



## Research article

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# Seven new species of cestode parasites (Neodermata, Platyhelminthes) from Australian birds

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**Abstract.** Cestodes (Platyhelminthes) from Australian birds from the South Australian Museum collections were studied with a focus on common endemic terrestrial hosts. Despite the variable state of preservation of the examined worms, we could identify several new taxa, including *Sobolevitaenia whittingtoni* sp. nov. and *Spiniglans beveridgei* sp. nov. (Dilepididae) in *Corvus mellori* Mathews, 1912 (Corvidae); *Notopentorchis musealis* sp. nov. (Paruterinidae) in *Hirundapus caudacutus* (Latham, 1801) (Apodidae); *Monopylidium australiense* sp. nov. (Dilepididae) in *Menura novaehollandiae* Latham, 1801 (Menuridae); *Dictymetra gerganae* sp. nov. (Dilepididae) in *Podargus strigoides* (Latham, 1802) (Podargidae); *Dictymetra longiuncinata* sp. nov. in *Esacus magnirostris* (Vieillot, 1818) (Burhinidae) and *Cracticotaenia adelaidae* sp. nov. (Metadilepididae) in *Gymnorhina tibicen* (Latham, 1801) (Artamidae) and *Corcorax melanorhamphos* (Vieillot, 1817) (Corcoracidae). Several other presumably new taxa that cannot be fully described are also reported. This diversity found in common hosts suggests the presence of a rich, and presently almost completely unknown, fauna of cestode parasites in Australian birds. As field collection permits allowing to explore this fauna are extremely difficult to obtain, this is a demonstration of the usefulness of museum collections to describe at least part of it.

**Keywords.** Dilepididae, Paruterinidae, Metadilepididae, avian hosts, Australian endemics.

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## Introduction

With close to 1000 species, including over one third of endemics, the Australian bird fauna is highly diverse and very particular (Lepage 2017). The cestode parasites of this avifauna, especially those of terrestrial endemic species, remain however very poorly known. In their review, Mawson *et al.* (1986)

list about 30 cestode species in these hosts and only a few more have been described more recently (O’Callaghan *et al.* 2000, 2001). Unfortunately, for administrative reasons, it is presently difficult or even impossible to collect wild birds with the specific objective to survey their parasitological diversity in this country. Thus, the main, or possibly, the single opportunity to study this component of the Australian biodiversity is to access older materials that are conserved in museum collections. Although obviously a second-best option, because of the quality or representativeness of the available material, this approach may allow for some interesting discoveries when old collections have been preserved in good condition. Presently, the single large indigenous Australian parasite collection is maintained in Adelaide in the South Australian Museum (SAMA). It includes historical specimens like those of T.H. Johnston (early 20<sup>th</sup> Century) or more recent material like those of I. Beveridge. Due to the reasons mentioned above (and possibly also because of the lack of specialists or of recent interest) almost all of the bird parasites in the Adelaide collections are relatively old and part of them is in poor condition. In the course of a visit organized within the framework of a large international collecting effort (Caira *et al.* 2017), the senior author reviewed this collection, particularly focusing on parasites from Australian endemic species. This allowed for the identification of a number of new taxa that are described below. The fact that a wide variety of novelties were found in a limited number of hosts is a hint that the Australian cestode fauna in birds is most certainly still largely unknown.

## **Material and methods**

The best available material from hosts of interest was selected during a stay of the senior author at the South Australian Museum, Adelaide, in January 2014. In addition to a small number of stained and mounted specimens, we prepared additional slides from ethanol preserved material using Mayer’s hydrochloric carmine staining, dehydration in increasing 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.

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. No prevalences are given because these cannot be derived from the available material. Intensities are approximate as most of the material is heavily fragmented. All specimens are deposited in the Australian Helminthological Collections (AHC) at the SAMA. The nomenclature of birds follows the last available edition of Avibase (Lepage 2017).

## **Results**

The SAMA collection of parasitic helminths holds close to 2000 lots of cestodes of birds, of which we examined around 150 that seemed the best preserved and potentially exploitable for the purpose of this study. Many of those turned out to be in poor condition or consisted of too few specimens for any formal study. In this work, we concentrated on parasites from several groups of terrestrial hosts, mostly Passeriformes like Corvidae, Menuridae, Artamidae and Corcoracidae, as well as from Apodidae (Apodiformes), Podargidae (Caprimulgiiformes) and Burhinidae (Charadriiformes). We also focused on birds with a restricted distribution, including endemics, in order to maximize the discovery of novelties. Altogether we report on cestodes from eight different hosts species. Seven new taxa are described and five other, possibly also new but represented by a few or poorly preserved specimens, are also reported. It is likely that a closer examination of the rest of the collection would reveal a larger diversity of unknown taxa.

Class Cestoda van Beneden, 1848  
Order Cyclophyllidea van Beneden in Braun, 1900  
Family Dilepididae Fuhrmann, 1907  
Genus *Sobolevitaenia* Spasskaya & Makarenko, 1965

*Sobolevitaenia whittingtoni* sp. nov.

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Figs 1–6, Table 1

**Etymology**

The species is dedicated to our colleague and friend, the late Professor Ian Whittington, principal research scientist at the South Australian Museum, Parasites Department.

**Material examined**

**Holotype**

AUSTRALIA: Victoria, Geelong, 38°8' S, 144°22' E, 22 Apr. 2001, Ian Beveridge leg. (AHC 36460).

**Paratypes**

AUSTRALIA: six specs, same data as for holotype (AHC 36461–36466).

**Type host**

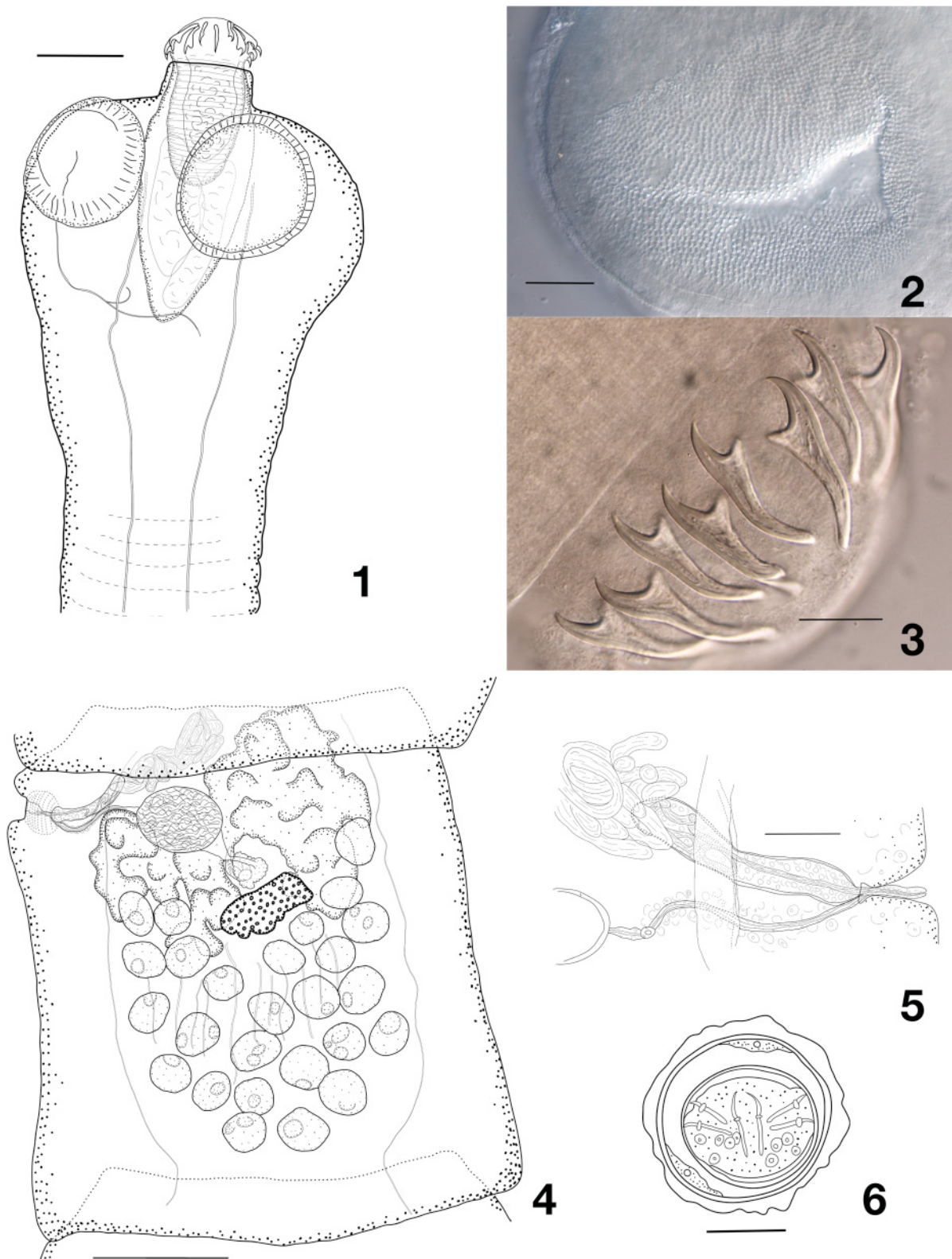
*Corvus mellori* Matthews, 1912 (Passeriformes, Corvidae).

**Intensity**

About 55 specimens in a single host, together with *S. beveridgei* sp. nov.

**Description**

Body of medium size, with length 40–45 mm and maximum width 890–1050 (985, n = 6) at level of early gravid proglottides. Most complete specimens consisting of 110–115 proglottides. Proglottides craspedote, initially up to twice as wide as long, progressively becoming longer, as long as wide at mature stage and longer than wide at late mature or pregravid stage; gravid proglottides elongating significantly and becoming up to twice longer than wide. Scolex rounded, not delineated from neck, with diameter 260–425 (355, n = 7) (Fig. 1). Suckers rounded 116–169 (144, n = 28) in diameter; internal surface of suckers armed with large triangular spine-like microtriches, 2–3 µm long, arranged in dense regular rows (Fig. 2); microtriches only partly preserved in some specimens. Rostellar apparatus musculo-glandular, with strongly developed glandular tissue within rostellar sac. Rostellar sac well-delineated, tapering posteriorly, extending beyond level of posterior margin of suckers, 275–340 × 110–157 (304 × 128, n = 7). Rostellum with expanded anterior part bearing rostellar hooks, slightly constricted behind hooks, 172–210 × 81–109 (191 × 95, n = 7), with thick muscular walls and moderately developed glandular tissue inside it. Rostellar hooks (Fig. 3) in 2 regular rows, 19 (in one worm)–20 (n = 6) in number, robust, handle showing a discrete concave depression at guard level, extremity of handle slightly to markedly bent toward guard. Anterior hooks 42–50 (46, n = 22), posterior hooks 38–44.5 (40.5, n = 21). Neck 125–250 (209, n = 4) wide; proglottization distinct at 325–400 (367, n = 3) from posterior margin of suckers. Genital pores lateral, situated in anterior 20–25% of length of lateral proglottis margin, irregularly alternating in very short series, e.g., 2, 1, 1, 1, 2, 1, 2, 1, 1, 1, 1, 1, 2, 2, 1, 1, 1, 2, 1, 1, 1, 2, 1, 1, 1; no more than three consecutive pores observed on a single side. Ventral osmoregulatory canals 11.5–44 (23.5, n = 21) wide, connected posteriorly in each proglottis by transverse anastomosis. Dorsal osmoregulatory canals 1.5–6 (3.5, n = 22) wide. Genital ducts passing between osmoregulatory canals.



**Figs 1–6.** *Sobolevitaenia whittingtoni* sp. nov. 1. Scolex. 2. Sucker armament. 3. Hooks. 4. Mature proglottis. 5. Terminal genitalia. 6. Egg. Scale bars: 1 = 100 µm; 2, 5 = 50 µm; 3, 6 = 20 µm; 4 = 250 µm.

Genital atrium well marked, infundibular or sink-shaped, with slight muscular sphincter, up to about 30–40 deep and 40–50 in diameter. Genital papilla present, often conspicuous.

Testes 20–30 (24, n = 43) in number, in single layer, in one continuous posterior field, extending laterally up to level anterior to vitellarium, not overlapping osmoregulatory canals and often overlapping posterior lobes of ovary (Fig. 4). External vas deferens 16–22 in diameter (18.5, n = 20), highly convoluted in antero-poral part of median field, sometimes slightly overlapping cirrus-sac. Cirrus-sac elongate, 133–173 × 23–31 (153 × 27, n = 42), slightly oblique, often bent anteriorly in proximal part, extending beyond osmoregulatory canals; with slightly-expressed bulb and pipette-like tapering porally and with rounded antiporal end; filled with large cells, more numerous in distal part (Fig. 5). Internal vas deferens forming several (at least 5–6) coils. Cirrus cylindrical, unarmed, 7 in diameter.

Vitellarium central, slightly antiporal to seminal receptacle, lobate, mostly oval and transversely elongated, variable in shape. Ovary transversely elongated, bi-alate, antiporal wing larger than poral wing; occupying all width of anterior third of median field, with lateral branches often overlapping longitudinal osmoregulatory canals; highly lobed, lobes mostly elongate. Mehlis' gland subglobular, 50–62 (55, n = 14) in diameter, anterior to vitellarium. Empty seminal receptacle round, becoming oval when filled, reaching up to 200 × 115, dorsal and between ovary wings or over poral wing, closely posterior to proximal extremity of cirrus-sac. Vagina opened posteriorly to male pore, mostly straight and transverse, parallel to cirrus-sac, sometimes bent posteriorly; lumen of copulatory part thick-walled, surrounded by sleeve of loose, large cells; no vaginal sphincter; conductive part of vagina very short, thin.

Uterus starts its development in late mature proglottides as reticulum situated ventrally to testes and female gonads and occupying entire median field, crossing osmoregulatory canals and lateral parts of it situated in lateral fields. Developing eggs situated in rows mostly by one, rarely in groups of 2–4 eggs along canals of reticulum. Uterine walls persistent even in most developed gravid proglottides, though sometimes become very transparent and difficult for observation. Outer shell of eggs with irregular shape, sometimes not distinct (Fig. 6). Embryophore oval, 37–50 (42, n = 31) in diameter, thick. Oncosphere round to slightly oval, 30–40 (33, n = 28) in diameter, thick. Embryonic hooks subequal, 11–12 long.

### Remarks

The presence of spines on suckers, the topology of genital organs in mature proglottides, the pattern of the uterine development and the thick embryophore of eggs unambiguously link our material to the genus *Sobolevitaenia* Spasskaya & Makarenko, 1965 erected for two species found in Motacillidae in Russia (Spasskaya & Makarenko 1965). This genus comprises about 15 species found in various passeriform birds, mostly Motacillidae and Turdidae, although Corvidae are also known as hosts (Table 1). Spasskaya & Spasskii (1977) listed seven species while Kugi (2000) reported 12 species in the genus. Hosts are all from Northern Hemisphere (Spasskaya & Spasskii 1977; Kugi 2000), except *S. korochirei* (Voser & Vaucher, 1988) that has been found in Paraguay (Voser & Vaucher 1988). Bona (1994), however, noted the probable cosmopolitan distribution of this genus.

*Sobolevitaenia* spp. have a homogeneous morphology, including about 20 hooks on two rows for most of them. In order to facilitate comparisons and because metrical reports are highly variable for most species (see e.g., Spasskaya & Spasskii 1977), values from original descriptions are reported as much as possible in Table 1. Most known species show rostellar hooks that are of different size than observed in our material. Furthermore many of them also have a smaller number of testes and (or) cirrus-sacs of different sizes. These characters allow the easy differentiation of our material from the majority of the known *Sobolevitaenia* spp. (see Table 1). A few remain however more difficult to distinguish:

**Table 1** (continued on next page). Comparison of *Sobolevitaenia whittingtoni* sp. nov. with the other species of the genus *Sobolevitaenia*. Notes: \* in the original description, the species is found in a second host species, with slight variations in measurements; \*\* synonym of *S. anthusi* (Spasskaya, 1958) according to Spasskaya & Spasskii (1977), \*\*\* additional measurements in parentheses from Dubinina (1953) in Matevosyan (1963).

Species	Host family	Type locality	Scolex diameter	Suckers diameter	Rostellar sac	Rostellum	Hooks number	Anterior hooks length	Posterior hooks length	Testes number	Cirrus sac	Source
<i>S. whittingtoni</i> sp. nov.	Corvidae	Australia	260–425	116–169	275–340 × 110–157	172–210 × 81–109	19–20	42–50	38–44.5	20–30	133–173 × 23–31	New data
<i>S. anthusi</i> (Spasskaya, 1958) (Type species)	Motacillidae	Palaearctic	168	72	227 × 74	129 × 72	20	31–33	28–31	16–25	179–184 × 56–67	Spasskaya & Spasskii (1977)
<i>S. iola</i> (Lincicome, 1939)	Corvidae and others	USA	244–444	92–127	102–239 × –	– × 46–97	17–20	26–43	26–43	13–17	122–224 × 26–40	Lincicome (1939)
<i>S. japonensis</i> Kugi, 2000	Turdidae	Japan	250–280	118–120	178–180 × 63–65	128–130 × 63–75	20	48–50	43–45	26–35	98–120 × 15–17.5	Kugi (2000)
<i>S. korochirei</i> (Voser & Vaucher, 1988)*	Turdidae	Paraguay	293–410	82–166	–	148–229 × 64–112	20–22	44–56	37–49	14–17	76–114	Voser & Vaucher (1988)
<i>S. moldavica</i> (Shumilo & Spassakaja, 1975)	Turdidae	Moldova	330	145 × 126	–	180–207 × 84–90	20	45–47	40–42	12–20	160–195 × 17–22	Kugi (2000)
<i>S. oitaensis</i> Kugi, 1996	Turdidae	Japan	480–550	200–250	370 × 160	190 × 60	22	53	43	16–17	100–120 × 25	Kugi (1996)
<i>S. orientalis</i> Spasskii & Konovalov 1969**	Motacillidae	Russia	225	115	115 × 100	170 × 79	20	33–34	31	14–18	180–225 × 39–42	Spasskaya & Spasskii (1977)
<i>S. similis</i> Spasskii & Konovalov, 1969	Motacillidae	Russia	205	80 × 95	140 × 74	125 × 70	20	31	25	24–28	285–300 × 42–57	Spasskaya & Spasskii (1977)
<i>S. sobolevi</i> Spasskaya & Makarenko, 1965	Motacillidae	Russia	200	155 × 82	173 × 82	109 × 45	20	19–20	19–20	20	238 × 45	Spasskaya & Makarenko (1965)

Table 1 (continued).

Species	Host family	Type locality	Scolex diameter	Suckers diameter	Rostellar sac	Rostellum	Hooks number	Anterior hooks length	Posterior hooks length	Testes number	Cirrus sac	Source
<i>S. spinoscapite</i> (Joyeux & Baer, 1955)	Corvidae and others	France	370	150	250	60	20–30	42–45	37–39	20–23	180–250 × 25–40	Joyeux & Baer (1955)
<i>S. turdi</i> Kugi, 1996	Turdidae	Japan	550	180	340 × 150	240–270 × 90	16	45	42	17–18	75–80 × 15–18	Kugi (1996)
<i>S. unicononata</i> (Fuhrmann, 1908)	Turdidae	Europa	290–330	130	196–308 × 80–112	207 × 70–100	22	48	48	20–24	140 × 28	Fuhrmann (1908)
<i>S. verulamii</i> (Mettrick, 1958)	Turdidae	England	350–370	–	–	–	20	63–65	49–53	20–24	240 × 48	Mettrick (1958)
<i>S. (?) borealis</i> (Krabbe, 1869)	Calcaritidae	Greenland	206	79	–	–	18	30	23	16–20	136–204 × 45–57	Baer (1956)
<i>S. (?) caenodex</i> (Mettrick & Beverley-Burton, 1962)	Turdidae	England	290–380	130–140	150 × 80	– × 80	18–20	50–54	45–47	20–24	140–180 × 20	Mettrick & Burton (1962)
<i>S. (?) trigonocephalum</i> (Krabbe, 1869) ***	Muscicapidae and others	Greenland	(200–230)	(80–100)	–	–	20 (22)	31–34	31–34 (–35)	(12–15)	290 × 21	Krabbe (1869)

- *Sobolevitaenia iola* (Lincicome, 1939), a North American taxon originally reported from *Turdus migratorius* Linnaeus, 1766 (Turdidae), but also reported from corvids *Cyanocitta cristata* (Linnaeus, 1758) in Canada (Cooper & Crites 1974). Although resembling our material, *S. iola* has fewer testes (13–17), slightly shorter hooks (32 long on average) and an armed cirrus (Lincicome 1939).
- *Sobolevitaenia japonensis* Kugi, 2000 from *Turdus naumanni* Temminck, 1820 in Japan has both a smaller rostellar sac (178–180 × 63–65) and cirrus-sac (96–120 × 1518) as well as spinose cirrus (Kugi 2000).
- *Sobolevitaenia spinosocapite* (Joyeux & Baer, 1955) from various passerines in France, shows a longer cirrus-sac (180–250). Furthermore, Joyeux & Baer (1955) report up to 30 rostellar hooks in this species. Minute spines are mentioned not only on the suckers but on the whole scolex. Joyeux & Baer (1955) also reported this taxon from a corvid, *Garrulus glandarius* (Linnaeus, 1758), but with noticeably different measurements, including longer (50) and more numerous rostellar hooks (25–28).
- *Sobolevitaenia unicoloronata* (Fuhrmann, 1908) from a number of *Turdus* spp., has hooks of different shape; the length of hooks is similar on both crowns and therefore slightly longer (48) for the second row than those in our material and the double row of hooks is indistinct. Fuhrmann (1908) reported hooks in a single row but Clerc (1911) found them in 2 rows and this point remains contentious. Mettrick's (1958), and numerous other reports of this species in the Palaearctic probably refer to different taxa (Spasskaya & Spasskii 1977).

Two other species initially described from Greenland by Krabbe (1869) possibly belonging to *Sobolevitaenia* resemble our material, but their exact generic assignments remain unsettled. However, both *S. (?) borealis* (Krabbe, 1869) and *S. (?) trigonocephalum* (Krabbe, 1869) have much shorter rostellar hooks and fewer testes. Furthermore *S. (?) borealis* has an armed cirrus (Baer 1956). We conclude that our material differs from all described species of the genus and we recognise it as a new species, *Sobolevitaenia whittingtoni* sp. nov.

We should, however, consider that the definition of *Sobolevitaenia*, based essentially on the presence of spines on the suckers, makes the exact content of this genus uncertain as these structures are easily lost or overlooked. The diversity of the genus is thus probably greater than presently known and, possibly, some taxa currently recognised as members of the genus *Monopylidium* Fuhrmann, 1899 should be re-examined as possible further species of *Sobolevitaenia*.

The little raven, *Corvus mellori*, is closely related to *C. coronoides* Vigors & Horsfield, 1827. Both are endemic to South and Eastern Australia (Lepage 2017). They are omnivorous and feed predominantly on insects and other soil arthropods among which the intermediate host of *S. whittingtoni* is likely to be found. The cestode fauna of Australian corvids is very poorly known: besides a single full identification of *Raillietina corvina* (Fuhrmann, 1905) in *C. orru* Bonaparte, 1850, Mawson *et al.* (1986) only mention a *Hymenolepis* sp. in *C. mellori*, a *Davainea* sp. in *C. coronoides* and a few unidentified cestodes. We know seven species of these birds from Australia (Lepage 2017), which must certainly host a much wider diversity of tapeworms.

Genus *Spiniglans* Yamaguti, 1959

*Spiniglans beveridgei* sp. nov.

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Figs 7–11, Table 2

### Etymology

The species is dedicated to Professor Ian Beveridge, a friend and colleague, collector of this material, in recognition of his major contribution to systematic helminthology.

## Material examined

### Holotype

AUSTRALIA: Victoria, Geelong, 38°8' S, 144°22' E, 22 Apr. 2001, Ian Beveridge leg. (AHC 36467).

### Paratypes

AUSTRALIA: 10 specs, same data as for holotype (AHC 36468–36477).

### Type host

*Corvus mellori* Matthews, 1912 (Passeriformes, Corvidae).

### Intensity

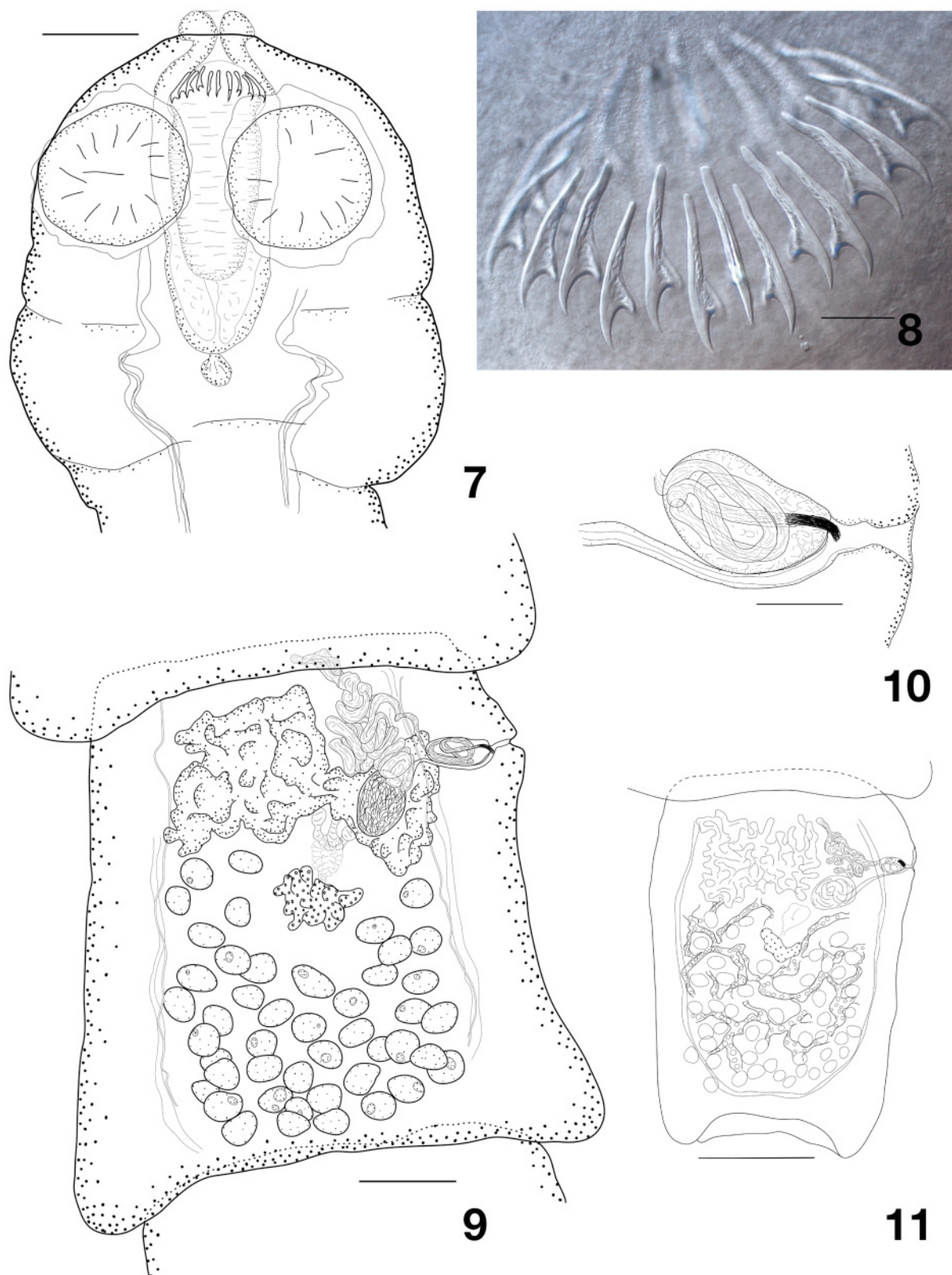
About 55 specimens in a single host, together with *S. whittingtoni* sp. nov.

### Description

Body of medium size with length 57–63 mm and maximum width 1050–1280 (1170, n = 6) at level of late mature proglottides. Most complete late mature to pregravid specimens consisting of 169–198 proglottides. Proglottides craspedote, initially wider than long, progressively becoming longer, square at mature stage and longer than wide at late mature stage. Ventral osmoregulatory canals connected posteriorly in each proglottis by transverse anastomosis. Longitudinal musculature with well-marked bundles. Scolex (Fig. 7) rounded, well marked, sometimes showing a transverse fold behind suckers, with diameter 325–450 (397, n = 6). Suckers strong, rounded, 145–180 in diameter (161, n = 24), unarmed. Rostellar apparatus musculo-glandular, with developed glandular tissue along whole rostellar sac length often slightly protruding apically even when retracted. Rostellar sac well-delineated, 374–450 × 132–152 (383 × 142, n = 6) tapering posteriorly, extending beyond level of posterior margin of suckers, often with terminal bubble-like extension. Rostellum oval, strongly muscular, with well-marked constriction behind hooks, 224–270 × 85–105 (242 × 94, n = 6). Rostellar hooks (Fig. 8) in two mostly regular rows (with occasional slight irregularities or indistinct row delineation), 20 (n = 1), 21 (n = 3) or 22 (n = 4) in number, robust, with strong guard and slightly bent tapering extremity of handle. Anterior hooks 40.5–44 (42, n = 8), posterior hooks 38.5–40.5 (39.5, n = 6). Proglottization distinct at 500–650 (568, n = 7) from posterior margin of suckers. Genital pores anterior situated at about 20% of length of lateral proglottis margin, irregularly alternating in short series, e.g., ...1, 1, 2, 2, 1, 1, 3, 1, 1, 2, 2, 3, 1, 4, 5, 3, 1, 1, 2... No more than five consecutive pores observed on single side. Genital ducts passing between osmoregulatory canals. Genital atrium small.

Testes 40–58 (49, n = 54) in number (43–55 in 90% of counts), in one or two layers, in one continuous posterior file, denser posteriorly, mostly extending antero-laterally up to level of vitellarium but a few may be more anterior, especially at antiporal side, occasionally overlapping osmoregulatory canals (Fig. 9). External vas deferens 13.5–21 in diameter (17, n = 15), highly convoluted in the antero-poral part of proglottis, not overlapping cirrus-sac. Cirrus-sac short, oval or bean-shaped, 87–118 × 47–68 (102 × 55, n = 44), transverse or slightly curved anteriorly, rarely reaching poral osmoregulatory canals. Internal vas deferens coiled, making several large loops within cirrus-sac. Cirrus armed with compact tuft of fine bristle-like spines about 35 long (Fig. 10).

Vitellarium central, transversely elongated, lobate, variable in shape. Ovary transversely elongated, deeply and finely branched, lobulate, bi-alate, antiporal wing much larger than poral one. Mehlis' gland 70–105 (84, n = 15) closely anterior to vitellarium. Seminal receptacle initially round, rapidly becoming oval, reaching up to 175 × 114, dorsal, posterior to external vas deferens, often over poral ovary wing. Vagina thick-walled, along posterior margin of cirrus-sac, mostly straight 7.5–11.5 in diameter (9.5



**Figs 7–11.** *Spiniglans beveridgei* sp. nov. 7. Scolex. 8. Hooks. 9. Mature proglottis. 10. Terminal genitalia. 11. Pregravid proglottis with young reticular uterus. Scale bars: 7 = 100 µm; 8 = 20 µm; 9 = 200 µm; 10 = 50 µm; 11 = 500 µm.

n = 12), externally gained with loose parenchymal cells. Vaginal pore posterior to pore of cirrus-sac. Young uterus reticular (Fig. 11) in pregravid proglottides. Gravid segments and eggs not observed.

### Remarks

The genus *Spiniglans* Yamaguti, 1959 has been discussed by Bona (1994), Salamatin (1999) and Korniyushin *et al.* (2009). The latter authors briefly reviewed the generic characters and listed 4 valid species, from Corvidae in the Old World, as well a few other closely related taxa possibly belonging to the genus. They also predicted that more taxa in this group would be found both in other European and tropical corvid species.

Our material can easily be distinguished from most presently recognized species in the genus (Table 2). It differs from *S. microsoma* (Southwell, 1922) by having more testes; from *S. affinis* (Krabbe, 1869) by smaller rostellar hooks, fewer testes and a smaller rostellum; from *S. constricta* (Molin, 1858) by a larger cirrus-sac, rostellar pouch and rostellum; from *S. pirinica* (Georgiev, Korniyushin & Genov, 1987) by much shorter hooks and a smaller cirrus-sac. Our material most closely resembles *S. sharpiloi* Korniyushin *et al.*, 2009 but can be distinguished from it by slightly larger rostellar hooks and a longer rostellar pouch and rostellum. It is also similar to *S. corvi* (Joyeux, Baer & Martin, 1937) but it has more testes and a shorter cirrus-sac. In consequence, we consider it to belong to a new species, *Spiniglans beveridgei* sp. nov.

Up to now, *Spiniglans* was known from the Old World only and its host range essentially limited to the Corvidae although the type species was reported in granivore passerines (Emberizidae and Ploceidae) in captivity (Southwell 1922). Its presence in Australia may be due to a recent importation as *Corvus* colonized (or re-colonized) this continent after diversifying in the Palaearctic (Ericson *et al.* 2005; Haring *et al.* 2012). The Corvidae includes around 130 species and is cosmopolitan. It is therefore expected that a larger diversity of parasites of this genus is still unknown, especially in Asia. It remains to be seen whether New World corvids are also hosts of these cestodes, as hinted by the brief report of Pfaffenberger & Butler (1981) of *S. constricta* (“*Anomotania constricta*”) in *Corvus cryptoleucus* Couch, 1854 in New Mexico. If confirmed, many more *Spiniglans* spp. are likely to be discovered in American corvids as the family is highly diversified in the Americas.

Genus *Neoliga* Singh, 1952

*Neoliga* sp.

### Material examined

AUSTRALIA: New South Wales, Sydney, 33.48' S, 151°6' E, 2005, Karie Rose leg., 1 spec. in two parts, rather good condition but no gravid proglottides, on same slide as type material of *Notopentorchis musealis* sp. nov. (AHC 36479); multiple small to minute fragments in bad condition, co-infection with *Notopentorchis musealis* sp. nov. (AHC 33108).

### Host

*Hirundapus caudacutus* (Latham, 1801) (Apodiformes, Apodidae).

### Description

The available material is not sufficient to allow for a full description. Scolex 310 in diameter. Suckers weak, oval, 205–220 in diameter. Rostellar pouch 250 × 125, weakly muscular. Rostellum 250 × 100, bearing an incomplete (14 hooks observed, likely > 20 when complete) double crown of subequal hooks, 46–49 long, with small epyphysis on guard. Genital pores alternating mostly regularly. Testes in single posterior field, in two layers, 23–27 in number. Cirrus-sac very large and strong, reaching antiporal

**Table 2.** Comparison of *Spiniglans beveridgei* sp. nov. with the other species of the genus *Spiniglans* Yamaguti, 1959.

Species	Host	Type locality	Scolex diameter	Suckers diameter	Rostellar sac	Rostellum	Hooks number	Anterior hooks length	Posterior hooks length	Testes number	Cirrus sac	Source
<i>S. beveridgei</i> sp. nov.	Corvidae	Australia	325–450	145–180	374–450 × 132–152	224–270 × 85–105	20–22	40.5–44	38.5–40.5	40–58	87–118 × 47–68	New data
<i>S. affinis</i> (Krabbe, 1869)	Corvidae	Ukraine	550	150	420 × 200	350 × 120	22	55–58	50–55	78–86	75–100 × 25–30	Salamatin (1999)
<i>S. constricta</i> (Molin, 1858)	Corvidae	Ukraine	330	120	250 × 134	200 × 120	20	40–41	36–37	38–49	60–80 × 30–35	Salamatin (1999)
<i>S. corvi</i> (Joyeux <i>et al.</i> , 1937)	Corvidae	Somalia	260	170	350–430 × 110	– × 160	22	43–45	–	32–35	140 × 50	Joyeux <i>et al.</i> (1937)
<i>S. microsoma</i> (Southwell, 1922) (Type species)	Ploceidae, Emberizidae	India (Zoological Garden)	220	140	–	180 × 50	16–20	35	–	16–20	short and narrow	Southwell (1922)
<i>S. pirinica</i> (Georgiev <i>et al.</i> , 1987)	Corvidae	Bulgaria	312–406	114–175	344–456 × 144–206	262–368 × 87–125	20–22	67–73	61–68	39–61	85 × 110 × 32–45	Georgiev <i>et al.</i> (1987)
<i>S. sharpiloi</i> Kornyushin <i>et al.</i> , 2009	Corvidae	Ukraine	276–530	130–210	301–350 × 112–220	180–200 × 75–110	20–22	31–38	28–36	32–45	80–131 × 30–50	Kornyushin <i>et al.</i> (2009)

excretory canals. Cirrus armed terminally. Vagina opening anteriorly (or dorsally) to cirrus-sac in a well-marked ductus hermaphroditus connected to deep and wide atrium. Vagina dorsal to cirrus-sac strongly marked, terminating with characteristic sclerotized clamp [“dumb-bell organ”, see Bona (1994), or “vaginal sclerites”, see Dimitrova *et al.* (2013)]. Ovary central, deeply multilobulated, with digitiform lobes. Genital ducts dorsal to osmoregulatory canals. Young uterus saccular.

### Remarks

This material belongs to the genus *Neoliga* Singh, 1952 as defined by Bona (1994), a genus specific to swifts and tree swifts (Apodidae) and known from Morocco to India, Java and Siberia. Four species are listed by Spasskaya & Spasskii (1977), but the present material does not allow for a detailed comparison. There is no known species of this genus in Australia, but given the migratory pattern of the white-throated needletail it is quite possible that parasites from Siberian hosts could be found in Australia. This confirms the prediction of Bona (1994) that the genus distribution is probably wider than presently known.

Genus *Monopylidium* Fuhrmann, 1899

*Monopylidium australiense* sp. nov.

[urn:lsid:zoobank.org:act:DB89AB09-63A2-43DB-9F30-5C9D41424955](https://zoobank.org/urn:lsid:zoobank.org:act:DB89AB09-63A2-43DB-9F30-5C9D41424955)

Figs 12–16, Table 3

### Etymology

The specific name is derived from the country where the material was found.

### Material examined

#### Holotype

AUSTRALIA: Victoria, Healesville Sanctuary, 37°41' S, 145°32' E, 4 Oct. 1994, Peter Holz leg. (AHC 36480, field number 94/773).

#### Paratypes

AUSTRALIA: about 24 specs, same data as for holotype (AHC 36481–36486).

#### Other material

AUSTRALIA: 2 specs, Victoria, Healesville, 3 Aug. 1991, David Middleton leg. (AHC 22931, 36487); 1 spec., Victoria, Sherbrooke, 37°53' S, 145°22' E, 2005, Peter Holz leg (AHC 29271); 1 spec., Victoria, Healesville, 2006, Peter Holz leg. (AHC 29281).

### Type host

*Menura novaehollandiae* Latham, 1801 (syn. *M. superba* Dacis, 1820) (Passeriformes, Menuridae).

### Site of infection

Small intestine.

### Intensity

About 25 specimens in a single host.

### Description

Body very small, up to 6.5–8.1 (7.3, n = 7) mm long, consisting of 39–53 proglottides; maximum width 600–725 (694, n = 9) at level of gravid proglottides. Proglottides craspedote, mostly wider

than long, but shape depending on contraction. Ventral osmoregulatory canals with posterior transverse anastomoses in each proglottis. Strong longitudinal muscular bundles. Scolex 258–305 in diameter (280, n = 6), slightly wider than neck, widest at level of suckers (Fig. 12). Neck poorly or not marked. Suckers elongated, very muscular, with irregular margins, 130–150 in diameter (132, n = 27). Rostellar pouch strong, musculo-glandular, usually with distinctive widening anterior to suckers, extending beyond level of posterior margin of suckers and becoming much narrower; often folded posteriorly, 270 × 112 (224–320 × 105–130, n = 6). Rostellum muscular, mushroom-shaped 135–150 × 55–83 (144 × 73, n = 3), with distinct apical pad. Rostellar hooks 20–21 in number, in two regular rows, sub-equal; anterior hooks 23–26 (24.2, n = 24) long, posterior hooks 22.5–25.0 (23.7, n = 26) long; all hooks of similar shape, with straight handle, strong short guard and very short blade; small epiphyseal-like outgrowth at tip of handle (Fig. 13). Neck short, proglottization distinct at 25–65 (46, n = 6) from posterior margin of suckers. Genital pores at border of first third of lateral proglottis margin, irregularly alternating in short series, rarely more than 2 (maximum observed 4) consecutive pores on a single side. Genital ducts passing between osmoregulatory canals. Genital atrium infundibular.

Testes large, 16–29 in number (24, n = 52), in median field of proglottis, in double, sometime triple, compact posterior layer, often overlapping vitellarium and ovary. External vas deferens extremely developed, massive and highly convoluted, antero-central, often covering cirrus-sac. Cirrus-sac cylindrical, sometimes slightly wider distally, 86–138 × 26–38 (113 × 33, n = 43), crossing excretory canals and half of it might be situated in median field (Fig. 14). Cirrus 10–12 in diameter, armed with well developed spines situated on part of it with length 50. Internal vas deferens convoluted.

Vitellarium central, oval, mostly regular, composed of few compact lobes. Ovary central, massive, bi-winged, multilobate, filling entire width of median field when fully developed, sometimes even slightly crossing lateral osmoregulatory canals. Mehlis' gland central, overlapping seminal receptacle but not always distinct. Seminal receptacle elongated, anterior to vitellarium and between wings of ovary. Vagina thin-walled with discrete basal muscular sphincter; opening posteriorly to cirrus-sac, sometimes partly overlapping it; lined with thin spines in its distal copulatory part (Figs 14–15).

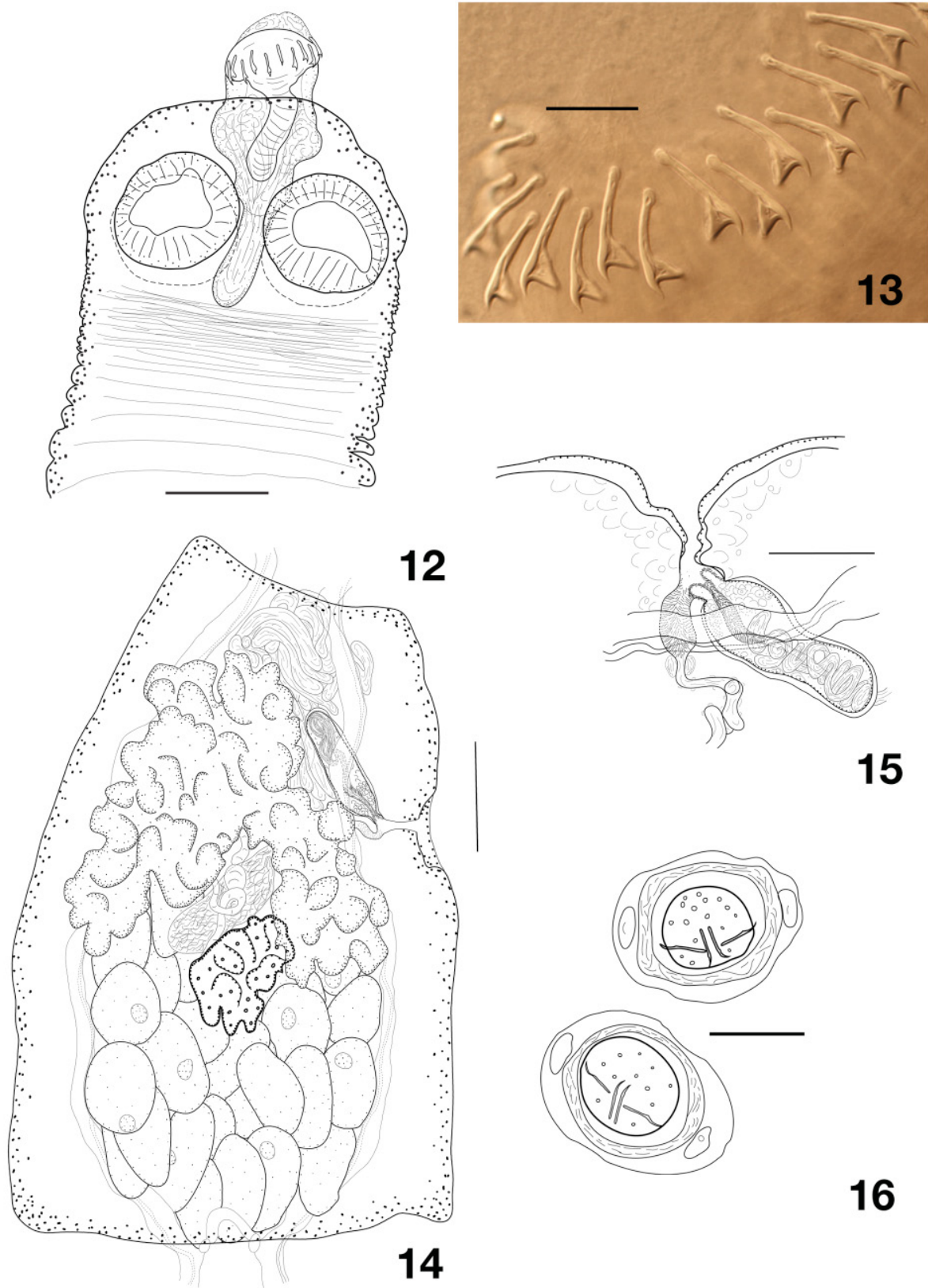
Uterus initially broadly reticulate, developing quickly over whole median field width and extending in lateral field. With further development, uterus becoming compact, saccular, with few deep lobes. Oncospheres slightly oval, 19–24 (21, n = 20) in diameter. Eggs with thin outer shell provided with two big and distinct nuclei; embryophore spherical, thick (Fig. 16). Central embryonic hooks 11 long, lateral embryonic hooks 10 long.

#### **Observations on additional material** (not belonging to the type series)

AHC 22931: about 40, extremely small specimens, shorter than 2 mm, maximum width 510, composed of fewer than 20 proglottides but with extremely rapid development. Some early gravid proglottides present. General characters in accordance with the above description to the exception of slightly wider rostellum [85–105 (95, n = 10)] and slight variation in number of rostellar hooks (single specimens with 19, 22 or 23 rostellar hooks).

AHC 29271: two slides with fragments of generally poor quality. The observable characters fit the above description.

AHC 29281: a single slide composed of fragments of smaller worms, similar to material from host 22931. Slightly smaller scoleces (200–225 in diameter).



**Figs 12–16.** *Monopylidium australiense* sp. nov. **12.** Scolex. **13.** Hooks. **14.** Mature proglottis. **15.** Terminal genitalia. **16.** Eggs. Scale bars: 12, 14 = 100 µm; 13, 16 = 20 µm; 15 = 50 µm.

## Remarks

In its report on helminth parasite of lyrebirds in Australia, Johnston (1913) described a new acanthocephalan but no cestode. Much later, McOrist & Scott (1989) examined superb lyrebirds suffering from enteritis that was caused by acanthocephalan infections in Southern Victoria and noted the presence of “occasional cestodes of the genus *Choanotaenia*” in the specimens they studied. To the best of our knowledge, these are the only helminthological reports for these birds.

To our knowledge, there are only two reports of a *Monopylidium* in Australia. Johnston (1909) mentioned the cosmopolitan species *M. passerinum* (Fuhrmann, 1907) in *Passer domesticus* L. in New South Wales and gave a detailed description. This species differed from the present material by several characters including significantly shorter rostellar hooks (Table 3). *Monopylidium fieldingi* has also been reported from Australia in the butcherbird *Cracticus destructor* Temminck, 1824 [now *C. torquatus* (Latham, 1801)] in North Queensland (Maplestone & Southwell 1923). However, this taxon has a clearly different anatomy, in particular the presence of 80 rose-thorn shaped hooks in two rows, and is now placed in the genus *Cracticotaenia* Spasskii, 1966 (Metadilepididae) (see below).

Here, we follow the concept of Spasskii (1993) as updated by Bona (1994) for the definition of *Monopylidium*. Thus, *Icterotaenia* Railliet & Henry, 1909 is considered a synonym and some species validated by Spasskii (1993) are now placed in different genera (like *Cuculincola* Bona, 1994 or *Spasspasskya* Bona, 1994). Globally, about 25 species of *Monopylidium* are presently recognized (Table 3), although the status of some of them remains equivocal. Our material can easily be differentiated from nearly all of them, although *M. attenuatum* (Dujardin, 1845) and *M. tandani* (Singh, 1964) present relatively similar characteristics. However, the former shows a smaller rostellum bearing hooks of different shape, larger oncospheres and embryonic hooks than those of our specimens. It may also have unarmed cirrus (Spasskaya & Spasskii 1977). The latter is a short worm with few (< 20) proglottides, hooks with longer blades and shorter handles and an unarmed cirrus. It is only known from *Myophonus caeruleus temminckii* Vigors, 1831, a trush found in the Himalayan region (Singh 1964).

Consequently, *Monopylidium australiense* sp. nov. is the single known cestode parasitizing this endemic host.

## Dilepididae indet.

### Material examined

AUSTRALIA: about 12 specs, Victoria, Healesville Sanctuary, 37°41' S, 145°32' E, 2002, Dave Middleton leg. (AHC 36488).

### Host

*Menura novaehollandiae* Latham, 1801 (syn. *M. superba* Davies, 1802) (Passeriformes, Menuridae).

### Description

This material is in poor state of conservation with contracted and (or) macerated partial strobila and no intact scolex. Scolex width 300–370 (338, n = 3) in diameter; suckers muscular 125–208 (164, n = 12) in diameter. Rostellum 225–255 × 85–137. A single scolex bears an incomplete series of hooks with length 21–25 (23.5, n = 8) (Fig. 39). Worms are much larger and wider than *M. australiense* (up to 26 mm long and 2.6 mm wide observed, although complete worms should be even larger). The overall

anatomy is similar, in particular the few observable rostellar hooks are of the same size and shape as in *M. australiense*, but, among the observable characters, it seems to have more testes (ca 35–40), a vagina lined with setae and a slightly larger cirrus-sac. The cirrus is armed with well-marked small spines. The available material does not allow for a description but hints at the possible diversity of Dilepididae within lyrebirds.

Genus *Dictymetra* Clark, 1952

*Dictymetra gerganae* sp. nov.

[urn:lsid:zoobank.org:act:B01CE7CD-9AB5-4861-9938-9C39350875BB](https://zoobank.org/act:B01CE7CD-9AB5-4861-9938-9C39350875BB)

Figs 17–22, Table 4

### **Etymology**

The species is dedicated to our friend and colleague, Dr. Gergana Vasileva (Sofia, Bulgaria), a recognized specialist of avian cestodes taxonomy.

### **Material examined**

#### **Holotype**

AUSTRALIA: Tasmania, 16 Oct. 1981, David Obendorf (?) leg. (AHC 36489).

#### **Paratypes**

AUSTRALIA: about 14 specs, same data as for holotype (AHC 36490–36494).

#### **Other material**

AUSTRALIA: about 20 very fragmented specs, previously identified as “*Choanotoania* sp. nov.” by R. Wilcox, Victoria, Healesville, 37°41' S, 145°32' E, 20 Mar. 1997, P. Holz leg., 21 Oct. 1997 (AHC 36495).

### **Host**

*Podargus strigoides* (Latham, 1802) (Caprimulgiformes, Podargidae).

### **Site of infection**

Intestine.

### **Intensity**

About 15 specimens in a single host.

### **Description**

Body of medium size, with length 65–73 mm and maximum width 1.88–2.3 mm (2.03 mm, n = 5) at level of gravid proglottides. Most complete specimens consisting of 79–92 proglottides. Proglottides craspedote, wider than long, progressively becoming longer than wide and up to over twice as long as wide when gravid. Osmoregulatory canals mostly indistinct due to the slight maceration of the specimens.

Scolex rounded (Fig. 17), with diameter 305–360 (n = 2). Suckers rounded, 145–175 (158, n = 8) in diameter, smooth. Rostellar apparatus musculo-glandular (Fig. 17). Rostellar sac well-delineated, but weakly muscular, extending beyond level of posterior margin of suckers, 230–292 × 118–145 (n = 4). Rostellum heavily muscular with expanded anterior part bearing rostellar hooks, bulb-shaped behind hooks, 195–212 × 98–132 (n = 2). Rostellar hooks in two regular rows, 24 in number, robust, slightly curved overall, with long blade and handle. Anterior hooks 46–53 when measured on complete scolex (49.5, n = 6) long (see also other material below); posterior hooks, slightly larger and more curved than

**Table 3** (continued on next page). Comparison of *Monopylidium australiense* sp. nov. with the other species of the genera *Monopylidium* Fuhrmann, 1899 and *Icterotaenia* Railliet & Henry, 1909. See text for the accepted generic concept. Note: \* 20, 10 and 19 respectively in original reference, a printing error, as confirmed by the length of cirrus-sac on the original illustration.

Species	Host family	Type locality	Scolex diameter	Suckers diameter	Rostellar sac	Rostellum	Hooks number	Anterior hooks length	Posterior hooks length	Testes number	Cirrus sac	Source
<i>Monopylidium australiense</i> sp. nov.	Menuridae	Australia	258–305	130–150	Up to 320 × 113	135–150 × 55–83	20–21	23–26	22.5–25	20–30	86–138 × 26–38	New data
<i>M. musculostum</i> (Fuhrmann, 1896) (Type species)	Various Passeriformes	Palaearctic	260–300	90	–	70–80	20–22	25–29	–	20–30	180–200 × 50	Spasskaya & Spasskii (1977)
<i>M. albani</i> (Mettrick, 1958)	Sturnidae	Europe	320–350	135–150	172–183 × 101–113	98–123 × 55–75	25–30	19–23	–	20–28	220–290 × 30–50	Komisarovas <i>et al.</i> (2007)
<i>Icterotaenia asymmetrica</i> (Fuhrmann, 1908)	Caprimulgidae	Brasil	290	100	–	–	20–22	26	–	70	–	Spasskaya & Spasskii (1977)
<i>M. attenuatum</i> (Dujardin, 1845)	Various Passeriformes	Europe	220–260	95	–	78	20	20–27	–	12–28	–	Spasskaya & Spasskii (1977)
<i>M. barbara</i> (Meggitt, 1927)	Corvidae & Passeridae	India	200*	–	–	100*	23	17	–	24–26	190* × –	Meggitt (1927)
<i>M. binzui</i> (Yamaguti, 1956)	Motacillidae	Japan	160	75–90	150 × 48	120–130 × 40–42	18 (?)	27	18	14–16	110–230 × 30–45	Yamaguti (1956)
<i>M. borealis</i> (Krabbe, 1869)	Various Passeriformes	Palaearctic	206	79	–	– × 68	18	30	23	16–20	136–204 × 45–57	Baer (1956)
<i>I. columbi</i> Borgarenko, 1976	Columbidae	Tajikistan	440	165	275 × 22	240 × 150	34–36	92–106	–	19–22	252 × 56	Borgarenko (1981)
<i>M. dubium</i> Spasskii & Konovalov, 1986	Muscicapidae	Chukotka	280	110	200–300 × 79	114 × 45	20	24	–	14–18	120–170 × 39–44	Spasskii & Konovalov (1986)
<i>M. exiguum</i> (Dujardin, 1845)	Various Passeriformes	Palaearctic	150–270	60–100	130–164 × 89–92	40–90 × 51–53	24–28	22–25	20–21	10–14	100–184 × 41–49	Komisarovas <i>et al.</i> (2007)
<i>I. galbulae</i> (Gmelin, 1790)	Various Passeriformes	Palaearctic	410	150	–	70	22–26	30	28	15	140–200 × 40–50	Spasskaya & Spasskii (1977)
<i>M. hamatum</i> Spasskii, 1993	Passeridae	Tuva	173	82	191	145	36	17	–	18–20	191 × 40	Spasskaya & Spasskii (1977)

Table 3 (continued).

Species	Host family	Type locality	Scolex diameter	Suckers diameter	Rostellar sac	Rostellum	Hooks number	Anterior hooks length	Posterior hooks length	Testes number	Cirrus sac	Source
<i>M. metamariae</i> Spasskaya & Spasskii, 1977	Alaudidae	Murmansk	450	150	246 × 84	230 × 62	22	17–19	–	6–8	62–89 × 30	Spasskaya & Spasskii (1977)
<i>I. monedulae</i> Spasskaya & Spasskii, 1971	Corvidae	Tuva, Mordovaia	440	200	–	200 × 172	22	19–20	17	14	165–200 × 22	Spasskaya & Spasskii (1977)
<i>M. paradiseum</i> Spasskaya & Borgarenko, 1977	Monarchidae	Tajikistan	130	56	–	50	18–20	12–14	–	7–8	117–162 × 56–99	Spasskaya & Spasskii (1977)
<i>I. paucianulata</i> (Fuhrmann, 1908)	Caprimulgidae	Brasil	450	130	–	–	16	25	–	18	200	Spasskaya & Spasskii (1977)
<i>M. passerinum</i> Fuhrmann, 1907	Various Passeriformes	Palaeartic, Australia	150–170	80	–	110 × 40	20	16	14	20–30	170–200 × 40	Johnston (1909)
<i>M. perisorei</i> (Spasskaya, 1957)	Corvidae and other passerines	Palaeartic	420	145	Beyond suckers	108–118 × 40–45	20	18–19	–	25	225 × 44	Spasskaya & Spasskii (1977)
<i>M. praecox</i> (Krabbe, 1879)	Passeriformes, Cuculiformes	Palaeartic	238–247	100–110	–	66–81 × 35	18	12–14	–	15–16	150 × 35	Spasskaya & Spasskii (1977)
<i>M. rowettiae</i> (Yeh Liang-Shen, 1957)	Thraupidae	Gough Island	140–170	60	–	30	25–30	18–19	–	29–31	85 × 30	Spasskaya & Spasskii (1977)
<i>M. srivastavai</i> (Mukherjee, 1965)	Turdidae	India	310	100	–	130 × 100	22	10–20	–	21–29	100 × 20–30	Spasskaya & Spasskii (1977)
<i>I. tandani</i> (Singh, 1964)	Turdidae	India	223–312	100–122	160–200	– × 56–66	20	28–32	24–28	19–22	140–160 × 22–24	Singh (1964)
<i>M. timuri</i> Borgarenko 1976	Alaudidae	Tajikistan	375	174	330 × 160	–	20–22	16	–	14–18	224–280 × 60	Spasskaya & Spasskii (1977)
<i>M. trigonocephalum</i> (Krabbe, 1869)	Passeriformes, Cuculiformes	Palaeartic	350–380	145–182	274–313 × 106–140	146–184 × 72–100	20–22	32–36	–	18–30	160–190 × 22	Spasskaya & Spasskii (1977)
<i>M. tugarinovi</i> (Dubinina, 1950)	Musciapidae	Tajikistan	170–180	65–75	–	–	20	31–32	29–30	10–12	To canals	Spasskaya & Spasskii (1977)

those of anterior row (Fig. 18) (see also other material below). Neck short and weakly marked, 200–250 (n = 2) wide; proglottization distinct at 230–325 (268, n = 3) from posterior margin of suckers. Genital pores anterior, situated at border of anterior 20% of lateral proglottis margin, irregularly alternating in short series; up to seven consecutive pores observed on one side. Position of genital ducts in relation to excretory canals not observed. Genital atrium small, barely marked. No genital papilla.

Testes 60–77 (70, n = 16) in number, in single layer with occasional overlaps, in one continuous large field, filling posterior two thirds of median field, extending in anterior direction up to level of vitellarium both porally and antiporally, often more anteriorly, up to level of ovary on antiporal side (Fig. 19). External vas deferens 20–27 in diameter highly convoluted and making compact mass adjacent to cirrus-sac at level of antiporal wing of ovary; sometimes partially overlapping cirrus-sac and (or) seminal receptacle. Cirrus-sac small, ovoid to pyriform, 100–132 × 65–83 (115 × 74, n = 42), opening into ductus masculinus surrounded with thin setae (26–36 long), forming a dense terminal tuft (Figs 20–21). Internal vas deferens forming several coils. Cirrus cylindrical, terminally ornate, with long thin setae, mostly difficult to distinguish from those of ductus masculinus.

Vitellarium slightly posterior to level of cirrus-sac, poral to proglottis' midline, antiporal to seminal receptacle, compact and weakly lobate. Ovary small, anterior, slightly poral, bi-alate and lightly lobulate: antiporal wing larger and more anterior than poral wing, at level of vas deferens; poral wing smaller and at level of vitellarium; ovarian wings on both sides of vitellarium. Seminal receptacle elongate, poral to or partially overlapping poral wing of ovary. Vagina opening posteriorly to male pore, most often straight, sometimes slightly bent, rather wide (18–30 in diameter) and short. Vaginal walls regular, bordered externally by loose small cells.

Uterus starts its development in late mature proglottides as reticulum situated ventrally to testes and female gonads and occupying entire median field, crossing osmoregulatory canals and lateral parts of it situated in lateral fields. Outer shell of eggs with irregular shape, sometimes not distinct (Fig. 22). Embryophore oval, 50–65 (57, n = 20) in diameter, thick. Oncosphere round to slightly oval, 28–40 (33, n = 17) in diameter. Central embryonic hooks 20–21.5 (20.5, n = 12) long, lateral ones 16.5–19.5 (18, n = 18).

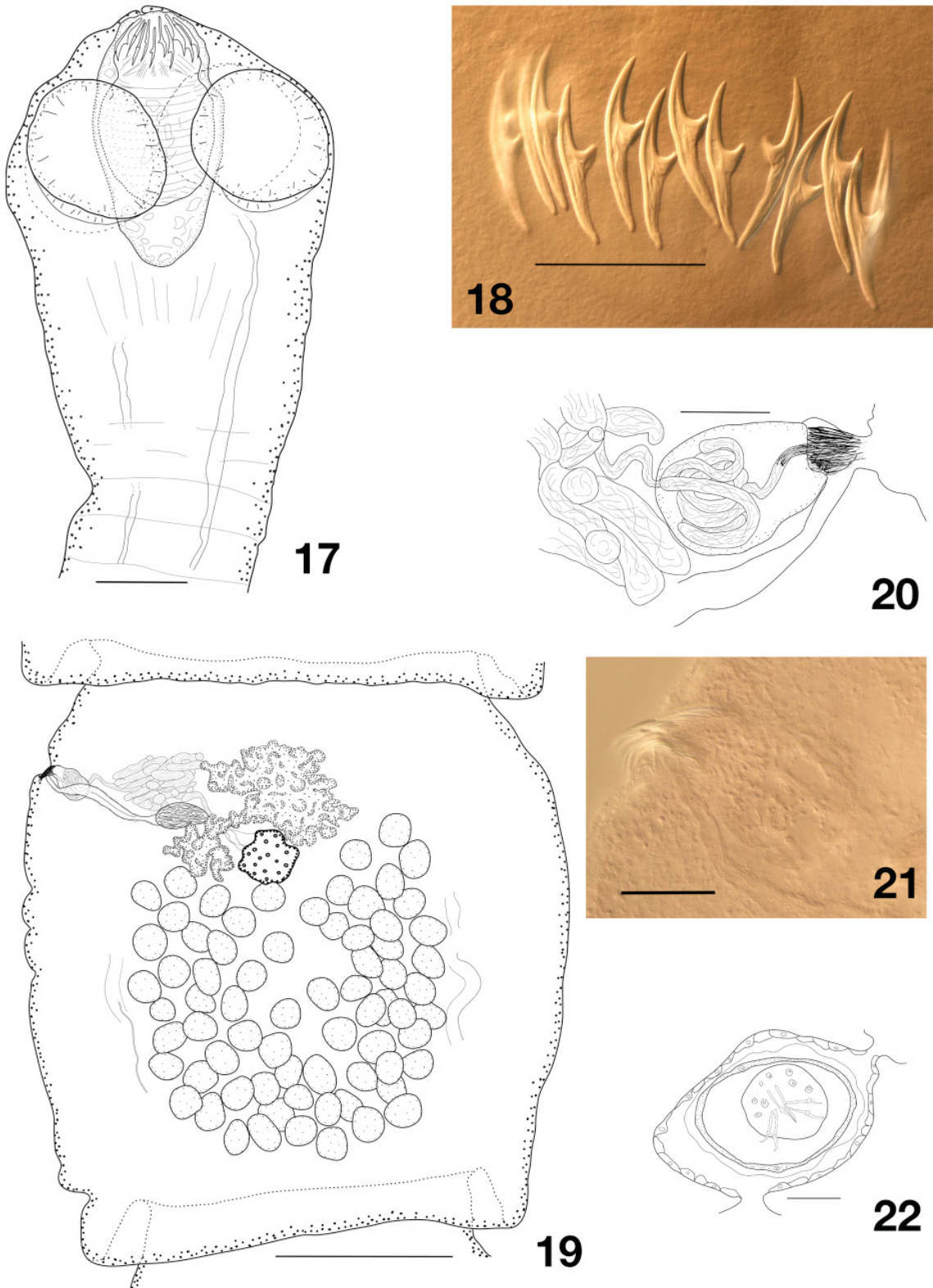
### Observations on additional specimens

Although there is no doubt that this material is conspecific with the one described above, we do not include it in the type series due to its poor preservation state. Its observable general characteristics fit the above description with the exception of the occasional presence of well-marked genital papillae. Three hook preparations allowed for more precise observations and measurements of the rostellar armament. We counted 24 hooks on two complete sets, and 20 on an incomplete one. Hooks measuring 48–52 (49.2, n = 23) and 50–56 (52.8, n = 26) in the anterior and posterior crowns, respectively.

### Remarks

Helminth parasites of frogmouths are virtually unknown. As for tapeworms, the single reported taxon from these birds is *Proparuterina aruensis* Fuhrmann, 1911 from the Aru Islands in *Podargus papuensis* (Fuhrmann 1911; Georgiev & Vaucher 2003). Unidentified cestodes were however more recently reported in *P. strigoides* in Queensland by Gelis *et al.* (2011).

Some confusion exists around the systematic organization of dilepidids with cirrus bearing a terminal tuft of long fine spines. According to Bona (1994), they should be distributed in 12 distinct genera and this author provided diagnoses for each of them. By presenting medium-sized strobila, rostellar hooks in two rows, irregularly alternating pores and a reticulate uterus, our material should be placed in *Dictymetra* Clark, 1952 that has Charadriiformes as 'typical hosts' (Bona 1994). Egg polar processes



**Figs 17–22.** *Dictymetra gerganae* sp. nov. **17.** Scolex. **18.** Hooks. **19.** Mature proglottis. **20.** Terminal genitalia. **21.** Terminal genitalia tuft. **22.** Egg. Scale bars: 17 = 100  $\mu\text{m}$ ; 18, 20, 21 = 50  $\mu\text{m}$ ; 19 = 500  $\mu\text{m}$ ; 22 = 20  $\mu\text{m}$ .

that are typical of worms with aquatic life-cycles are found in these taxa. It should be noted that other (including terrestrial) birds are also considered by Bona as hosts of members of *Dictymetra*. They include Passeriformes (for *D. belopolskajae* Spasskaya & Spasskii, 1973) and Trogoniformes, although the latter are unpublished. This obviously casts some doubts about the monophyly of the genus.

The genus *Dictymetra* has been erected by Clark (1952) for cestodes found in North American curlews and has been considered very variably by different authors since then, including as a synonym of *Krimi* Burt, 1944 (see Matevosyan 1963) or *Anomotaenia* Cohn, 1900 (see Bona 1975; Schmidt 1986). In the review of the Dilepididae that we follow here, Bona (1994) gives a detailed diagnosis of the genus, which is significantly different from the original one from Clark (1952). In accordance with Spasskaya & Spasskii (1978), and contrary to Schmidt (1972), he also considers *D. radiaspinosa* Matevosyan, 1953 (syn. *D. numenii* Clark, 1952, nec Owen 1949) as its type species.

*Liga* Weinland, 1857, which is found in terrestrial birds, mostly Piciformes, is another genus with characters close to those of *Dictymetra* but normally with a small strobila and dorsal genital ducts. Several members of this genus, however, have a longer strobila reaching the size of the present material. For this reason, we compared our material to the presently recognized species of *Dictymetra* as well as to the “long” *Liga* spp. (Table 4).

As for Australia, *D. adelaidae* (Schmidt, 1972) from the spur-winged plover (*Lobibyx novaehollandiae* Stephens, 1819 now *Vanellus miles novaehollandiae*) in Queensland was described by Schmidt (1972) as a member of *Lapwingia* Singh, 1952, which is now considered a synonym of *Dictymetra* (see Bona 1994). This species does not fit to the diagnosis of *Dictymetra* and should be placed in another genus. Spasskaya & Spasskii (1978) transferred it to the genus *Anomotaenia* Cohn, 1900. It is in any case very different from the present material for most usual characters, including the length of hooks (shorter) and number of testes (less numerous).

Our material clearly differs from all recognized species in the genus (Table 4) by several characters, the most obvious being the high number of testes, which is only approached but not matched by *D. volvulus* (von Linstow, 1906). The latter species has however slightly smaller rostellar hooks and a much shorter cirrus-sac. In consequence, we consider our specimens as belonging to a new species that we name *Dictymetra gerganae* sp. nov. Even though we are confident that this taxon is new, we should notice that the whole taxonomic organization of this group of genera remains quite uncertain due to the scarcity of reliable information for many species. This will probably lead to their complete revision and the definition of new genera, in which our material may need to be placed in the future.

***Dictymetra longiuncinata* sp. nov.**

[urn:lsid:zoobank.org:act:71A5F386-689C-4416-A46C-8FC5078441E4](https://zoobank.org/urn:lsid:zoobank.org:act:71A5F386-689C-4416-A46C-8FC5078441E4)

Figs 23–28

**Etymology**

From Latin *longus* (long) and *uncinus* (hook) in reference to the large rostellar hooks of this species.

**Material examined**

**Holotype**

AUSTRALIA: Queensland, Yeppoon, 23°8' S, 150°44' E, 30 Sep. 1999, Ian Beveridge leg. (AHC 36496).

**Paratypes**

AUSTRALIA: about 44 specs, same data as for holotype (AHC 36497–36515).

**Host**

*Esacus magnirostris* (Vieillot, 1818) (syn. *Burhinus magnirostris*) (Charadriiformes, Burhinidae).

**Site of infection**

Small intestine.

**Intensity**

About 45 specimens in a single host.

**Description**

Body small, 10.1–13.9 mm (n = 2) long with maximum width 950–1400 (1144, n = 8) at level of early gravid proglottides. Most complete specimen consisting of 76–83 proglottides. Proglottides markedly craspedote, wider than long, progressively becoming longer, but mostly remaining wider than long except for a few terminal or exceptionally extended ones. Osmoregulatory canals only very partially visible. Scolex rounded, in continuity with strobila (without a marked neck); diameter 470–665 (551, n = 7) (Fig. 23). Proglottization starting precociously, often just behind suckers. Suckers rounded to slightly oval, muscular, unarmed, 230–300 (262, n = 32) in diameter. Rostellar apparatus mostly muscular, with a layer of glandular tissue at mid-length of rostellar sac. Rostellar sac well-delineated, with cylindrical anterior part and markedly tapering posterior part, extending well beyond level of posterior margin of suckers and sometimes into first proglottides, 475–690 × 150–210 (608 × 178, n = 7). Rostellum strongly muscular, with expanded anterior part bearing rostellar hooks, 400–620 × 110–145 (537 × 133, n = 8). Rostellar hooks (Fig. 24) in two regular rows, 20 (n = 6) in number, long and robust, curved overall; blade longer than handle. Anterior hooks 119–125 (121.5, n = 13) long, posterior hooks 124–135 (129.5, n = 15) long. Genital pores situated at border of anterior 40% of lateral proglottis margin, alternating irregularly in very short series, e.g., 1, 1, 1, 1, 1, 1, 2, 1, 2, 1, 1, 1, 1 or 1, 1, 2, 1, 1, 3, 1, 1, 1, 1; no more than 3 consecutive pores observed on one side. Genital ducts passing between osmoregulatory canals. Genital atrium as simple depression without particular structures. Genital papilla occasionally expressed in some proglottides.

Testes numerous, 18–28 (22, n = 19) in number, large, reaching 75–92 (84, n = 19) in diameter, situated in 2–3 layers, in one continuous and compact posterior field, extending in anterior direction to level of antiporal wing of ovary (Fig. 25). External vas deferens 13–18 in diameter, highly convoluted and particularly voluminous in antero-poral part of median field, sometimes slightly overlapping cirrus-sac, seminal receptacle or even testes. Cirrus-sac elongate, 137–180 × 33–45 (159 × 38, n = 44), delicate, slightly oblique, usually straight but with distal quarter sometimes bent anteriorly, crossing osmoregulatory canals, rarely not. Internal vas deferens forming several coils. Cirrus cylindrical, 7.5 in diameter, ornamented with tuft of thin hair-like bristles (Figs 26–27).

Vitellarium central, compact, irregularly shaped and slightly lobated. Ovary transversely elongated, bi-alate, lobate, antiporal wing larger than poral wing; the latter mostly covered by vas deferens. Mehlis' gland not observed. Empty seminal receptacle round, becoming oval when filled, reaching up to 135 × 68, close to proximal extremity of cirrus sac. Vagina, large, opened posteriorly to male pore, mostly straight and transverse, parallel to cirrus-sac, thin-walled. No sphincters or other ornamentations.

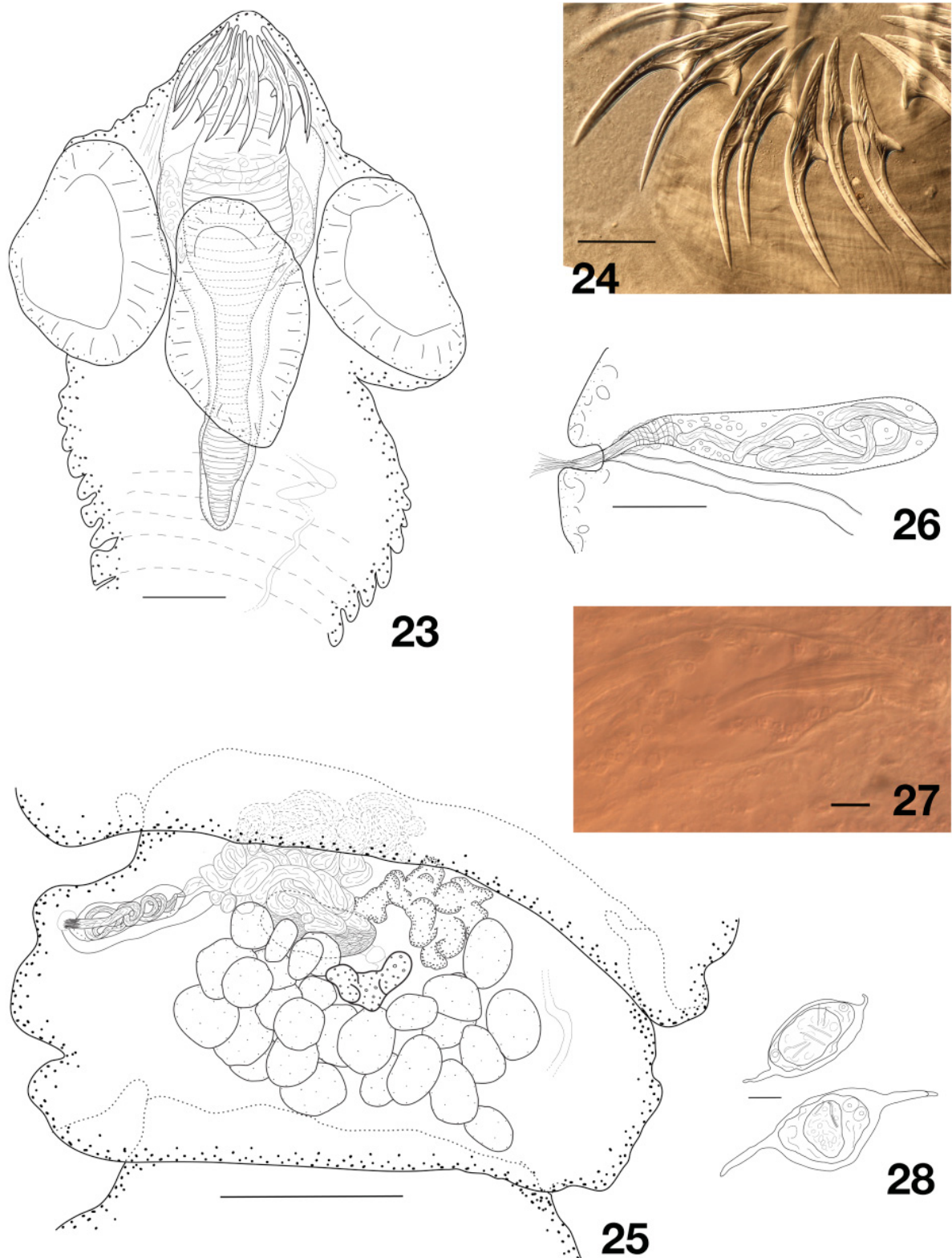
Uterus starts its development in late mature proglottides as diffuse reticulum occupying the whole median field and part of lateral fields, and developing into dense network of tube and chambers. Eggs large, outer shell with polar extensions (Fig. 28). Complete eggs with external membrane difficult to see *in utero* but reaching at least 85 (without extensions). Embryophores oval, 53–65 (59.5, n = 15) in

**Table 4** (continued on next page). Comparison of two new *Dictyometra* Clark, 1952 species with the presently recognized species in the genus and with “long” *Liga* Weinland, 1857 species (see text). All data as reported in Spasskaya & Spasskii (1978) for *Dictyometra* and Spasskaya & Spasskii (1977) for *Liga* except Burt (1940) for *D. dispar*, Clark (1952) for *D. paranumenii*, Fuhrmann & Baer (1943) for *D. riccii* and Spasskaya & Spasskii (1973) for *D. volvulus*. Note that values reported by various authors for *D. laevigata* (Rudolphi, 1919) and *D. volvulus* (Linstow, 1903) vary to a large extent (Spasskaya & Spasskii 1978). *Dictyometra paranumenii* and *D. radiaspinosa* have rows of small spines on rostellum.

Species	Host family	Type locality	Body maximum length (mm)	Scolex diameter	Suckers diameter	Rostellar sac	Rostellum	Hooks number	Anterior hooks length	Posterior hooks length	Testes number	Cirrus sac
<i>D. gerganae</i> sp. nov.	Podargidae	Australia	72	305–360	145–175	230–292 × 118–145	195–212 × 98–132	24	46–53	50–56	60–77	100–132 × 65–83
<i>D. longiuncinata</i> sp. nov.	Burhinidae	Australia	13.2	470–665	230–300	475–690 × 150–210	400–620 × 110–145	20	119–125	124–135	18–28	137–180 × 33–45
<i>D. radiaspinosa</i> Mathevossian, 1953	Scolopacidae	USA	15–25	247–330	204–231	–	83–115	24	65–68	–	15–17	146–198 × 23–25
<i>D. belopoliskajae</i> Spasskaya & Spasskii, 1973	Alaudidae	Russian Arctic	80	313	123	347–408 × 106–123	252–308 × 95–112	20	56–67	–	18–30	106 × 39
<i>D. discoidea</i> (Beneden, 1868)	Ciconiidae	Palaeartic	–	370–400	210	–	100	22–23	37–38	33–34	40–45	250–270 × 65–70
<i>D. dispar</i> (Burt, 1940)	Charadriidae	Sri Lanka	40–50	330–385	143–175	325 × 110	175–229 × 65–88	24	41–45	44–49	18–28	170–200 × 38–41
<i>D. gamii</i> Spasskaya & Shumilo, 1971	Scolopacidae	Moldavia	70	695	335	246 × 140	162 × 67	22–24	28	–	(~40)	94 × 67
<i>D. laevigata</i> (Rudolphi, 1819)	Charadriiformes	Palaeartic	75	650	–	428	314 × 141	20	104–106	109–112	50	98 × 48
<i>D. numenii</i> (Owen, 1946)	Scolopacidae	Holarctic	14–20	192–538	133–221	–	124–162	22	99–103	–	42–46	111–140 × 44–58
<i>D. nymphaea</i> (Schränk, 1790)	Charadriiformes	Palaeartic	25–30	210–220	80–85	–	80–85	24	60–80	–	30–36	100–130 × 38–55
<i>D. paranumenii</i> (Clark, 1952)	Scolopacidae	USA	150–300	476–523	143–165	408–620 × 176–204	442–516 × 136–176	20	100–105	110–115	35–40	132–165 × 33–60

Table 4 (continued).

Species	Host family	Type locality	Body maximum length (mm)	Scolex diameter	Suckers diameter	Rostellar sac	Rostellum	Hooks number	Anterior hooks length	Posterior hooks length	Testes number	Cirrus sac
<i>D. riccii</i> (Fuhrmann & Baer, 1943)	Ciconiidae	Africa	35–40	400	240	–	400 × 72	24	96–100	–	20–22	115–126 × 39
<i>D. volvulus</i> (Linstow, 1906)	Charadriiformes	Palaearctic	60	275–26	–	–	125 × 67	24–26	45	48	40–60	75–85 × 45
<b>Liga</b>												
<i>L. centuri</i> (Rysavy, 1966)	Picidae	Cuba	22–47	370–390	198–228	–	234–260 × 104–137	18–20	62–64	one row	–	92–122 × 60–68
<i>L. crateriformis</i> (Goeze, 1782)	Picidae	Palaearctic	18–25	275–430	109–173	229–240	136–229 × 70–73	28–35	27–35	–	16–35	64–145 × 40–55
<i>L. pici</i> (Baer, 1959)	Picidae	D.R. Congo	15	160–190	98–102	–	– × 45–50	26	17–18	–	38–40	68–91 × 34–45
<i>L. picusi</i> (Singh, 1964)	Picidae	India	19.5–26.2	370–490	130–150	270–310 × 134–140	80–100	130	46–54	one row	25–30	120–200 × 32–40



**Figs 23–28.** *Dictymetra longiuncinata* sp. nov. **23.** Scolex. **24.** Hooks. **25.** Mature proglottis. **26.** Terminal genitalia. **27.** Cirrus armament. **28.** Eggs. Scale bars: 23 = 100  $\mu\text{m}$ ; 24, 26 = 50  $\mu\text{m}$ ; 25 = 200  $\mu\text{m}$ ; 27 = 10  $\mu\text{m}$ ; 28 = 20  $\mu\text{m}$ .

diameter. Oncospheres 38–46 (42, n = 22) in diameter. Embryonic hooks: central 20–21.5 (21, n = 8) long, lateral 17–20 (19, n = 16) long.

### Remarks

This material is partly macerated, with many fragments contracted and overall in an average state of conservation. This explains the lack of data for several characters such as osmoregulatory canals or Mehlis' gland. Our observations, nevertheless, allow for a description that fits the definition of *Dictyometra*, in particular because of its characteristic scolex structure and tuft of setae in the genital atrium and on the cirrus. The genus *Dictyometra* is typically found in various families of Charadriiformes, including Burhinidae (Bona 1994) (see remarks above for *D. gerganae* sp. nov.) and is cosmopolitan (Table 4). Our material can easily be differentiated from other species in the genus because of its very long hooks and large rostellum. Similar characters are only found in *D. laevigata* (Rudolphi, 1919), another parasite of thick-knees, and *D. paranumenii* (Clark, 1952), a parasite of curlews in North America. It differs from both by its smaller number of testes. Additionally, it can be distinguished from the former species by its larger cirrus-sac, and from the latter by its shorter strobila (Table 4).

In addition, the genus *Stenovaria* Spasskii & Borgarenko, 1973 also resembles our material. It differs from *Dictyometra* by relatively minor characters related to genital pore alternation, the position of genital ducts in relation to osmoregulatory canals and the absence of armament of long setae on the cirrus and (or) genital atrium. The genus was erected by Spasskii & Borgarenko (1973) and is presently recognized as valid (Bona 1994, Mariaux *et al.* 2017). It includes 2 species found in thick-knees: *Stenovaria facile* (Meggitt, 1927) Spasskaya & Spasskii, 1978 and *S. falsificata* (Meggitt, 1927) Spasskii & Borgarenko, 1973 that deserve to be compared to our material. Both differ from it by their much shorter hooks and smaller strobila. In addition, the former species also shows a smaller cirrus-sac and the latter has a larger cirrus-sac and a smaller number of testes. In consequence we consider the present material as a new species that we name *Dictyometra longiuncinata* sp. nov.

### *Dictyometra* sp.

### Material examined

AUSTRALIA: Queensland, Redland Bay, 27°39' S, 153°19' E, date unknown, Matthews (?) leg., fragments from 2 specs (AHC 35795, AHC 35796).

### Host

*Burhinus grallarius* (Latham, 1802) (Charadriiformes, Burhinidae).

### Site of infection

Small intestine.

### Description

Despite its similarity with the above described new species, this material probably belongs to another congeneric species. The available mounted specimens do not however allow for a detailed description. From the single scolex and few fragments available, the hook arrangement is similar to that of *D. longiuncinata* but hooks are somewhat larger (about 145 long). The rostellar sac (320 × 140) and rostellum (270 × 90) are smaller. It also has a cirrus armed with long setae but has a higher number of testes, i.e., 29–45 (37, n = 12) – and a smaller cirrus-sac, 107–113 × 25–28 (110 × 27, n = 4). It most probably belongs to *Dictyometra* but additional fresh material is obviously needed to confirm its status.

**Dilepididae** indet.

Fig. 39

**Material examined**

AUSTRALIA: Queensland, Eidsvold, 25°22' S, 151°5' E, Sep. 1918, Thomas L. Bancroft leg. (AHC 36528).

**Host**

*Corcorax melanorhynchos* (Vieillot, 1817) (Passeriformes, Corcoracidae).

**Site of infection**

Small intestine.

**Intensity**

About 8 specimens.

**Description**

A few fragmented specimens of this species are found as co-parasites of *Cracticotaenia adelaidae* sp. nov. in our material from Queensland. Unfortunately, hooks are lost on the single available scolex. Longest fragment 13 mm, maximum width 1.4 mm at level of gravid proglottides. Up to 61 craspedote proglottides, wider than long except for the most gravid ones. Scolex not clearly separated from strobila, 227 in diameter. Suckers rounded 97–115 in diameter. Rostellar pouch very glandular, 167 × 70, extending past posterior margin of suckers. Rostellum muscular, with well-marked terminal pad, 132 × 72. Neck not marked. Genital pores, opening laterally and very anteriorly, at about 15% of lateral proglottis margin, alternating irregularly in short series. Ventral osmoregulatory canals connected posteriorly in each proglottis by transverse anastomosis. Genital ducts passing between osmoregulatory canals. Testes 17–23 (19.7, n = 26) in number, in a single layer and one continuous posterior field, extending antero laterally up to level of vitellarium. Cirrus-sac short and weak, 76–92 × 30–42, not reaching poral osmoregulatory canals. Cirrus armed with a small tuft of setae, often lost in our material. Vitellarium central, compact. Ovary anterior transversely elongated. Seminal receptacle rounded, lateral to vitellarium. Vagina posterior to male pore. Uterus initially labyrinthic. No fully gravid proglottides observed.

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

***Passerilepis* (?) sp.**

Fig. 40

**Material examined**

AUSTRALIA: Victoria, Kangaroo Grounds, 37°42' S, 145°12' E, 1979, Karl Harrigan leg. (AHC 36527).

**Host**

*Corcorax melanorhynchos* (Vieillot, 1817) (Passeriformes, Corcoracidae).

**Intensity**

About 6 specimens.

### Description

Although several specimens of this species are available, including almost complete ones, just a single squashed scolex is present and the material is highly macerated, thus preventing a full description. Longest fragment 38 mm, maximum width 1.6 mm at level of gravid proglottides. Ten hooks on a single crown, 24–25 long, with short blade, robust guard and slightly curved handle (Fig. 40). Three testes arranged in triangle, 2 antiporal. Cirrus-sac crossing osmoregulatory canals dorsally, about 165–185 long. Genital openings unilateral, dextral. Both seminal vesicles and seminal receptacles inflating considerably. Uterus initially bisaccular, becoming unisaccular with deep lobes. Oncosphere 45–50. Embryonic hooks 20–22 (lateral), 22–24 (central). These few available characters hint toward the genus *Passerilepis* Spasskii & Spasskaya, 1954 (Hymenolepididae).

Family Paruterinidae Fuhrmann, 1907

Genus *Notopentorchis* Burt, 1938

*Notopentorchis musealis* sp. nov.

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Figs 29–33, Table 5

### Etymology

The species name refers to the fact that this species is described from museum material.

### Material examined

#### Holotype

AUSTRALIA: New South Wales, Sydney, 38°8' S, 144°22' E, 2005, Karie Rose leg. (AHC 36478).

#### Paratype

AUSTRALIA: same data as for holotype (AHC 36478).

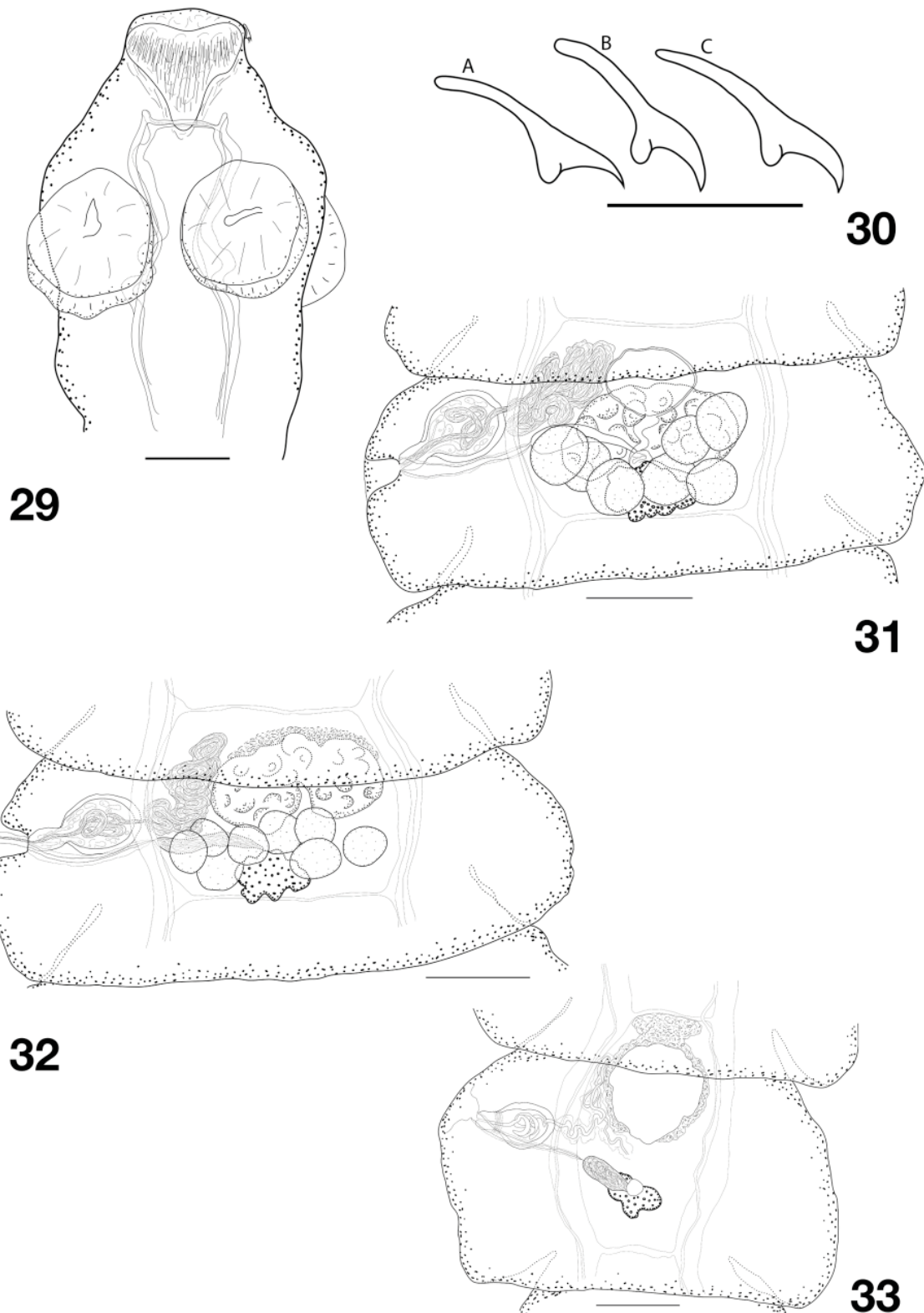
### Intensity

Two specimens and a few small fragments. Co-infection with *Neoliga* sp.

### Description

Body of medium size, with maximum length 34 mm for 404 proglottides; maximum width 590, at level of gravid proglottides. Proglottides craspedote, all but the few most developed (pre-gravid) ones wider than long. Ventral osmoregulatory canals connected posteriorly in each proglottis with transverse anastomosis. Scolex slightly rounded, not distinctly separated from neck, with diameter 248–345 (n = 2). Suckers elongated 170–215 in diameter (182, n = 7). Rostellum very muscular, sucker-like, slightly concave anteriorly and conical posteriorly, 114–139 in diameter and 107–125 long (n = 2) (Fig. 29). Rostellar hooks mostly lost (probably several tens, only 7 remaining), in two rows, subequal, 21–23 in length (22, n = 5). Posterior hooks with slightly more curved handle than anterior hooks (Fig. 30); guard bifid. Small epiphyses on both guards and handles. Neck long; proglottization distinct at 475 from posterior margin of suckers. Genital pores at mid-length of lateral proglottis margin, irregularly alternating in short series, maximum 5 consecutive pores observed on one side. Ventral osmoregulatory canals connected posteriorly in each proglottis by single transverse anastomosis. Genital ducts passing ventrally to osmoregulatory canals. Genital atrium cup-shaped, voluminous.

Testes large, spherical, 5–8 (6.5, n = 11) in number, in single posterior and dorsal layer, often overlapping vitellarium and posterior parts of ovary, occasionally overlapping longitudinal



**Figs 29–33.** *Notopentorchis musealis* sp. nov. **29.** Scolex. **30.** Hooks: A, C. Anterior hooks, B. Posterior hook. **31.** Mature proglottis. **32.** Postmature proglottis. **33.** Pregravid proglottis. Scale bars: 29, 31–33 = 100  $\mu$ m; 30 = 20  $\mu$ m.

osmoregulatory canals. External vas deferens convoluted antero-porally, poral to developing uterus surrounded by intensely-stained cells and forming together with them dense mass in antero-poral part of median field. Cirrus-sac 91–112 × 54–64 (105 × 59, n = 15), consisting of narrower, almost cylindrical, distal part and spherical thick-walled proximal part, often overlapping poral osmoregulatory canals; internal vas deferens coiled in proximal part of cirrus-sac. Cirrus cylindrical, unarmed, 10–12 in diameter.

Vitellarium oval, massive, mostly irregular, 55–76 × 40–50 (68 × 46, n = 10), situated adjacent to posterior proglottis margin. Ovary central, transversely elongate, initially slightly bilobate but rapidly becoming more compact and irregular (Figs 31–32). Mehlis' gland overlapping or just anterior to vitellarium. Seminal receptacle with rounded distal end and tubular and gradually tapering proximal end. Vaginal pore dorsal to pore of cirrus-sac; most of copulatory part of vagina passing posteriorly to cirrus-sac, straight; lumen encircled by thin cellular sleeve; connected with seminal receptacle by thin and short conductive part (Fig. 32).

Young uterus in mature proglottides well marked, with strong walls, developing antero-dorsally to ovary, initially globular (Fig. 32), often with some irregular incomplete septa. With increasing in size, uterus becoming more irregular, with densification surrounding its anterior wall (Fig. 33); with further development, uterus increasing in size; paruterine organ developing mostly anterior to it but also embracing uterus laterally. No fully developed eggs available.

### Remarks

The present material unambiguously belongs to *Notopentorchis* Burt, 1938 as diagnosed by Georgiev & Korniyushin (1994). This genus has recently been thoroughly reviewed and presently comprises eight species, all of them found in swifts from the Old World (Georgiev & Bray 1991; Dimitrova *et al.* 2017).

Our material is unfortunately in a rather poor state of conservation and limited as neither a scolex with a full set of hooks nor fully developed gravid proglottides are available. It is, however, sufficient to allow examination of most diagnostic characters. These characters were proved to be sufficiently unique to distinguish it from congeners and to allow for a species description.

Of the eight known species, three belong to a group with rostellar hooks of clearly distinct length in each of the two rostellar rows (Dimitrova *et al.* 2017). The present material differs from all remaining species by a larger cirrus-sac and larger suckers (Table 5). In addition, it differs from *N. collocaliae* Burt, 1938 by a larger scolex and rostellum; from *N. javanica* (Hübscher, 1937) by fewer testes; from *N. iduncula* (Spasskii, 1946), *N. caffrapi* (Mokhehle, 1951), and *N. micropus* Singh, 1952 by smaller rostellar hooks (Mokhehle 1951; Singh 1952; Baer 1959; Dimitrova *et al.* 2017).

So far, no species of *Notopentorchis* has been reported from Australia. The white-throated needletail *Hirundapus caudacutus*, hosting the worms described here, however occurs in Central and East Asia and winters in Eastern Australia (Lepage 2017), making this range extension logical. The single occurrence of *Notopentorchis* in this host was reported as *N. vesiculigera* (Krabbe, 1882) by Oshmarin (1963) in 15 out of 29 birds in the Primorye Region (South-Eastern Russia). Besides its European and African distribution, *N. vesiculigera* clearly differs from our material by its much larger hooks and higher number of testes. We conclude that the present material belongs to an undescribed species that we name *Notopentorchis musealis* sp. nov.

**Table 5.** Comparison of *Notopentorchis musealis* sp. nov., with the presently known species of *Notopentorchis* Burt, 1938 (only species with rostellar hooks of similar length in both rows are listed). Values for known species are summarized from various sources as reported in Dimitrova *et al.* (2017). All species are parasites of Apodidae.

Species	Type locality	Body length (mm) × width	Scolex diameter	Suckers diameter	Rostellum diameter	Hooks number	Anterior hooks length	Posterior hooks length	Testes number	Cirrus sac	Vitellarium width
<i>N. musealis</i> sp. nov.	Australia	34 × 590	248–345	170–215	114–139	–	21–23	21–23	5–8	91–112 × 54–64	55–76
<i>N. collocaliae</i> Burt, 1938 (Type species)	Sri Lanka	20–26 × 290–480	110–150	65–75	70–82	30–35	24	27	4–6	30–35 × 16–30	40–48
<i>N. caffrapi</i> (Mokhele, 1951)	South Africa	20–52 × 623	316	63	–	–	28	–	4–6	46 × 28	40
<i>N. iduncula</i> (Spasskii, 1946)	Russia	18–45 × 340–1000	200–262	75–95	81–120	38–44	24–31	27–32.5	4–7	45–70 × 23–35	55
<i>N. javanica</i> (Hübbscher, 1937)	Indonesia (Java)	26.5 × 327–500	170–228	78–102	110–135	44–51	25	25–28	8–13	40–120 × 20–50	50–83
<i>N. micropus</i> Singh, 1952	India	34–42 × 438–684	141–274	90–123	85–131	48–56	21?–27	27–31	5–8	72–72 × 27–37	35–79

Family Metadilepididae Spasskii, 1959  
Genus *Cracticotaenia* Spasskii, 1966

***Cracticotaenia adalaidae* sp. nov.**

[urn:lsid:zoobank.org:act:5F32D506-1E05-421F-B891-DDB9E89F4195](https://urn:lsid:zoobank.org:act:5F32D506-1E05-421F-B891-DDB9E89F4195)

Figs 34–38

**Etymology**

The species name is derived from the name of the City of Adelaide, where the type series was collected.

**Material examined**

**Holotype**

AUSTRALIA: South Australia, Adelaide, 34°54' S, 138°36' E, 27 Oct. 1983, David Shulz leg. (AHC 36516).

**Paratypes**

AUSTRALIA: 5 specs, same data as for holotype (AHC 36517–36525).

**Additional material from the same host**

AUSTRALIA: **South Australia** 3 specs, South Australia, Ashbourne, 35°18' S, 138°36' E, Dec. 1969, Michael Smyth and Lee leg. (AHC 29591); 2 specs, very fragmented, Coromandel Valley, 35°6' S, 138°36' E, 4 Apr. 1969, Michael Smyth leg. (AHC 29592); about 30 specs, Coorong, 36°2' S, 139°33' E, Oct. 1935, D. Brunswick leg. (AHC 230). – **Victoria** 2 specs, Torquay, 38°18' S, 144°18' E, May 1979, Karl Harrigan leg., from *Strepera* sp. (Artamidae, Passeriformes) (AHC 29596).

**Other material**

AUSTRALIA: from *Strepera versicolor* (Latham, 1801): 6 specs and numerous fragments, no locality, 12 Dec. 1910 (AHC 533). – From *Corcorax melanorhamphos* (Vieillot, 1817) (Corcoracidae, Passeriformes): 4 specs, Queensland, Eidsvold, 25°22' S, 151°5' E, Sep. 1918, Thomas L. Bancroft leg. (AHC 531, AHC 29598, co-infection with a Dilepididae, see above); 12 specs, South Australia, Elwomple, 35°17' S, 139°32' E, 19 Oct. 1937, collector unknown (AHC 3368).

**Other comparison material**

Type material of *Monopylidium fieldingi* (Maplestone & Southwell, 1923), from *Cracticus destructor* [now *C. torquatus*] in Queensland, Townsville (The Natural History Museum, London 1977.11.3.34, 2 slides).

**Host**

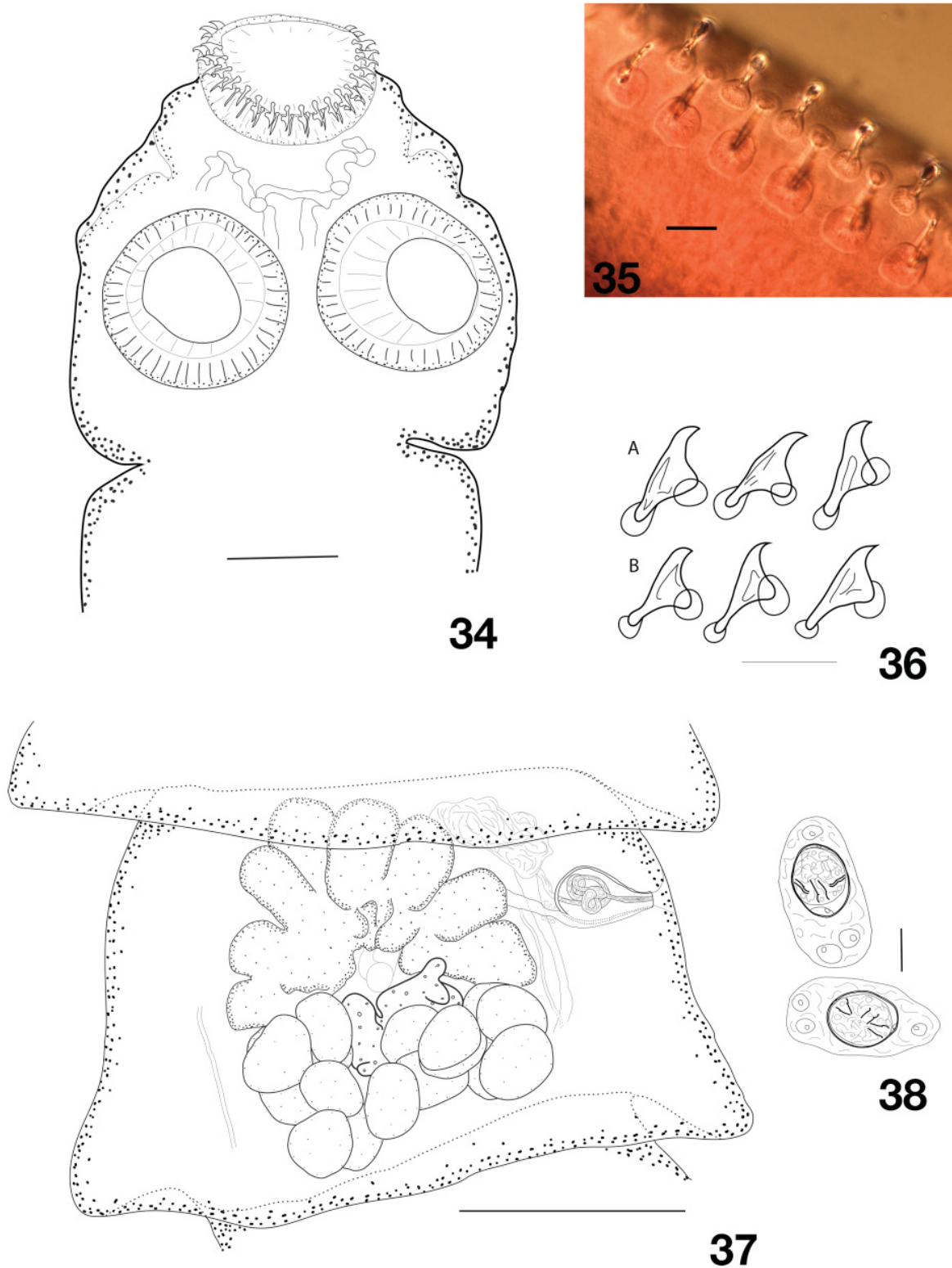
*Gymnorhina tibicen* (Latham, 1801) (syn. *Cracticus tibicen*) (Artamidae, Passeriformes).

**Intensity**

Six specimens.

**Description**

Body of medium size, with maximum length 35.5 mm and maximum width 1.3–2.12 mm (1.7, n = 6) at level of pregravid or early gravid proglottides. Most complete specimen consisting of 240 proglottides. Proglottides craspedote, wider than long, progressively becoming longer, up to slightly longer than wide when gravid. Scolex rounded, not markedly delineated from neck, with diameter 350–475 (407, n = 8), Suckers unarmed, muscular, rounded, 142–198 (169, n = 35) in diameter. Rostellum muscular,



**Figs 34–38.** *Cracticotaenia adelaidae* sp. nov. **34.** Scolex. **35.** Detail of hooks crowns. **36.** Hooks: anterior (A) and posterior (B). **37.** Mature proglottis. **38.** Eggs. Scale bars: 34 = 100  $\mu\text{m}$ ; 35 = 10  $\mu\text{m}$ ; 19 = 500  $\mu\text{m}$ ; 36, 38 = 20  $\mu\text{m}$ ; 37 = 250  $\mu\text{m}$ .

cushion-like 128–188 (149, n = 8) in diameter (Fig. 34). Rostellum bearing double crown of regularly arranged hooks, 52–61 (56, n = 8) in number. Hooks triangular, blade terminating with a short, curved tip. Handles and guards bearing well-developed epiphyses, more developed on guard. Epiphyses of hooks in posterior row clearly larger than those of hooks in anterior row (Figs 35–36). Anterior hooks 23.5–25 (24, n = 4), posterior hooks 21–22 (21.5, n = 5) long. Neck 192–257 (216, n = 5) wide; proglottization starting shortly behind neck. Genital pores unilateral (a single side-switch observed), opening at border of first third of proglottis length margin. Ventral osmoregulatory canals up to 60 wide, connected posteriorly by anastomosis in each proglottis. Dorsal osmoregulatory canals up to 12 wide. Genital ducts passing between osmoregulatory canals. Genital atrium small. Internal organs closely packed in short and wide proglottides, their shape and relative position clearly visible only in very relaxed or extended proglottides.

Testes 12–18 (14.5, n = 38) in number, in two or, rarely, three layers, in one continuous posterior field, slightly extending laterally up to level of anterior margin of vitellarium (Fig. 37). External vas deferens discrete, convoluted, in antero-poral part of median field, at distance from cirrus-sac. Cirrus-sac short, with strong walls, most often pear-shaped, sometimes more oval, 90–118 × 43–58 (103 × 51, n = 57), not always reaching poral longitudinal osmoregulatory canals, sometimes slightly overlapping them. Internal vas deferens forming several coils. Cirrus straight with well marked walls, often appearing refractory.

Vitellarium central, compact, often heart-shaped or slightly transversely elongated, variable in shape. Ovary fanlike when not contracted, with deep lobes filling most of anterior part of proglottides. Mehlis' gland central and anterior to vitellarium, connected to seminal receptacle by wide and often clearly visible canal that may become almost as wide as seminal receptacle. Seminal receptacle oval to fusiform, remaining rather small, reaching up to 150 × 50, dorsal and between ovary wings or over poral wing, closely to proximal extremity of cirrus-sac. Vagina opens dorsally and slightly posteriorly to male pore, mostly straight, with faint sphincter (Fig. 37).

Uterus starts its development in late mature proglottides as a postero-central and dorsal mass, developing into a laterally-extended multisaccular and reticulate cavity with well marked wall, then becoming saccate. Outer shell of eggs delicate, oval 62–73 × 33–38 (68 × 35, n = 11), becoming more circular and irregular in broken proglottides. Embryophore thin and regular, oval, 30–41 (35, n = 23) in diameter. Oncosphere subspherical to slightly elongate, 30–40 (35.5, n = 18) in diameter. Embryonic hooks: central 13–15.5 long (14.5, n = 14) long, lateral 11–13 (12, n = 17) long (Fig. 38).

## Remarks

This material is very similar to *Cracticotania fieldingi* (Maplestone & Southwell, 1923), the only species known in the genus. *Cracticotania fieldingi* was described from *Cracticus destructor* (now *C. torquatus*, Artamidae) in Queensland and attributed to *Monopylidum* by Maplestone & Southwell (1923). It was later placed in a newly erected monotypic genus by Spasskii (1966) and transferred to the Metadilepididae by Korniyushin & Georgiev (1994). Our material fits the most recent generic diagnosis of these authors with the notable exception that only a very faint vaginal sphincter is visible. Besides this character, it differs from the single known species in the genus by a smaller number of rostellar hooks (52–61 vs about 80), a slightly fewer testes (12–18 vs 16–21) and the differently-shaped and shorter cirrus-sac (globular vs pipette-like and 90–118 vs 130). It should, however, be noted that we examined the type material of *C. fieldingi* and the measurements provided by Maplestone & Southwell (1923) do not fully correspond to our observations. Although only two slides, mostly with gravid proglottides, are available, we noted a somewhat longer cirrus-sac (up to 180) and fewer testes (12–15). This, however, does not prevent the unambiguous separation of our material from *C. fieldingi* and we place it in a new species which we name *Cracticotaenia adelaidae* sp. nov.

The specimens found in *Corcorax* Lesson, 1831 fit the above description of *Cracticotaenia adelaidae* sp. nov. in *Gymnorhina tibicen* quite well for most metric and meristic characters that can be observed. The main observed differences are in slightly smaller suckers (123–147 vs 155–198) and possibly more rostellar hooks (62–66 vs 52–61), and the faint vaginal sphincter that could not be observed. Keeping in mind that these observations are based on a limited number of incomplete specimens, we consider for now that these small variations (which may be partially exaggerated due to the poor preservation state of our specimens) are likely to be intraspecific.

Although both belonging to the Corvides (see Jönsson *et al.* 2016), the hosts of *C. adelaidae* sp. nov. are not closely related and belong to clades that have probably diverged some 20 to 30 Ma ago (Jönsson *et al.* 2016; Moyle *et al.* 2016). The Australian magpie (*G. tibicen*) and the white winged chough (*C. melanorhamphos*) have however similar diets and habitats (Russell *et al.* 2017) as well as overlapping ranges (hosts reported in this study were captured a mere 100 km apart). This relative phylogenetic proximity and quite similar ecology probably largely explain the hosting of shared parasites.

*Cracticotaenia fieldingi* (Maplestone & Southwell, 1923)

Fig. 41

**Material examined**

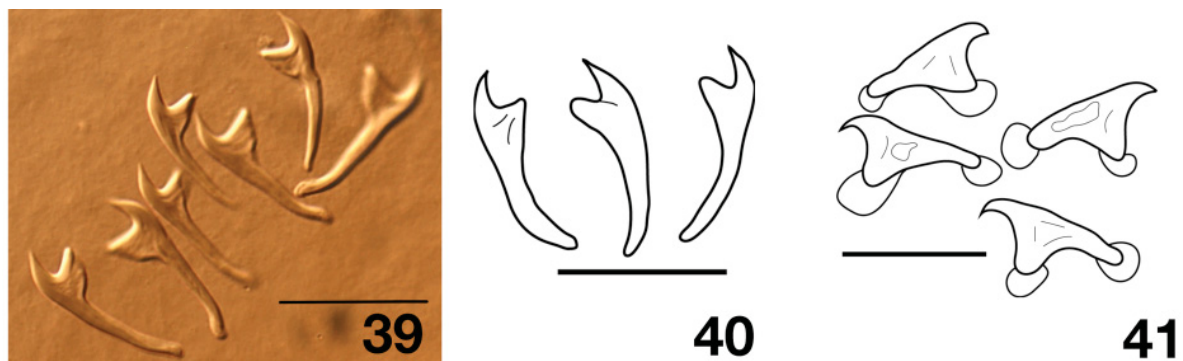
AUSTRALIA: 1 spec., New South Wales, coll. Tonks, Coluvale, 34°24' S, 150°30' E, Apr. 1911, T.H. Johnston leg., host: *Strepera graculina* (Shaw, 1790) (AHC 20393); 2 fragmented specs from small intestine, New South Wales, Taronga Zoo (Sydney), Mar. 2000, Karie Rose leg., host: *Strepera versicolor* (Latham, 1801) (AHC 28975); 3 specs, New South Wales, Rydal, 33°30' S, 150°0' E, 4 Feb. 1906, Moreau leg. (AHC 36526).

**Hosts**

*Strepera graculina* (Shaw, 1790) and *Strepera versicolor* (Latham, 1801) (Artamidae, Passeriformes).

**Description**

This material is very similar to *C. adelaidae* described above, in most of its morpho-anatomical characters. A clear difference lies however in the shape and size of copulatory organs. While the cirrus-sac of *C. adelaidae* is short and globular, it is much more elongated and cylindrical here, always clearly



**Figs 39–41.** 39. Dilepididae genus sp. Hooks. 40. *Passerilepis* sp. Hooks. 41. *Cracticotaenia fieldingi* (Maplestone & Southwell, 1923) Hooks. Scale bars: 39–41 = 20  $\mu$ m.

crossing the excretory canals and 70% longer, reaching 155–193 × 30–40 (176 × 36, n = 20). Another discriminating character is the presence of a massive terminal vaginal sphincter, which is absent in *C. adelaidae*. Hooks are 23–25 (24, n = 9) and 22–24 (22.5, n = 9) long (Fig. 41). The material is however macerated and difficult to interpret, and it is not possible to associate rostellar hook counts and other measurements to specimens for which anatomy is available. The few available specimens from AHC 36526 include some long ones (up to 39.2 mm), including one with a complete scolex (scolex diameter 525, suckers diameter 200–220, about 88 hooks). A vaginal sphincter is present and cirrus-sacs are of a similar shape as *C. fieldingi* but larger (235–300 × 38–65).

Globally, this material corresponds to the description of *C. fieldingi* from *Cracticus destructor* [= *C. torquatus*] as described by Maplestone & Southwell (1923) and observed by ourselves (see above). It should, however, be noted that *C. fieldingi* has not only been described in a different host, but also from a locality in Queensland which is some 1500 km north of the New South Wales stations considered here. The available specimens do not allow for a detailed study, but the variability observed in our different samples suggest a possible diversification of *Cracticotaenia* in the Artamidae.

## Discussion

The rich and diversified avian fauna of Australia is undoubtedly hosting a wide variety of cestodes that we safely assume to reach several hundreds of species. Unfortunately, with a few dozens species reported, this area of the country's biodiversity remains both unknown and unexplored. The fact that our study of the SAMA collections allowed to describe seven new taxa from common and abundant host species allows at least two comments. First, museum collections, even older ones, are important tools for the discovery of new taxa, including common but neglected ones. Second, these discoveries only represent a tiny proportion of the real-life diversity, and museum specimens are no substitutes for the exploration of the living world. The diversity, ease of study and access to diverse sources of characters are only guaranteed by fresh collections. In this work, for example, we did not try any sequencing of our samples, because the limited chances of success with these long-preserved specimens, together with the small amount of available material made us deem such attempt too risky. Obviously, a methodical, state of the art collection program would allow for a much easier access to all categories of characters, including molecular, to describe new taxa.

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