

Cestode Parasites (Platyhelminthes) of Rodents from New Guinea and Adjacent Islands with a Redescription of *Paroniella blanchardi* (Parona, 1897) (Davaineidae)

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ABSTRACT. Cestodes collected from a variety of species of rodents of the genera *Chiruromys* Thomas, 1888, *Hydromys* Geoffroy, 1804, *Melomys* Thomas, 1922, *Paramelomys* Rümmler, 1936, *Pogonomys* Milne-Edwards, 1877, *Rattus* Fischer de Waldheim, 1803 and *Uromys* Peters, 1867 from New Guinea and adjacent islands are reported. The species most frequently encountered was the cosmopolitan species *Hymenolepis diminuta* (Rudolphi, 1819) with a single occurrence of the related hymenolepidid *Rodentolepis fraterna* (Stiles, 1906). Davaineid cestodes were common with *Raillietina celebensis* (Janicki, 1902) and *R. melomyos* Jones & Anderson, 1996 being found in several host species. *Paroniella blanchardi* (Parona, 1897) is reported and is redescribed together with an apparently novel species of *Paroniella* Fuhrmann, 1920. Two species of *Bertiella* Stiles & Hassall, 1902, *B. anapolytica* Baylis, 1934 and *B. musasabi* Yamaguti, 1942 were encountered considerably extending their known host and geographical ranges. *Mathevotaenia niuguiniensis* Beveridge, 2008, previously reported from New Guinea was found in additional host species. A dilepidid cestode species was also found but the material available was insufficient to allow identification. Numerous new host species are reported for the cestodes described.

KEYWORDS. Cestoda; parasites; Platyhelminthes; rodents; New Guinea

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The island of New Guinea and its adjacent islands are home to a diverse array of rodents (Flannery, 1995a, 1995b; Rowe *et al.*, 2008). The cestode fauna of rodents in New Guinea and its adjacent territories is extremely poorly documented, in spite of the propensity of these rodents to harbour cestodes of zoonotic significance. Both *Hymenolepis diminuta*

(Rudolphi, 1819) and *Rodentolepis nana* (Siebold, 1852) (as *Hymenolepis nana*) have been reported from humans in Papua New Guinea and are considered to be zoonotic (Owen, 2005).

Reports of cestodes from rodents however are limited. Jones & Anderson (1990) reported *H. diminuta* from

Pogonomelomys ruemmleri (Tate & Archbold, 1941), now *Coccyomys ruemmleri* (Tate & Archbold, 1941) and from “*Rattus ruber*”, currently a synonym of *Rattus nitidus* (Hodgson, 1845) at the Baiyer River Sanctuary and near Mount Hagen (Fig. 1). Subsequently they (Jones & Anderson, 1996) described *Raillietina melomyos* Jones & Anderson, 1996 from *Melomys rufescens* (Alston, 1877). Smales (2006) reported *H. diminuta* from *Hydromys chrysogaster* Geoffroy, 1804 while Smales & Spratt (2008) reported the same species from *Uromys caudimaculatus* (Krefft, 1867). Beveridge (2008) reported the first species of *Mathevotaenia* Akumyan, 1946, *M. niuguiniensis* Beveridge, 2008, from the region in *Parahydromys asper* (Thomas, 1906) and Smales (2009) reported *Raillietina celebensis* from *Melomys rufescens*. Owen (2011) listed *R. ?celebensis* (Janicki, 1902) from *Rattus exulans* (Peale, 1848) and *Raillietina* sp. from *Rattus leucopus* (Gray, 1867), *H. diminuta* from *R. leucopus* and *R. rattus* (Linnaeus, 1758), *Rodentolepis fraterna* (Stiles, 1906) from *R. exulans* as well as the strobilocercus (larval stage) of the taeniid cestode *Taenia taeniaeformis* (Batsch, 1786) from *Mallomys rothschildi* Thomas, 1898 and *R. rattus*. Smales (2012), in a review of the helminth parasites of rodents belonging to the tribe Hydromyini (formerly the subfamily Hydromyinae), also recorded incompletely identified species of *Bertiella* Stiles & Hassall, 1902 and *Hunkeleria* Spasskii, 1992 in *Lorentzimys nouhuysi* Jentink, 1911. There are additional early descriptions of cestodes such as those of Parona (1897) of a davaineid cestode, *Paroniella blanchardi* (Parona, 1897) from rodents from Seram, but for which the descriptions are extremely poor.

Based on these reports, it is evident that knowledge of the cestode fauna of rodents in New Guinea and its adjacent islands is extremely fragmentary. The present study contributes to a more detailed understanding of the cestode parasites of this region.

Materials and methods

Cestodes were recovered from the digestive tracts of rodents held in the collections of the Australian Museum, Sydney (AM). The fixation history of the rodents is not known but at the time of removal of the cestodes, they were stored in 70% ethanol. Representative cestodes were stained in Celestine blue, dehydrated in ethanol, cleared in methyl salicylate and mounted in Canada balsam. To examine egg structures, gravid segments of a few cestodes were teased apart in Hoyer’s medium and for the examination of rostellar hooks, some squash preparations of scoleces were also prepared in Hoyer’s medium (Pritchard & Kruse, 1982). Additional portions of strobila of some specimens were embedded in paraffin, sectioned at a thickness of 5–7 µm and stained with haematoxylin and eosin. In descriptions, measurements are given in millimetres as the range followed by the mean in parentheses. All specimens have been deposited in AM and registration numbers (W) cited in the text.

Principal collecting localities are indicated in Fig. 1. For island locations, all collections based on different localities on a single small island were grouped together for simplicity. A single collecting locality, Manggole Island in the Moluccas, is not shown in Fig. 1.

The host taxonomy used in this report follows Lecompte *et al.* (2008), with common names based on Wilson & Reeder (2005).

Results

Cyclophyllidea van Beneden in Braun, 1900

Hymenolepididae Perrier, 1897

***Hymenolepis* Weinland, 1858**

***Hymenolepis* cf *diminuta* (Rudolphi, 1819)**

Material examined. From *Hydromys chrysogaster* Geoffroy, 1804 (water rat): Mabea Village, Itugli, Fergusson Island, Milne Bay Province, 9°30'S 150°E (W23775); Imalele Village, Bunala River, Fergusson Island, Milne Bay Province, 9°30'S 150°33'E (W23776); from *Rattus elaphinus* Sody, 1941 (Sulu Archipelago rat): Cepalulu Village, Manggole Island, North Moluccas, 1°53'S 125°50'E (W23768); from *Rattus leucopus* (Gray, 1867) (Cape York rat): Jirlai, Kobroor Island, Aru Islands, West Papua, 6°02'S 134°32'E (W48826–827); from *Rattus mordax* (Thomas, 1904) (eastern New Guinea rat): Wamla Village, Normanby Island, Milne Bay Province, 10°30'S 151°17'E (W23787); from *Rattus niobe* (Thomas, 1906) (eastern New Guinea mountain rat): south of Tifalin, West Sepik Province, 5°05'S 141°25'E (W23790); Dokfuma, Star Mountains, West Sepik Province, 5°01'S 141°07'E (W23793); Kamptamen, South of Hindenberg Wall, West Sepik Province, 5°10'S 141°16'E (W23788–789); Ofekaman–Telefonin Area, West Sepik Province, 5°05'S 141°35'E (W23794); from *Rattus tanezumii* Temminck, 1844 (oriental house rat): Piliiana Village, Seram, Maluku Province, 3°15'S 129°30'E (W48825); from *Rattus verecundus* (Thomas, 1904) (New Guinea slender rat): Kutubu Lake, Mt Kemenagi, Southern Highlands Province, 6°23'S 143°19'E (W23821); Munimum Village, Agaun, Milne Bay Province, 9°53'S 149°23'E (W23822); from *Rattus vandeuseni* Taylor & Calaby, 1982 (Van Deusen’s New Guinea mountain rat): Munimum Village, Aguan, Milne Bay Province, 9°53'S 149°23'E (W23816–818).

Remarks. This cosmopolitan species is known from rodents throughout the world (Schmidt, 1986) including New Guinea where it has been found in “*Rattus ruber*” (now a synonym of *Rattus nitidus* (Hodgson, 1845) and *Pogonomelomys ruemmleri* Tate & Archbold, 1941 (see Jones & Anderson, 1990). It has been reported previously from *H. chrysogaster* in Australia (Smales *et al.*, 1990) although not previously in New Guinea or from any species of the other hosts listed above all of which therefore represent new records. The species has been identified as “cf *diminuta*” as recent molecular studies have indicated that it probably constitutes a species complex currently undifferentiable using morphological criteria (Haukisalme *et al.*, 2010).

***Rodentolepis* Spasskii, 1954**

***Rodentolepis fraterna* (Stiles, 1906)**

Material examined. From *Paramelomys rubex* (Thomas, 1922) (mountain paramelomys): Ofekama, Telefomin, West Sepik Province, 5°08'S 141°38'E (W48772).

Remarks. Only a single specimen of this common parasite of rodents was identified. The nomenclature for the specific name used here follows the principal text in Baer & Tenora (1970), although it appears from footnotes in the paper (p. 27) that the two authors disagreed on its taxonomic status,

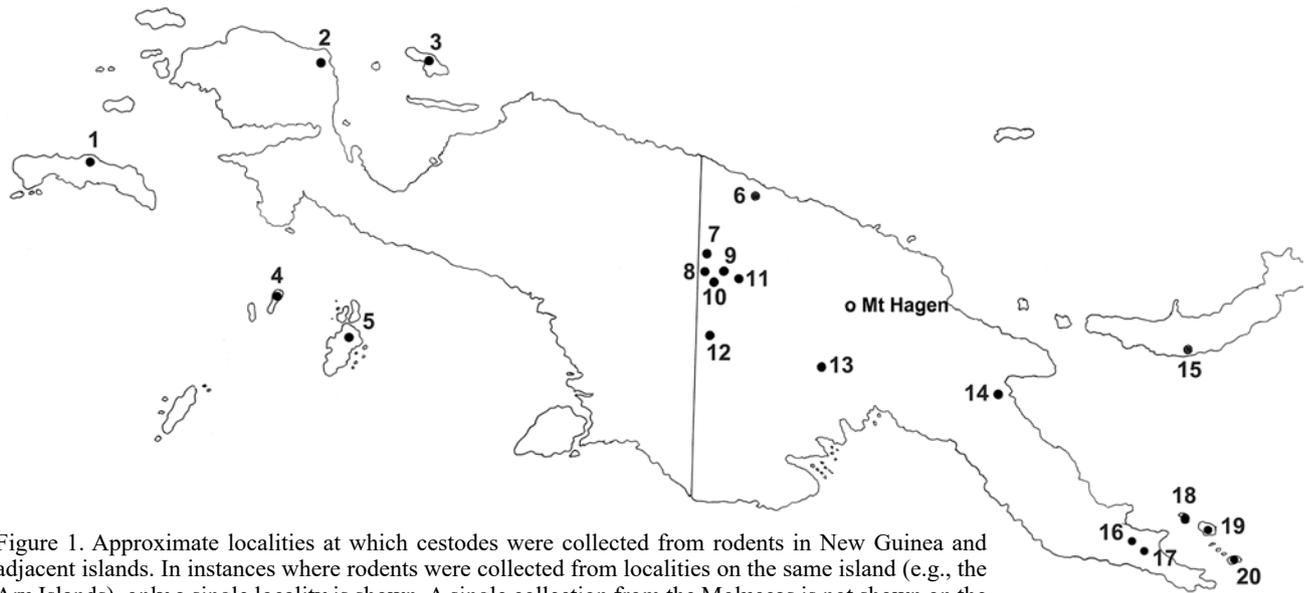


Figure 1. Approximate localities at which cestodes were collected from rodents in New Guinea and adjacent islands. In instances where rodents were collected from localities on the same island (e.g., the Aru Islands), only a single locality is shown. A single collection from the Moluccas is not shown on the current figure. Collection localities are indicated by numerals: 1, Seram; 2, Mokwam; 3, Supiori Island; 4, Kei Basar; 5, Wokan Island, Aru Islands; 6, Mount Somoro; 7, Yapsiei; 8, Star Mountains; 9, Tifalin; 10, Hindenburg Wall; 11, Ofekaman-Telefonin; 12, Ok Tedi; 13, Lake Katubu; 14, Mount Missim; 15, Fulleborn; 16, Aguan; 17, Munimum; 18, Goodenough Island; 19, Fergusson Island; 20, Normanby Island.

Baer preferring *nana*. The same species is frequently reported under the name *Hymenolepis fraterna* (as in Baer & Tenora, 1970) and it may or may not be a synonym of *R. nana*, a common parasite of humans (Haukisalimi *et al.*, 2010). Some evidence exists from experimental and molecular studies that the rodent and human parasites are genetically and biologically distinct (Macnish *et al.*, 2002a,b), but the evidence is not conclusive. *Rodentolepis nana* (as *Hymenolepis nana*) has been reported as a zoonosis in Papua New Guinea (Owen, 2005). *Paramelomys rubex* is a new host for this species of cestode.

Anoplocephalidae Cholodkovsky, 1902

Bertiella Stiles & Hassall, 1902

Bertiella anapolytica Baylis, 1934

Material examined. From *Paramelomys lorentzii* (Jentink, 1908) (Lorentz's paramelomys): Wokam Island, Aru Islands, Western Papua, 6°10'S 134°30'E (W23783).

Remarks. This cestode species has been reported from Sumatra (Baylis, 1934) and from south-eastern Australia (Beveridge, 1985) from species of *Rattus*. The current report is the first from New Guinea and extends the known host range of the species to the genus *Melomys*. The host specimen from which these cestodes were obtained is apparently that referred to by Flannery (1995a), as the only specimen of this host collected on the Aru Islands.

Bertiella musasabi Yamaguti, 1942

Material examined. From *Chiruromys forbesi* Thomas, 1888 (Forbes' chiruromys): Vivililimana Village, Fergusson Island, Milne Bay Province, 9°24'S 150°26'E (W23779); Yabamakubokubo Village, Fergusson Island, Milne Bay Province, 9°25'S 150°26'E (W23780–781); from *Pogonomys championi* Flannery, 1988 (Champion's pogonomys):

Tifalmin Valley, West Sepik Province, 5°07'S 141°25'E (W23772–774);

Remarks. *Bertiella musasabi* was originally described from *Petaurista leucogenys* (Temminck, 1827) from Japan (Yamaguti, 1942), and was redescribed from *Petaurista petaurista* (Pallas, 1766) from Taiwan by Beveridge (1989). It is also known from India from *P. petaurista* (as *Indotaenia indica* Singh, 1962) (Singh, 1962). The current reports are the first reports of the species from the region and involves additional rodent genera as hosts for this species of cestode.

Mathevotaenia Akhumyan, 1946

Mathevotaenia niuguiniensis Beveridge, 2008

Material examined. From *Pogonomys silvestris* Thomas, 1920 (grey-bellied pogonomys): Mount Biyao, Munimum Village, Agaun, Milne Bay Province, 9°53'S 149°23'E (W23810–812); Kawayo Village, Aguan, Milne Bay Province, 9°53'S 149°22'E (W23813); from *Rattus niobe* (Thomas, 1906) (eastern New Guinea mountain rat): Dokafuma, Star Mountains, West Sepik Province, 5°01'S 141°07'E (W23792–793);

Remarks. This species was originally described from *Parahydromys asper* (Thomas, 1906) from the Southern Highlands Province of Papua New Guinea (Beveridge, 2008), being the only species of the genus known from the region. The current collections substantially increase the known host and geographic range of the cestode.

Davaineidae Braun, 1900

Railletina Fuhrmann, 1920 *sensu lato*

Many of the rodents examined were parasitised by davaineid cestodes belonging to this genus. However, because of their poor state of preservation and the presence of few entire

specimens, only a small number were identifiable to species. In addition, one species was recognised which does not fit the description of any known species, but the available material is too poor to allow a full description.

Yamaguti (1959), Artykh (1966) and Schmidt (1986) recognised four sub-genera within *Raillietina*, these being *Raillietina sensu stricto*, *Fuhrmannetta* Stiles and Orleman, 1926, *Skrjabinia* Fuhrmann, 1920 and *Paroniella* Fuhrmann, 1920. The most recent review of the family (Jones & Bray, 1994) treats these taxa as independent genera, a practice followed here.

Raillietina Fuhrmann, 1920 *sensu stricto*

Raillietina celebensis (Janicki, 1902)

Material examined. From *Paramelomys rubex* (Thomas, 1922) (mountain paramelomys): Mabiomskin, Ok Tedi, Western Province, 6°06'S 141°17'E (W23802); from *Rattus feliceus* Thomas, 1920 (spiny Seram rat): Piliiana Village, Seram, Maluku Province, 3°15'S 129°30'E (W23778); from *Rattus praetor* (Thomas, 1888) (large New Guinea spiny rat): Tawa Ridge, Fulleborn West, New Britain Province, 6°03'S 150°42'E (W23800);

Remarks. This cestode is widely distributed in south-east Asia including Australia and is reported also from Iraq (Sandars, 1956, 1957; Al-Hadithi *et al.*, 1985; Huq *et al.*, 1985; Hasegawa *et al.*, 1994; Xuan *et al.*, 2001). Sandars (1956) summarised the morphological features of the species, but the ranges of measurements for some characters are very broad, leading to the suspicion that the current descriptions may include more than one species. It has previously been reported from New Guinea only as *R. ?celebensis* by Owen (2011) and hosts recorded here represent new host records.

Raillietina melomyos Jones & Anderson, 1996

Material examined. From *Paramelomys rubex* (Thomas, 1922) (mountain paramelomys): Mt Somoro, Torricelli Mountains, West Sepik Province, 3°24'S 142°08'E (W23804); from *Rattus steini* Rümmler, 1935 (Stein's New Guinea rat): Mt Missim, Wau, Morobe Province, 7°17'S 146°46'E (W23809).

Remarks. This species was originally described from *Melomys rufescens* from the Western Highland Province of Papua New Guinea (Jones & Anderson, 1996). The species is readily identifiable by its small rostellar hooks 8–11 µm long and its armed suckers. The cestode species is recorded here from two new host species. Material from a single *M. rufescens* was available in the current collection, but it lacked scoleces.

Paroniella Fuhrmann, 1920

Paroniella blanchardi (Parona, 1897)

Figs. 2–9

Davainea blanchardi Parona, 1897

Brumptiella blanchardi (Parona, 1897), Lopez-Neyra, 1931

Delamurella blanchardi (Parona, 1897), Spasskii & Spasskaya, 1976

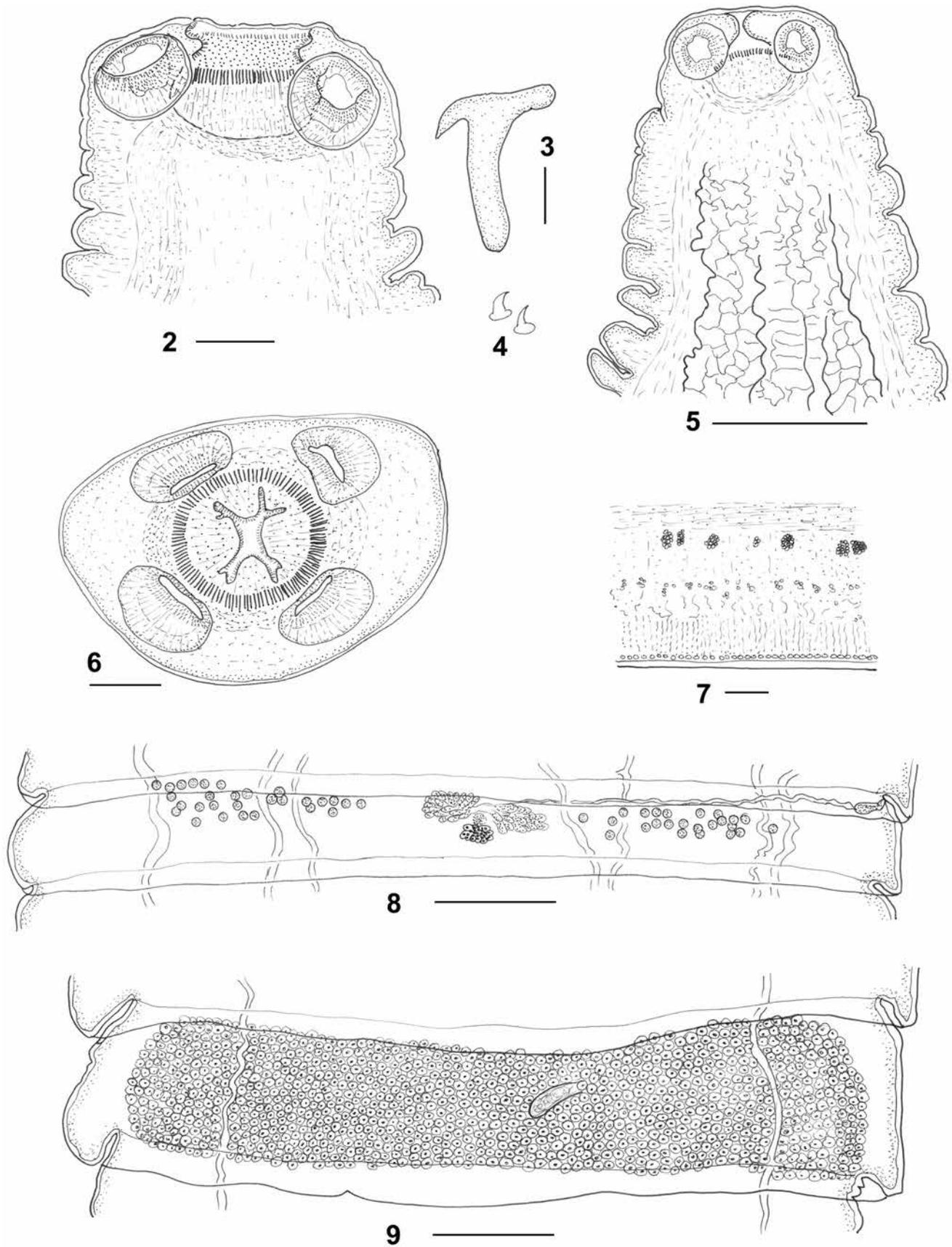
Material examined. From *Paramelomys lorentzii* (Lorentz's paramelomys): Wokan Island, Aru Islands, West Papua,

5°37'S 143°30'E (W48821); from *Rattus feliceus* Thomas, 1920 (spiny Seram Island rat): Piliiana Village, Seram, Maluku Province, 3°15'S 129°30'E (W23778).

Description

Large cestodes up to 110 mm long, 5 mm in width; scolex 0.42–0.50 (0.48, n = 5) in diameter; suckers 0.10–0.14 (0.12, n = 5) in diameter, armed with rows of spines; rostellum 0.17–0.24 (0.20, n = 5) in diameter; internal wall of rostellar sac lined with tiny spines; rostellar hooks c. 125 in number, hammer-shaped, arranged in two circles, 0.025–0.035 (0.030, n = 5) long; genital pores essentially unilateral; single block of 4 segments with reversed polarity seen in one section of strobila; mature segments elongated laterally, craspedote, 0.17–0.25 (n = 0.21, n = 5) long, 1.84–3.35 (2.47, n = 5) wide, length: width ratio 12; genital atrium close to anterior margin of segment; cirrus sac small, c. 0.10–0.14 long, 0.05 wide, not reaching osmoregulatory canals; distal cirrus armed (visible only in histological sections); vas deferens, sinuous, running along anterior margin of segment; 18–28 (23, n = 5) and 29–40 (34, n = 5) poral and aporal testes respectively; testes 0.04–0.05 (0.05, n = 5) in diameter. Vagina opens to genital atrium posterior to cirrus sac, wall muscular, internal lining of distal vagina armed (visible only in histological sections); female genital complex in mid-line; ovary bilobed, poral lobe slightly smaller, 0.08–0.13 (0.10) × 0.08–0.13 (0.10) with fewer lobules than aporal lobe, 0.12–0.20 (0.17, n = 5) × 0.08–0.11 (0.10, n = 5); Mehlis' gland posterior to ovarian isthmus, c. 0.04 in diameter; vitellarium lobulate, posterior to Mehlis' gland, 0.07–0.14 (0.11, n = 5) × 0.05–0.06 (0.06, n = 5); vagina slender; seminal receptacle evident in gravid but not in mature segments; gravid segments 0.35–0.60 (0.52, n = 5) long, 2.70–4.10 (3.20, n = 5) wide, length: width ratio, 6.2; with eggs in individual capsules, capsules 0.025–0.040 (0.035, n = 5) in diameter; eggs 0.018–0.025 (0.021, n = 5) in diameter; egg capsules entirely fill gravid segments, extending beyond osmoregulatory canals; osmoregulatory system highly reticulate; largest vessels in gravid segments 0.03 in diameter. Longitudinal musculature composed of two bands of fibres; inner band of larger bundles of up to 20 fibres; 40 bundles on each side of segment; outer band composed of individual fibres or bundles of up to 5 fibres; transverse muscle forming a broad band medial to inner longitudinal muscles; dorsoventral muscles scattered, individual.

Remarks. In possessing unilateral pores and a single egg per egg capsule, this species belongs to the genus *Paroniella*. Sawada (1964) in a comprehensive list of all known species included only a single species of *Paroniella* from rodents, *P. blanchardi* (Parona, 1897) described from *Leopoldamys siporamus* (Thomas, 1895) (as *Mus siporamus*) and *Maxomys rajah* (Thomas, 1894) (as *Mus rajah*) on Sipura Island (as Sipora or Sereinu), part of the Mentawai group of islands off Sumatra (Parona, 1897). No species of *Paroniella* from rodents has been added since Sawada (1964). The description and illustrations by Parona (1897) are limited in detail, but report a maximum length of 75 mm, a width of 5 mm, with about 300 segments, a scolex 0.5 mm in diameter, a rostellum bearing 70–80 hooks 0.032 mm long and sucker spines 0.006 mm long. Most of the principal dimensions provided by Parona (1897) thus match those of the specimens described above, apart from the number of rostellar hooks.



Figures 2–9. *Paroniella blanchardi* (Parona, 1897). (2) scolex, dorsoventral view; (3) rostellar hook; (4) sucker spines; (5) Anterior extremity of strobila showing reticulated osmoregulatory system; (6) scolex, apical view; (7) optical transverse section of hand-cut section showing longitudinal and transverse musculature; (8) mature segment; (9) gravid segment. Scale bars: Figs. 5, 8, 9—1.0 mm; Figs. 2, 6, 7—0.1, mm; Figs. 3, 4, to same scale—0.01 mm.

Counting the number of hooks from lateral views of a scolex and then doubling the number gave a value of 70–80, the number estimated by Parona (1897), while examination of an apical view of the scolex (Fig. 6) suggested a number of about 125 hooks. Parona (1897) provided no details of the mature segment such that comparisons with the data presented here are not possible. He illustrated the lateral region of several gravid segments, which indicate that the genital pores were unilateral. In the fragments available for examination here, genital pores were generally unilateral, but one area of strobila was seen in which a series of four segments in a fragment containing 14 segments, exhibited a reverse polarity. The current re-description, while still incomplete due to the poor nature of the material, increases the known number of host species and is the first report of the species from New Guinea.

The captions to the figures of the original description of this species (p. 124) have November, 1897 as the publication date and in a table of measurements on p. 106, the species is cited as “*D. blanchardi* n. sp. Parona, 1897”. However, the initial page of the issue of the journal gives the publication date as 1898. In spite of this discrepancy, the citation date has not been altered from that used in the literature.

Joyeux & Baer (1927) recorded *P. blanchardi* from *Thryonomys swinderianus* (Temminck, 1827) from Dahomey (Abomey) in Benin and illustrated the scolex and a rostellar hook but provided no description. The same illustrations were used by Artykh (1966) in his summary of the species. Janicki (1906) and Shipley (1908) included the species (as *Davainea blanchardi*) in their lists of cestodes from rodents (*Rattus*) known at that time, but did not provide any additional details.

No other species of *Paroniella* has been reported from rodents apart from a record of *P. retractilis* (Stiles, 1895), described initially as a parasite of lagomorphs in North America, and also from *Rattus rattus* in Benin (Joyeux & Baer, 1927).

Of the various species of *Paroniella* known from New Guinea (Sawada, 1964), *P. conopophilae* (Johnston, 1911), *P. corvina* (Fuhrman, 1905) and *P. paradisiae* (Fuhrmann, 1909) are known from birds (Sawada, 1964, Schmidt, 1986), but are readily distinguishable from *P. blanchardi* using the metrical data provided in Sawada (1964). *Paroniella appendiculata* (Fuhrmann, 1909) was described from an unknown host (Fuhrmann, 1909), but differs from *P. blanchardi* in lacking scolex and sucker spines, in having larger hooks (36–43 μm) and in having characteristically shaped campanulate segments (Fuhrmann, 1909).

Paroniella sp.

Figs. 10–14

Material examined. From *Melomys lutillus* (Thomas, 1913) (Papua grassland melomys): Ohoilin Village, Kei Besar, Maluku Province, 5°36'S 133°03'E (W23784); from *Rattus feliceus* Thomas, 1920 (spiny Seram Island rat): Piliiana Village, Seram, Maluku Province, 3°15'S 129°30'E (W23778); from *Rattus mordax* (Thomas, 1904) (eastern New Guinea rat): Kalo-kalo Village, Fergusson Island, Milne Bay Province, 9°25'S 150°26'E (W23786); from *Rattus tanezumi* Temminck, 1844 (oriental house rat): Ohoilin Village, Kei Besar, Maluku Province, 5°36'S 133°3'E (W23815).

Description

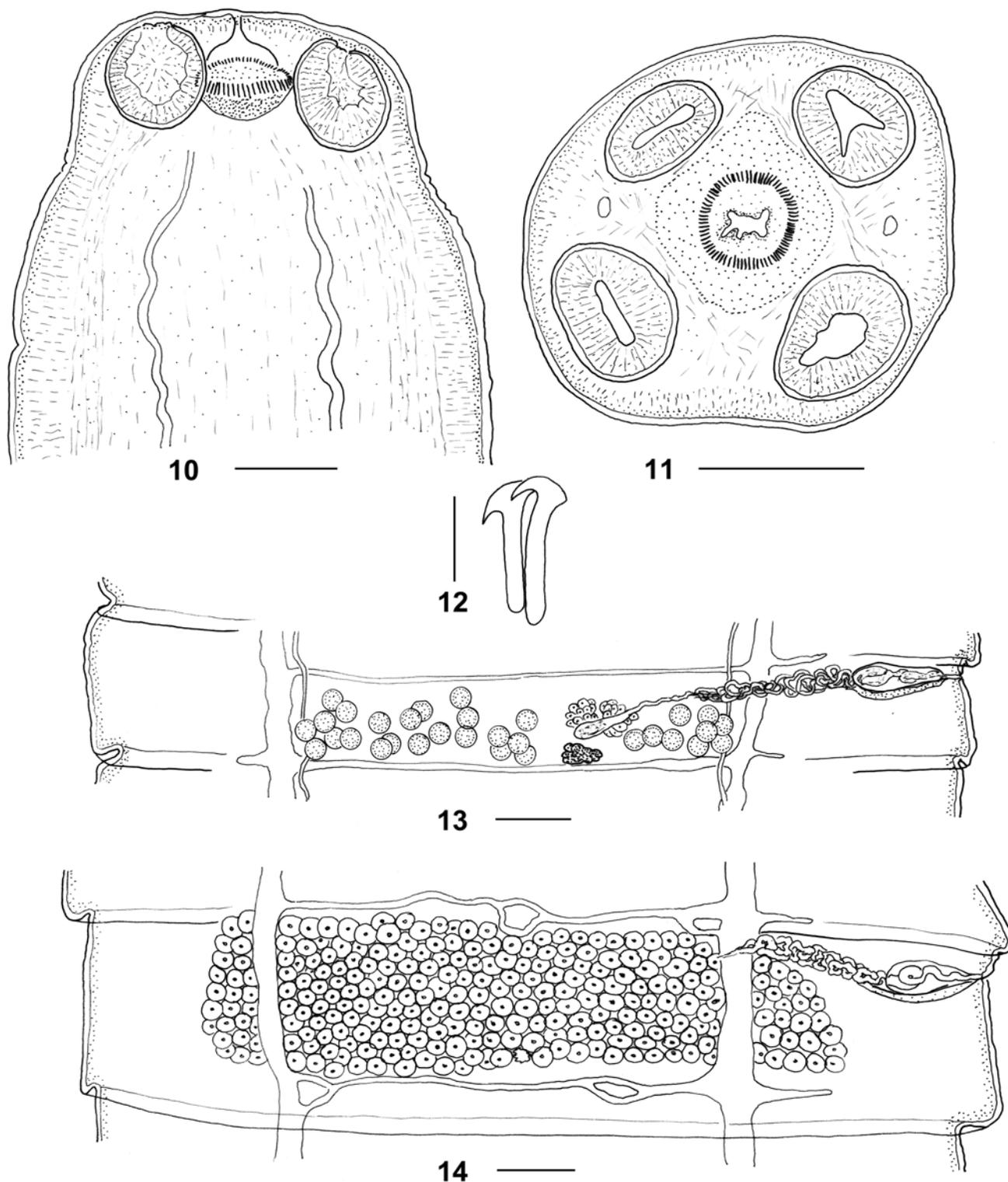
Description based on 4 specimens from *R. feliceus*: small cestodes; scolex 0.30–0.45 (0.36, n = 4) in diameter; retracted rostellum 0.09–0.10 (0.10, n = 3) in diameter; suckers 0.09–0.12 (0.10, n = 6) in diameter, lacking spines; rostellar hooks c. 80 in number; hooks 0.015–0.020 (0.017, n = 5) long; mature segments craspedote, 0.12–0.20 (0.16, n = 5) long, 1.1–1.2 (1.17, n = 7) wide, length: width ratio 7.3; genital pores unilateral; genital atrium close to anterior margin of segment; cirrus sac small, pyriform, 0.10–0.14 (0.12, n = 5) long, 0.04–0.06 (0.05, n = 5) wide, not reaching osmoregulatory canals; seminal vesicles absent; vas deferens coiled runs along anterior margin of segment; c. 10 poral and c. 20 aporal testes respectively, crossing dorsal but not ventral osmoregulatory canals; testes 0.030–0.045 (0.040, n = 5) in diameter. Vagina opens to genital atrium posterior to cirrus sac; distal region of vagina enlarged; seminal receptacle c. 0.05 \times 0.02; female genitalia in midline; ovary with poral lobe 0.05–0.11 (0.08, n = 5) \times 0.04–0.06 (0.05, n = 5), slightly larger than aporal lobe, 0.04–0.08 (0.05) \times 0.03–0.06 (0.05); vitellarium reniform, posterior to ovary, 0.06–0.10 (0.07, n = 5) \times 0.04–0.06 (0.05, n = 5); Mehlis' gland not seen. Gravid segments 0.25–0.30 (0.28, n = 3) long, 1.0–1.6 (1.3, n = 3) wide, length: width ratio 4.6; eggs in individual capsules; egg capsules 0.030–0.050 (0.035, n = 5) in diameter, eggs 0.015–0.025 (0.019, n = 5) in diameter; egg capsules extend beyond osmoregulatory canals; on both sides of segment; osmoregulatory canals paired; ventral canal external, 0.025–0.03 (0.028, n = 3) in diameter; dorsal canal internal to ventral canal, narrower, c. 0.01 in diameter, more sinuous; narrow transverse canal, 0.010–0.015 (0.012, n = 3) in diameter connects ventral canals at posterior margin of each segment; in many segments, lateral extension of transverse canal present, of variable size.

Remarks. These cestodes belong within *Paroniella*, but have smaller rostellar hooks than *P. blanchardi*. As there are no other species of this genus known to be parasitic in rodents (Sawada, 1964), it is assumed that it represents an undescribed species or possibly even more than one species. Unfortunately, the current material is inadequate to allow a full formal description and for this reason the species has not been named. The description has been restricted to specimens from a single host species as some variation in testis number and distribution was noted in material from other hosts.

Raillietina sensu lato

Specimens clearly identifiable as belonging to the *Raillietina* group of genera but not further identifiable are listed below.

Material examined. From *Melomys lutillus* (Thomas, 1913) (Papua grassland melomys): Mokwam area, Arfak Mountains, West Papua, 1°06'S 133°56'E (W23785); from *Melomys rufescens* (Alston, 1877) (black-tailed melomys): Yapsiei Area, West Sepik Province, 4°35'S 141°05'E (W23808); from *Paramelomys rubex* (Thomas, 1922) (mountain paramelomys): Ofektama, Telefomin, West Sepik Province, 5°08'S 141°38'E (W48824); Mokwam area, Arfak Mountains, West Papua, 1°06'S 133°56'E (W23805–806); Mount Somoro, Torricelli Mountains, West Sepik Province, 3°24'S 142°08'E (W23803); from *Paramelomys platyops* (Thomas, 1906) (common lowland paramelomys): Tibik



Figures 10–14. *Paroniella* sp. (10) scolex, dorsoventral view; (11) scolex, apical view; (12) rostellar hooks; (13) mature segment; (14) gravid segment. Scale bars: Figs. 10, 11, 13, 14—0.1 mm; Fig. 12—0.01 mm.

Village, Skonga River, Yapsiei area, West Sepik Province, 4°35'S 141°10'E (W23798); Kampong Korido, Supiori Island, West Papua, 0°50'S 135°36'E (W23799); Boulder camp, Goodenough Island, Milne Bay Province, 9°20'S 150°16'E (W23766); from *Rattus steini* Rümmler, 1935 (Stein's New Guinea rat): Mt Missim, near Wau, Morobe Province, 7°17'S 146°46'E (W23809); from *Uromys*

caudimaculatus (Kreffft, 1867) (giant white-tailed uromys): Kokogadi Village, Fergusson Island, Milne Bay Province, 9°30'S 150°34'E (W23770).

Remarks. Most of the specimens of *Raillietina sensu lato* could not be identified to a genus, either because of extremely poor preservation, because scoleces were lacking

Table 1. Cestodes of rodents from New Guinea and adjacent islands reported in this study. Host classification follows Lecompte *et al.* (2008).

Host	Parasite
Subfamily Murinae	
Tribe Hydromyini	
Hydromys division	
Hydromys Geoffroy, 1804	
Hydromys chrysogaster Geoffroy, 1804	<i>Hymenolepis</i> cf. <i>diminuta</i>
Pogonomys division	
Chiruromys Thomas, 1888	
Chiruromys forbesi Thomas, 1888	<i>Bertiella musasabi</i>
Pogonomys Milne-Edwards, 1877	
Pogonomys championi Flannery, 1988	<i>Bertiella musasabi</i>
Pogonomys silvestris Thomas, 1920	<i>Mathevotaenia niuguiniensis</i>
Uromys division	
Melomys Thomas, 1922	
Melomys lutillus (Thomas, 1913)	<i>Paroniella</i> sp.
	<i>Raillietina</i> sp. <i>sensu lato</i>
	<i>Raillietina</i> sp. <i>sensu lato</i>
Melomys rufescens (Alston, 1877)	
Paramelomys Rümmler, 1936	
Paramelomys lorentzi (Jentink, 1908)	<i>Bertiella anapolytica</i>
	<i>Paroniella blanchardi</i>
Paramelomys platyops (Thomas, 1906)	<i>Raillietina</i> sp. <i>sensu lato</i>
Paramelomys rubex (Thomas, 1922)	<i>Rodentolepis fraterna</i>
	<i>Raillietina celebensis</i>
	<i>Raillietina melomyos</i>
	<i>Raillietina</i> sp. <i>sensu lato</i>
Uromys Peters, 1867	
Uromys caudimaculatus (Krefft, 1867)	<i>Raillietina</i> sp. <i>sensu lato</i>
Tribe Rattini	
Rattus division	
Rattus Fischer de Waldheim, 1803	
Rattus elaphinus Sody, 1941	<i>Hymenolepis</i> cf. <i>diminuta</i>
Rattus feliceus Thomas, 1920	<i>Raillietina celebensis</i>
	<i>Paroniella blanchardi</i>
	<i>Paroniella</i> sp.
Rattus leucopus (Gray, 1867)	<i>Hymenolepis</i> cf. <i>diminuta</i>
Rattus mordax (Thomas, 1904)	<i>Hymenolepis</i> cf. <i>diminuta</i>
	<i>Paroniella</i> sp.
Rattus niobe (Thomas, 1906)	<i>Hymenolepis</i> cf. <i>diminuta</i>
	<i>Mathevotaenia niuguiniensis</i>
	Dilepididae ?genus
Rattus praetor (Thomas, 1888)	<i>Raillietina celebensis</i>
Rattus steini Rümmler, 1935	<i>Raillietina melomyos</i>
	<i>Raillietina</i> sp. <i>sensu lato</i>
Rattus tanezumi Temminck, 1844	<i>Hymenolepis</i> cf. <i>diminuta</i>
	<i>Paroniella</i> sp.
Rattus verecundus (Thomas, 1904)	<i>Hymenolepis</i> cf. <i>diminuta</i>
Rattus vandeuseni Taylor & Calaby, 1982	<i>Hymenolepis</i> cf. <i>diminuta</i>

or because specimens were fragmented. As several instances of mixed infections were encountered, care was taken not to inadvertently associate a scolex of one species with the strobila of another. The data presented here do however suggest the presence of a relatively rich cestode fauna in rodents in New Guinea and careful preservation of future specimens collected should allow the description of new species.

Dilepididae Railliet & Henry, 1909

Material examined. From: *Rattus niobe* Thomas, 1906 (eastern New Guinea mountain rat): Ofekaman–Telefonin Area, West Sepik Province, 5°05'S 141°35'E (W48813); S of Tifalin, West Sepik Province, 5°07'S 141°25'E (W48816); hill south of Tifalmin, West Sepik Province, 5°07'S 141°25'E (W48818, W23795).

Description

Cestodes with an eversible rostellum bearing two circles of 32 hooks; anterior hooks 35 µm long, posterior row 45 µm long; rostellar sac 0.22 mm long. Mature proglottides craspedote, c. 20 testes anterior to female genital complex; eggs in individual capsules; no other features discernible.

Remarks. Due to the lack of morphological features visible in whole mounts, these cestodes could not be identified to generic level. They are recorded here as the specimens may be of use in further studies of the cestodes of rodents from New Guinea.

Discussion

In spite of the generally poor state of preservation of the collection of cestodes reported here, it provides novel insights into the diversity of cestodes in rodents in the region of New Guinea, with numerous new host and geographic records as well as the recognition of potentially new species.

The cosmopolitan species *H. diminuta* was the cestode species most commonly encountered. This result was unsurprising as the species has been recorded from over 80 species of host, primarily rodents, throughout the world (Gibson *et al.*, 2005), including from humans in Papua New Guinea (Owen, 2005). Nevertheless, the current study significantly extends its host range and provides some information on potential sources of infections for humans in New Guinea.

Rodentolepis fraterna, another potentially zoonotic cestode (see above), was found in a single host only.

Two species of *Bertiella* are reported for the first time from New Guinea, although one, *B. musasabi*, is known from countries to the north (Japan, India, Taiwan) and the second, *B. anapolytica* is known from Indonesia and Australia. The majority of species of *Bertiella* occur in arboreal mammals (marsupials, primates, dermopterans, arboreal rodents) and the finding of *B. musasabi* in species of tree-mice (*Chiruromys* and *Pogonomys*) is consistent with this general pattern. *Bertiella anapolytica* appears to be an exception, being found in terrestrial rodents (*Rattus* spp.) in Australia and Indonesia. Of the new host reported here, *Paramelomys lorentzi*, little is apparently known concerning its biology (Flannery, 1995b).

The linstowiid cestode *Mathevotaenia niuguiniensis* was first reported from *Parahydromys asper* by Beveridge (2008). Current records greatly expand its host range in New Guinea. Species of this genus are common in rodents in Africa, Europe, North America and central Asia, but are not known from rodents in south-east Asia (Beveridge, 2008). The genus occurs in bats in southeast Asian and Australia and is common in marsupials in South America, but with only a single species in Australasian marsupials (Beveridge, 2008). As a consequence, additional records of this genus in rodents in New Guinea provide useful additions to its present enigmatic host and geographical distribution.

Two species of the davaineid genus *Raillietina* were encountered. *Raillietina celebensis* has a widespread distribution including southeast Asia and Australia. The probable occurrence of this species in New Guinea was reported by Owen (2011) and therefore was not unexpected. This species may be zoonotic (Sandars, 1956), but has not

been reported as a zoonosis in Papua New Guinea (Owen, 2005). By contrast, *R. melomyos* appears to be endemic to New Guinea, but not, as the specific name suggests, restricted to the rodent section Uromyini, as it has now been found in a species of *Rattus*.

The finding of *P. blanchardi* is the second report of the species since its original description in 1897 and additional morphological details have been added. It was first described from rodents on a small island off the west coast of Sumatra, and the new records, from Seram and the Aru Islands in the Maluku area of the Banda Sea are not far removed from the type locality. Although additional data have been provided on the morphology of this species, its description remains incomplete.

Additional undescribed species of *Paroniella* are clearly present, but cannot be named based on the limited material currently available.

Study of the species of *Raillietina sensu lato*, was clearly restricted by the poor state of preservation of specimens in this collection. However, the data presented here should provide insights into a more detailed exploration of the cestode fauna of rodents in New Guinea based on newer collections.

Overall, in spite of the limitations of poorly preserved specimens, the current reports indicate a diverse cestode fauna in the New Guinea which clearly warrants more detailed investigation.

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References

- Al-Hadithi, I. A. W., A. H. Habash, and M. J. Alwan. 1985. The incidence of helminth parasites of the digestive tract of *Rattus norvegicus* from Basra area, Iraq. *Journal of Biological Sciences Research* 16: 137–154.
- Artykh, E. S. 1966. [*Davaineata—Helminths of Wild and Domestic Animals. Foundations of Cestodology, vol. 6*]. ed. K. I. Skrjabin. Moscow: Akademia Nauk [in Russian].
- Baer, J., G., and F. Tenora. 1970. Some species of *Hymenolepis* (Cestoidea) from rodents and primates. *Acta Scientiarum Naturalium, Brno* 4: 1–32.
- Baylis, H. A. 1934. On two new species of the cestode genus *Bertiella*, with a note on the presence of uterine pores. *Annals and Magazine of Natural History* 14: 412–421.
<https://doi.org/10.1080/00222933408654914>
- Beveridge, I. 1985. The genus *Bertiella* (Cestoda: Anoplocephalidae) from Australasian mammals: new species, new records and redescription. *Systematic Parasitology* 7: 241–289.
<https://doi.org/10.1007/BF00009995>
- Beveridge, I. 1989. Species of *Bertiella* (Cestodea: Anoplocephalidae) in dermopterans and squirrels from south-east Asia. *Systematic Parasitology* 14: 1–15.
<https://doi.org/10.1007/BF00019990>
- Beveridge, I. 2008. *Mathevotaenia niuguiniensis* n. sp. (Cestoda: Anoplocephalidae: Linstowiinae) from the water rat *Parahydromys asper* (Thomas) in Papua New Guinea, with a list of species of *Mathevotaenia* Akumyan, 1946. *Systematic Parasitology* 71: 189–198.
<https://doi.org/10.1007/s11230-008-9155-5>
- Flannery, T. F. 1995a. *Mammals of the South-West Pacific and Moluccan Islands*. Chatswood, NSW: Australian Museum/Reed Books.

- Flannery, T. F. 1995b. *Mammals of New Guinea*. 2nd edition. Chatswood, NSW: Australian Museum/Reed Books.
- Fuhrmann, O. 1909. Neue Davaineiden. *Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene. Abteilung Originale* 49: 94–124.
- Gibson, D. I., R. A. Bray, and E. A. Harris. 2005. Host-parasite Database of the Natural History Museum, London. <http://www.nhm.ac.uk/research-curation/projects/host-parasites/>
- Hasegawa, H., J. Kobayashi, and M. Otsuru. 1994. Helminth parasites collected from *Rattus rattus* on Lanyu, Taiwan. *Journal of the Helminthological Society of Washington* 61: 95–102.
- Haukisalmi, V., L. M. Hardman, P. Foronda, C. Feliu, J. Laakkonen, J. Niemimaa, T. Lehtonen, and H. Henttonen. 2010. Systematic relationships of hymenolepidid cestodes of rodents and shrews inferred from sequences of 28S ribosomal RNA. *Zoologica Scripta* 39: 631–641. <https://doi.org/10.1111/j.1463-6409.2010.00444.x>
- Huq, M. M., M. J. Karim, and H. Sheikh. 1985. Helminth parasites of rats, house mice and moles in Bangladesh. *Pakistan Veterinary Journal* 5: 143–144.
- Janicki, C. von. 1906. Studien an Säugetiercestoden. *Zeitschrift für wissenschaftliche Zoologie* 81: 505–597.
- Jones, A., and T. J. C. Anderson. 1990. Helminths of rodents and marsupials from Papua New Guinea, with the description of two new species, *Echinostoma echymiperæ* n. sp. (Digenea: Echinostomatidae) and *Vampirolepis peroryctis* n. sp. (Cestoda: Hymenolepididae). *Systematic Parasitology* 15: 223–237. <https://doi.org/10.1007/BF00010139>
- Jones, A., and T. J. C. Anderson. 1996. *Raillietina melomyos* n. sp. (Cestoda, Davaineidae) from mosaic-tailed rats in Papua New Guinea. *Systematic Parasitology* 33: 73–76. <https://doi.org/10.1007/BF01526635>
- Jones, A., and R. A. Bray. 1994. Family Davaineidae Braun, 1900. In *Keys to the Cestode Parasites of Vertebrates*, ed. L. F. Khalil, A. Jones and R. A. Bray. Wallingford: CAB International.
- Joyeux, C., and J. G. Baer. 1927. Etude de quelques cestodes provenant des colonies françaises d'Afrique et de Madagascar. *Annales de Parasitologie humaine et comparée* 5: 27–36. <https://doi.org/10.1051/parasite/1927051027>
- Lecompte, E., K. Aplin, C. Denys, F. Catzfelis, M. Chades, and P. Chevret. 2008. Phylogeny and biogeography of African Murinae based on mitochondrial and nuclear gene sequences, with a new tribal classification of the subfamily. *BMC Evolutionary Biology* 8 (199): 1–21. <https://doi.org/10.1186/1471-2148-8-199>
- Macnish, M. G., U. M. Morgan, J. M. Behnke, and R. C. A. Thompson. 2002a. Failure to infect laboratory rodent hosts with human isolates of *Rodentolepis* (= *Hymenolepis*) *nana*. *Journal of Helminthology* 76: 37–43. <https://doi.org/10.1079/JOH200198>
- Macnish, M. G., U. M. Morgan-Ryan, P. T. Monis, J. M. Behnke, and R. C. A. Thompson. 2002b. A molecular phylogeny of nuclear and mitochondrial sequences in *Hymenolepis nana* (Cestoda) supports the existence of cryptic species. *Parasitology* 125: 567–575. <https://doi.org/10.1017/S0031182002002366>
- Owen, I. L. 2005. Parasitic zoonoses in Papua New Guinea. *Journal of Helminthology* 79: 1–14. <https://doi.org/10.1079/JOH2004266>
- Owen, I. L. 2011. Parasites of animals in Papua New Guinea recorded at the National Veterinary Laboratory: a catalogue, historical review and zoogeographical affiliations. *Zootaxa* 3143: 1–163.
- Parona, C. 1897. Elminti raccolti dal Dott. Elio Modigliani alle isole Mentawai, Engano e Sumatra. *Annale del Museo Civico di Storia Naturale di Genova, serie 2*, 19 (39): 102–125.
- Pritchard, M. H., and G. O. W. Kruse. 1982. *The Collection and Preservation of Animal Parasites*. Lincoln, Nebraska: University of Nebraska Press.
- Rowe, K. C., M. L. Reno, D. M. Richmond, R. M. Adkins, and S. J. Steppan. 2008. Pliocene colonization and adaptive radiations in Australia and New Guinea (Sahul): multilocus systematics of the old endemic rodents (Murioidea: Murinae). *Molecular Phylogenetics and Evolution* 47: 84–101. <https://doi.org/10.1016/j.ympev.2008.01.001>
- Sandars, D. F. 1956. The first record of *Raillietina (Raillietina) celebensis* (Janicki, 1902), (Cestoda) in man from Australia, with a critical review of previous cases. *Journal of Helminthology* 30: 173–182. <https://doi.org/10.1017/S0022149X00033137>
- Sandars, D. F. 1957. Cestoda from *Rattus assimilis* (Gould, 1858) from Australia. *Journal of Helminthology* 31: 65–78. <https://doi.org/10.1017/S0022149X00033307>
- Sawada, I. 1964. On the genus *Raillietina* Fuhrmann, 1920 (I). *The Journal of Nara Gakugei University, Japan* 12: 19–36.
- Schmidt, G. D. 1986. *CRC Handbook of Tapeworm Identification*. Boca Raton, Florida, USA: CRC Press Inc.
- Shipley, A. E. 1908. Rats and their animal parasites. *Journal of Economic Biology* 3: 61–83.
- Singh, K. S. 1962. Parasitological survey of Kauman region. Part IX. *Indotaenia indica* n.g., n.sp. (Cestoda: Anoplocephalidae) from the Himalayan flying squirrel. *Indian Journal of Helminthology* 14: 86–91.
- Smales, L. R. 2006. A new acuariid species (Spirurida, Acuariidae) and other nematodes from *Hydromys* (Muridae, Hydromyinae) from Papua, Indonesia and Papua New Guinea. *Zootaxa* 1110: 27–37.
- Smales, L. R. 2009. Helminths of *Melomys rufescens* and *Melomys* spp. (Muridae: Hydromyinae) from Papua New Guinea with the descriptions of a new genus and five new species in the Heligmonellidae (Nematoda: Trichostrongyloidea). *The Raffles Bulletin of Zoology* 57: 5–15.
- Smales, L. R. 2012. Helminth parasites of hydromyine rodents from the island of New Guinea. In *Rodents: Habitat, Pathology and Environmental Impact*, ed. A. Triunver and D. Scalise. New York: Nova Scientific Publishers.
- Smales, L. R., A. K. Miller, and D. L. Obendorf. 1990. Parasites of the water rat, *Hydromys chrysogaster*, from Victoria and South Australia. *Australian Journal of Zoology* 37: 657–663. <https://doi.org/10.1071/ZO9890657>
- Smales, L. R., and D. M. Spratt. 2008. Helminth assemblages of *Uromys* spp. (Muridae: Hydromyinae) from Australia, Papua New Guinea and Papua Indonesia and comparison with assemblages in *Melomys* spp. *Australian Journal of Zoology* 56: 85–94. <https://doi.org/10.1071/ZO08011>
- Wilson, D. E., and D. M. Reeder. 2005. *Mammal Species of the World. A Taxonomic and Geographic Reference*, 3rd edition. Baltimore, USA: Johns Hopkins University Press.
- Xuan, D. P., C. L. Tran, and H. Hasegawa. 2001. Helminths collected from *Rattus* spp. in Bac Ninh Province, Vietnam. *Comparative Parasitology* 68: 261–264.
- Yamaguti, S. 1942. *Studies on the Helminth Fauna of Japan. Part 42. Cestodes of Mammals. II*. Tokyo: S. Yamaguti.
- Yamaguti, S. 1959. *Systema Helminthum. Vol. II. The Cestodes of Vertebrates*. New York & London: Interscience Publishers.