The anoplocephalid cestode parasites of the spectacled hare-wallaby, *Lagorchestes conspicillatus* Gould, 1842 (Marsupialia: Macropodidae)

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ABSTRACT

*Progamotaenia gynandrolinearis* sp. nov. is described from the small intestine of *Lagorchestes conspicillatus* Gould, 1842 from Barrow I., Western Australia. It is distinguished from other species by the small number of testes arranged in a single transverse row. *Progamotaenia lagorchestis* (Lewis, 1914) is redescribed. The name *Progamotaenia thylogale* sp. nov. is proposed for a second species described previously under the name *P. lagorchestis*. *Progamotaenia zschokkei* (Janicki, 1905), *Progamotaenia festiva* (Rudolphi, 1819) and *Progamotaenia villosa* (Lewis, 1914) were also found in *L. conspicillatus*.

The helminth fauna of the spectacled hare-wallaby, *Lagorchestes conspicillatus* Gould, 1842, is very poorly known (Mackerras, 1958), only a few species of anoplocephalid cestode having so far been reported from it (Lewis, 1914; Beveridge, 1976). The hare-wallaby occurs in widely scattered areas in the northern part of the Australian continent, but is abundant only on islands off the Western Australian coast (Ride, 1970). The present paper reports cestode collections made from Western Australia, as well as from northern Queensland. The material described includes a new species and also shows that in the past, two distinct species have been confused under the name *Progamotaenia lagorchestis* (Lewis, 1914).

MATERIALS AND METHODS

Specimens of *Lagorchestes conspicillatus* Gould, 1842 were trapped alive on Barrow I., Western Australia and were held in yards at the University of Western Australia for varying lengths of time. At autopsy some carcasses were examined fresh although most were frozen and examined later. Cestodes recovered were relaxed briefly in water and were fixed in 10% formol saline or 10% buffered formalin.

Further specimens of *L. conspicillatus* were shot by Dr. J. Nelson, Monash University, Melbourne, near Rubyvale, North Queensland. The carcasses were first perfused with 20% formol saline and the entire carcass was subsequently immersed in 10% formol saline. Cestodes were subsequently recovered in the laboratory.

Whole specimens were stained in acid carmine or Mayer’s haemalum and mounted in balsam. Scoleces, mature and gravid proglottides were embedded in paraffin and transverse, longitudinal and sagittal serial sections cut and stained with haematoxylin and eosin.

All measurements are in mm.

RESULTS

*Progamotaenia lagorchestis* (Lewis, 1914) (Figs. 1–7).

**Host:** *Lagorchestes conspicillatus*.

**Type Locality:** Hermite I., Monte Bello Is., Western Australia, whereabouts of types unknown.

**Material examined:** 10 specimens from 4 hosts, Barrow I., Western Australia. Collected by L. Hemsley.

**Specimens deposited:** South Australian Museum, Adelaide, Nos. V1322, V1323; British Museum (Natural History) No. 1977. 10.3.2.
Gravid specimens are 32–65 long and have a maximum width of 2–4. The scolex is unarmred but is divided into 4 bulbous lobes. Scolex diameter varies from 0.72–1.25 depending upon the degree of separation of the lobes. Each lobe bears an oval sucker 0.33–0.42 by 0.22–0.33 with a thick muscular wall which is incomplete at the anterior extremity. A distinct neck is present in a few specimens only and measures up to 0.15. In most specimens, segmentation begins immediately posterior to the suckers. Proglottides are craspedote and number 95–150 in gravid strobilae. The velum is fringed, forming 20–35 finger-like projections on each side of proglottis. The length of the fringes varies markedly between strobilae. In the majority of gravid strobilae, the fringe extends entirely over the adjacent proglottis, partially covering the next proglottis. In smaller specimens the fringe may only partially cover the adjacent proglottis.

The first mature proglottis is about the 50–60th, and mature proglottides measure 2.5–5.0 by 0.40–0.45. The first gravid proglottis is about the 100th, and gravid proglottides measure 2.7–3.6 by 0.45–0.60.

The longitudinal osmoregulatory canals are paired. The dorsal canal is narrow, measuring 0.02 in diameter in mature proglottides and lies lateral to the ventral canal. The ventral canal measures 0.04–0.10 in mature proglottides and 0.08–0.10 in gravid proglottides. A transverse canal measuring 0.03–0.04 in diameter connects left and right ventral canals at the posterior margin of each proglottis.

The longitudinal muscles form a broad band around the inner region of the cortex. Muscle bundles are arranged in radially directed pallisades, the bundles closest to the medulla having the greatest radial diameter (approx. 0.05 by 0.02) and containing a large number of fibres. Bundles in the outer zone are smaller (approx. 0.01 by 0.01) and contain 10 fibres or less. The transverse muscle consists of relatively few, fine fibres immediately internal to the longitudinal musculature.

The genital ducts pass the longitudinal osmoregulatory canals dorsally.

The genitalia are paired. The genital pores are situated in the posterior half of the lateral proglottis margin, dividing the margin in the approximate ratio of 2:1. A genital papilla frequently surrounds the pore. The genital atrium is shallow and is surrounded by a condensation of parenchymal tissue which appears as a darker staining zone in whole mounts.

The cirrus sac is elongate, measuring 0.38–0.65 by 0.05–0.12, and may extend to or beyond the longitudinal osmoregulatory canals, though in young proglottides or when the cirrus is everted, the cirrus sac may not extend as far as the canals. The cirrus is coiled when inverted and is armed with refractile spines. A small oval internal seminal vesicle is present. An external seminal vesicle is absent. The vas deferens is a straight duct passing medially, anterior to the seminal receptacle then turning laterally and dividing into numerous fine vasa efferentia in the vicinity of the testes. The vas deferens is seen dilated with sperm only in gravid or near-gravid proglottides. The testes are spherical, measure 0.03 in diameter and number 70–90 per proglottis. They are divided into 2 equal groups and lie close to the longitudinal osmoregulatory canals on each side of the strobila, anterior to the uterus and vas deferens. The testes are distributed in 2–5 horizontal and several dorso-ventral rows. They extend medially as far as the seminal receptacle or lateral border of the ovary, but never lie anterior or medial to the ovaries.

The vagina is a narrow, uncoiled tube which opens into the genital atrium posterior to the cirrus sac. The seminal receptacle which measures 0.13–0.25 by 0.19 is ovoid and is lateral and dorsal to the ovary. The genital anlagen first appears in the 10–16th proglottis and the seminal receptacle is sperm-filled in the 21–29th proglottis even though the other genital organs in the same proglottis are at a rudimentary stage of development. The ovary is composed of numerous lobules, measures 0.27–0.50 by 0.20–0.36 and lies on the ventral side of the medulla. The slightly lobulated vitellarium measures 0.11–0.15 by 0.05–0.11.
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and lies posterior and dorsal to the ovary. Mehlis' gland measures 0.07–0.08 in diameter and lies slightly medially to the vitellarium.

The uterus is paired in each proglottis. The undeveloped uterus consists of a transverse tube extending laterally from the ovary towards the lateral osmoregulatory canals. The mature uterus consists of a sac with numerous diverticula and extends laterally beyond the longitudinal osmoregulatory canals.

The egg is ellipsoidal and thin-shelled, measuring 0.045 by 0.022. The oncosphere measures 0.018 by 0.014 and is surrounded by a very thick oncospheral membrane. The oncospheral hooks are 0.008 long. A pyriform apparatus is absent.
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Progamotaenia gynandrolinearis sp. nov. (Figs. 8–16).

Host: Lagorchestes conspicillatus

Location in host: Small intestine.

Type locality: Barrow Island, Western Australia.

Material examined: 7 specimens. Collected by L. Hemsley.

Types deposited: South Australian Museum, Adelaide, holotype, No. V1315; 4 paratypes Nos. V1316–1319, serial sections, V1320; British Museum (Natural History) paratype No. 1977.10.3.1.

Gravid specimens are 23–26 long and have a maximum width of 2.5. The scolex is very large relative to the size of the worm and measures 2.1–2.5 in diameter. It is divided into 4 bulbous fleshy lobes into each of which is set an oval sucker measuring 0.93–1.10 by 0.90–0.93 cleft at its posterior extremity. In all specimens, the suckers appear to be retracted within the body of the scolex as the scolex forms irregular projections around the margins of the suckers. It is possible therefore that the scolex might be much larger in the fully relaxed state. The neck region is short or absent. Proglottides are craspedote and number 110–115 in gravid strobilae. The velum is very narrow and is straight-edged. The genital anlagen appears in the 2–4th proglottis, and maturity is reached in about the 20th proglottis. The first gravid proglottis is the 70–80th. Mature proglottides measure 1.5–2.4 by 0.08–0.12 and gravid proglottides 1.7–1.8 by 0.4–0.5.

The longitudinal musculature is poorly developed and is composed of a narrow circle of muscle fibres arranged either singly or in groups of 2 or 3. The transverse musculature consists of a few individual fibres lying internal to the longitudinal muscles. The fibres of the dorso-ventral muscle system are fine and are arranged in an irregular manner.

The longitudinal osmoregulatory canals are paired and narrow, both ventral and dorsal canals measuring approximately 0.01 in diameter. A transverse canal connects left and right ventral canals at the posterior margin of each proglottis. Minute canals make irregular connections between adjacent transverse canals across the width of the proglottis.

The genital ducts cross the longitudinal osmoregulatory canals dorsally.

The genitalia are paired. The genital atrium is very shallow, and is surrounded by a condensation of parenchymal tissue, appearing as a darker staining area in whole mounts.

The cirrus sac is elongate and extends beyond the longitudinal osmoregulatory canals. It measures 0.32–0.35 by 0.09–0.10. The cirrus is uncoiled and is armed with bristles. A short unarmed region surrounded by prostatic cells leads into an internal seminal vesicle which measures 0.07–0.15 by 0.03–0.08. A prominent external seminal vesicle measuring approx. 0.20 by 0.10 is present, from which a coiled vas deferens leads towards the proglottis centre, giving off minute vasa efferentia which lead to the testes. There are approx. 50 testes in each proglottis, measuring 0.06–0.09 in diameter. They are arranged in a single uninterrupted row, extending across the proglottis from left to right pairs of longitudinal osmoregulatory canals.

The vagina is thick-walled and opens to the genital atrium posterior to the cirrus sac. Medial to the external seminal vesicle, the vagina enlarges gradually to form a seminal receptacle measuring approx. 0.10 by 0.05. The ovary is an extremely elongate, mildly lobed organ measuring 0.12–0.35 by 0.04–0.10, extending, when fully developed, from the external seminal vesicle almost to the centre of the proglottis. The ovary is well developed by the 5–10th proglottis and involutes rapidly at about the 35th proglottis. The vitellarium measures 0.05–0.08 by 0.03–0.05 and is situated dorsal to the ovary. Mehlis’ gland, which measures only 0.03 in diameter is situated between the vitellarium and the external seminal vesicle. The uterus is paired in each proglottis and develops as a cord of cells anterior to the vitellarium and dorsal to the uterus. The uteri develop as paired transverse sacs with numerous small anterior and posterior diverticula, and rapidly cross the longitudinal osmoregulatory canals.
FIGS. 8–16. *P. gynandrolinearis* sp. nov.
(Scale lines: Figs. 8–11, 13, 0.1mm, Figs. 12, 14–16, 0.01mm.)

osmoregulatory canals to the proglottis margin. The 2 uteri eventually fuse in the midline and fill the proglottis obliterating all trace of other organs including the diverticula.

The egg is thin-shelled and spherical and measures 0.06 in diameter. An inner membrane is present. The oncosphere measures 0.011 by 0.014 and the oncospheral hooks 0.006. The oncosphere is surrounded by a pyriform apparatus, the body of which measures 0.023 by
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0.017. At its apex, the pyriform apparatus terminates in 2 or more reflected arms, each of which may be subdivided. The variation seen in the pyriform apparatus is shown in Figs. 14–16.

**Progamotaenia villosa** (Lewis, 1914)
- **Hosts:** Lagorcheses conspicillatus.
- **Location in hosts:** small intestine.
- **Material examined:** 65 specimens from Barrow I., Western Australia, collected by L. Hemsley. 40 specimens from Rubyvale, Queensland, collected by J. Nelson.
- **Material deposited:** specimens in British Museum (Natural History) Nos. 1977.10.3.3–12; South Australian Museum. No. V1321.

The new material conforms to the description given by Beveridge (1976).

**Progamotaenia zschokkei** (Janicki, 1905)
- **Host:** Lagorcheses conspicillatus.
- **Location in host:** small intestine.
- **Material examined:** 4 specimens, Rubyvale, Queensland, collected by J. Nelson.

The new material conforms to the description given by Beveridge (1976).

**Progamotaenia festiva** (Rudolphi, 1819)
- **Host:** Lagorcheses conspicillatus.
- **Location in host:** bile ducts.
- **Material examined:** fragmented specimens from 2 wallabies, Rubyvale, Queensland, collected by J. Nelson.

The species was previously reported from this host by Beveridge (1976).

**DISCUSSION**

The first anoplocephalid cestodes described from Lagorcheses conspicillatus were *Cittotaenia lagorchestis* Lewis, 1914, and *Cittotaenia villosa* Lewis, 1914, both of which were collected by P. D. Montague in 1912 on Hermite Island during a survey of the fauna of the Monte Bello Islands (Montague, 1914). *C. lagorchestis* was subsequently transferred to the genus *Progamotaenia* by Nybelin (1917) as was *C. villosa* by Beveridge (1976). The location of the type specimens is unknown and difficulties have been encountered in accurately identifying these species from other hosts and geographic areas (Beveridge, 1976). Beveridge (1976) suggested that it might be difficult to obtain further specimens from the type locality as the Monte Bello Islands have since been used for testing of atomic weapons. However, hare-wallabies had apparently become extinct on Hermite Island prior to 1952 when atomic weapon tests were carried out (Sheard, 1950). Subsequent visits to the islands have failed to discover existing populations (Serventy and Marshall, 1964; Burbidge, 1971). Consequently, the present collection of cestodes from Barrow Island, which is only 15 miles away from the Monte Bello group, is particularly valuable as there is no longer any possibility of making collections from the type locality itself.

*Progamotaenia lagorchestis* (Lewis, 1914) was redescribed by Beveridge (1976) based on material principally from three species of pademelon, *Thylogale thetis* (Lesson, 1827) *T. stigmatica* Gould, 1860 and *T. billardierii* (Desmarest, 1822), from eastern Australia. Working from Lewis’ original description (Lewis, 1914) there was little to distinguish *P. lagorchestis* from the cestodes found in pademelons and they were therefore assigned to this species. The new specimens described above differ distinctly from Beveridge’s (1976) redescription, principally in proglottis fringing, presence of proterogyny, distribution of testes and the morphology of the egg.

Lewis (1914) described the proglottis fringe as overlapping half the succeeding proglottis, although in the material now available, the fringe is usually much broader, entirely covering
the succeeding proglottis and extending over the next proglottis. The individual projections of the fringe are long and finger-like. In some immature specimens, the fringe extends only part of the way over the succeeding proglottis, as described by Lewis (1914) and its free margin is scalloped rather than developed into a series of finger-like projections. Although a variable character, in gravid specimens of *P. lagorchestis* from *L. conspicillatus* the proglottis fringing is generally much broader and bears much longer, narrower projections than specimens from *Thylogale* spp. formerly identified as *P. lagorchestis*.

The testes in specimens from *L. conspicillatus* are restricted to the area lateral to the seminal vesicle and do not usually reach the lateral margin of the ovary. By contrast, in specimens from *Thylogale* spp. the testes extend medially to the seminal receptacle, as far as the medial margin of the ovary. Lewis (1914) described the testes as “confined to the dorsal region between the ventral excretory canal and the inner termination of the cirrus sac”. The present description does not support Lewis’ observation since in the specimens examined, the cirrus sac rarely crosses the longitudinal osmoregulatory canals. Lewis (1914) noted that in *P. lagorchestis*, insemination and filling of the seminal receptacle preceded the maturation of the other reproductive organs and that the vagina atrophied from the distal end following insemination. The new material examined conforms to the original description. In specimens from *Thylogale* spp., described by Beveridge (1976), insemination occurred at the same time as the proglottis matured and was followed by vaginal atrophy. Beveridge (1976) concluded that in several species (*Progamaotenia zschokkiei* (Janicki, 1906) and *P. diaphana* (Zschokke, 1907)) the degree of proterogyny was variable; however, the conclusion is not supported by present observations in which the two series of specimens show consistent differences.

The eggs of the majority of species of *Progamaotenia* have a characteristic pyriform apparatus which terminates in a number of reflexed filaments (Beveridge, 1976), including cestodes from *Thylogale* spp. currently identified as *P. lagorchestis*. Lewis (1914) stated that the pyriform apparatus was absent in *P. lagorchestis* but did not describe the egg in detail. As described above, the egg of *P. lagorchestis* is distinct from that of every other species in the genus in general shape and in completely lacking a pyriform apparatus. The eggs described contained fully developed oncospheres and were taken from the terminal proglottides of the largest specimens which were obviously apolytic so it seems unlikely that the absence of a pyriform apparatus could be due to the immaturity of the egg. In other species of *Progamaotenia* even immature eggs have a pair of bud-like projections on one pole of the pyriform apparatus (Beveridge, 1976).

There are other minor features which depart from the original description. Lewis (1914) described a sphincter surrounding the genital atrium of *P. lagorchestis*. The interpretation of this structure was discussed by Beveridge (1976), in relationship to other species. The conclusion reached is also applicable to the new specimens from *Lagorchestes conspicillatus* and the structure does not warrant the term “sphincter”.

It is evident therefore, that in the past two very similar yet distinct species have been confused under the name *P. lagorchestis* (Lewis, 1914). The original species is redescribed above and is known only from the single host species *Lagorchestes conspicillatus*. The specimens described by Beveridge (1976) as belonging to *P. lagorchestis* represent an unnamed species for which we propose the new name *Progamaotenia thylogale* sp. nov. since the species occurs predominantly in pademelons of the genus *Thylogale* as well as in *Macropus rufogriseus* (Desmarest, 1817) (see Beveridge, 1976).

We here designate *Thylogale billardierii* (Desmarest, 1822) as the type host, and Launceston, Tasmania as the type locality. The holotype (collected by B. L. Munday on 23 October 1972) is deposited in the South Australian Museum, No. V783. A paratype bearing the same collection data is deposited in the same museum (No. V784). Further
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Paratypes are deposited in the British Museum (Natural History) No. 1977.4.4.77–80. 

*Progamotaenia lagorchestis* was present in 3 or 5 specimens of *L. conspicillatus* collected on Barrow I., but was absent in the 2 specimens from North Queensland. It was not present amongst the material previously available (Beveridge 1976), also originating from north Queensland.

*P. gynandrolinearis* sp.nov. is a small species with a relatively enormous, fleshy scolex. Grossly, it is most similar to *Progamotaenia proterogyna* (Fuhrmann, 1932) though it is readily distinguishable both from this species and other members of the genus since the testes are few in number and are distributed in a single transverse row. The seminal receptacle is quite small in *P. gynandrolinearis* and contrasts sharply with other species of the genus, except *Progamotaenia bancrofti* (Johnston, 1912). The new species does not conform precisely to Beveridge’s (1976) definition of the genus *Progamotaenia* since the testes are not confined to the area anterior to the uteri. However, in other respects (uteri, eggs) it is a typical member of the genus.

*Cittotaenia villosa* Lewis, 1914 was removed to the genus *Progamotaenia* Nybelin, 1917 by Beveridge (1976) based on a redescription of specimens from *L. conspicillatus* from northern Queensland. In the absence of the type specimens, Beveridge (1976) concluded that Lewis’ (1914) description contained a number of serious errors, but that the Queensland specimens almost certainly belonged to the species and as such should be transferred to the genus *Progamotaenia*. The new material from Barrow I. conforms to Beveridge’s redescription (Beveridge, 1976) and thereby substantiates the position of the species in the genus *Progamotaenia* as well as the assumption that Lewis’ original description was faulty.

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