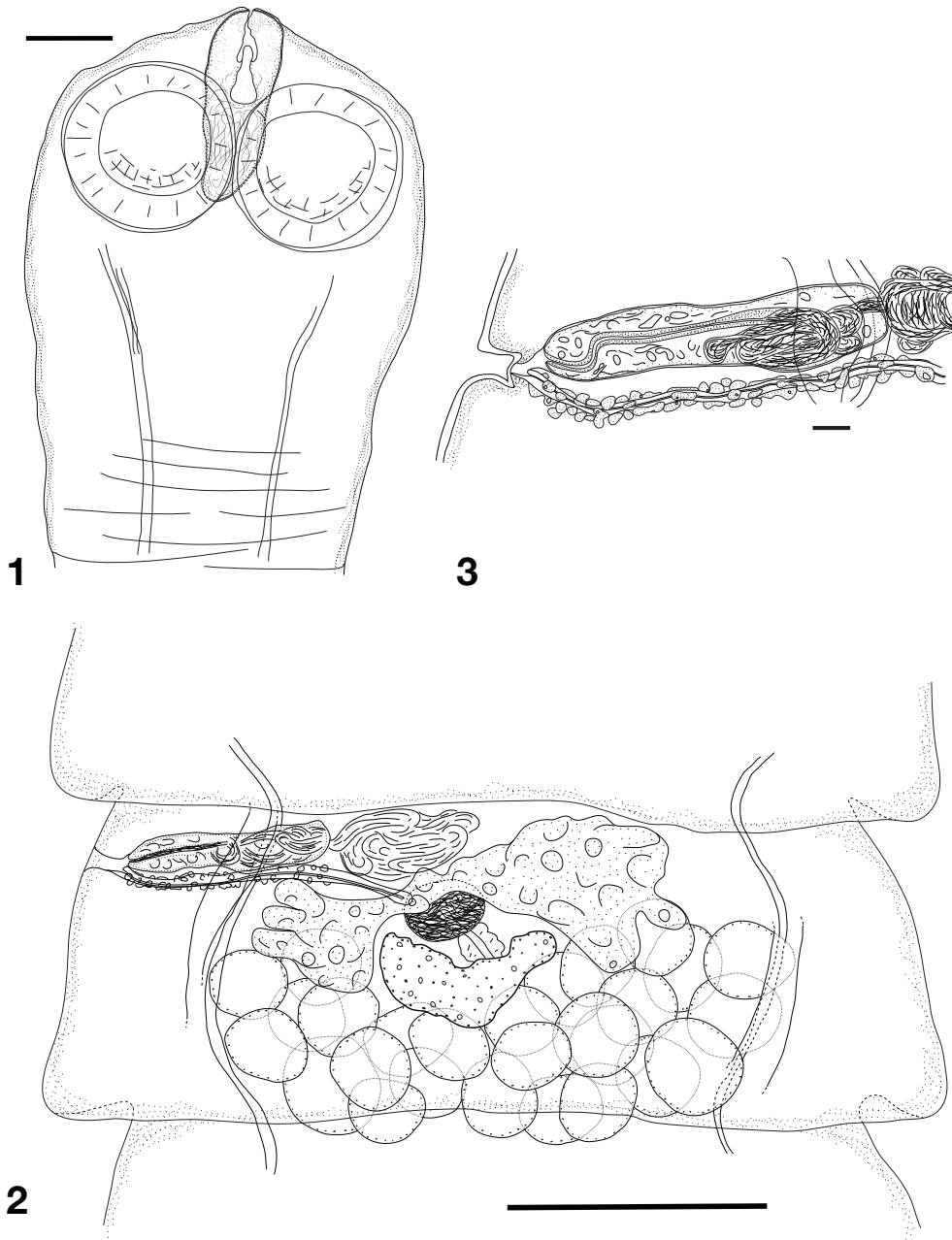
Prevalence

17% (1/6).

Description

Body small, 22.5 mm long, with maximum width 1075 at level of pregravid proglottides; consisting of 115 proglottides (last proglottides pregravid). Proglottides craspedote, always wider than long. Scolex rounded, not delineated from neck, 430 in diameter (Fig. 1). Suckers rounded, 185–200 (194, n = 4) in diameter; muscular, unarmed. Rostellar apparatus unarmed, weakly muscular, with well-developed glandular tissue within rostellar sac, especially in its posterior half. Rostellar sac regular, cylindrical, almost reaching level of posterior margin of suckers, 225 × 88. Rostellum discrete, poorly delineated and very weak, 64 × 20, glandular. Proglottization distinct at 300 from posterior margin of suckers. Genital pores situated in anterior 25% of length of lateral proglottis margin, irregularly alternating in very short series, e.g., 2, 2, 2, 1, 2, 1, 3, 1, 3, 1, 2, 1; no more than 4 consecutive pores observed on one side. Ventral osmoregulatory canals up to 40 wide, connected posteriorly in each proglottis by transverse anastomosis. Dorsal osmoregulatory canals 6–7 wide. Genital ducts passing between osmoregulatory canals. Genital atrium small, sink-shaped, up to about 18–22 deep and 15–17 in diameter.

Testes 26–34 (29, $n = 14$) in number; in 2 or 3 layers, in one continuous posterior field, sometimes overlapping osmoregulatory canals and often overlapping posterior lobes of ovary and vitellarium (Fig. 2). External vas deferens convoluted in antero-poral part of median field. Cirrus-sac elongate, 170–212 \times 36–50 (191 \times 43, $n = 20$), usually straight, crossing osmoregulatory canals; distal extremity with large cells (Fig. 3). Internal vas deferens forming several coils, mostly in proximal half of cirrus sac. Cirrus unarmed, about 100–130 long and usually straight when invaginated.



Figs 1–3. *Emberizotaenia aeschlii* sp. nov. 1. Scolex. 2. Mature proglottis, ventral view. 3. Cirrus-sac. Scale bars: 1 = 100 μm ; 2 = 250 μm ; 3 = 20 μm .

Vitellarium central, compact, transversely elongate, variable in shape but often forming a flattened V or reniform. Ovary antero-central, transversely elongate, bi-alate, multilobate, antiporal wing larger than poral wing; not overlapping longitudinal osmoregulatory canals. Mehlis' gland subglobular, anterior to vitellarium. Seminal receptacle round, becoming more oval when full but never elongated, reaching up to 190×145 in pregravid proglottides, dorsal and between ovary wings. Vagina opens posterior to male pore, straight and transverse, parallel to cirrus-sac; thick-walled, surrounded by a loose sheath of large cells irregularly positioned along entire canal; no vaginal sphincter (Fig. 3).

Uterus starts its development in late mature proglottides as a diffuse ventral reticulum, progressively forming numerous small lobes and occupying entire median field; crossing osmoregulatory canals and extending into lateral fields. Uterus eventually becoming sacciform with deep septa. Developing oncospheres round, 19–21 in diameter, no fully developed eggs or embryonic hooks observed.

Remarks

Dilepidids with a reduced, unarmed, apical apparatus belong to a number of genera. An important differentiating character for distinguishing among them is the presence (or not) of a rudimentary unarmed rostellum, or “bulb” (Bona 1994). This structure is a diagnostic character of two genera, *Eburneotaenia* Bona, 1994, with type species *E. eburnea* (Mariaux & Vaucher, 1988), characterised also by the presence of sucker armature consisting of small punctiform spines (see Mariaux & Vaucher 1988), and *Emberizotaenia* Spasskaya, 1970, which has unarmed suckers. Our specimen has such an unarmed bulb, albeit weak, and has unarmed suckers. Therefore, it belongs to *Emberizotaenia*, a genus known from birds of the order Passeriformes in the Palearctic Region and in Australia. Bona (1994) mentioned Africa and Sri Lanka in the geographical range of this genus but without further explanation or reference; we consider the information about these geographical areas may come from his personal unpublished data.

The new species described here essentially fits the generic diagnosis proposed by Bona (1994). There is an exception related to the number of testes, which are “numerous” (26–34) in our material, instead of “very numerous” as mentioned in the generic diagnosis; according to Bona (1994), the adopted range for “very numerous testes” refers to “from about 36 to 60, seldom more”. However, the type species *E. reductorhyncha* (Spasskaya, 1957), as well as *E. skrjabiniana* (Spasskaya, 1958), also have “numerous” testes (Table 1), i.e., between 14 and 35 according to Bona's (1994) definition. In addition, we could not observe the osmoregulatory canals forming a network posterior to the scolex in our specimens; this character may, however, be difficult to observe depending on the state of conservation and the fixation of the material, and has not been reported in the original descriptions of the majority of the known species. Therefore, we doubt that it is a reliable character to be used for generic differentiation.

Currently, the genus *Emberizotaenia* includes 4 species:

1. *Emberizotaenia reductorhyncha* (Spasskaya, 1957) (type species) [*Anomotaenia reductorhyncha* Spasskaya, 1957; *Unciunia reductorhyncha* in Matevosyan 1963; *Ptilotolepis reductorhyncha* in Spasskaya & Spasskii 1977], originally described from *Poecile cinctus* (Boddaert, 1783) (syn. *Parus cinctus*) (Paridae) from Vilyuyskiy Rayon, Yakutia, Russia (Spasskaya 1957). Subsequently, this species was redescribed and illustrated from “*Parus atricapillus*” from Tuva (Russia); however, *Poecile atricapillus* is currently believed to represent a North American species (Lepage 2019) and this record probably refers to *P. montanus* Conrad von Baldenstein, 1827. Other host records are those from *P. palustris* Linnaeus, 1758 from Tuva (Spasskaya & Spasskii 1971) and from *Parus major* Linnaeus, 1758 from Ukraine (Salamatin 1999). The records of *E. reductorhyncha* from *Turdus philomelos* Brehm, 1831 (= *Turdus ericetorum*) from Moldova (Shumilo & Spasskaya 1975; Spasskaya & Spasskii 1977) and Kaliningradskaya Oblast' of Russia (Galkin 1981) most

Table 1. Main morphological characteristics of species of *Emberizotaenia* Spasskaya, 1970. * With additional counts or measurements from sections of type material.

	<i>E. aeschlii</i> sp. nov.	<i>E. reductorhyncha</i> (Spasskaya, 1957)	<i>E. skrjabiniana</i> (Spasskaya, 1958)	<i>E. raymondi</i> (Gigon & Beuret, 1991)	<i>E. chlamyderae</i> (Kreffft, 1873)
Source	Present study	Spasskaya (1957)	Spasskaya (1958)	Gigon & Beuret (1991)	Kreffft (1873)
Host family	Pycnonotidae	Paridae	Emberizidae	Turdidae	Ptilonorhynchidae
Type locality	Malaysia	Yakutia (= Sakha), Russia	Tuva, Russia	Switzerland	Australia
Body length × width [mm]	22.5 × 1.075	30–35 × 1.5	30 × 1	25–39 × 1.3	ca 76.2 × 2.12
Scolex diameter	430	392–686	475	590–750 × 490–700	–
Sucker diameter	185–200	168 × 154	–	260–270	–
Rostellum	64 × 20	72 × 41	135 × 81	60–70 × 30–40	–
Rostellar sac	225 × 88	168 × 112	320 × 330	200–260 × 140–160	–
Testes number	26–34	16–20	30	30–40	< 20 ?*
Cirrus sac	170–212 × 36–50	145 × 38	248–256 × 41	170–280 × 40–50	90–137 × 27–41*
Oncospheres	19–21	36 × 29	39 × 25	27–31 × 19–25	–

probably refer to another congeneric species, *E. raymondi* (see Georgiev & Genov 1993). Therefore, *E. reductorhyncha* is a specific parasite to birds of the family Paridae known from the Northern Palaearctic.

- Emberizotaenia skrjabiniana* (Spasskaya, 1958) Spasskaya, 1970 [*Anomotaenia skrjabiniana* Spasskaya, 1958; *Pseudanomotaenia skrjabiniana* in Matevosyan 1963; *Ptilotolepis skrjabiniana* in Spasskaya & Spasskii 1977] from *Emberiza leucocephalos* Gmelin, 1771 (Emberizidae) from Tuva (Russia) (Spasskaya 1958). Korniyushin (1972) reported this species from Ukraine but without providing data on its host and morphology. Spasskaya & Spasskii (1977) mentioned it from *Galerida cristata* (Linnaeus, 1758) (Alaudidae) from Nakhchivan Autonomous Republic (Transcaucasia) on the basis of the unpublished dissertation by Sadykhov but this record needs additional confirmation. Ryšavý (1979) believed that the original description by Spasskaya (1958) had been based on specimens with lost rostellar hooks and identified cestodes with armed rostella from *Fringilla coelebs* Linnaeus, 1758 (Fringillidae) from Czechia as this species; the details in the description given by Ryšavý (1979) do not allow the identification of his cestodes at the generic level. Therefore, the only reliable report of *E. skrjabiniana* is the original description by Spasskaya (1958).
- Emberizotaenia raymondi* (Gigon & Beuret, 1991) [*Unciunia raymondi* Gigon & Beuret, 1991; *Ptilotolepis raymondi* in Georgiev & Genov 1993; *Ptilotolepis philomelae* Okulewicz, 1991] from *Turdus philomelos* (Turdidae) from Switzerland (type locality) (Gigon & Beuret 1991), Poland (Okulewicz 1991), Bulgaria (Georgiev & Genov 1993) and, possibly from Moldova and Kaliningradskaya Oblast', Russia (as *Emberizotaenia reductorhyncha*, see above). Therefore, for the moment, this species is a specific parasite of *Turdus philomelos* known from Europe only.
- Emberizotaenia chlamyderae* (Kreffft, 1873) [*Taenia chlamyderae* Krefft, 1873; *Choanotaenia chlamyderae* in Johnston 1911; *Icterotaenia chlamyderae* in Baer 1925; *Paricterotaenia chlamyderae* in Fuhrmann 1932; *Polycercus chlamyderae* in Schmidt 1986] from *Chlamydera maculata* (Gould, 1837) (Ptilonorhynchidae) from New South Wales, Australia, known from its original description (Kreffft 1873) and a drawing of the scolex by Bona (1994). Unfortunately, most of Krefft's material,

including specimens observed by Bona, seems to be lost, with only 3 slides of sections remaining. These allowed us to obtain a few measurements of the cirrus-sac at 111×33 ($90\text{--}137 \times 27\text{--}41$, $n = 7$), as well as to obtain a very rough estimate of testis number, probably less than 20 (Table 1).

Even in the absence of gravid proglottides, our specimen is unambiguously distinguishable from all of them (Table 1). It differs from *E. reductorhyncha* by the higher number of testes (26–34 vs 16–20) and a longer cirrus sac (170–212 vs 145); from *E. skrjabiniana* by its smaller cirrus sac (170–212 vs 248–256) and smaller rostellar sac (225×88 vs 320×330). Our material is more similar to *E. raymondi*. Metrical characters in both taxa are very similar, but a number of differences nevertheless allow them to be distinguished morphologically. The most obvious ones are the shape of the rostellar pouch, which is globular in *E. raymondi* and more elongated in our material, as well as the presence of distinctive large cells making a loose sheath around a strongly walled vagina in the Malaysian material. Additionally, *E. raymondi* has a larger scolex and suckers; a more elongate cirrus sac, a higher proportion of it extending in median field; and a smaller seminal receptacle. From *E. chlamydrae*, a species with very poorly known anatomy, our specimen differs by its three times smaller body length, a larger cirrus-sac and, possibly, higher number of testes.

Together with the host and the geographical origin of our material, these observations allow its recognition as a new species, *Emberizotaenia aeschlii* sp. nov. Pycnonotidae represents a new host family for this genus of cestodes.

Genus *Sobolevitaenia* Spasskaya & Makarenko, 1965

Sobolevitaenia anthusi (Spasskaya, 1958)

Figs 4–7

Material examined

MALAYSIA • 2 specs (in fragments, one without gravid proglottides); Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 11 Aug. 2010; no COI sequence successfully retrieved; MHNG-PLAT-121462.

Host

Motacilla cinerea Tunstall, 1871 (Passeriformes, Motacillidae).

Description

Body of small size, with length up to 25.5 mm and maximum width 720 at level of gravid proglottides; consisting of at least 101 proglottides. Proglottides craspedote, initially wider than long but rapidly elongating; gravid proglottides up to 2.5 times as long as wide. Scolex elongate, fragile, 112–150 in diameter (Fig. 4). Suckers rounded, 82–95 (89, $n = 8$) in diameter, weakly muscular, with internal surface covered by small shovel-shaped spines, ca 2.5 wide (Fig. 5). Rostellar sac large, filling most of scolex volume, cylindrical, passing beyond level of posterior margin of suckers, $175\text{--}185 \times 77$. Rostellum large, well-delineated and weakly muscular, $150\text{--}155 \times 70\text{--}72$. Hooks 20 in number, in 2 poorly delineated rows; each hook with short blade and guard and long handle (Fig. 6). Anterior hooks 30–33 (32, $n = 6$) long. Posterior hooks 26.5–30 (27.5, $n = 9$) long. Proglottization distinct at 138–160 from posterior margin of suckers. Genital pores situated anteriorly at 20–25% of length of lateral proglottis margin, irregularly alternating in very short series; no more than 3 consecutive pores observed on one side. Ventral osmoregulatory canals up to 20 wide, more commonly 5–10 wide, connected posteriorly in each proglottis by transverse anastomosis. Dorsal osmoregulatory canals narrow, 2–4 wide. Genital ducts passing between osmoregulatory canals. Genital atrium small, unremarkable.

Testes 17–21 (18.5, $n = 23$) in number; in 2 layers, in one continuous posterior field, not overlapping osmoregulatory canals and rarely overlapping posterior lobes of ovary and vitellarium (Fig. 7). External vas deferens coiled anteriorly, overlapping proximal extremity of cirrus-sac. Cirrus-sac elongate, strong and very large, $183\text{--}228 \times 35\text{--}45$ (201×41 , $n = 14$), often slightly bent anteriorly at mid-length, reaching or extending beyond middle of proglottis. Internal vas deferens forming several coils, mostly in proximal third of cirrus-sac. Cirrus armed with well-developed spines of various sizes; spines smaller proximally and less numerous, stronger and larger distally, up to 5 long.

Vitellarium central, compact, globulous, particularly large, $70\text{--}110 \times 90\text{--}140$ (86×109 , $n = 7$) in late mature proglottides. Ovary antero-central, bi-alate, longitudinally elongate, large; antiporal wing slightly larger than poral wing; not overlapping longitudinal osmoregulatory canals. Mehlis' gland globular, immediately anterior to vitellarium. Seminal receptacle oval, central, dorsally overlapping ovary and, possibly, vitellarium in part, reaching up to 225×175 in pregravid proglottides. Vagina opens posterior to male pore, well-marked with compact cellular sheath over its entire length, straight and transverse, parallel to cirrus-sac up to two thirds of its length, then markedly bent posteriorly, sometimes partially overlapping cirrus-sac dorsally (Fig. 7).

Uterus starts its development as a diffuse reticulum, progressively forming numerous small lobes and occupying entire median field; crossing osmoregulatory canals and extending in lateral fields. Uterus eventually becoming multisaccular, almost labyrinthine. Embryophores thick. Oncospheres oval, $26\text{--}31 \times 20\text{--}23$ (28×21 , $n = 15$). Embryonic hooks 10 long.

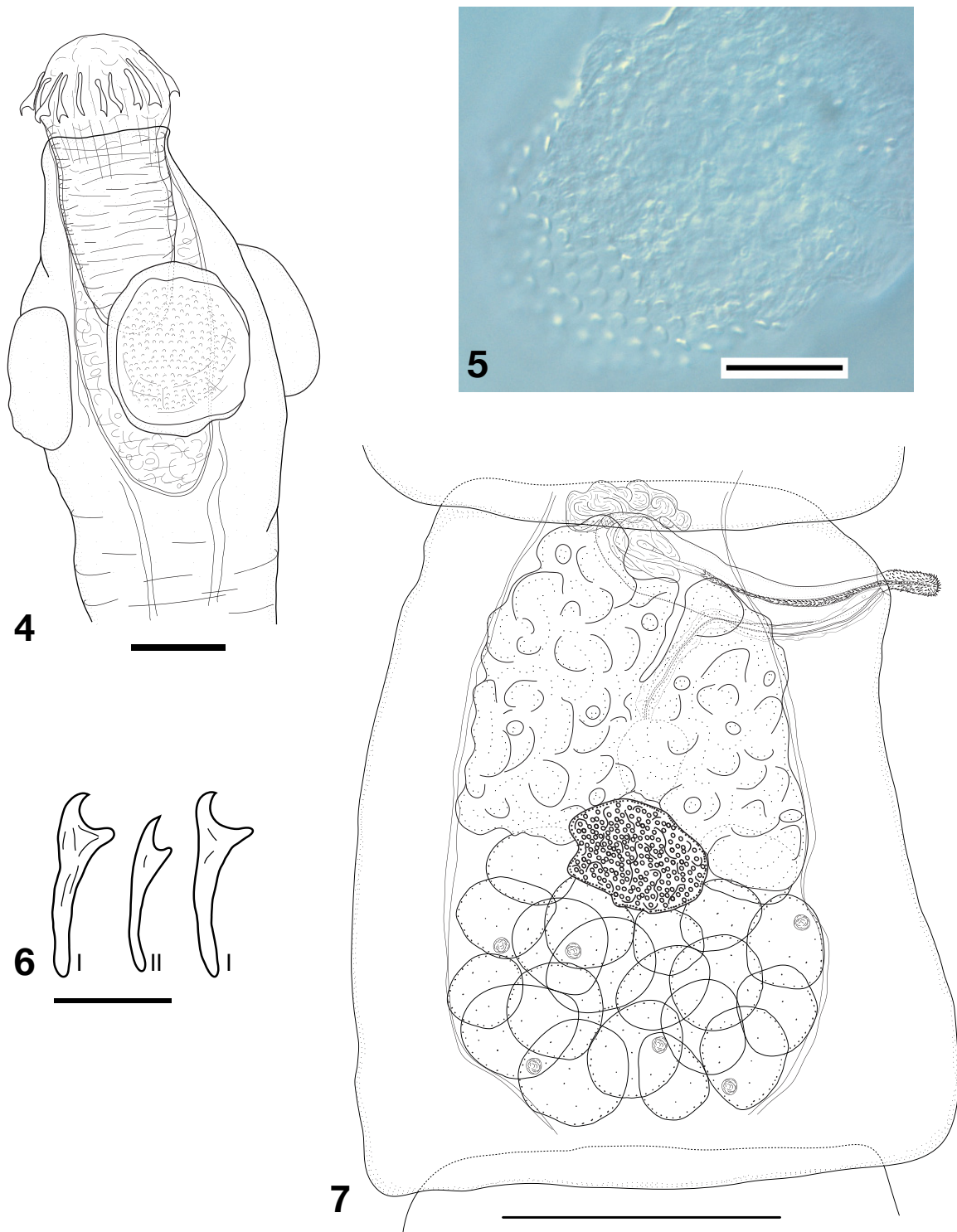
Remarks

This material presents all the characters of the genus *Sobolevitaenia*, a genus found in various passerines, including Motacillidae, that we recently discussed in detail (Mariaux & Georgiev 2018b). In that work, we presented a summary of the main metrical and meristic characters of the 17 known species of the genus. Most of them differ obviously from the present material because of their (mostly larger) hook length, number of testes or cirrus-sac length.

The most similar taxa are the type-species *S. anthusi* (Spasskaya, 1958) and its possible synonym *S. orientalis* Spasskii & Konovalov, 1969, which are found in various Motacillidae, rarely in other passerines, in the Palearctic (Spasskaya & Spasskii 1977). Although some variation is known for this taxon, *S. anthusi* shows a rostellar armature and number of testes similar to the present material. It differs, however, essentially by having a shorter cirrus-sac (that also has a more limited extension across the proglottis), a longer rostellar sac, and a shorter rostellum. Its strobila is also shorter, not exceeding 15 mm (Spasskaya & Spasskii 1977). *Sobolevitaenia orientalis* has a different subset of differentiating characters, including a larger scolex, a shorter rostellar sac and slightly larger posterior hooks.

Finally, *S. (?) borealis* (Krabbe, 1869) also show characteristics similar to the present material. However, besides its very different hosts (Calcariidae) and distribution (Greenland), this poorly known taxon also has a larger scolex, only 18 rostellar hooks and shorter posterior hooks (according to Baer 1956).

The status of *S. anthusi* as a single species or a complex of similar species, and its possible synonymy with *S. orientalis*, remains unclear. Our material differs slightly from both original descriptions but would be included in the global variation of both taxa taken together. In addition, *S. anthusi* has been reported with significant morphological variation across its range that extends at least along the entire north coast of Russia and south to Tajikistan and Tuva. Those elements may be indicative of a complex of species, but for now we will take the cautious option of placing our material in *S. anthusi* sensu Spasskaya & Spasskii (1977).



Figs 4–7. *Sobolevitaenia anthusi* (Spasskaya, 1958). 4. Scolex. 5. Sucker spines. 6. Rostellar hooks (I: anterior, II posterior). 7. Mature proglottis, ventral view. Scale bars: 4 = 50 μm; 5–6 = 20 μm; 7 = 200 μm.

Dilepididae gen. sp.

Material examined

MALAYSIA • 1 spec. (in fragments); Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 11 Aug. 2010; no COI sequence successfully retrieved; MHNG-PLAT-121225.

Host

Orthotomus sericeus Temminck, 1836 (Passeriformes, Cisticolidae).

Remarks

Our specimen is about 32 mm long, with a maximum width of 850. It consists of 64 proglottides which very rapidly become longer than wide. The anatomy is typical for a member of the Dilepididae: numerous testes (18–27) in one posterior field; irregularly alternating genital pores opening at anterior 20% of proglottis margin; unarmed cirrus; oval cirrus-sac reaching osmoregulatory canals; genital ducts passing between osmoregulatory canals; a large two-winged central ovary. Uterus is densely labyrinthine. Unfortunately, no scolex is available and a more precise identification is not possible. To our knowledge, no cestode had previously been reported from this host species or, indeed, from any of the 12 other species of tailorbirds.

Family Paruterinidae Fuhrmann, 1907

Genus *Anonchotaenia* Cohn, 1900

Anonchotaenia kornyushini sp. nov.

[urn:lsid:zoobank.org:act:7CB90CCB-EC69-401F-AAA6-10A697956E1A](https://zoobank.org/act:7CB90CCB-EC69-401F-AAA6-10A697956E1A)

Figs 8–13

Etymology

The species is dedicated to our colleague Prof. Vadim V. Kornyushin (Kiev, Ukraine), a dedicated cestode taxonomist with numerous contributions to the knowledge of the family Paruterinidae.

Material examined

Holotype

MALAYSIA • Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 9 Aug. 2010; MHNG-PLAT-121232.

Paratypes

MALAYSIA • 2 specs; same collection data as for holotype; MHNG-PLAT-121233.

Hologenophore

MHNG-PLAT-121234 [field # MAL-075/C3]. Partial COI sequence, Genbank MN590285.

Type host

Trichastoma malaccense (Hartlaub, 1844) (Passeriformes, Pellorneidae).

Description

Body of medium size, 42 mm (n = 1) long, with maximum width 930 at level of early gravid proglottides; consisting of 540 proglottides. Mature proglottides acraspedote, about 15–20 times as wide as long; progressively becoming longer, 8–10 times wider at pregravid stage, then becoming markedly craspedote

when gravid; last gravid proglottides almost as long as wide. Scolex rounded, 710–760 (730, n = 3) in diameter, poorly delineated from strobila. Suckers strong, muscular, 300–350 (327, n = 12) in diameter. Rostellum and rostellar sac absent (Fig. 8). Unsegmented zone 1.7–1.8 mm long behind posterior margin of suckers. Genital pores irregularly alternating in short series (mostly 1 or 2, maximum of 5 consecutive pores on the same side), opening in middle of lateral margin of proglottis. Genital ducts ventral to osmoregulatory canals. Ventral osmoregulatory canals up to 75 wide, connected posteriorly in each proglottis by transverse anastomosis. Dorsal osmoregulatory canals 5–10 wide. Genital atrium simple, with narrow infundibular orifice, 17–25 deep.

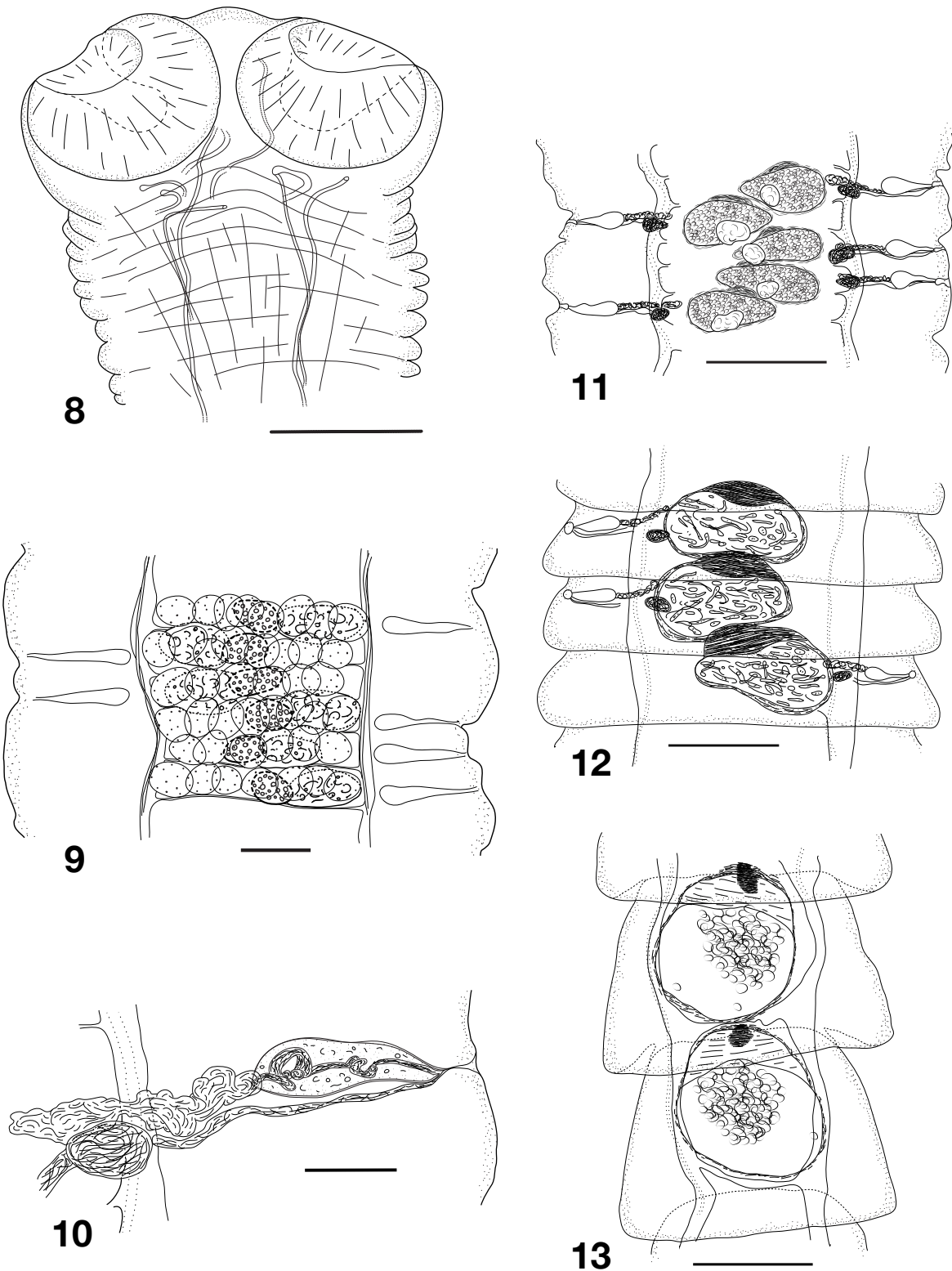
Testes large, spherical to slightly oval, 6–9 in number [6 (19%), 7 (37.5%), 8 (36%), 9 (7.5%)] (7.3, n = 53); 43–62 (50, n = 20) in diameter; arranged in single transverse row (with some partial overlapping) situated dorsally, occupying entire median field. Cirrus sac discrete, claviform, straight, with narrow poral half; not reaching osmoregulatory canals, 93–114 × 26–36 (103 × 30, n = 30). Cirrus unarmed. Internal vas deferens making a few loops in cirrus sac. External vas deferens coiled, situated antiporally to cirrus sac (Figs 9–10).

Vitellarium compact, oval, 45–55 × 58–80 (51 × 67, n = 20); aporal to ovary or partially overlapping its antiporal extremity dorsally. Ovary oval, 57–85 × 100–148 (68 × 123, n = 20); in poral half of median field. Mehlis' gland not distinct. Vagina well-marked, opening posterior to male pore. Seminal receptacle oval to fusiform, on poral side of developing uterus. Uterus saccular, appearing centrally, dorsal to ovary in post-mature and pregravid proglottides, expanding laterally, becoming teardrop-shaped with thicker poral extremity (Fig. 11), then becoming more and more globular. Uterine wall thick. Paruterine organ consisting of fibrillar tissue, appearing rapidly adjacent to developing uterus, directed anteriorly to it and progressively becoming thicker (Figs 12–13). Eggs initially spherical, becoming vermiform in gravid proglottides, gradually filling uterus. At spherical stage, oncospheres 12.5–16.5 (14, n = 20) and eggs 18–20.5 (19.5, n = 20) in diameter. Embryonic hooks (poorly visible) ca 8 in length. Eggs passing into paruterine cavity not observed, but most developed proglottides with antero-central densification suggesting formation of this cavity.

Remarks

This material belongs to the genus *Anonchotaenia* Cohn, 1900 as defined by Mariaux (1991) or Georgiev & Korniyushin (1994). The most recent review of its diversity was by Phillips *et al.* (2014), who presented a summary of the main characters of the known species. Subsequently, a single additional species, *A. adhiraji* Banerjee, Manna & Sanyal, 2018, was described in India (Banerjee *et al.* 2018). This allows the easy comparison of our material with the 30 known species of *Anonchotaenia*. Most of *Anonchotaenia* spp. clearly differ by more than one of the characters listed by Phillips *et al.* (2014) (scolex and sucker diameters, position of genital ducts, testis number, cirrus sac extent and size) and only 2 species are similar to our material, i.e., *A. castellanii* Fuhrmann & Baer, 1943, described from an Ethiopian laniid bird, and *A. globata* (von Linstow, 1879), initially described from a parid bird from Germany (von Linstow 1879). The former species exhibits close similarities with our material; however, its testis number (9–10) is only marginally overlapping our observations (6–9, with a dominant proportion of 7–8 testes). *Anonchotaenia castellanii* further differs from our material in showing a much more muscular cirrus-sac as well as a strong atrial sphincter (Fuhrmann & Baer 1943). Furthermore, *Eurocephalus rueppellii* Bonaparte, 1853, the host of *A. castellanii*, is endemic to Eastern Africa.

Anonchotaenia globata has been reported from a wide range of Passeriformes all over the world (Matevosyan 1969). It also resembles our material for most characters, even if a precise description of this species is difficult to infer from the multiple reports of this taxon. Korniyushin (1989) believed that the reports of *A. globata* should be referred to a complex of species. Phillips *et al.* (2014) presented metrical data based on summarising known ranges reported for *A. globata* by many authors from various



Figs 8–13. *Anonchotaenia kornyushini* sp. nov. **8.** Scolex. **9.** Mature proglottis. **10.** Cirrus-sac, dorsal view. **11–13.** Various stages of uterine and paruterine organ development. Scale bars: 8–9 = 100 μm ; 10 = 50 μm ; 11–13 = 250 μm .

hosts and various geographical origins (but erroneously mentioning in their table that these data come from the original description only). Even considered in this wide and doubtful taxonomic context, *A. globata* is characterized by a smaller number of testes (4–5) than our material, though a larger range has occasionally been reported for this species. Although a few other unusual morphological characters (such as the changes of the shape of the paruterine organ during its development) seem promising for specific identifications in the group (Phillips *et al.* 2014), they still lack a complete comparative basis. Testis number presently remains crucial, and the most reliable criterion to identify *Anonchotaenia* spp. at the morphological level (Mariaux 1991). We consider it sufficient to justify the placement of our material in a new species that we name *Anonchotaenia kornyushini* sp. nov.

Genus *Biuterina* Fuhrmann, 1902

Biuterina jensenae sp. nov.

urn:lsid:zoobank.org:act:5B34DD7D-6AA3-43A3-A8B3-6423594ACD3E

Figs 14–21

Etymology

The species is dedicated to our colleague Prof. Kirsten Jensen, University of Kansas, Lawrence, in recognition of her remarkable contribution to tapeworms systematics.

Material examined

Holotype

MALAYSIA • Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.: 30 Jul. 2010; MHNG-PLAT-121156.

Paratypes

MALAYSIA • 1 fragment; same collection data as for holotype; MHNG-PLAT-121157.

Hologenophore

MHNG-PLAT-121157. Partial COI sequence, Genbank MN590287.

Other material

MALAYSIA • 3 juveniles from *Tricholestes criniger* (Blyth, 1845) (Passeriformes, Pycnonotidae); same locality as for type material; 5 Aug. 2010; partial COI sequence, Genbank MN590286; MHNG-PLAT-121158.

Type host

Chloropsis cochinchinensis (Gmelin, 1789) (Passeriformes, Irenidae).

Description (from type material)

Worm with body of medium size, 36 mm long, with maximum width 1100 at level of gravid proglottides; consisting of 276 proglottides. Proglottides craspedote, wider than long except for very last gravid ones. Scolex poorly delineated from neck, 400 in diameter (Fig. 14). Suckers muscular, rounded, 185–200 (190, n = 4) in diameter. Rostellum discoid, with strong conical anterior extremity, 128 in diameter, 95 in length, musculo-glandular, armed with a double crown of about 42 small triangular hooks of similar size, with short handle, more elongate in anterior row, more massive in posterior row, with reduced or indistinguishable epiphyseal thickenings. Length of anterior hooks 15.5–16 (n = 4), of posterior hooks 15–15.5 (n = 3) (Fig. 15). Neck poorly marked, unsegmented zone extending to 900 from posterior margin of suckers. Genital pores irregularly alternating in short unequal series (e.g., ... 5, 1, 1, 1, 3, 7, 1, 2, 1, 2, 1, 1, 2...); situated at anterior 40% of lateral proglottis margin. Ventral osmoregulatory canals up

to 120 wide, connected posteriorly in each proglottis by transverse anastomosis. Dorsal osmoregulatory canals 10–15 wide. Genital ducts between osmoregulatory canals. Genital atrium simple, narrow, inconspicuous.

Testes 9–13 in number (11, $n = 11$), in a single dorso-central field (Fig. 17). External vas deferens forming numerous compact coils situated in median field adjacent to antiporal extremity of cirrus-sac. Cirrus-sac cylindrical to pyriform, straight, thick-walled, not or just reaching excretory canals, $107\text{--}122 \times 41\text{--}51$ (114×46 , $n = 14$) (Figs 16–17); internal vas deferens forming a few coils in its proximal half. Cirrus unarmed.

Vitellarium posterior, central, compact and transversely elongate, $90\text{--}120 \times 35\text{--}50$ (103×41 , $n = 9$). Ovary anterior and transversely elongate, poorly visible in our material. Vagina well-marked, with strong wall, opened posteriorly to male pore, then parallel to cirrus sac, straight. Seminal receptacle elongated and discrete, just poral to ovary or partially dorsal to it (Fig. 17).

Uterus starts its development as an antero-dorsal sac, developing into a transverse sac and rapidly forming 2 connected postero-lateral sacs containing developing eggs. Paruterine organ simultaneously formed anteriorly, then progressively posteriorly over uterus. Paruterine organ with compact walls but loose internal tissues. Connecting (transverse) part of uterus widening and developing anteriorly into paruterine organ together with eggs. Eggs eventually passing into fully developed paruterine organ; vestigial uterine sacs empty and progressively disappearing (Figs 18–20). Eggs oval, with thin outer envelope, $35\text{--}41 \times 25\text{--}31$ (38×27 , $n = 15$) (Fig. 21). Oncospheres 25–30 (26 , $n = 15$). Lateral embryonic hooks 13–14 (13.1 , $n = 15$) long, central embryonic hooks 14–15 (14.7 , $n = 10$) long.

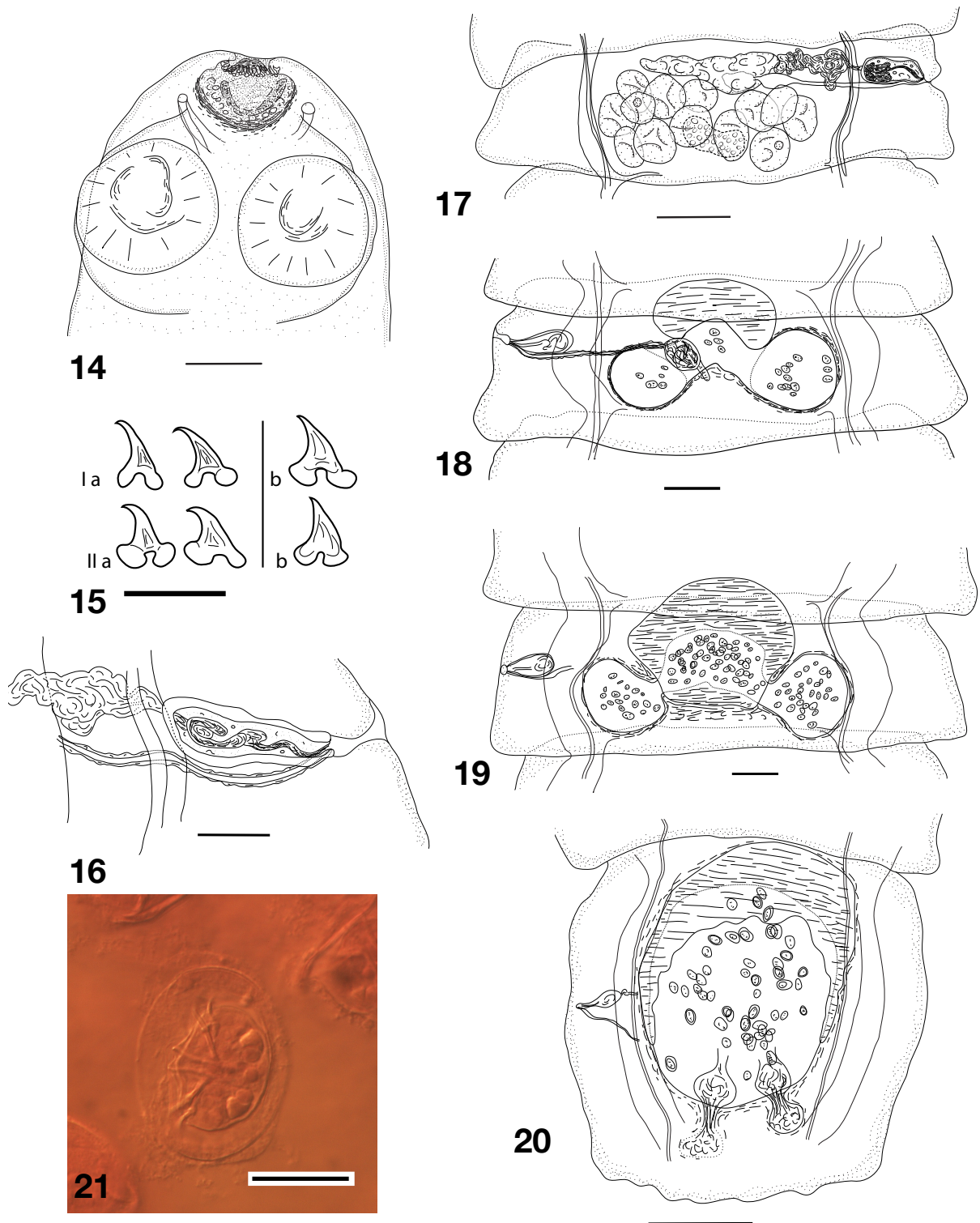
Additional data from juvenile specimens in *T. criniger*: Scolex diameter 370–385. Sucker diameter 190–217 (198 , $n = 12$). Rostellum 116–135 in diameter, 96–100 in length. Hook number 42–44, 15.5–17 in length.

Remarks

With its distinctive pair of uterine sacs, paruterine organ and typical rostellum, our material unambiguously belongs to the genus *Biuterina* Fuhrmann, 1902 as defined by Georgiev & Korniyushin (1994). The last review of the group by Georgiev & Mariaux (2007) reported 34 species in the genus and presented an identification key to the species. To our knowledge, no additional species has been reported since this publication. None of the species in this genus is known from Irenidae or Pycnonotidae, and only 3 of them have an Oriental distribution, all of them in India. No species of *Biuterina* spp. are known from SE Asia yet.

The majority of the known species differ markedly from our material by a combination of their rostellar hook numbers and length (which are mostly both more numerous and longer), resulting in only 2 species showing similar metric characters:

- *Biuterina chlorurae* (Rausch & Schiller, 1949), a parasite of *Pipilo chlorurus* (Audubon, 1839) (Passerellidae) in Wyoming, USA. It differs from our material by showing fewer proglottides (140 vs 276), slightly longer (up to 20) rostellar hooks in two rows differing in length and shape, smaller seminal receptacle (20 in diameter), different development of the uterus (with uterine sacs not clearly separated) and larger eggs (43–50 in diameter).
- *Biuterina dicruri* Singh, 1964, from *Dicrurus leucophaeus* Vieillot, 1817 (Dicruridae) in North-East India. Its rostellar hooks are of different length on both rows. Although the testis number in this species overlaps that of our specimens, it most commonly has 7 testes against 11 on average in our material and its cirrus pouch is shorter ($80\text{--}110 \times 26\text{--}40$).



Figs 14–21. *Biuterina jensenae* sp. nov. **14.** Scolex. **15.** Rostellar hooks (I: anterior; II: posterior; a: from holotype; b: from *Tricholestes criniger* (Blyth, 1845)). **16.** Cirrus-sac. **17.** Mature proglottis, dorsal view. **18–20.** Various stages of paruterine organ development. **21.** Egg. Scale bars: 14, 17–19 = 100 µm; 15 = 10 µm; 16 = 50 µm; 20 = 250 µm; 21 = 20 µm.

The differences listed above, together with clearly different hosts and distributions lead us to place our material in a new species that we name *Biuterina jensenae* sp. nov.

We are well aware that, ideally, more material would be desirable to describe this species. However, given the unambiguous characters considered and the fact that access to these parasites is extremely scarce, we think it is worth taking the opportunity to describe and name it, even if additional information, especially concerning the variability of the metrical data, is to be provided when more specimens are available.

Specimens from *T. criniger* are juvenile and therefore not included in the type series. Their observable characters, especially the shape and organization of their rostellum and hooks, are, however, very similar to those of *B. jensenae* sp. nov. Unless access to fully developed specimens shows otherwise in the future, we consider them conspecific.

***Biuterina* (?) sp. 1**

Material examined

MALAYSIA • 2 specs (juveniles, no strobilar anatomy); Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 30 Jul. 2010; MHNG-PLAT-120686.

Host

Pycnonotus brunneus Blyth, 1845 (Passeriformes, Pycnonotidae).

Remarks

The hook arrangement in two rows, as well as their triangular shape and epiphyses on both guard and handles, are reminiscent of the genus *Biuterina*. If confirmed, the combination of numerous (about 60 in number) and very small triangular hooks of same shape and size (about 14) in both rows, would be unique for this genus (Georgiev & Mariaux 2007).

***Biuterina* (?) sp. 2**

Material examined

MALAYSIA • 1 incomplete specimen (terminating with a few early mature proglottides); Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 31 Jul. 2010; partial COI sequence, Genbank MN590288; MHNG-PLAT-120689.

Host

Alophoixus bres (Lesson, 1832) (Passeriformes, Pycnonotidae).

Remarks

This worm also shows characters of the genus *Biuterina*, although the lack of gravid proglottides does not allow a definitive identification. Scolex 325 in diameter. Suckers strong, 162–165 in diameter. Rostellum muscular, 120 in diameter, armed with double crown of 38 typical triangular hooks. Hooks about 15–16 long in both rows, those from first row slightly less massive. Genital pores irregularly alternating, opening slightly anteriorly to middle of lateral proglottis margin. Genital ducts passing between excretory canals. Testes in one continuous posterior field, 7–10 in number. Cirrus pouch elongate, regular, with strong walls, 74–84 × 28–34 (80 × 30, n = 7), not reaching or just reaching poral osmoregulatory canals. Vagina posterior to cirrus-sac. As for *Biuterina* sp. 1, the combination of number/length of rostellar hooks of this specimen seems to have not been observed in the presently known species of *Biuterina* (see Georgiev & Mariaux 2007). It is similar to *B. jensenae* sp. nov. and

found in the same host family, but shows fewer rostellar hooks, slightly fewer testes and a shorter cirrus-sac. It is considered here a different taxon to be described when more abundant material is available.

Family Davaineidae Braun, 1900

Genus *Raillietina* Fuhrmann, 1920

Raillietina hymenolepidoides sp. nov.

[urn:lsid:zoobank.org:act:0E5860D5-3EAA-4F26-8F0D-DF5ED3718219](https://zoobank.org/act:0E5860D5-3EAA-4F26-8F0D-DF5ED3718219)

Figs 22–26, Table 2

Etymology

The species name refers to the overall similarity of the strobilar anatomy of this species to that of cestodes of the family Hymenolepididae.

Material examined

Holotype

MALAYSIA • Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 1 Aug. 2010; MHNG-PLAT-120869.

Paratypes

MALAYSIA • 2 specs; same collection data as for holotype; MHNG-PLAT-120870.

Hologenophore

MHNG-PLAT-120869. Partial COI sequence, Genbank MN590290. Additional sequence: MHNG-PLAT-130033. Partial COI sequence, Genbank MN590289.

Comparative material

PHILLIPINES • holotype and two paratypes of *Raillietina palawanensis* Deardorff, Schmidt & Kuntz, 1976 from *Chalcophaps indica* (Linnaeus, 1758) (Columbiformes, Columbidae); Palawan Island; May–Jun. 1962; NHM 1369066, 1369067.

Type host

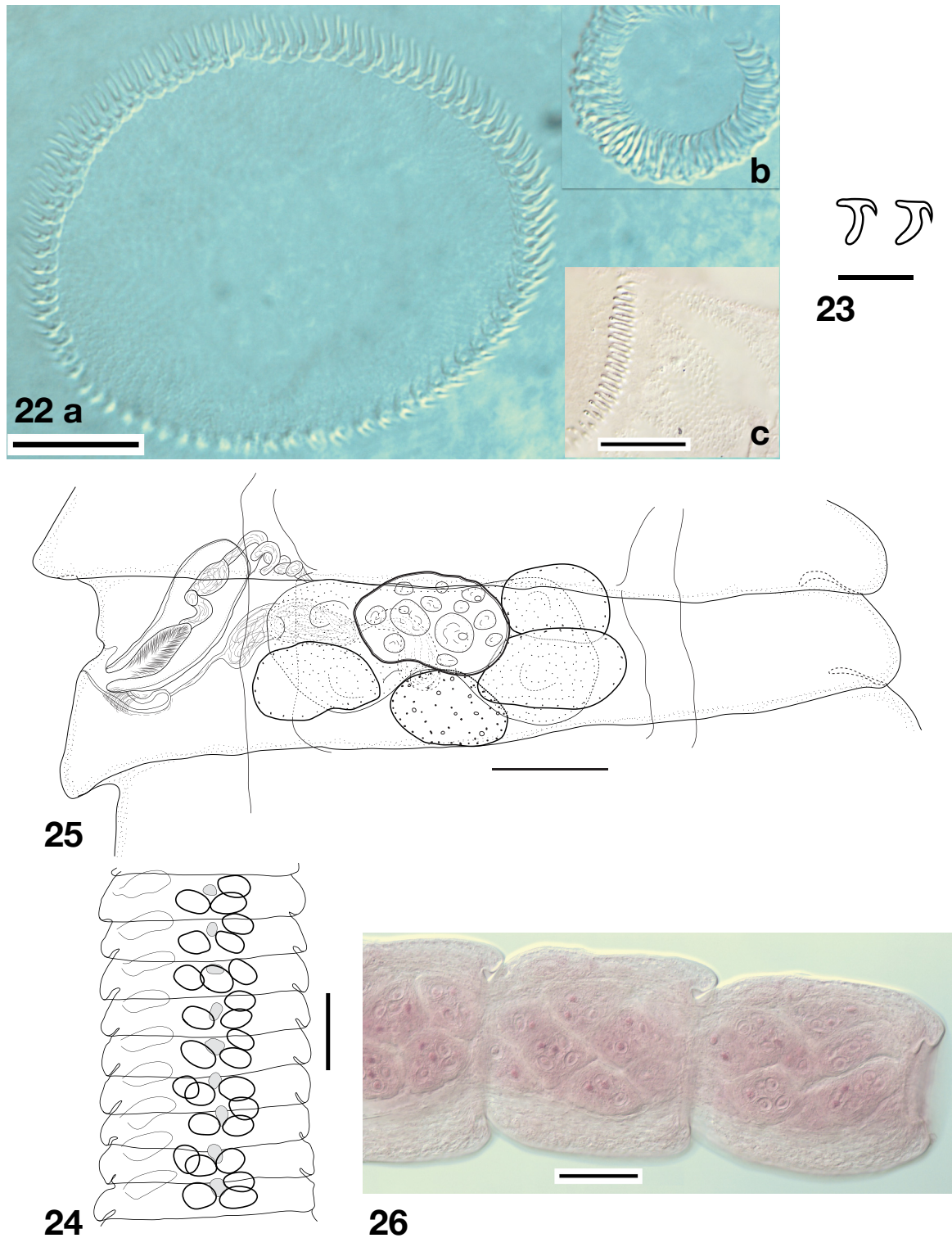
Chalcophaps indica (Linnaeus, 1758) (Columbiformes, Columbidae).

Prevalence

50% (2/4).

Description

Body very thin and fragile, of medium size; maximum length 55 mm, width mostly 150–350 along entire length of worm, reaching maximum of 425 at level of gravid proglottides; consisting of up to 800 proglottides. Proglottides craspedote, always wider than long except for very last gravid ones; detached gravid proglottides may be almost spherical. Scolex very small, well-delineated from neck, 100–137 (122, n = 3) in diameter. Suckers rounded, 34–43 (39.5, n = 10) in diameter, muscular, armed with 4–5 dense rows of hooklets, 6–8 in length (Fig. 22b). Rostellar sac absent. Rostellum discoid, 46–69 (61, n = 3) in diameter, muscular, armed with double row of 150–160 small typical davaineid hooks of length 7–8 (Figs 22a, 23). Pseudoproboscis armed with clearly visible minute accessory spines on about 50 of length (Fig. 22c). Neck well-marked, narrow, 50 in diameter; followed by a long unsegmented section. Proglottization distinct at about 2.5 mm from posterior margin of suckers. Genital pores unilateral, situated slightly anteriorly to mid-length of lateral proglottis margin. Ventral osmoregulatory canals up to 40 wide, connected posteriorly in each proglottis by transverse anastomosis. Dorsal osmoregulatory



Figs 22–26. *Raillietina hymenolepidoides* sp. nov. **22.** a) Complete rostellar crown. b) Hooklets of sucker. c) Apical tegument with spiniform microtriches. **23.** Rostellar hooks. **24.** Sketch of male proglottides showing relative position of testes. **25.** Early pregravid proglottis, dorsal view. **26.** Gravid proglottides with developed capsules. Scale bars: 22 = 20 μm ; 23 = 10 μm ; 24, 26 = 100 μm ; 25 = 50 μm .

canals absent. Genital ducts dorsal to ventral osmoregulatory canals. Genital atrium small, 7–13 × 9–21 (9 × 14, n = 21), infundibular, with wide orifice.

Testes 3 in number; most commonly in triangle, 2 posterior and 1 anterior antiporal, but with frequent variations, sometimes more or less in posterior line, partially overlapping each other (Fig. 24); slightly oval, 35–50 in maximal diameter (43, n = 33). External vas deferens short and making only few coils antero-laterally to proximal end of cirrus-sac. Cirrus-sac elongate, 63–81 × 28–39 (74 × 34, n = 22), straight, with strong wall, reaching osmoregulatory canals, rarely crossing them (Fig. 25); proximal extremity of cirrus-sac often directed anteriorly, positioning cirrus-sac almost parallel to proglottis lateral margin. Internal vas deferens forming a few coils and distinctive proximal dilatation resembling internal seminal vesicle. Cirrus armed with dense long setae.

Vitellarium posterior, central, compact, 26–35 × 17–26 (30 × 21, n = 14). Ovary antero-central, transversely elongate, bilobed, compact and becoming massive, dumbbell-shaped. Mehlis' gland anterior to vitellarium. Vagina opens posterior to male pore, copulatory part 25–48 × 6–15 (36 × 12, n = 15), with strong walls, surrounded by a large but discrete muscular sphincter (Fig. 25). Proximal (conductive) part of vagina straight, thin, without cellular sleeve, with length similar to that of copulatory part; parallel to posterior wall of cirrus sac; connected with seminal receptacle in lateral field of proglottis. Seminal receptacle slightly convoluted, tubular, crossing poral osmoregulatory canal, poral to ovary.

Uterus starts its development in late mature proglottides as a small antero-dorsal and central sac; with further development, turning into transverse sac filled with large developing eggs; confined in median field. Uterus eventually forming 8–12 (10, n = 13) egg capsules situated in 2 layers, each one containing 5–10 eggs (7, n = 30) (Fig. 26), occasionally overlapping excretory canals. Eggs often, but not always, developing at different rates, possibly leading to the simultaneous presence of fully developed eggs together with others at diverse stages of development within a single capsule. Eggs globular, 32–39.5 (36.5, n = 27). Oncospheres round to oval, 12–14 (13, n = 20) along longest axis. Embryonic hooks subequal, 5.5–7 (6, n = 12) in length.

Remarks

Columbiformes are second only to Galliformes as hosts for cestodes of the genus *Raillietina*. Over 60 species of these worms have been reported from pigeons and doves (Movsessian 2003a), three of them in Malaysia (Amin-Babjee & Lee 1992; Lee *et al.* 1998). In addition, *R. palawanensis* Deardorff, Schmidt & Kuntz, 1976 was described by Deardorff *et al.* (1976) in *C. indica* in the Philippines. To our knowledge, no other species have subsequently been described from these hosts.

Our material is quite unique in having an extremely reduced and constant number of testes per proglottis and can thus easily be differentiated from all these taxa. Although the number of testes is very variable among species of *Raillietina*, only a very few have fewer than 5, and none has 3 as observed in our specimens. Two species, *R. palawanensis* and *R. quadritesticulata* Moghe, 1925, are nevertheless relatively similar, though not identical, to our material for this character (3–4 and 4 testes, respectively, according to their descriptions). We reexamined part of the *R. palawanensis* type series, including its holotype, and although several original observations in Deardorff *et al.* (1976) are confirmed, we also observed several significant differences (Table 2):

- the worms are much longer (length more than 60 mm, complete specimen probably more than 100 mm long) and wider (up to 790 at level of gravid proglottides);
- the dorsal osmoregulatory canals are absent (likely mistaken for longitudinal muscle bundles in the original description);

Table 2. Main morphological characteristics of *Raillietina hymenolepidoides* sp. nov. and closely similar taxa. * New values from our observations of type material. Abbreviations: L = Length; W = Width; ø = Diameter.

	<i>R. hymenolepidoides</i>	<i>R. palawanensis</i>	<i>R. quadritesticulata</i>
Reference	Present study	Deardorff <i>et al.</i> (1976)	Moghe (1925)
Host	<i>Chalcophaps indica</i>	<i>Chalcophaps indica</i>	<i>Streptopelia tranquebarica</i>
Ditribution	Malaysia	Philippines	India
L [mm] × W	55 × 425	* > 60 × *790	62–137 × 924–1230
# proglottides	800 +	–	188–196
Scolex ø	100–137	300–320	165
Sucker ø	34–43	72–76	52–54 × 35–40
Rostellum ø (× L)	46–69	125–170 × 110–160	96
# hooks	150–160	108	180
L hooks	7–8	20–24	6
L neck [mm]	2.5	1.5–2.8	1
Dorsal canals	Absent	*Absent	Present (?)
Atrium L [mm] × W	7–13 × 9–21	6–15 × 7–26	–
Testes number	3	*(3)–4–5–(6)	4
Testes ø	35–50	45–57	68–75 × 75–77
Cirrus sac (L × W)	63–81 × 28–39	93–*120 × 28–*56	138 × 68
Copulatory vagina (L × W)	25–48 × 6–15	*39–52 × 10–17	108 × 32
Vitellarium (L × W)	26–35 × 17–26	25 × 30	–
# egg capsules	8–12	10–*17	40–50
Eggs per capsule	5–10	4–*7	6–8
# oncospheres	12–14	*16–18	18 × 16

- testis number is essentially 4 (5 is not unusual, 3 and 6 are very rare); it should be noted that the initial development of testes is not synchronous, with one, sometimes two, antiporal testes showing a delayed growth;
- the cirrus sac may be slightly larger than reported (up to 120 in length and 56 in width);
- the copulatory vagina part is longer (39–52);
- up to 17 egg capsules per proglottis, each containing up to 7 eggs can be observed in gravid proglottides;
- oncospheres are 16–18 in diameter.

These observations confirm that *R. palawanensis* differs from our material by having a larger scolex and rostellum and fewer, much larger, rostellar hooks, as well as a larger cirrus-sac, while *R. quadritesticulata* has more rostellar hooks, a larger cirrus-sac and more egg-capsules per proglottis (Table 2). Our material is therefore clearly distinct and we place it in a new species, *Raillietina hymenolepidoides* sp. nov.

Interestingly, all three species with an extreme reduction of testis number are found in South/South East Asia and two in the same host species. Although this clearly suggests a close relationship between these taxa, the significance of this observation in a phylogenetic context remains to be studied. A similar reduction in testis number is observed in the genus *Diorchirailletina* Yamaguti, 1959, whose single species has only 2 testes per segment. It is found in various pangolin species in Africa and South Asia, including in species distributed in Malaysia, and may be indicative of a host-switching event. Molecular samples from pangolin parasites would allow the examination of this hypothesis.

The absence of dorsal excretory canals is an uncommon feature found in some davaineids. It is observed in the monotypic genera *Porogynia* Railliet & Henry, 1909 and *Baerfainia* Yamaguti, 1959. The latter, found in African Pholidota and erected for *Raillietina anoplocephaloides* Baer & Fain, 1955 (Yamaguti 1959), shows a similar reduction of testis numbers (4, sometimes 3) as observed in our material. Its rudimentary rostellum and particular vagina structure are, however, very different.

***Raillietina mahnerti* sp. nov.**

[urn:lsid:zoobank.org:act:0705D781-68CD-4B0B-BF6B-0E8DAF4A24EF](https://doi.org/10.3897/zoobank.org/act:0705D781-68CD-4B0B-BF6B-0E8DAF4A24EF)

Figs 27–30

Etymology

The species is dedicated to Prof. Volker Mahnert, former director of the Museum of Natural History of Geneva and eminent naturalist (Schwendinger 2019), who passed away during the preparation of this paper.

Material examined

Holotype

MALAYSIA • Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 5 Aug. 2010; MHNG-PLAT-121344.

Paratypes

MALAYSIA • 4 specs; same collection data as for holotype; MHNG-PLAT-121347.

Hologenophore

MHNG-PLAT-121346. Partial COI sequence, Genbank MN590291.

Type host

Chalcophaps indica (Linnaeus, 1758) (Columbiformes, Columbidae).

Prevalence

25% (1/4).

Description

Thin and very long worm with body consisting of more than 850 proglottides, reaching ca 200 mm in length (estimated from fragments) and 950 in maximum width at level of pregravid proglottides. Proglottides weakly craspedote, wider than long, except for the very last gravid ones. Scolex not clearly delineated from neck, 185 in diameter. Suckers round, 46–50 (49, n = 4) in diameter; muscular, armed with 6 dense rows of hooklets 3–6 long; crown of hooklets progressively reduced in posterior direction, then interrupted (Fig. 27b). Rostellum discoid, 100 in diameter, 60 long, weakly muscular, armed with double crown of about 270 hooks (Fig. 27a). Rostellar hooks of typical davaineid shape, delicate, 9 long

(Fig. 27c). Pseudoproboscis covered with minute, spine-like microtriches. Neck segmentation distinct at 1.3 mm from posterior margin of suckers. Genital primordia appearing at about 200th proglottis. Genital pores unilateral, situated at 35% of lateral proglottis margin. Ventral osmoregulatory canals up to 58 wide, connected posteriorly in each proglottis by wide transverse (occasionally bifurcated) anastomosis. Dorsal osmoregulatory canals 1–2 wide; not distinct in many proglottides. Genital ducts passing between osmoregulatory canals (or dorsal to ventral canals when dorsal canal not distinct). Genital atrium small, infundibular, inconspicuous.

Testes 8–14 in number (11, $n = 75$), in single layer; in two fields, each with variable number of testes: poral group of 1–6 testes and larger antiporal group of 5–10 testes (average 4 and 7, respectively, $n = 75$), one detached testis sometimes positioned posteriorly; testes round, in single layer (Fig. 28). External vas deferens highly convoluted, extended transversely almost up to middle of proglottis. Cirrus-sac elongate, oval, with well-marked walls, $90\text{--}115 \times 44\text{--}58$ (102×49 , $n = 45$), not reaching osmoregulatory canals. Internal vas deferens short, making single loop before reaching rounded expansion resembling internal seminal vesicle, $19\text{--}26$ (22 , $n = 20$) in diameter. Cirrus armed with dense long setae, connected to sac by distinct retractor muscles (Fig. 29).

Vitellarium posterior, central, compact and globular, $50\text{--}75$ (62 , $n = 26$). Ovary antero-central, compact fan-shaped, composed of a few large lobes. Mehlis' gland just anterior to vitellarium. Seminal receptacle tubular, more distinct in pregravid proglottides. Vagina opened posteriorly to male pore, composed of a copulatory part $40\text{--}48 \times 8\text{--}15$ (44×11 , $n = 12$), surrounded by a well-defined and thick wall, terminally surrounded by discrete but wide muscular sphincter, followed by short and narrow proximal (conductive) part and wider elongate seminal receptacle extending transversely, then posteriorly toward mid-proglottis (Figs 28–29).

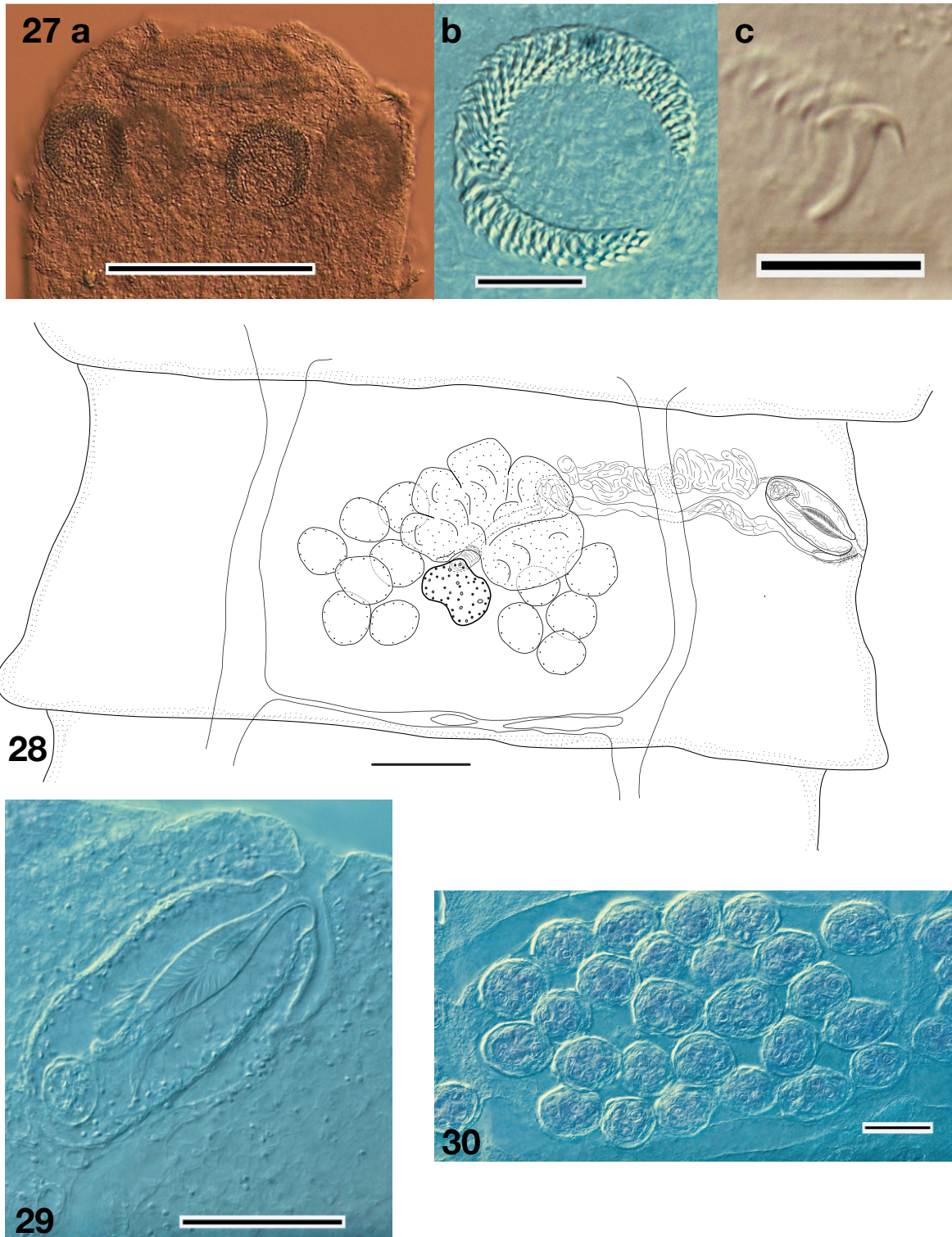
Eggs developing in well-defined parenchymatous capsules. Capsules $19\text{--}31$ (26 , $n = 34$) in number per proglottis, $80\text{--}120$ (95 , $n = 20$) in diameter, each containing 4–10 (6 , $n = 85$) eggs (Fig. 30). Eggs $26\text{--}35$ (31 , $n = 20$) in diameter, oncospheres $14\text{--}19$ (16 , $n = 24$) in diameter, embryonic hooks $6\text{--}8$ (7 , $n = 10$) long.

Remarks

With its typical rostellar apparatus and hammer-shaped hooks, armed suckers, unilateral genital pores and multiple egg capsules, this material can confidently be placed in the genus *Raillietina*. As stated above, over 60 species of this genus are known from Columbiformes worldwide (Movsessian 2003a). In order to check whether our material belongs to any of them, we initially compared the number and size of rostellar hooks as well as the number of testes with our observations, allowing the differentiation of most of these species from the present material. The few remaining species listed below are more similar to our material and are compared in more detail.

Raillietina flamiata (Meggitt, 1931) (usually erroneously reported as *R. flaminata*) was described from *Columba punicea* Blyth, 1842 and *Goura coronata* (= *G. cristata* (Pallas, 1764)) in Myanmar (Meggitt 1931). The former host is also present in Malaysia. The species description is incomplete, in particular as the number of rostellar hooks is lacking, but most available characters are similar to our observations. However, the number of testes (5–9) is somewhat smaller and the number of egg capsules (16) and eggs per capsule (2–6 but mostly 2) are distinctive.

Raillietina kunisakiensis Sawada & Kugi, 1979 is known from *Treron sieboldii sieboldii* (Temminck, 1835) in Japan, a host that is absent from the Malaysian Peninsula. Its description makes it very similar to our material, but it has longer (14) rostellar hooks, a slightly different disposition and number of testes and a vagina that is not split into distinct copulatory and conductive parts (Sawada & Kugi 1979).



Figs 27–30. *Raillietina mahnerti* sp. nov. **27.** a) Scolex. b) Sucker hooklets. c) Rostellar hook. **28.** Mature proglottis, ventral view. **29.** Copulatory organs. **30.** Gravid proglottis with egg capsules. Scale bars: 27a, 28, 30 = 100 μ m; 27b = 20 μ m; 27c = 10 μ m; 29 = 50 μ m.

Raillietina fuhrmanni idiogenoides (Baer, 1933) is known from various African Columbidae. According to Mahon (1958), it has slightly fewer (230) rostellar hooks than in our material and a longer (145–164) cirrus sac.

Raillietina joyeuxbaeri (Nguyen Thi Ky & Dubinina, 1980) is a parasite of *Streptopelia tranquebarica* (Hermann, 1804) in Vietnam (the host has been introduced to Malaysia), showing close similarity to our material. However, it is a smaller species with slightly larger (11–13) rostellar hooks and fewer testes (6–7).

Finally, we also consider *Raillietina polychalix* (Kotlan, 1921) here. Although this species is parasitic in Psittaciformes, it was also reported in *Columba livia* by Movsessian (2003a) (however, no source is cited). This species is very similar to our material for most characters, including a close (240–250) number of rostellar hooks, which are, however, somewhat longer (13). It also has a slightly longer cirrus-sac (120) and wider scolex (320).

Even though morphological identification of *Raillietina* is notoriously difficult, we consider that the differences listed above, together with its new host and locality, are sufficient to conclude that our material differs from all known species of *Raillietina* and to place it in a new species, *R. mahnerti* sp. nov.

Raillietina (sensu lato) sp.

Material examined

MALAYSIA • 1 juv.; Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 5 Aug. 2010; no molecular voucher; MHNG-PLAT-121159.

Host

Tricholestes criniger (Blyth, 1845) (Passeriformes, Pycnonotidae).

Description

This material is distinct from other davaineid species described in this work. Scolex *Raillietina*-like, 215 in diameter; large suckers, 135–145 (139, n = 4) in diameter, armed with 8 rows of hooklets, 10–13 long; rostellum 92 in diameter and 89 long, bearing ca 110 hooks in two rows, anterior row 17–19 long, posterior row 16–18 long. Genital pores unilateral. Early male proglottides containing 17–23 testes.

Remarks

The combination of hook characteristics observed in our material is uncommon and has almost never been reported in *Raillietina* (s. lat.) (Artiukh 1966; Movsessian 2003a). Interestingly, the single species with overlapping characters is *Paroniella pycnonoti* (Yamaguti & Mitunaga, 1943) found in *Pycnonotus sinensis formosae* Hartert, 1910 in Taiwan.

However, although the original description of Yamaguti & Mitunaga (1943) was correctly summarized by Artiukh (1966) and Movsessian (2003a), these authors failed to notice that in the original description the number of rostellar hooks was described as "... arranged in two alternating circles of 105–115 each". The total number of hooks in *P. pycnonoti* should thus be 210–230 in total, a figure different from what we observed in our material, which remains an unidentified species, either in *Raillietina* or *Paroniella*.

Genus *Ophryocotyloides* Fuhrmann, 1920

Ophryocotyloides dasi Tandan & Singh, 1964

Figs 31–32

Material examined

MALAYSIA • 1 spec.; Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 4 Aug. 2010; partial COI sequence, Genbank MN590292; MHNG-PLAT-121155.

Host

Psilopogon henricii (Temminck, 1831) (Piciformes, Ramphastidae; also placed in Megalaimidae).

Description

Strong worm with body of medium size, 74 mm long; maximum width 2.9 mm at level of gravid proglottides; strobila consisting of 302 proglottides. Proglottides weakly craspedote, always wider than long. Scolex 375 in diameter, separated from strobila by a well-marked constriction. Suckers round to oval, 180–190 (184, n = 4) in diameter; muscular, armed with about 10 dense rows of hooklets, approximately 11–13 in length. Rostellar sac absent, rostellum discoid, 175 in diameter, 90 long, glandular, with weak surrounding muscular layers, armed with two rows of hooks. Hooks 230 in number, with typical davaineid shape, 15.5–16.5 long in both rows. Apical extremity of scolex (pseudoproboscis) tegument covered by distinct minute spines (Fig. 32). Neck 175 in diameter; first proglottides distinct at 1 mm behind posterior margin of suckers. Genital pores unilateral, situated at 20–25% of lateral proglottis margin. Ventral osmoregulatory canals up to 45 wide, connected posteriorly in each proglottis by transverse anastomosis. Dorsal osmoregulatory canals 5–12 wide, connected posteriorly by transverse anastomosis in some proglottides. Genital ducts passing between osmoregulatory canals. Genital atrium regular, inconspicuous, 18–25 deep and 12–20 in diameter.

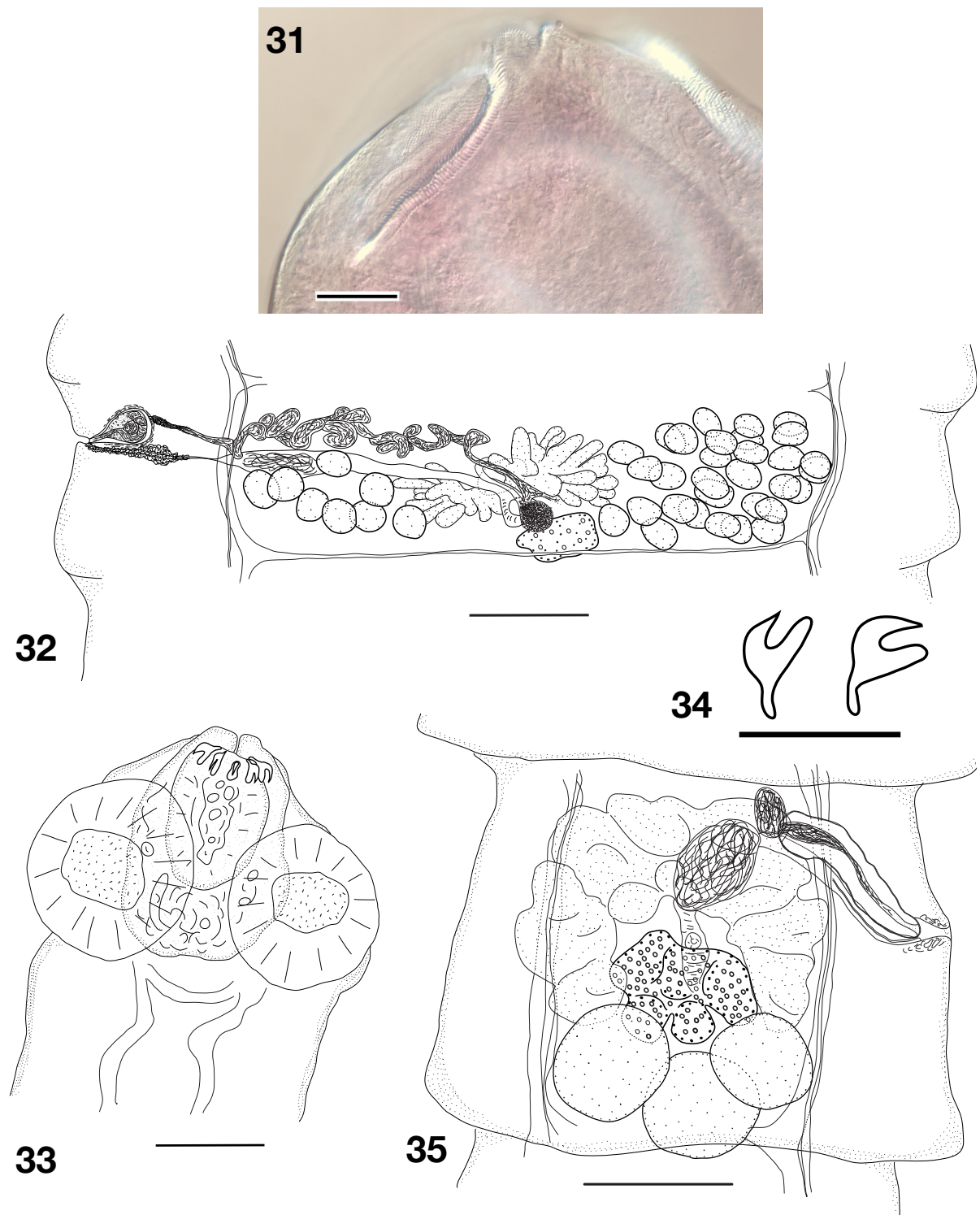
Testes 30–40 in number (34, n = 17); in 2 unequal fields, one poral consisting of 5–9 testes and one larger antiporal, consisting of 22–31 units (7 and 26, respectively, n = 17); testes rounded, in 2 layers, sometimes in 3 layers antiporally; a few of them may overlap some ovarian lobes. External vas deferens well-marked and oriented transversely, making many loops around a straight line, becoming wider centrally, up to 40 in diameter. Cirrus-sac pear-shaped, thick-walled, with short narrower distal part, almost globular, 120–135 × 68–78 (125 × 72, n = 18), not reaching osmoregulatory canals (Fig. 33). Internal vas deferens 17–25 in diameter, forming a few large coils. Cirrus unarmed.

Vitellarium posterior, central, transversely elongate, compact, with irregular shape, 85–120 × 140–220 (103 × 189, n = 12). Ovary antero-central, fan-shaped, deeply lobated, becoming more massive in advanced mature proglottides. Mehlis' gland anterior to vitellarium. Seminal receptacle poorly marked, elongate, poral. Vagina opened posteriorly to male pore, straight, surrounded in its distal part by a well-developed sheath of large cells, forming small dilation behind cirrus-sac.

Egg developing in entire proglottis, including external to osmoregulatory canals. Uterus apparently saccular although barely visible, no egg capsules. Oncospheres small but no fully-developed eggs observed, as last proglottides in our specimen are filled with calcareous corpuscles.

Remarks

With numerous typical davaineid hooks in 2 rows, armed suckers, unilateral genital pores and an absence of egg capsules, our material belongs to the genus *Ophryocotyloides* Fuhrmann, 1920. According to Movsessian (2003b), 6 species of this genus parasitize Piciformes and 3 are found in the genus *Psilopogon*. All of them have been described from India and show very similar characters.



Figs 31–35. — **31–32.** *Ophryocotlyoides dasi* Tandan & Singh, 1964. **31.** Scolex with double crown of hooks, spinuous pseudoprobooscis and armed suckers margins. **32.** Mature proglottis, ventral view. — **33–35.** *Variolepis* cf. *bilharzii* (Krabbe, 1869). **33.** Scolex. **34.** Rostellar hooks. **35.** Mature proglottis. Scale bars: 31, 33 = 50 μ m; 32 = 250 μ m; 34 = 20 μ m; 35 = 100 μ m.

Ophryocotyloides barbeti Singh, 1959 was described from the Brown-headed Barbet, *P. zeylanicus* (Gmelin, 1788) and *O. haemacephala* Singh, 1959 from the Coppersmith Barbet, *P. haemacephalus* (Muller, 1776). The former taxon can easily be differentiated from our material by its smaller number (150) of longer (22–27) hooks and higher number (10–15) of poral testes. The latter resembles our specimen but has a smaller rostellum (110–160); although the total numbers of testes are comparable, it has a larger poral number of testes according to Singh's (1959) drawing.

The third species, *O. dasi* Tandan & Singh, 1964 described from *P. haemacephalus*, is the most similar to our material on the basis of the description by Tandan & Singh (1964). It only differs in minor details like smaller suckers, which are reported to only bear 6–7 rows of hooklets. *Ophryocotyloides dasi* is also described with slightly fewer aporal testes (17–21), although the total number just overlaps our own observations. This is not sufficient to differentiate this species from our material with any certainty, as superimposed aporal testes are difficult to differentiate. Finally, Tandan & Singh (1964) reported a vaginal sphincter that is not present in our material (unless they refer to the cellular sheath we have observed). All other characters closely match our measurements. Without access to the type specimens of *O. dasi*, we consider that the minor differences noted above are not sufficient to distinguish our specimen from this species. In addition, it should be noted that the host of *O. dasi* and the Yellow-crowned Barbet (in which we found our material) have overlapping geographical ranges. This is the first report of this taxon since its original description. *P. henricii* is a new host for this species, and this is the first record of *O. dasi* in SE Asia.

Family Hymenolepididae Perrier, 1897
Genus *Variolepis* Spasskii & Spasskaya, 1954

Variolepis cf. *bilharzii* (Krabbe, 1869)
Figs 33–35, Table 3

Material examined

MALAYSIA • 1 spec.; Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 2 Aug. 2010; partial COI sequence, Genbank MN590293; MHNG-PLAT-121153.

Host

Copsychus malabaricus (Scopoli, 1786) (Passeriformes, Muscicapidae).

Description

Worm with body of medium size, 7.5 mm long; maximum width 380 at level of last available pregravid proglottides. Strobila consisting of 73 proglottides. Proglottides craspedote, wider than long. Scolex poorly delineated from neck, 150 in diameter (Fig. 33). Suckers muscular, rounded, 75–88 (82, n = 4) in diameter; base covered with well developed microtriches. Rostellar sac 104 × 74, wide, mostly glandular. Rostellum well-developed, 66 × 45, muscular, armed with a single row of 10 small cricetoid hooks, about 15 long. Hooks with strong guard and thin, reduced handles (Fig. 34). Neck not well marked, 140 in diameter; proglottization distinct at about 280 behind posterior margin of suckers. Genital pores unilateral, dextral, situated at about 40% of lateral proglottis margin length. Ventral osmoregulatory canals 8–13 wide, connected posteriorly in each proglottis by transverse anastomosis. Dorsal osmoregulatory canals 4–5 wide. Genital ducts dorsal to osmoregulatory canals. Genital atrium narrow, 10–15 deep, infundibular, with wide orifice.

Testes 3 in number; large, up to 109 in diameter, situated posteriorly and basically on transverse line, although one or another can be located anterior to the two others. Small external seminal vesicle present, just proximal to cirrus-sac. Cirrus-sac, elongate, 112–134 × 25–33 (124 × 29, n = 11), crossing

osmoregulatory canals. Discrete internal seminal vesicle present, in proximal quarter of cirrus-sac. Cirrus unarmed.

Vitellarium posterior to ovary, central, massive. Ovary antero-central, bi-winged with wings diverging posteriorly, compact but forming a few lobes in late development. Mehlis' gland anterior to vitellarium. Vagina opened posteriorly to male pore and parallel, postero-ventrally to cirrus pouch. Seminal receptacle central and dorsal, between ovary wings, anterior to vitellarium, up to 74 in largest diameter (Fig. 35).

Uterus starts its development in late mature proglottides as an antero-central sac, developing into a horseshoe-shaped saccular structure. Completely developed uterus and eggs not observed.

Remarks

Our material most closely matches the definition of *Variolepis* Spasskii & Spasskaya, 1954. This genus has been treated very differently by various authors. Notably it has recently been put in synonymy with *Wardium* Mayhew, 1925 by Czaplinski (in Czaplinski & Vaucher 1994). This synonymy has, however, been widely considered as unjustified and *Variolepis* is now recognised as being valid (Mariaux *et al.* 2017; Dimitrova *et al.* 2019).

The most widespread species of *Variolepis* is the type-species, *V. farciminosa* (Goeze, 1782), that has been found on several continents and in a wide diversity of passerine hosts. Most of these contributions report substantial variations in the observed characters (see, e.g., Illescas Gómez & Gómez García 1984), casting some doubts on their conspecificity and possibly being indicative of a complex of species. A common character of "*V. farciminosa*" s. lat. is nevertheless the presence of relatively long (20 or more) rostellar hooks, that unambiguously differentiate it from our material. Nine more species of the genus are known from Passeriformes worldwide (Schmidt 1986). We have summarized their available distinctive characters in Table 3. Most differ from our material by their larger rostellar hook size and only *V. planestici* (Mayhew, 1925) and *V. bilharzii* (Krabbe, 1869) are comparable for that crucial character.

Variolepis planestici was described from an American robin by Mayhew (1925), unfortunately without some crucial details such as rostellar or cirrus-sac measurements. Despite its similar hooks, this species seem to differ from our material by having its testes clearly disposed in a triangle.

The original description of *V. bilharzii* is incomplete; however, Krabbe's drawings show hooks with massive guards that are much longer than the blades (Krabbe 1869: figs 228–229.). A later description by Joyeux & Baer (in Joyeux *et al.* 1928) from a West African drongo is the most complete to date but remains partial. The species was subsequently only found again by Johri (1935) in a crow from Myanmar. Interestingly, in his figure 4, Johri illustrates hooks of the same shape as shown by Krabbe. It is difficult to separate our material from *V. bilharzii*, although our specimen has a smaller scolex and suckers and a somewhat larger cirrus-sac. Furthermore *V. bilharzii* is described with testes in a triangular arrangement, but testes are mostly in a row in our material (although some variation is possible, see Fig. 35).

Globally, the characters available to differentiate our material and the two species discussed above are extremely limited and basically insufficient. Previously used arguments (e.g., Mayhew (1925) claimed a slight difference in hook shape for erecting *V. planestici*) need to be critically evaluated with more material. As a consequence, it is very difficult to separate our material from both above-mentioned taxa, or indeed to separate them from each other. For now, we attribute our specimen to *V. bilharzii*, given its species range and diversity of hosts, which include East Asia and Muscicapidae. Due to priority, it is also the name that would apply to all these specimens in case they are eventually considered conspecific. A more definite conclusion would require additional specimens to assess their morphological variation and,

Table 3. *Variolopsis* Spasskii & Spasskaya, 1954 of Passeriformes. Data from original descriptions except: * from Spasskaya (1966), ** from Skrjabin & Matevosyan (1945), *** from Joyeux *et al.* (1928). Abbreviations: L = Length; W = Width; \emptyset = Diameter.

	Host	Distribution	L x W (max)	Scolex \emptyset	Suckers \emptyset	Rost. sac \emptyset x L	L hooks	Testes \emptyset
<i>Variolopsis cf. bilharzii</i>	Muscicapidae	Malaysia	> 7.5 x 0.38	150	75-88	104 x 74	15	109
<i>V. farcinimosa</i> (Goeze, 1782)*	Many Passeriformes (* Phasianidae, Anatidae)	Europe, Asia, Americas, Japan	38-60 x 1.87-2	200-330	90-110	40 x 58	19-21	250
<i>V. bilharzi</i> (Krabbe, 1869)***	Many Passeriformes, incl. Muscicapidae	Europe, Africa, Asia	10 x 0.5	250	130 x 80	70	14-16	-
<i>V. fernandensis</i> (Nybelin, 1931)	Turdidae	Chile	39 x 1	180-230	75-95	110-150 x 75	18-19	150
<i>V. globocephala</i> (Fuhrmann, 1918)	Zosteropidae	New Caledonia	40 x 2	300	140	-	19	100-140
<i>V. microscolecina</i> (Fuhrmann, 1906)**	Cotingidae	Brazil	20-25 x 0.5	-	-	-	23	90
<i>V. planestici</i> (Mayew, 1925)	Turdidae, Sturnidae	USA, India	35 x 1.5	200	-	-	14	60-80
<i>V. pycnonoti</i> (Tubangui & Matilungan, 1927)	Pycnonotidae	Philippines	45 x 2	300	100	90 x 50	19	-
<i>V. troglodytis</i> (Yamaguti, 1956)	Troglodytidae	Japan	7.5 x 0.7	140-180	60-75	90-150 x 54-70	24	30-60
<i>V. variabilis</i> (Mayhew, 1925)	Corvidae	USA	30 x 1	200	80	20	20-22	-
<i>V. victoriata</i> (Inamdar, 1934)**	Sturnidae	India	60 x 1.35	200	70	212 x 87	28-30	-

in the case of the Malaysian material, fully gravid proglottides to observe the morphological characters of the eggs.

Family Mesocestoididae Perrier, 1897

Genus *Mesocestoides* Vaillant, 1863

Mesocestoides sp. (larvae)

Material examined

MALAYSIA • 6 larval forms (in mesenteries); Selangor, University of Malaya's Gombak Field Station; 3.32° N, 101.77° E; 280–350 m a.s.l.; 7 Aug. 2010; partial COI sequence, Genbank MN590294; MHNG-PLAT-121160.

Host

Philentoma pyrhoptera (Temminck, 1836) (Passeriformes, Vangidae).

Remarks

The presence, possibly massive, of tetrathyridia is known from many avian species, including Passeriformes over almost all the world (Litérák *et al.* 2004; Mariaux *et al.* 2017; Heneberg *et al.* 2019). This is a new host and locality for the genus.

Discussion

The helminth parasitofauna of Malaysian birds, and especially its cestode component, has been very little studied. Surveys are few (e.g., Kuntz (1969) examined over 100 species of birds, but from Malaysian Borneo only) and recent isolated reports mostly deal with the parasitofauna of domestic animals or focusing on other types of parasites, especially ectoparasites, haematozoa or viruses. A few isolated contributions by S. Amin Babjee and C. Lee are an exception, as these authors examined various wild birds belonging to the Corvidae (Amin-Babjee *et al.* 1987), Phasianidae (Amin-Babjee *et al.* 1985) and Columbidae (Amin-Babjee & Lee 1992; Lee *et al.* 1998). As far as cestodes are concerned, the specific diversity reported in these papers remains, however, extremely limited. In addition, Singh *et al.* (1987) conducted a survey of vertebrates from the Ulu Endau area (South of Malay Peninsula) but found no (!) endoparasites in 17 species of birds. Some more comprehensive reports focused on 'neighbouring' Myanmar or Sri Lanka birds (e.g., Meggitt 1927, 1931; Johri 1935, 1951; Burt 1940) but are mostly outdated now in terms of degree of detail compared to the recent standards in cestode taxonomy and remain patchy. It is thus no overstatement to consider that the parasitofauna of the over 800 species of birds known from Malaysia is basically unexplored. More generally, Southeast Asia remains one of the large areas in the world where the cestodes of wild animals are particularly poorly known.

Despite the fact that the small size of our sample prevents a detailed analysis of its faunal structure, we observe that all major bird cestode families are represented, most by several taxa. The apparent high diversity of Paruterinidae is especially interesting and further data for this group would allow for useful comparisons with its better known African fauna.

In this contribution we identified 13 taxa, 5 of them new. There is little doubt that most of the others would also represent new species, provided a sufficient number of specimens is available. In fact, we postulate that a systematic study of wild birds would allow the description of dozens of new taxa with limited efforts, even if restricted to a few specimens from common bird species.

Given the particular vulnerability of these hosts (Soh *et al.* 2006) and a more general rapid disappearance of tropical habitats in Southeast Asia (see, e.g., Sodhi *et al.* 2010), large scale surveys focusing on

the parasitofauna of non-model vertebrate hosts, an essential component of global biodiversity, should urgently be undertaken.

Acknowledgements

We are grateful to Prof. Rosli Hashim and Prof. Rosli Ramli (Kuala Lumpur), as well as to the staff from the University of Malaya's Gombak field station for their efficient and friendly support in organizing our field trip in Malaysia. Dr Andrea Waeschenbach (London) is heartily thanked for sharing unpublished sequence data. We thank Dr Leslie Chisholm (Adelaide) and Dr Anna Phillips (Washington, DC) for providing comparison material, and Dr Scott Gardner (Lincoln, NE) who kindly helped with rare literature. We thank Janik Pralong (Geneva) for the preparation of specimens and Dr Alice Cibois (Geneva) for ornithological advice.

Support from NSF-PBI, USA (awards DEB 0818696 and 0818823 to J.N. Caira and K. Jensen) and from the Natural History Museum of Geneva is acknowledged.

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Manuscript received: 23 October 2019

Manuscript accepted: 16 December 2019

Published on: 16 March 2020

Topic editor: Rudy Jocqué

Desk editor: Pepe Fernández

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