

**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)**

L. R. Smales

Parasitology Section, South Australian Museum, North Terrace, Adelaide, South Australia 5000, Australia

Email: l.warner@cqu.edu.au

ABSTRACT. – A cestode, a trematode and 14 nematodes, including five new species in the Heligmonellidae (Trichostrongyloidea), were collected from the digestive tracts of 25 *Melomys rufescens* (Rodentia: Hydromyinae) from Papua New Guinea. Of these *Heligmonoides mirzai*, new species, is nearest to *H. bulbosus* in the form of the synophe but is distinguished by males with longer spicules and females with a praepuce and a spiked tail tip. *Melomystrongylus sepikensis*, new genus, new species, differs from all other heligmonellids in having a single hypertrophied ventral ridge extending from the excretory pore along the anterior third of the body. *Odilia similis*, new species, is allied to *O. maxomyos*, *O. praeputialis*, *O. polyrhabdote*, and *O. uromyos* in the number of ridges in the midbody but differs in having a spicule to body length ratio of 1:6.5 and a blunt conical female tail. *Odilia* species 1, tiny male worms with 16–18 ridges in the synophe and spicules 260–280 µm long, could not be characterised further because there was insufficient material available. *Paraheligmonelloides singauwaensis*, new species, resembles *P. triangulus* but has longer spicules and smaller eggs. Overall the composition of the helminth assemblage found in *M. rufescens* resembled neither that of *M. lutillus* (also from Papua New Guinea) nor those of *M. burtoni* or *M. cf. burtoni* from Australia but was indicative of closer relationships with the helminths found in Indonesian and Malaysian rodent hosts.

KEY WORDS. – Papua New Guinea, Muridae, *Melomys*, Heligmonellidae, *Odilia*, *Paraheligmonelloides*, *Melomystrongylus*.

INTRODUCTION

The endemic Australasian rodent tribe, the Uromyini (Muridae: Hydromyinae), is a heterogeneous clade of primarily herbivorous murids with medium to large eyes and sparsely haired tails (Flannery, 1995). Assumed to have been derived from the earliest murid invasion of the island of New Guinea, uromyin ancestors may have arrived, from Southeast Asia, during the Miocene Epoch (10–15 million years ago (mya) when the region consisted of no more than an island archipelago (Holloway & Hall, 1988). Subsequently, representatives of at least one genus, *Melomys* (Thomas, 1922), may have travelled to Australia during the Pleistocene 0.02–0.04 mya across the land-bridges formed during that time (Flannery, 1995; Godthelp, 2001). Following revision by Menzies (1996) the genus now comprises four species from New Guinea, including *Melomys rufescens* (Alston, 1877) (the first rodent species from New Guinea to be described), four species from Australia and 13 extralimital species (Duff & Lawson, 2004).

Melomys rufescens is widespread across lowland New Guinea and is also found in areas of disturbed vegetation at higher altitudes (Flannery, 1995). Little is known about the helminth fauna of *Melomys* species in New Guinea, with four species of nematode and one cestode reported from *Melomys lutillus* (Thomas, 1913) (see Smales, 2005a) but none from *M. rufescens*.

This study was undertaken to report on the helminth fauna of the digestive tract of *M. rufescens* and to compare it with that of *M. lutillus* and with that of the closely related Australian representatives of the genus, *Melomys burtoni* (Ramsay, 1887) and *Melomys cf. burtoni* (see Menzies, 1996), whose helminths have been documented (Smales, 2005a).

MATERIALS AND METHODS

The digestive tracts from the bodies of 23 *M. rufescens*, and 10 *Melomys*, not identified to species level and not including *M. lutillus*, previously collected from Papua New Guinea,

fixed in 5–10% formalin and stored in 70% ethanol, were examined for helminths. Additional specimens dissected from two individuals of *M. rufescens* were also studied.

The following list is of 16 localities where hosts (with the number of individuals in parentheses) were collected. Latitude and longitude are given where they were recorded or where they can reasonably be estimated from the locality data available.

***Melomys rufescens*.** – Yapsiei area, 4° 35'S 141°5'E (1); 2km S Mt Samoro, West Sepik (1); Sanduan Province: Sideia Mission, 10°32'S 150°48' E (2); Milne Bay Province: NNW slopes Mt. Boravi, 6°35'S 142°52'E (1); Southern Highlands Province: Jumbora Plantation, Popondetta, 8°46'S 148°14'E (1); Oro Province: Aribaa Village, 13 miles (21 km) E Chuave, 6°06'S 144°56'E (1); Doido Village, Mt Karimui, 6°32' S 142°52'E (1); Yuro Village (1); Chimbu Province: Western Highlands Province, no further data (1); 12 km NW Tep Tep, 5°57'S 146°05'E (3); Wanuma, 4°54'S 145°19'E (2); Madang Province: Kalolo (4); 10 km W Bulolo, 7°12'S 146°39' E (3); Minava Village, Watut, 6°50'S 146°2'E (1); 14 miles (23 km) NW Nauti Village, 7°15'S 146°13'E (1); Singauwa River, Lae, 6°07'S 146°59'E (1); Morobe Province.

***Melomys species*.** – Boulder Camp, Goodenough Island 9°21'S 150°16'E (2); Munimun Village, Aguan, 9°53'S 149°23'E (4); Sanduan Province: Dokfuma Star Mountains 5°01'S 141°07'E (2); Milne Bay Province: Aru Island, 6°10'S 134°30'E (2).

All helminths recovered from the digestive tracts were stored in 70% ethanol. Prior to microscopical examination nematodes were cleared in lactophenol and examined as temporary wet mounts; cestodes were stained in celestine blue, dehydrated in ethanol, cleared in methyl salicylate and mounted in Canada balsam. Transverse sections were prepared by cutting by hand using a cataract scalpel and mounting in polyvinyl lactophenol and spicules were mounted in Berlese's medium, for detailed study. Figures were prepared with the aid of a drawing tube and measurements, in micrometres unless otherwise stated, given as the range followed by the mean in parentheses, were taken using an ocular micrometer. Terminology of hosts follows Flannery (1995) and Menzies (1996) and parasites Durette-Desset (1983, 1985).

All specimens have been returned to their home institutions, the Bernice Bishop Museum, Honolulu, Hawaii (BBM) or the Australian Museum, Sydney, Australia (AM), or the South Australian Museum, Adelaide, Australia (SAM).

All measurements are in micrometres (µm) except for lengths which are given in millimetres (mm).

RESULTS

Two platyhelminths, a cestode and trematode, and 14 nematodes were identified, to species level where possible, from 22 of 25 *M. rufescens* (Table 1). The trematode fragments, the capillariid nematode, *Capillaria* sensu lato, the larval heligmonellids and a single female heligmonellid could not be identified further, nor was there sufficient material to fully characterise one of the two species of *Odilia* described below. All are new host records.

The cestode, *Raillietina celebensis*, occurs across the region from Indonesia, Papua, Papua New Guinea to Australia, in a range of murid hosts.

Of the nematodes, the spirurid *Protospirura kainiensis*, and the oxyurid *Syphacia longicauda* have been described from New Guinean hosts, the heterakid, *Heterakis spumosa* is a cosmopolitan species that has previously been recorded from the Island of New Guinea and the chabertiid, *Cyclodontostomum purvisi*, although previously noted from Indonesia and Australia, is a new record for New Guinea.

The dominant nematode group, the trichostrongyloids, were represented by the heligmonellids *Nippostrongylus brasiliensis*, a cosmopolitan species but a new record for New Guinea, *Odilia mackerrasae* previously recorded from Australia and New Guinea and *Macrostrongylus ingens*, known only from New Guinean hosts as well as the trichostrongylid *Peramelistrongylus* sp. previously recorded from Australia and New Guinea. New species of the Heligmonellidae from the genera *Heligmonoides*, *Odilia* and *Paraheligmonelloides* were found and together with a new genus, *Melomystrongylus*, are described below.

One *Melomys* sp. was infected with the new species of *Heligmonoides*, one with the new species of *Odilia* and five with the new genus, *Melomystrongylus*.

TAXONOMY

Heligmonoides mirzai, new species

(Figs. 1–14)

Material examined. – Holotype male and allotype female: BBM-NG-99529, from the small intestine of *Melomys rufescens* (Muridae: Hydromyinae), type host, Nauti Village, 7°15'S 146°13'E, Morobe Province, Papua New Guinea, coll. A. B. Mirza, 10 Oct.1970.

Paratypes: 12 males, 12 females, SAM AHC34783; collection data as above.

Voucher specimens: BBM NG- 97928 1 male, 2 females from the small intestine of *Melomys rufescens*, Minava Village, Watut, 6°50'S 146°21'E, Morobe Province, coll. A. B. Mirza, 23 Oct.1969; AM W32620, 2 males, 3 females from small intestine of *Melomys rufescens*, Yapsiei area, 4°35'S 141°5'E, Sanduan Province, coll. T. Flannery, 17 Jan.1984; 1 male, 2 females, AM W32625 from the small intestine of *Melomys species*, Dokfuma Star Mountains

Table 1. Helminth parasites from 25 *Melomys rufescens* from Papua New Guinea.

Taxon	Site in host	Prevalence %
Cestoda		
Davaineidae		
<i>Raillietina celebensis</i> (Janicki, 1902)	Small intestine	4.0
Trematoda		
fragments	Small intestine	4.0
Nematoda		
Capillariidae		
<i>Capillaria</i> sensu lato	Small intestine	4.0
Chabertiidae		
<i>Cyclodontostomum purvisi</i> Adams, 1933	Caecum	16.0
Heligmonellidae		
<i>Heligmonoides mirzai</i> , new species	Small intestine	20.0
<i>Macrostrongylus ingens</i> Smales, 2008	Small intestine	24.0
<i>Melomyostrongylus sepikensis</i> , new species	Small intestine	20.0
<i>Nippostrongylus brasiliensis</i> (Travassos, 1919)	Small intestine	4.0
<i>Odilia mackerrasae</i> (Mawson, 1961)	Small intestine	16.0
<i>Odilia similis</i> , new species	Small intestine	16.0
<i>Odilia</i> sp.	Small intestine	4.0
<i>Parahelimonoides singauwaensis</i> , new species	Small intestine	4.0
heligmonellid larvae	Small intestine	12.0
heligmonellid species	Small intestine	4.0
Heterakiidae		
<i>Heterakis spumosa</i> (Schneider, 1866)	Caecum	4.0
Oxyuridae		
<i>Syphacia longaecauda</i> Smales, 2001	Caecum	20.0
Spiruridae		
<i>Protopirura kainiensis</i> Smales, 2001	Stomach	4.0
Trichostrongylidae		
<i>Peramelistrongylus</i> sp.	Small intestine	24.0

5°01'S 141°07'E, West Sepik, Sanduan Province, coll. T. Flannery, 5 Apr. 1984.

Prevalence. – A total of 5 of 25 *M. rufescens* and 1 of 10 *Melomys* spp.

Etymology. – The species name is in recognition of the extensive collecting done by A. B. Mirza in the 1960s and 1970s in New Guinea.

Description. – Small coiled worms; prominent cephalic vesicle present; buccal capsule vestigial. Mouth opening triangular with rudimentary lips; labial and cephalic papillae not observed. Oesophagus claviform. Nerve ring surrounds oesophagus at about middle third; deirids and excretory pore at about same level, posterior to nerve ring. Synlophes of pointed longitudinal cuticular ridges extends from the posterior margin of the cephalic vesicle to level of spicules or vulva; 16–18 ridges in anterior, 21–24 in midbody. Axis of orientation of ridges passing from ventral right to dorsal left side, inclined about 75° from sagittal axis; 10–12 ridges dorsal side, 11–12 ridges ventral side in midbody. Ridges 1, 1' large but not thickened basally, together with ridges 2, 2' form a carene of type B. Ridges 3–7 decreasing in size, ridges 8–10 increasing in size, ridge 11 smaller; ridges 3'–8' increasing in size, ridges 9'–11' decreasing in size. Posterior region of body with 19–20 (male) 20–21 (female) ridges reduced in size; 10–11 dorsal side, 9–10 ventral side ridges.

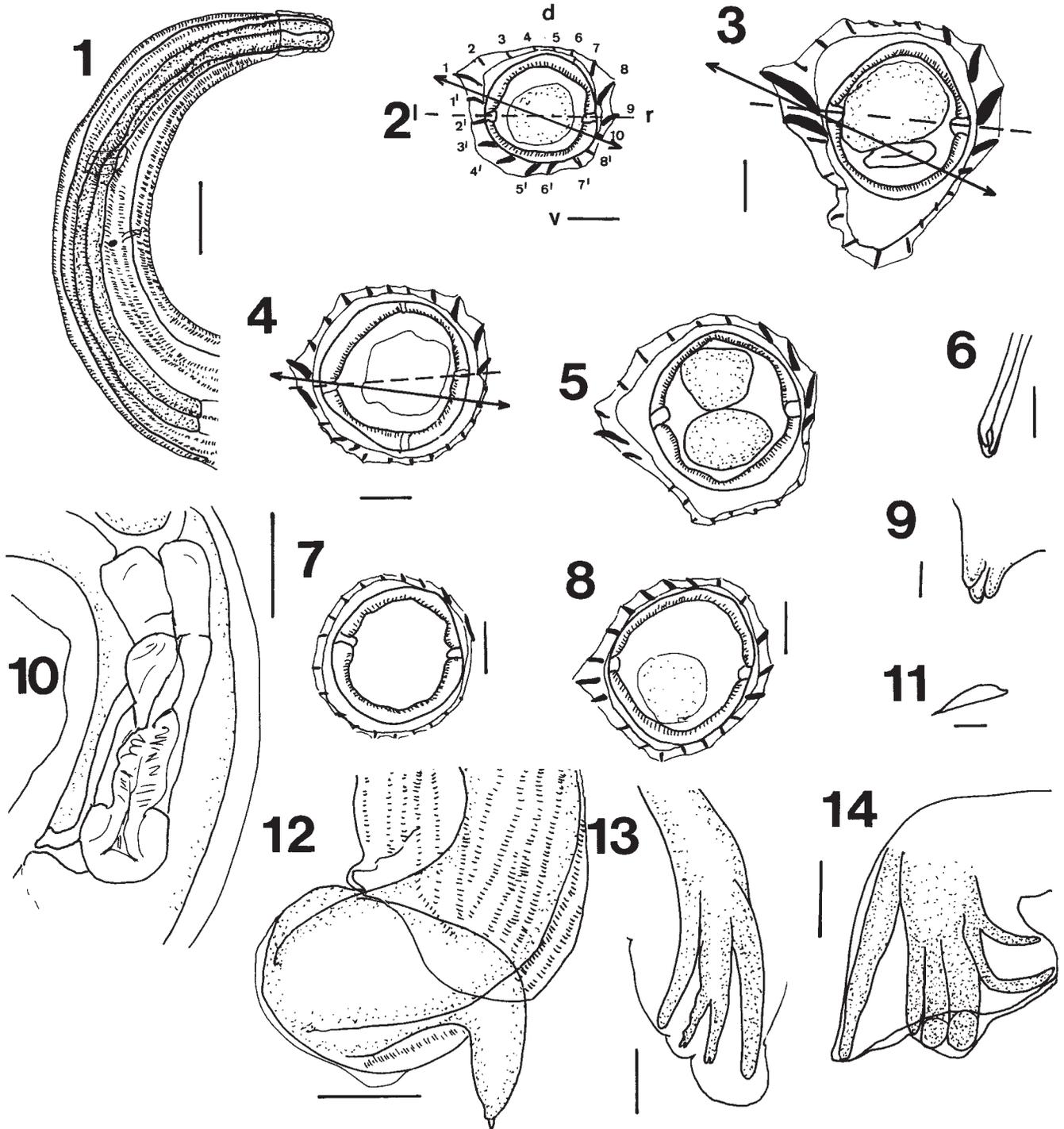
Male (holotype and 9 paratypes): Length 2.2–3.3 (2.8) mm, maximum width 83–107 (90). Cephalic vesicle 36–46 (39.25) long. Oesophagus 350–550 (420) long; nerve ring 145 from cephalic end. Bursa asymmetrical, left lobe larger, rays of left lobe more robust; without dorsal median notch. Dorsal ray symmetrical; divided at about half its length, each branch dividing again at distal tip; terminal divisions, rays 9, 10 symmetrical; rays 8 arising at same level proximally to division of dorsal ray, left ray 8 slightly more robust than right. Rays 4, 5, 6 with common stem, reaching margin of bursa, rays 6 more slender than rays 4, 5. Rays 2, 3 with common stem, widely divergent distally, rays 3 longer than rays 2. Genital cone short, lightly sclerotized, ventral lobe with unpaired papillae 0, dorsal lip bifid, each lobe with single papilla 7. Spicules equal, filiform, proximal ends rounded, distal tips simple, straight, 250–320 (275) long. Gubernaculum 27 long.

Female (allotype and 9 paratypes): Length 2.95–3.7 (3.4) mm, maximum width 99–107 (104). Cephalic vesicle 42.0–49.5 (45) long. Oesophagus 350–400 (380) long; nerve ring 190, 220, excretory pore 250, 280 deirids 250, 280 from cephalic end. Posterior end twisted and flexed ventrally, with praepuce in mature worms; vulva opening about 100 from tail tip. Monodelphic; ovejector with sphincter, 95, longer than vestibule 40, and infundibulum, 45. Tail conical, tip with spike 39.5–55 (48.5) long. Eggs thin-shelled, ellipsoidal, in utero 51–69 (57) by 30–36 (33.8).

Remarks. – Despite the fact that much of the material had been fixed in the hosts in situ, making it difficult to discern the morphology of the anterior end of the worms, it could be seen that *Heligmonoides mirzai*, new species, has most of the morphological features of the genus *Heligmonoides* and resembles *H. bulbosus* Ow Yang et al., 1983, in the number and arrangement of the ridges on the synlophes (Ow Yang et al., 1983, Fig 11A, B). *Heligmonoides mirzai*, new

species, differs from *H. bulbosus* in spicule length (250–320 compared with 92–100), the proportions of the dorsal ray, the length of rays 3 and the shape of the female posterior end, with a praepuce and spiked tail tip.

Hasegawa & Syafruddin (1994a) originally described *Maxomystrongylus musseri* as *Heligmonoides musseri*, noting that it most closely resembled *H. bulbosus*, particularly in



Figs. 1–14. *Heligmonoides mirzai*, new species, from *Melomys rufescens* and *Melomys* sp. from Papua New Guinea: 1, female anterior end, lateral view; 2, male cross section, anterior body; 3, female cross section, anterior body; 4, male cross section, midbody; 5, female cross section, midbody; 6, spicule tips; 7, male cross section, posterior body; 8, female cross section, posterior body; 9, genital cone, dorsal view; 10, ovejector, lateral view; 11, gubernaculum, lateral view; 12, female posterior end, lateral view; 13, dorsal ray; 14, bursa, left lateral view. Scale bars: 1, 10, 11, 14 = 50 μ m; 2–5, 7, 8, 12 = 25 μ m; 6 = 10 μ m; 9, 13 = 12.5 μ m.

the features of the carene; supported by 3–4 slender ridges lacking thickened roots. Subsequently these authors erected the new genus *Maxomystrongylus* Hasegawa & Syafruddin, 1997, and transferred *H. musseri* into it on the basis of the characters of the synlophe discussed above, having the division of the dorsal ray distal to the derivation of rays 8 and a vagina vera with a unilateral diverticulum (Hasegawa & Syafruddin, 1994a). Further they commented that the systematic relationship between *H. bulbosus* and *Maxomystrongylus* remained unclear. Although *H. mirzai*, new species, has characters of the synlophe and a form of the dorsal ray consistent with *Maxomystrongylus*, it does not have a unilateral diverticulum of the vagina. Consequently it has been placed in the genus *Heligmonoides* together with the other Southeast Asian representatives of the genus, *H. bulbosus* and *H. lanceolatus* Ow Yang et al., 1983, pro tem. A revision of the heligmonellid genera from the Oriental and Australasian regions is needed to resolve the relationship between *Heligmonoides* and *Maxomystrongylus* and the systematic position of the Australasian species.

Melomystrongylus, new genus

Diagnosis. – Trichostrongyloidea: Heligmonellidae: Nippostrongylineae. Synlophe well developed with pointed ridges; in midbody axis of orientation of ridges passing through ventral right and dorsal left sides inclined about 65° from sagittal axis in anterior body, lacking clear orientation in mid and hind body. Ventral ridge 5' hypertrophied anteriorly. Bursa asymmetrical with larger left lobe. Dorsal ray divided distal to level of branching of rays 8 from dorsal trunk. Parasites of hydromyine murids.

Type species. – *Melomystrongylus sepikensis*, new species.

Melomystrongylus sepikensis, new species

(Figs. 15–28)

Material examined. – Holotype male and allotype female: BBM-NG-104657B, from the small intestine of *Melomys rufescens* (Muridae: Hydromyinae) type host, 2 km south of Mt Samoro, West Sepik, Sanduan Province, Papua New Guinea, coll. A. B. Mirza, 10 May 1975.

Paratypes: 2 males, 5 females BBM-NG-105128B, from small intestine *Melomys rufescens*, 12 km northwest of Tep Tep, 5°57'S 146°05'E, Madang Province, coll. A. B. Mirza, 2 Dec.1975.

Voucher specimens: 4 males, 1 female BBM-NG-105155B, 5 females, 1 male, BBM-NG-105156B, from the small intestine of *Melomys rufescens*, 12 km northwest of Tep Tep, 5°57'S 146°05'E, Madang Province, coll. A. B. Mirza, 2 Dec.1975; 1 female, BBM-NG-103717, Wanuma, 4°54'S 145°19'E, Madang Province, coll. A. B. Mirza, 3 Feb.1974; 1 male, 2 females, AM W32617, from the small intestine of *Melomys rufescens*, Sideia Mission, 10°32'S 150°48'E, Milne Bay Province, coll. G. Hangay 31 Dec.1988; 3 males, 8 females, AM W32557, from the small intestine of

Melomys sp., Munimun Village, Aguan, 9°53'S 149°23'E, coll. P. German, 8 Aug.1992; 1 female, AM W32558, from the caecum of *Melomys* sp., Boulder Camp, Goodenough Island, 9°21'S 150°16'E, Sanduan Province, coll. T. Ennis, 25 Aug.1987; 2 females, AM W32559 from the small intestine of *Melomys* sp., Boulder Camp, Goodenough Island, 9°21'S 150°16'E, Sanduan Province, coll. T. Ennis, 25 Aug.1987; AM W32626, 5 males, from the small intestine of *Melomys* sp., Dokfuma Star Mountains 5°01'S 141°07'E, Milne Bay Province, coll. T. Flannery, 5 May 1987.

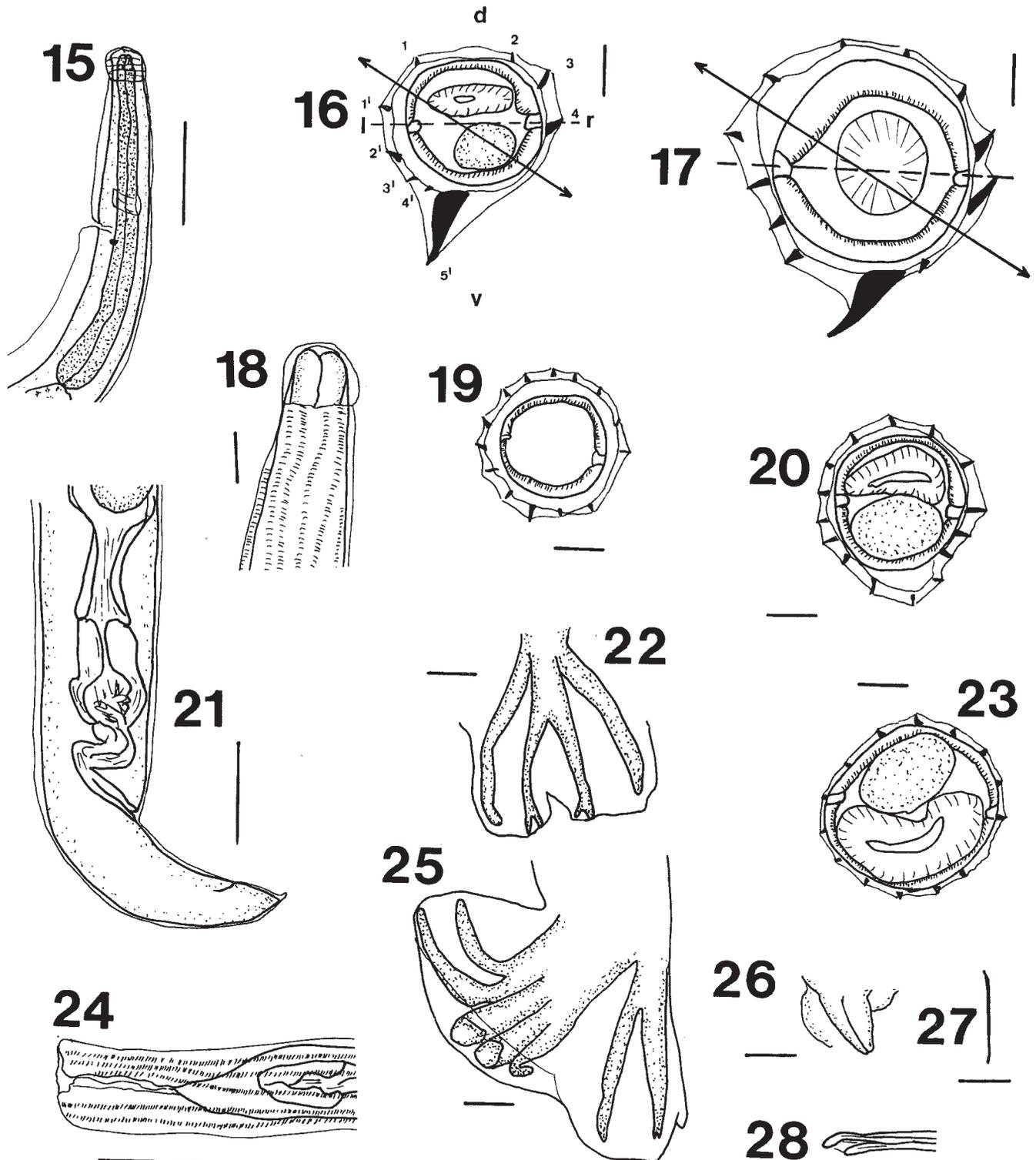
Prevalence. – A total of 5 of 25 *M. rufescens* and 3 of 10 *Melomys* spp.

Etymology. – The species name reflects the locality in which this nematode is found.

Description. – Relatively robust worms; prominent cephalic vesicle present; buccal capsule vestigial. Mouth opening triangular with rudimentary lips; surrounded by 4 cephalic papillae and 2 amphids; labial papillae not observed. Oesophagus claviform. Nerve ring surrounds oesophagus at about a third its length, digitiform deirids and excretory pore at about same level, posterior to nerve ring. Synlophe of continuous longitudinal pointed cuticular ridges extends from the posterior margin of the cephalic vesicle to just anterior to the bursa or vulva; 8–14 ridges in anterior, 14–16 in midbody. Axis of orientation passing from ventral right to dorsal left sides, inclined about 65° to sagittal axis in anterior body; 4–8 ridges dorsal side, 4–8 ridges ventral side. Ridges 1–6 decreasing in size; ridges 1'–4' decreasing in size, ridge 5' largest, ridges 6'–8' decreasing in size. Posterior region of body with 15 (male) 10–14 (female) ridges reduced in size with no clear axis of orientation; 7–8 (male), 6–7 (female) ridges dorsal side, 8 (male), 7–9 (female) ridges ventral side.

Male (holotype, 2 paratypes and 7 vouchers): Length 3.2–4.3 (3.8) mm, maximum width 82.5–99 (90.5). Cephalic vesicle 20.5–42.5 (33) long, 34–39 (37) wide. Oesophagus 280–355 (322) long; excretory pore 169–221 (186), deirids 204 from cephalic end. Bursa slightly asymmetrical, left lobe larger; dorsal lobe with median dorsal notch. Dorsal ray symmetrical, divided at about half its length, each branch dividing again at distal tip; terminal divisions, rays 9, 10 symmetrical; rays 8 arising at same level proximal to division of dorsal ray, right ray 8 slightly longer than left. Rays 4, 5, 6 with common stem, reaching margin of bursa, rays 6, more slender, curving anteriorly, rays 4, 5 curving posteriorly. Rays 2, 3 with common stem, dividing into 2 widely divergent branches, curving posteriorly, reaching margin of bursa. Genital cone slightly extended, lightly sclerotized, ventral lobe with unpaired papilla 0 and dorsal lip with paired papillae 7. Spicules equal, filiform, tips pointed, 450–660 (610) long. Gubernaculum forming thin plate 38–56 (43) long.

Female (allotype, 4 paratypes and 5 vouchers): Length 3.9–5.5 (4.6) mm, maximum width 80–114 (100). Cephalic vesicle 29.5–39.5 (30) long, 33–46 (35.5) wide. Oesophagus



Figs. 15–28. *Melomystrongylus sepikensis*, new genus, new species, from *Melomys rufescens* and *Melomys* spp. from Papua New Guinea: 15, female anterior end, lateral view; 16, male cross section, anterior body; 17, female cross section, anterior body; 18, female cephalic end, lateral view showing synophe; 19, male cross section, midbody; 20, female cross section, midbody; 21, female posterior end, lateral view showing ovejector; 22, dorsal ray; 23, female cross section, posterior end; 24, female posterior end, ventral view showing well developed praepuce; 25, bursa, left lobe, lateral view; 26, genital cone, lateral view; 27, gubernaculum, lateral view; 28, spicule tips. Scale bars: 15, 24 = 100 μ m; 16, 18–20, 22, 23, 25–28 = 25 μ m; 17 = 20 μ m; 21 = 50 μ m.

310–390 (345) long; nerve ring 150, excretory pore 145–248 (216), deirids 145–248 (216) from cephalic end. Vulva with prominent lips, opens 60–115 (95) from tail tip. Body wall extends over vulva and tail as praepuce in mature specimens. Monodelphic; ovejector with infundibulum, 90–100, longer than vestibule, 60–80, sphincter 30, 50, shortest element. Tail conical, tip rounded, reflected ventrally, 29–42.5 (35) long. Eggs thin-shelled, ellipsoidal, in utero 49–66 (57) by 30–39 (34).

Remarks. – *Melomstrongylus* new genus has all the characteristics of the subfamily Nippostrongylinae (see Durette-Desset, 1985). Lacking a carene and with a hypertrophied ventral ridge *Melomstrongylus* resembles *Hasanuddinia* Hasegawa & Syafruddin, 1994. It can be readily distinguished from *Hasanuddinia* in that it has a single hypertrophied ventral ridge beginning from the excretory pore and ending in the anterior third of the body. *Melomstrongylus* has smaller similar sized ridges showing no clear axis of orientation in the mid and posterior body while the axis of orientation of the ridges is maintained along the whole length of the body in *Hasanuddinia* (see Hasegawa & Syafruddin, 1994a). The gradient of ridge size in the anterior body in *Melomstrongylus* is from right to left (excepting ridge 5), but in *Hasanuddinia* it is from left to right.

Odilia similis, new species

(Figs. 29–38)

Material examined. – Holotype male and allotype female: BBM-NG-53130, from the small intestine of *Melomys rufescens* (Muridae: Hydromyinae), type host, Kalolo, Morobe Province, Papua New Guinea, coll. O. R. & J. W. Wilkes, 28 Aug. 1966

Paratypes: 1 male, 2 females, SAM AHC34782; collecting data as above.

Voucher specimens: 2 males, 3 females, BBM-NG-54020 & 20 males, 18 females, BBM-NG- 53691, from the small intestine of *Melomys rufescens*, 10 km west of Bulolo, 7°12'S 146°39'E, Morobe Province, coll. A. C. Zeigler, 7 Aug. 1967; 3 males, 2 females, AM W31470, from the small intestine of *Melomys rufescens*, Munimun Village, Aguan, 9°53'S 149°23'E Sanduan Province, coll. P. German, 8 Aug. 1992.

Prevalence. – Four of 25 *M. rufescens* and one of 10 *Melomys* spp.

Etymology. – The species name indicates that whilst having a unique set of characters there are no singular morphological features to highlight.

Description. – Small coiled worms; prominent cephalic vesicle present; buccal capsule vestigial. Mouth opening triangular with rudimentary lips; labial and cephalic papillae not observed. Oesophagus claviform. Nerve ring surrounds oesophagus in middle third, deirids and excretory pore at about same level, posterior to nerve ring. Synlophe of longitudinal cuticular ridges extends from the posterior margin of the cephalic vesicle to just anterior to the bursa or

vulva; 35–37 ridges in anterior, 35 in midbody of male. Axis of orientation from ventral right to dorsal left sides, inclined about 60° from sagittal axis. Ridges 1–16 increasing slightly in size; ridges 1'–10' increasing in size, ridges 11'–21' smaller. Posterior region of body with 28–30 ridges reduced in size; 20 ridges dorsal side, 8–10 ridges ventral side.

Male (holotype and 9 paratypes): Length 2.1–3.2 (2.5) mm, maximum width 67–100 (84). Cephalic vesicle 39.5–49.5 (43) long, 23–29.5 (27) wide. Oesophagus 320–520 (390) long; nerve ring 130, excretory pore 180, deirids 180 from cephalic end. Bursa slightly asymmetrical, right lobe larger, rays of right lobe more robust; without dorsal median dorsal notch. Dorsal ray symmetrical, divided at about half its length, each branch dividing again at distal tip; terminal divisions, rays 9, 10 symmetrical; rays 8 arising at same level proximally to division of dorsal ray, right ray 8 slightly more robust than left. Rays 4, 5, 6 with common stem, reaching margin of bursa, rays 6 curving anteriorly, rays 4, 5 curving posteriorly. Rays 2, 3 with common stem, diverging distally, curving posteriorly, reaching margins of bursa. Genital cone short, lightly sclerotized, with papillae 0 and 7. Spicules equal, filiform, tips simple, sharply curved, 340–450 (390) long. Gubernaculum 37–41 (39) long.

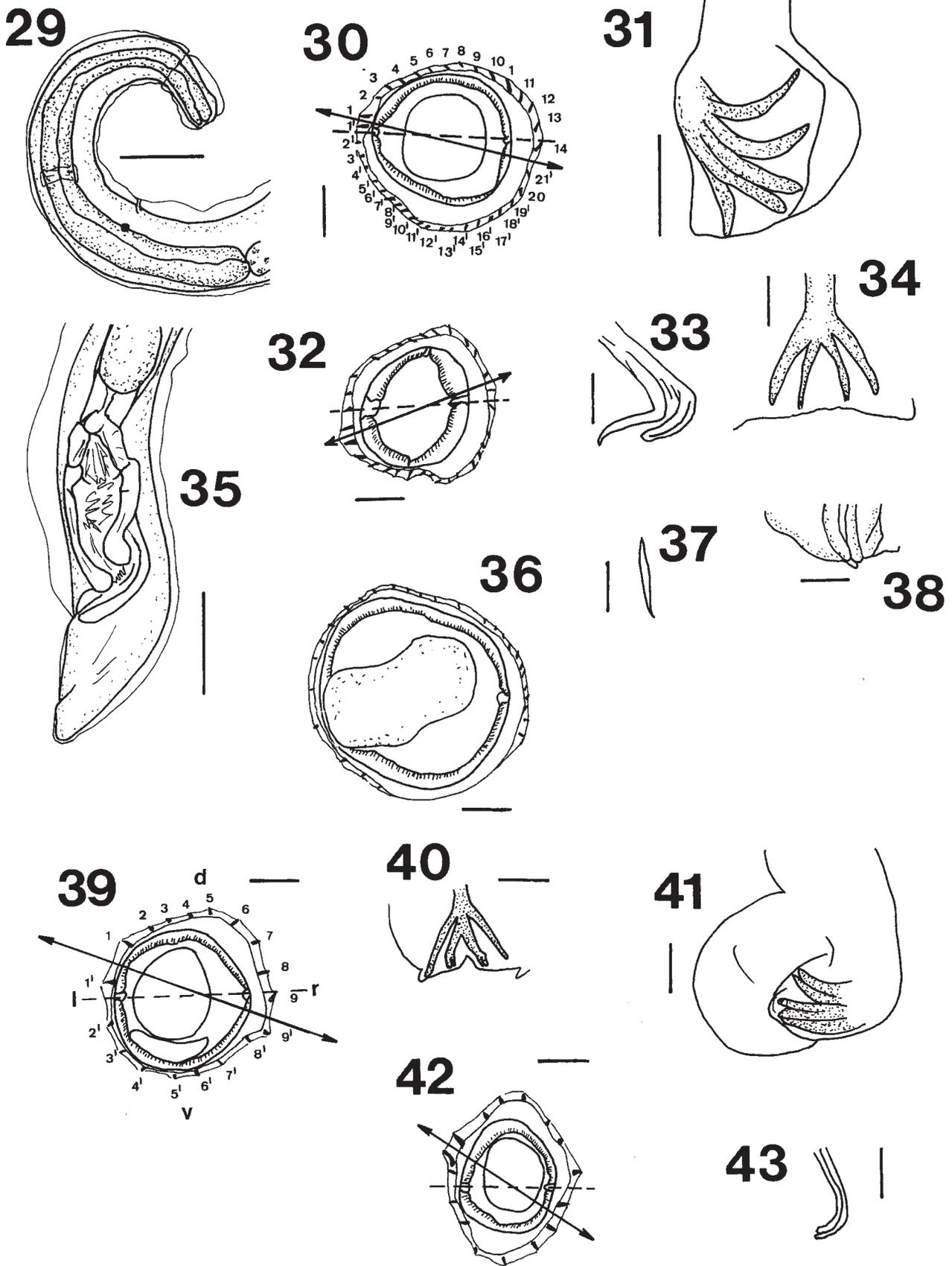
Female (allotype and 9 paratypes): Length 2.4–3.4 (2.8) mm, maximum width 66–87 (81). Cephalic vesicle 36–52 (43) long, 23–33 (28) wide. Oesophagus 250–520 (370) long; nerve ring 200, excretory pore 250, deirids 250 from cephalic end. Vulva opens 66–72.5 (71) from tail tip. Monodelphic; ovejector with sphincter 40, 40, and vestibule 40, 50, about same length, infundibulum 30, 40, and vagina, 25, 30, shorter. Tail blunt, conical, tip rounded, 16.5–24 (19) long. Eggs thin-shelled, ellipsoidal, in utero 53–63 (57) by 32–33 (32.8).

Remarks. – Although the fixation of this material, in situ in the intestine of the host, was not ideal it was sufficient to allow adequate examination of the specimens. *Odilia similis*, new species, has every morphological character of the genus *Odilia* (Mawson, 1961) (see Durette-Desset, 1983). Following the key to the species of *Odilia* of Smales (2005b), *O. similis*, new species, with 35 ridges in the midbody of the male, falls between the group of species with up to 35 ridges, *O. maxomyos* Hasegawa et al. 1999, and *O. praeputialis* Gibbons & Spratt, 1995, and the group with more than 35 ridges in the midbody, *O. polyrhabdote* (Mawson, 1961) and *O. uromyos* (Mawson, 1961). *Odilia similis*, new species, further differs from each of these species in having a spicule to body length ratio of 1: 6.5, simple pointed spicule tips and a female tail blunt, conical, neither twisted nor with a praepuce (Smales, 2005b).

Odilia sp.

(Figs. 39–43)

Material examined. – 6 males, AM W32552, from the small intestine of *Melomys rufescens* (Muridae: Hydromyinae), Yapsiei area, 4°35'S 141°5'E, Sanduan Province, Papua New Guinea, coll T. Flannery, 17 Jan. 1984.



Figs. 29–38. *Odilia similis*, new species, from *Melomys rufescens* and *Melomys* spp. from Papua New Guinea: 29, female anterior end, lateral view; 30, male cross section, anterior body; 31, bursa, right lateral view; 32, male cross section, midbody; 33, spicule tips; 34, dorsal ray; 35, female posterior end, lateral view; 36, male cross section, posterior body; 37, gubernaculum, lateral view; 38, genital cone, lateral view. Figs. 39–43. *Odilia* species from *Melomys rufescens* and *Melomys* sp. from Papua New Guinea: 39, male cross section, anterior body; 40, dorsal ray; 41, bursa, left lateral view; 42, male cross section, midbody; 43, spicule tips. Scale bars: 29 = 100 μ m; 30–34, 37–43 = 25 μ m; 35 = 200 μ m; 36 = 10 μ m.

Description. – Tiny, coiled worms; synlophe of 16–18 continuous ridges in the anterior and midbody. Axis of orientation of ridges passing through ventral right and dorsal left sides inclined at about 65° from the sagittal axis; gradient of size right to left on dorsal side, left to right ventrally.

Male (6 specimens): Length 1.9–2.35 (2.08) mm; maximum width 47–53 (50). Cervical vesicle 23–29.5 (26) long; oesophagus 280–350 (303) long. Bursa asymmetric, right lobe larger, dorsal lobe shorter than lateral lobes, with dorsal notch; dorsal ray divided in distal half; rays 8 arising at same level in dorsal trunk, proximal to branching of dorsal ray. Spicules filiform, tips pointed, curved but not hooked, 260–280 (275) long; gubernaculum 13.6–15.3 (14.2) long.

Remarks. – The morphology of the synlophe and bursa of the present species was congruent with the characteristics of the genus *Odilia* (Mawson, 1961) (see Durette-Desset, 1983). The suite of measurements and the form of the synlophe, were not however, consistent with any known species. The available specimens were difficult to study, with the details of the anterior end and bursa concealed by the coiling of the body and the infolding of the bursa. And since no females were obtained the proposal of a new species is withheld.

***Parahelimonelloides singauwaensis*, new species**

(Figs. 44–53)

Material examined. – Holotype male, allotype female: BBM-NG-24762 from the small intestine of *Melomys rufescens* (Muridae: Hydromyinae), type host, Singauwa River, Lae, 6°07'S 146°59'E, Morobe Province, Papua New Guinea, coll. P. J. Shanahan, 7 Apr. 1966.

Paratypes: 3 males, BBM-NG-24762, collecting data as above.

Prevalence. – Two of 25 *M. rufescens*.

Etymology. – The species name is taken from the type locality.

Description. – Small coiled worms; prominent cephalic vesicle present; buccal capsule vestigial. Mouth opening triangular with rudimentary lips; labial and cephalic papillae not observed. Oesophagus claviform. Nerve ring surrounds oesophagus in middle third; deirids and excretory pore at about same level, in posterior third of oesophagus length. Synlophe of pointed longitudinal cuticular ridges extends from the posterior margin of the cephalic vesicle to just anterior to bursa or vulva; 17 ridges in anterior, 20–22 in midbody. Axis of orientation of ridges passing from ventral right to dorsal left sides, inclined about 80° from sagittal axis; 8–11 ridges dorsal side, 9–13 ridges ventral side. Ridge 1' more developed than ridge 1 in anterior; ridges 1', 2' more developed than ridges 1, 2 in midbody. Ridges 1–11 increasing in size; ridges 3'–5' increasing in size, ridges 7'–11' decreasing in size. Posterior region of body with 22–23 (male) 20–21 (female) ridges reducing in size, retaining axis of orientation.

Male (holotype and 4 paratypes): Length 2.35–2.75 (2.6) mm, maximum width 99–100 (99). Cephalic vesicle 37.5–42.5 (40) long, 30.5–34 (32.5) wide. Oesophagus 320–350 (345) long; nerve ring 165, excretory pore 240 from cephalic end. Bursa asymmetrical, right lobe larger, rays of left lobe more robust; with small median dorsal notch. Dorsal ray symmetrical, divided at about 2 thirds its length, each branch dividing again at distal tip; terminal divisions, rays 9, 10 symmetrical; rays 8 arising at slightly different levels proximally to division of dorsal ray. Rays 4, 5, 6 with common stem, reaching margin of bursa, rays 6 more slender than rays 4, 5. Rays 2, 3 with common stem, robust, diverging distally, curving posteriorly, reaching margin of bursa. Genital cone short, lightly sclerotized; ventral lobe with unpaired papillae 0, dorsal lip bifid, each lobe with single papilla 7. Spicules equal, filiform, proximal ends rounded, tips simple pointed, 230–290 (265) long. Gubernaculum 34–35.5 (35) long.

Female (allotype): Length 2.9 mm, maximum width 130. Cephalic vesicle 42.5 long, 34 wide. Oesophagus 390 long. Vulva opens 95 from tail tip. Posterior end reflected dorsally; body wall extended to form praepuce. Monodelphic; ovejector with sphincter, 80, longest, infundibulum, 50, vestibule, 30, smallest element. Tail conical tip with spike. Eggs thin-shelled, ellipsoidal, in utero 45 by 30.

Remarks. – *Parahelimonelloides singauwaensis*, new species, is characterized by having a synlophe with ridge 1' much more developed than ridge 1, and with the relative sizes and orientation of the ridges as described for the southeast Asian members of the genus (Ow Yang et al., 1983; Hasegawa et al., 1999). Of these *P. singauwaensis*, new species, most closely resembles *Parahelimonelloides triangulus* Ow Yang et al., 1983 in the number of ridges on the synlophe. It differs from *P. triangulus* in having more ridges in the midbody (20–22 ridges compared with 19–21 ridges), as well as in the length of the spicules (230–290 compared with 61–85) the form of the spicule tips and the size of the eggs (45 by 30 compared with 67 by 36) (Ow Yang et al., 1983).

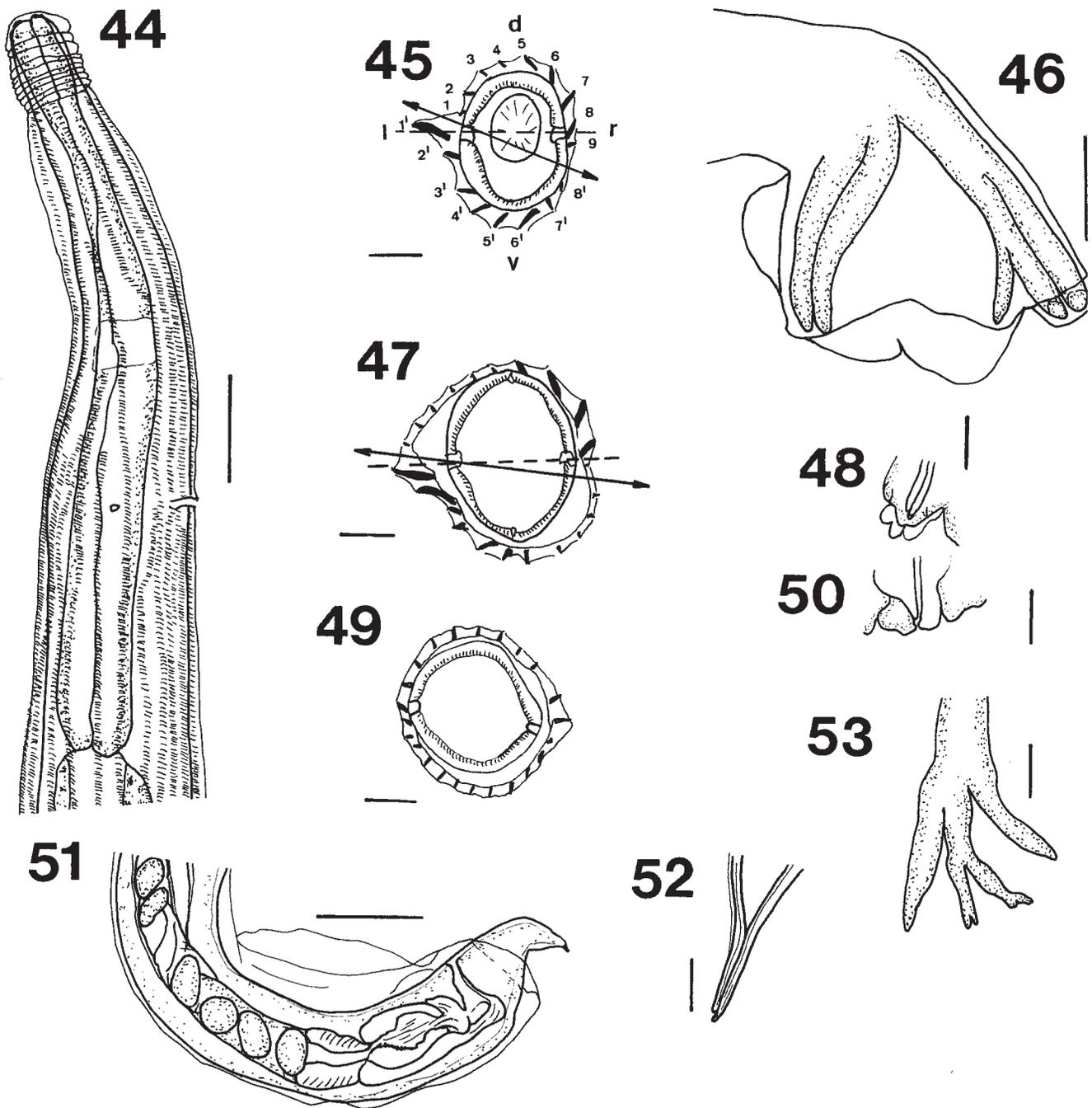
DISCUSSION

Although this study presents information on the helminths occurring in *M. rufescens*, it is limited by the small number of hosts collected at each locality and by the examination of digestive tracts only from hosts held in museum collections. These data therefore give conservative estimates of presence and prevalence of helminth species, with taxa such as *Strongyloides* being overlooked. In some instances there was insufficient material (the capillariid, and the helimonellid species), or all the specimens were immature (the hellimonellid larvae) such that identification to species level was not possible. In the case of *Peramelistrongylus* sp. only females were found. *Peramelistrongylus* is a monospecific genus, described by Mawson (1960) from bandicoots (Peramelidae) in Australia, which has also been recorded as an occasional infection in Australian rodents,

including *Melomys* spp. (Smales et al., 2004; Smales, 2005) and *Hydromys chrysogaster* Geoffroy, 1804 (see Mawson, 1961). There are, however, no records of the genus from either bandicoots or rodents in New Guinea, so it cannot be assumed that the female *Peramelistrongylus* reported here were *Peramelistrongylus skedastos* Mawson, 1960.

The total number of species recorded from *M. rufescens*, 16 from 25 hosts is less than the 22 species recorded from 112 grassland melomys; *Melomys burtoni* and *M. cf. burtoni* from Australia and *M. lutillus* from Papua New Guinea

(Smales, 2005a) but more than the subset of five species recorded from 20 *M. lutillus*. When compared, the helminth assemblages of the two hosts from New Guinea, *M. lutillus* and *M. rufescens* had in common only two species, the cestode *R. celebensis* and the trichostrongyloid nematode *O. mackerrasae*, both previously reported in Australia and Papua New Guinea (Smales, 1997, 2005a; Smales et al., 2004). The other species of helminths occurring in *M. rufescens* included the cosmopolitan species *H. spumosa* and *N. brasiliensis*, both usually found in the cosmopolitan murine rats *Rattus norvegicus* (Berkenhout, 1769) and *Rattus*



Figs. 44–53. *Parahelimonelloides singauwaensis*, new species from *Melomys rufescens* and *Melomys* spp. from Papua New Guinea: 44, male anterior end, lateral view; 45, male cross section, anterior body; 46, bursa left lateral view; 47, male cross section, midbody; 48, genital cone, ventral view; 49, male cross section, posterior body; 50, genital cone, lateral view; 51, female posterior end, lateral view; 52, spicule tips; 53, dorsal ray. Scale bars: 44 = 50 μ m; 45–50, 52, 53 = 25 μ m; 51 = 100 μ m.

rattus (Linnaeus, 1758) (see Smales, 1992; Durette-Desset, 1970). Their presence in a hydromyine host is indicative of occasional infections acquired from the normal host species. Species widespread from India to Australia were represented by *C. purvisi* (see Hasegawa & Syafruddin, 1994b) and species known only from New Guinea by *P. kaindiensis* and *S. longaecauda* (see Smales, 2001a, b).

Apart from *O. mackerrasae* and *N. brasiliensis* the heligmonellid fauna of *M. rufescens* comprised species or genera only found in New Guinea (*O. similis*, new species, *Odilia* sp. and *M. sepikensis*, new species) and species or genera also known from Indonesia or Malaysia, (*M. ingens*, *H. mirzai*, new species, *P. singauwaensis*, new species) (this study; Smales, 2008). This suggests closer relationships between the helminth fauna of *M. rufescens* and that of the endemic murid rodents of Indonesia and Malaysia than that of the endemic murid rodents of Australia, despite the fact that the genus *Melomys* is found in both geographical regions. An examination of the helminth fauna of the extralimital species of *Melomys*, including *M. rufescens* from the Molucca Islands could prove informative.

ACKNOWLEDGEMENTS

Special thanks are due to Ms C. Kisinami of the Bishop Museum and Prof. T. Flannery, formerly of the Australian Museum, for giving me access to the host bodies, to Mr B. Heinrich for assistance with sorting the specimens and to Prof I. Beveridge who kindly helped with the identification of the cestodes.

LITERATURE CITED

- Duff, A. & A. Lawson, 2004. *Mammals of the World A Checklist*. A. & C. Black, London. 312 pp.
- Durette-Desset, M.-C., 1970. Le genre *Nippostrongylus* Lane, 1923, (Nématode-Heligmosomatidé) *Annales de Parasitologie Humaine et Comparée*, **45**: 815–821.
- Durette-Desset, M.-C., 1983. Keys to genera of the Superfamily Trichostrongyloidea. In: R. C. Anderson & A. C. Chabaud (eds.), *CIH Keys to the Nematode Parasites of Vertebrates No 10*. Commonwealth Agricultural Bureaux, Farnham Royal, England. Pp. 1–85.
- Durette-Desset, M.-C., 1985. Trichostrongyloid nematodes and their vertebrate hosts: Reconstruction of the phylogeny of a parasitic group. *Advances in Parasitology*, **24**: 239–306.
- Durette-Desset, M.-C., Beveridge, I., & D. M. Spratt, 1994. The origins and evolutionary expansion of the Strongylida (Nematoda). *International Journal for Parasitology*, **24**: 1139–1165.
- Flannery, T., 1995. *The Mammals of New Guinea*. Reed Books, Sydney, Australia. 568 pp.
- Godthelp, H., 2001. The Australian rodent fauna, flotilla's, flotsam or just fleet footed? In Metcalfe, I., J. B. M. Smith, M. Morwood & I. Davidson (eds.), *Faunal and Floral Migrations and Evolution in SE Asia- Australasia*. A. A. Balkema Publishers, Lisse. Pp. 319–322.
- Hasegawa, H. & Syafruddin, 1994a. *Hasanuddinina maxomyos* n.gen., n.sp. and *Heligmonoides musseri* n.sp. (Nematoda: Heligmonellidae) collected from endemic murines of Sulawesi, Indonesia. *Journal of Parasitology*, **80**: 781–788.
- Hasegawa, H. & Syafruddin, 1994b. *Cyclodontostomum purvisi* (Syn *Ancistroneema coronatum*) (Nematoda: Chabertiidae) collected from murid rodents in Kalimantan, Indonesia. *Journal of Parasitology*, **80**: 657–660.
- Hasegawa, H. & Syafruddin, 1997. *Maxomystrongylus yasumai* gen. et sp. n. (Nematoda: Trichostrongylina: Heligmonellidae) collected from murid rodents in Kalimantan, Indonesia. *Journal of the Helminthological Society of Washington*, **64**: 263–268.
- Hasegawa, H., Miyata, A. & Syafruddin, 1999. Six new nematodes of the Heligmonellidae (Trichostrongylina) collected from endemic murines of Sulawesi, Indonesia. *Journal of Parasitology*, **85**: 513–524.
- Holloway J. D. & R. Hall, 1998. SE Asian geology and biogeography: an introduction. In: Hall, R. & J. D. Holloway (eds), *Biogeography and Geological Evolution of SE Asia*. Backhuys Publishers, Leiden The Netherlands. Pp. 1–23.
- Mawson, P. M., 1960. Nematodes belonging to the Trichostrongylidae, Subuluridae, Rhabdiasidae and Trichuridae from bandicoots. *Australian Journal of Zoology*, **8**: 261–284.
- Mawson, P. M., 1961. Trichostrongyles from rodents in Queensland, with comments on the genus *Longistriata* (Nematoda: Heligmosomatidae). *Australian Journal of Zoology*, **9**: 791–826.
- Menzies, J. I., 1996. A systematic revision of *Melomys* (Rodentia: Muridae) of New Guinea. *Australian Journal of Zoology*, **44**: 367–426.
- Ow Yang, C. K., Durette-Desset, M.-C., & M. Ohbayashi, 1983. Sur les nématodes parasites de rongeurs de Malaisie. II. Les Trichostrongyloidea. *Annales de Parasitologie Humaine et Comparée*, **58**: 467–492.
- Smales, L. R., 1997. A review of the helminth parasites of Australian rodents. *Australian Journal of Zoology*, **45**: 505–521.
- Smales, L. R., 2001a. *Syphacia longaecauda* n. sp. (Nematoda: Oxyuridae) Syphacinae from *Melomys* spp. (Muridae: Hydromyinae) from Papua New Guinea and Irian Jaya, Indonesia. *Parasite*, **8**: 39–43.
- Smales, L. R., 2001b. *Protospirura kaindiensis* n. sp. (Spiruridae) and other helminths from *Pseudohydromys* (Muridae: Hydromyinae) from Papua New Guinea. *Journal of Parasitology*, **87**: 169–172.
- Smales, L. R., 2005a. Helminth parasites of the grassland melomys (Muridae: Hydromyinae) from Australia and Papua New Guinea. *Australian Journal of Zoology*, **53**: 369–374.
- Smales, L. R., 2005b. A redescription of *Odilia emanuelae* (Nematoda: Trichostrongylina: Heligmonellidae) from Australian rodents with a key and comments on the genus *Odilia*. *Transactions of the Royal Society of South Australia*, **129**: 59–64.
- Smales, L.R., 2008. New species of Heligmonellidae (Nematoda: Trichostrongyloidea) from *Melomys*, *Paramelomys* and *Uromys* from Papua, Indonesia and Papua New Guinea. *Comparative Parasitology*, **75**: 52–60.