NEW HOST RECORDS, REDESCRIPTIONS AND NEW SPECIES OF LABIOSTRONGYLINEA (NEMATODA: CHABERTIIDAE) FROM MACROPODID MARSUPIALS, WITH A REVISED HOST-PARASITE CHECKLIST.

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Summary
New host records: from Macropus rufogriseus for Labiosimplex clelandi, M. robustus for Ls. aridus, Thylogale stigmatica for Ls. thetidis, and M. parma for Ls. bancrofti are reported. On re-examination of all material, Labiosimplex quasibancrofti was found to be morphologically indistinguishable from Ls. australis and is therefore a synonym of Ls. australis. A new species of Labiomultiplex, described from a single female from M. parma, is differentiated by the shape of the lateral lips and Lm. kimberleyensis is redescribed from additional material collected from the type-host, Onychogalea fraenata, from Queensland. Two new species of Labiosimplex are described from macropodid marsupials from central Australia. Labiosimplex centralis sp. nov. from the stomach of Petrogale lateralis differs from the most similar of its congenors, Ls. thomasae (both lacking a gubernaculum), in having shorter spicules, a shorter dorsal lobe of the bursa, and in the form of the dorsal ray. Labiosimplex territoriensis sp. nov. from the stomach of M. antilopinus differs from all its congenors in having large multi-lobed oesophago-intestinal diverticula. A new species, Labiostrongylus arnhemensis sp. nov. from the stomach of M. bernardus from the Northern Territory, differs from its congenors in a suite of characters including the position of the deirids, the shape of the oesophago-intestinal diverticula, the length of the dorsal lobe of the bursa, the morphology of the genital cone and gubernaculum and the length of the female tail. A revised host-parasite checklist, including Labiostrongylinea from the island of New Guinea together with those occurring in Potoroidae, is given.

KEY WORDS: Nematoda, marsupials, Macropus, Petrogale, Onychogalea, new species, Labiostrongylus, Labiosimplex, Labiomultiplex.

Introduction
The tribe Labiostrongylinea Beveridge, 1983 (Cloacininae: Chabertiidae: Strongylida), large stomach worms of macropodoid hosts (bettongs, kangaroos, potoroos and wallabies), was revised by Smales (2002). Amended and revised descriptions were given and two new genera, Labiosimplex Smales, 2002 and Labiomultiplex Smales, 2002 erected. The tribe now comprises seven genera, three of which, Labiostrongylus Yorke & Mapleton, 1926, the type-genus, Labiosimplex and Labiomultiplex are found on both sides of Torres Strait in the island of New Guinea and Australia. The other genera are found only in New Guinea (Dorcopsinema Mawson, 1977 and Paralabiostrongylus Smales, 1982), or only in Australia (Parazoniolaimus Johnston & Mawson, 1939 and Potorostrongylus Johnston & Mawson, 1939) (see Smales 2002). Recent collections of material from macropodid hosts from Queensland and the Northern Territory prompted a re-examination of as yet undescribed material held in the South Australian Museum, Adelaide (SAM) and the CSIRO Wildlife Collection, Canberra (CSIRO) and a re-evaluation of the validity of the species revised or described by Smales (1994, 1995, 2002), Chilton & Smales (1996) and Smales & Chilton (1997). The results of these analyses are presented below.

Materials and Methods
Specimens dissected from the stomachs of Macropus antilopinus (Gould, 1842), Macropus bernardus Rothschild, 1904, Macropus dorsalis (Gray, 1837) Macropus parryi Bennett, 1835,
Macropus robustus Gould, 1841, Onychogalea unguifera (Gould, 1841), and Thylogale stigmatica (Gould, 1860) were fixed in 10% formalin or Berland’s fluid and stored in 70% ethanol prior to examination. Other material, from Macropus parma Waterhouse, 1845, Macropus rufogriseus (Desmarest, 1817) and Petrogale lateralis Gould, 1842, registered in the South Australian Museum, Adelaide (SAM), whose collection history is unknown, was also stored in ethanol prior to examination. Worms were examined after clearing in lactophenol, or, if dark brown because of long-term storage in museum collections, in beechwood creosote. Figures were prepared with the aid of a drawing tube and all measurements made with the aid of an ocular micrometer or map measurer. Unless otherwise indicated, measurements of 10 individuals are in micrometres and given as the range followed by the mean in parentheses. All material is now registered in the SAM or the CSIRO Wildlife Collection, Canberra (CSIRO).

Results

New host records

The host range of the following species has been extended.

Labiosimplex aridus (Smales, 1995), from M. robustus from Kynuna (21°35´S, 144°55´E) and Jericho (23°36´, 146°07´E) Queensland (SAM AHC 32239, 32240);

Labiosimplex clevelandi (Johnston & Mawson, 1939) was identified from Macropus rufogriseus from Sandy Bay (42°54´S, 147°20´E), Tasmania (SAM AHC 16418);

Labiosimplex thetidis (Smales, 1995) from Thylogale stigmatica from Lamington National Park (28°15´S, 153°08´E) and Proserpine (20°24´S, 148°34´E), Queensland (SAM AHC 30074, 30949, 30957, 30962).

Labiosimplex bancrofti (Johnston & Mawson, 1939) from Macropus parma from Niagara Park (33°22´S, 151°21´E), New South Wales was found in SAM AHC 6069; this material, 5 males, 6 females (now SAM AHC 32900) and an immature male and female listed as Labiostrongylus (Labiosimplex) sp. 1 from Narara (30º45´S, 150°52´E) New South Wales (SAM AHC 8658) in Smales 1995, provide sufficient information to identify all the specimens as Ls. bancrofti.

Labiosimplex australis (Kung, 1948)

Smales & Chilton (1997) undertook an allozyme electrophoresis study of material collected from Macropus parryi and Macropus dorsalis in central Queensland localities, describing a new species Labiostrongylus (Labiosimplex) quasibancrofti (Smales & Chilton, 1997) as a consequence. Re-examination of that material (SAM AHC 30027, 30028, 30029, 30030, 30099) has shown that morphologically these specimens are identical to Ls. australis (Kung, 1948). Therefore L. (Ls) quasibancrofti falls as a synonym of Ls. australis.

New and redescribed species

Labiomultiplex sp.

Another collection of material from M. parma (CSIRO N1287) included a single immature female that could not be identified beyond genus level. The measurements of this specimen are as follows: Length 18 mm, width 0.68 mm. Oesophagus 2850 long; nerve ring 2550, excretory pore 2650 from base of lips. Female tail 1050 long, vulva 1800 from tail tip. Vagina 625 long; sphincter longest element of ovejector. The suite of characters available for examination from this specimen, including the morphology of the lateral lip (with a protrusion on the buccal surface, Fig. 2) and cephalic papillae (hook-like) are indicative of it representing an as yet undescribed species.
Figs 1-5. Labiomultiplex sp. nov. from Macropus parma. 1. Anterior end, lateral view. 2. Lateral lip, lateral view showing protrusion (arrow). 3. Oesophago-intestinal junction, lateral view. 4. Ovejector lateral view in part, showing an infundibulum, sphincters, the vestibule and vagina vera. 5. Female tail, lateral view. Scale bars = 80 µm, 1, 25 µm, 2, 200 µm, 3, 4, 5.

Labiomultiplex kimberleyensis (Smales, 1994)

Synonyms
Labiostrongylus (Labiomultiplex) kimberleyensis Smales, 1994, p. 207

Types
Holotype male from stomach of Onychogalea unguifera Gould, 1841, Crystal Creek, Kimberley, Western Australia 17º19’S, 124º47’E, coll. 31. viii. 1976. SAM AHC 44164. Allotype female, same data, SAM AHC 44165. Paratypes, same data, SAM AHC 22810.

Other material examined: from stomach of O. unguifera Queensland, 46 females 21 males, Springfield Station via Mt Surprise, (18º08’S, 144º18’E) SAM AHC 30070; Chinaman Creek, 8k west Georgetown, (18º17’S, 143º25’E) SAM AHC 30033, 30069; November 1994 coll I. Beveridge.

Redescription
Robust worms; body with fine transverse cuticular striations. Cephalic extremity with 6 fleshy well developed lips with pulp cavities; 4 submedian lips, slightly ridged, each bearing small cephalic papilla near base; 2 lateral lips rounded, shorter than submedians each bearing an amphid. Buccal capsule short, cylindrical, wider than deep, walls lightly scleritized not ridged. Oesophagus gradually widens to about 1.5 times diameter, suddenly constricts to terminal bulb; about 1/6-1/8 body length. Nerve ring encircles oesophagus at constriction to terminal bulb, excretory pore at about level of nerve ring, deirids small, anterior to nerve ring. No oesphago-intestinal diverticula.
Figs 6-18. *Labiomultiplex kimberleyensis* (Smales, 1995) from *Macropus irma*. 6. Anterior end, lateral view. 7. Cephalic end, lateral view. 8. Cephalic end, ventral view. 9. Cephalic end, *en face* view. 10. Bursa, lateral view. 11. Female tail tip, lateral view. 12. Dorsal ray of bursa, dorsal view. 13. Genital cone, dorsal view. 14. Ovejector lateral view in part, showing an infundibulum, a sphincter, the vestibule and anterior end of the vagina vera. 15. Gubernaculum, ventral view. 16. Spicule tip, lateral view. 17. Female tail, lateral view. 18. Spicule, anterior end. Scale bars = 500 µm, 6, 17, 100 µm, 7, 8, 9, 11, 12, 200 µm, 10, 14, 50 µm, 13, 15, 25 µm, 16, 18.

**Male**

Measurements of holotype followed by those of 10 specimens, this study.  
Length 12, 15-24 (20) mm, width 0.63, 0.5-0.95 (0.81) mm. Buccal capsule 80, 65-90 (75) wide by 40, 102-123 (118) deep. Oesophagus 1950, 2300-3400 (3080) long. Nerve ring 1675, 2890-3180 (3062), excretory pore 1550, 2130-3315 (3000), deirid 1310, 2755-2945 (2885) from base of lips. Bursa large; ventral lobes separate, shortest; lateral lobes longest. Ventro-ventral and ventro-lateral
rays apposed, reaching margin of bursa; externo-lateral ray divergent from central trunk, not reaching margin of bursa; medio-lateral and postero-lateral rays apposed, reaching margin of bursa, externo-dorsal ray arising near lateral trunk, not reaching margin of bursa; dorsal trunk stout, bifurcating at about mid length, each ray extending to margin or bursa, giving off a branchlet at about 1/3 its length, not extending to margin of bursa. Spicules 4560, 5695-6205 (6015), about 1/3 body length; anterior extremities irregularly knobbed, distal tips blunt, curved, striated alae broad, extending almost to tips. Genital cone small, anterior lip larger conical, posterior lip reniform with bifid appendages. Gubernaculum subcordate.

Female

Measurements of allotype followed by those of 10 specimens, this study.

Length 15, 28-38 (32.6) mm, width 0.85, 1.0-1.8 (1.3) mm. Buccal capsule 70-130 (105) wide by 110-185 (145) deep. Oesophagus 2125, 3170-4420 (3947) long. Nerve ring 1875, 3180-4175 (3725), excretory pore 1475, 2885-4590 (3795), deirids 1210, 2500-4095 (3790) from base of lips. Body narrows at level of vulva, tail 1000, 1275-2040 (1400) tapering to conical tip. Vulva close to anus 1950 2635-3740 (3050) from tip. Vagina straight 1650, 1950-2635 (2280) long. Ovejector with all elements about same length. Eggs thin-shelled, ellipsoidal, 149.5-175.5 (168.5) long by 71.5-84.5 (81.5) wide.

Remarks

The new material examined for this study confirms the validity of *Lm. Kimberleyensis*. That the specimens are larger overall is probably because they are more mature, with eggs being described for the first time. This new material confirms the proportions of the reproductive systems of the male and female with minor amendments. For the male the spicule tips are both similarly curved, with the alae extending almost to the tips and the paired bifid appendages on the posterior lip of the genital are not relatively long. For the female all the elements of the ovejector are about the same length rather than the infundibulum being the shortest element (Smales 1994).

The morphology of the anterior end has also been clarified. The submedian lips are slightly ridged. The oesophagus, previously interpreted as widening suddenly at about 1/3 its length is now known to widen gradually, ending in a terminal bulb. This form of the oesophageus is intermediate between having two regions of the oesophageal corpus with a terminal bulb, as found in *Labiomultiplex*, and a simple clavate oesophagus, without a terminal bulb, as in *Labiosimplex*, and is consistent with the analysis of Smales (2002). The examination of these specimens showed that the position of the excretory pore was variable, being found always posterior to the deirids but either anterior or posterior to the nerve ring.

The geographic range of *Lm. Kimberleyensis* is now extended from the Kimberley region of Western Australia into Queensland, suggesting that it occurs across northern Australia throughout the range of the host *O. unguifera*.

*Labiosimplex centralis* sp. nov.

Types

Holotype male from stomach of *Petrogale lateralis* Gould, 1842, Mt Liebig, Northern Territory 23°16’S 131°16’E, no other coll. details, SAM AHC 32898. Allotype female, same data, SAM AHC 32899. Paratypes, same data, 131 females, 102 males SAM AHC 2949.

Other material examined: from the stomach of *P. lateralis* South Australia, 4 males, 4 females, Ernabella, Musgrave Range (26°18’S, 131°15’E) SAM AHC 2907.
Figs 19-34. *Labiosimplex centralis* sp. nov. from *Petrogale lateralis*. 19. Anterior end, lateral view. 20. Cephalic end, submedian view. 21. Cephalic end, lateral view, optical section. 22. Spicule, anterior end. 23. Cephalic end, *en face* view. 24. Bursa, apical view. 25. Deirid, lateral view. 26. Genital cone, lateral view. 27. Bursa, lateral view. 28. Spicule tips, lateral view. 29. Female tail tip, lateral view. 30. Dorsal ray, dorsal view. 31. Dorsal ray, dorsal view showing additional branchlets. 32. Dorsal ray, dorsal view showing asymmetric branching. 33. Ovejector lateral view in part, showing an infundibulum, a sphincter, the vestibule and vagina vera. 34. Muscular sheath, ventral view. Scale bars = 500 µm, 19, 29, 100 µm, 20, 21, 23, 25 µm, 22, 25, 26, 28, 200 µm, 24, 27, 50 µm, 30, 31, 32, 400 µm, 33, 20 µm, 34.

**Description**

Large worms, body with fine transverse cuticular annulations. Cephalic extremity with 6 fleshy well developed lips with pulp cavities; 4 submedian lips, bilobed, ridged on outer surfaces, broader at base than distal end, bearing cephalic papillae near base; 2 lateral lips, simple, about same length
as submedians, bearing amphids. Buccal capsule short, cylindrical, wider than deep. Oesophagus long, clavate about 1/6-1/7 body length. Deirids long, fine, thread like, anterior to nerve ring which encircles oesophagus at about 1/5 its length. Excretory pore posterior to nerve ring. Oesophago-intestinal diverticula well defined, about same length as width of oesophagus.

**Male**

Length 30-50 (39.5) mm, width 1.0-1.5 (1.3) mm. Buccal capsule 115-165 (145) wide by 100-155 (125) deep. Oesophagus 5525-6970 (6310) long. Nerve ring 1120-1410 (1245), excretory pore 1700-2160 (1875), deirids 1040-1200 (1125) from base of lips. Bursa large, ventral lobes separate, all lobes about same length. Ventro-ventral and ventro-lateral rays apposed reaching margin of bursa; externo-lateral ray arising close to lateral trunk small, not reaching margin of bursa; externo-dorsal ray arising close to lateral trunk reaching margin of bursa; dorsal trunk stout, bifurcating at about mid length, each ray, giving off branchlet at about 1/2 its length, extending into lappets of dorsal lobe; some specimens with additional pair of branchlets arising from dorsal trunk. Spicules 6460-8075 (7195) long, 1/5 body length; anterior extremities irregularly knobbed, distal tips curved, striated alae extending almost to tips; right tip blunt, left tip pointed. Genital cone prominent, anterior lip larger, conical; posterior lip reniform with paired bifid appendages. Gubernaculum absent: muscular sheath guiding spicules.

**Female**

Length 47-65 (52.8) mm, width 2.0-2.8 (2.4) mm. Buccal capsule 160-200 (185) wide by 127-200 (160) deep. Oesophagus 6630-7905 (7295) long. Nerve ring 1360-1735 (1510), excretory pore 1700-2160 (1875), deirids 1040-1200 (1125) from base of lips. Body narrows at level of vulva, tail 850-1445 (1030) long, blunt, conical. Vulva close to anus 2200-2975 (2450) from tail tip. Ovejector with sphincters longest, infundibula and vestibule about same length. Vagina vera more or less straight 1360-3060 (2150) long. Eggs thin-shelled, ellipsoidal 195-290 (255) long by 100-120 (107) wide.

**Remarks**

*Labiosimplex centralis* sp. nov. differs from *Ls. thomasae* (Smales, 1995), the only other species of *Labiosimplex* described to date in which a gubernaculum has not been found, in the form of the bursa; all lobes are about the same length in *Ls. centralis* but the dorsal lobe is longest in *Ls. thomasae*; the spicules of *Ls. centralis* (6460-8075) are shorter than those of *Ls. thomasae* (9000-9900). *Labiosimplex centralis* is closest to those species of *Labiosimplex* with lateral lips the same length or longer than the submedian lips and lobes of the bursa separate, namely *Ls. clelandi* (Johnston & Mawson, 1939) and *Ls. bancrofti* (Johnston & Mawson, 1939) (see key of Smales 1995). *Labiosimplex bancrofti*, with the lateral lips longer than submedian lips, differs from both *Ls. centralis* and *Ls. clelandi*. *Labiosimplex centralis* further differs from both these species in the form of the dorsal ray, the length of the spicules (6460-8045 compared with 5400-6100 and 3500-6800 respectively), the shape of the female tail, relatively blunt without terminal knob in *Ls. centralis* longer and tapering to a tip with or without a terminal knob in *Ls. bancrofti* and *Ls. clelandi*. The eggs of *Ls. centralis* (195-290 by 100-120) are larger than those of *Ls. bancrofti* (100-140 by 60-75) or *Ls. clelandi* (135-160 by 80-90).

The host of *Ls. centralis* is registered in the SAM only as ‘rock wallaby,’ one animal from Ernabella and 3 animals from Mt. Liebig. The only *Petrogale* species known to occur in central Australia (South Australian and Northern Territory localities) is *P. lateralis* (see Strahan 1995). Accordingly this material has been assigned to *P. lateralis*.

Three other labiostrongylin species, *Ls. petrogale* (Johnson & Mawson, 1938), *Ls. pearsonensis* (Smales, 1995) and *Labiosimplex* sp. 2, are also found in *P. lateralis* (see Smales 1995). *Labiosimplex centralis* further differs from *Ls. petrogale* in the length of the lateral lips which are shorter in *Ls. petrogale*; the form of the oesophago-intestinal diverticula, bilobed in *Ls. petrogale*; the form of the bursa, ventral lobes shorter than dorsal lobes in *Ls. petrogale*; the proportions of
genital cone, the posterior lip relatively larger in *Ls. petrogale*; the vestibule the shortest element of the female ovejector in *Ls. petrogale* but the same length as the infundibula in *Ls. centralis*; female tail, short, (720 long) with terminal knob in *Ls. petrogale*, longer (800-1445) without terminal knob in *Ls. centralis*. *Labiosimplex pearsonensis* further differs from *Ls. centralis* in having longer spicules (9700-12100); the form of the dorsal ray, lateral branchlets are given off before the dorsal trunk bifurcates; the shape of the female tail, tapering, rather than stubby, and a sinuous vagina vera.

A single male worm, found in *P. lateralis* from Mt Liebig, was described briefly by Johnston & Mawson (1938) as similar to *Ls. longispcularis* (Wood, 1929) anteriorly, but with shorter spicules 1:5.6 body length; the specimen being 24mm long. Although the spicules of males measured for this study were longer, the males were also longer, giving a similar 1:5, spicule to body length ratio. Consequently this specimen, designated *Labiosimplex* sp. 2 by Smales (1995), is here considered to be *Ls. centralis*.

The host, *Petrogale lateralis*, consists of four subspecies and two as yet unnamed races (Eldridge & Close 1995). Of the three parasite species differentiated above, *Ls. petrogale* and *Ls. centralis* occur in the MacDonnell Ranges race from localities in Central Australia while *Ls. pearsonensis* occurs only in *P. lateralis pearsoni* from Pearson Island, South Australia.

### *Labiosimplex territoriensis* sp. nov.

**Types**

Holotype male from stomach of *Macropus antilopinus* (Gould, 1842) Jabiluka, Northern Territory (12°32’S, 132°55’E), coll. Sharman August, 1979, SAM AHC 32894. Allotype female, same data SAM AHC 32895. Paratypes, 5 females, 2 males, same data SAM AHC 6425.

*Other material examined:* from stomach of *M. antilopinus* Northern Territory, 2 females, Darwin (12°27’S, 130°50’E) SAM AHC 9784; 4 females, 5 males (all immature), Katherine (14°28’S, 132°17’E) coll I. Beveridge 12. 7. 2003, SAM AHC 32901.

**Description**

Large worms; body with fine transverse cuticular annulations. Cephalic extremity with 6 fleshy well developed lips, with pulp cavities; 4 submedian lips, bilobed, ridged on outer surfaces, slightly broader at base than distal end, bearing cephalic papillae in mid region; 2 lateral lips, simple, slender, shorter than submedian lips, bearing amphids. Buccal capsule short, cylindrical, wider than deep. Oesophagus long, clavate about 1/4 - 3/8 body length. Deirids small, anterior to nerve ring which encircles oesophagus at about 3/12 its length. Excretory pore posterior to nerve ring. Oesophago-intestinal diverticula large, multi-lobed, longer than width of oesophagus.

**Male** (measurements of 3 specimens)

Length 35-50 (43) mm, width 1.2-1.4 (1.3) mm. Buccal capsule 215-270 (295) wide by 105-155 (135) deep. Oesophagus 9520-12070 (10825) long. Nerve ring 1530-1700 (1645), excretory pore 1770-2035 (1900), deirids 575-750 (665) from base of lips. Bursa large, ventral lobes separate, lateral lobes longest, dorsal and ventral lobes about same length. Ventro-ventral and ventro-lateral rays apposed, reaching margins of bursa; exero-lateral ray, not reaching margin of bursa; mediolateral and postero-lateral rays apposed reaching margin of bursa; externo-dorsal ray arising close to lateral trunk, almost reaching margin of bursa, dorsal trunk stout, bifurcating at almost 1/3 its length, each ray bifurcating at about 1/4 its length, rays extending into lappets of bursa, branchlets almost reaching margin of bursa. Spicules 3400-4165 (3855) long, about 1/11 body length, anterior extremities irregularly knobbed with striated alae, tips curved. Genital cone small, 1/3-1/4 length of bursa, anterior lip larger, conical, posterior lip reniform, with paired, irregularly divided appendages (Figs 43-45). Gubernaculum cordate.
Figs 35-51. *Labiosimplex territoriensis* sp. nov. from *Macropus antilopinus*. 35. Anterior end, ventral view. 36. Cephalic end, lateral view. 37. Cephalic end ventral view. 38. Cephalic end, *en face* view. 39. Spicule anterior. 40. Gubernaculum, ventral view. 41. Spicule tip, lateral view. 42. Oesophago-intestinal junction, lateral view. 43. Dorsal lobe of genital cone, dorsal view. 44. Genital cone lateral view, showing variation in posterior lobe appendages. 45. Genital cone, dorsal view showing variation in posterior lobe appendages. 46. Deirid, lateral view. 47. Female tail, lateral view. 48. Female tail tip, lateral view. 49. Bursa, lateral view. 50. Ovejector in part, showing an infundibulum, a sphincter, the vestibule and vagina vera. 51. Bursa, apical view. Scale bars = 200 µm, 35, 36, 38, 42, 100 µm, 37, 49, 51, 25 µm, 39, 40, 43, 44, 45, 46, 50 µm, 41, 48, 500 µm, 47.

**Female** (measurements of 6 specimens)

Length 43-57 (51) mm, width 1.2-1.6 (1.4) mm. Buccal capsule 220-300 (250) wide by 120-165 (145) deep. Oesophagus 10200-13175 (11475) long. Nerve ring 1615-1955 (1730), excretory pore.
2010-2245 (2165), deirids 680-850 (740) from base of lips. Body narrows at level of vulva; tail 935-1410 (1110) long, tapering to conical tip with terminal knob. Vulva close to anus 1975-2940 (2405) from tail tip. Ovejector with conical tip with terminal knob. Vulva close to anus 1975-2940 (2405) from tail tip. Ovejector with sphincters longest, infundibula and vestibule about same length. Vagina vera slightly sinuous 645-850 (715) long. Eggs thin-shelled, ellipsoidal 114 long by 60-67 (64) wide.

Remarks

*Labiosimplex territoriensis* sp. nov. differs from all other species of *Labiosimplex* in having large multi-lobed oesophago-intestinal diverticula. With lateral lips shorter than submedians and spicules shorter than 6000, it is closest to *Ls. robustus* (Smales, 1995) and *Ls. occidentalis* (Smales, 1995) (see key of Smales 1995). *Labiosimplex territoriensis* further differs from *Ls. robustus* in having the dorsal ray shorter than the lateral rays, not longer; in the form of the bifid appendages on the dorsal lip of the genital cone; shorter spicules (3400-4165 compared with 4300-5500); shorter vagina (645-850 compared with 1000-1400) and smaller eggs (114 by 60-67 compared with 215-275 by 70-90). *Labiosimplex territoriensis* further differs from *Ls. occidentalis* in the form of the dorsal ray, branchlets given off close to bifurcation not after; the form of the dorsal lip of the genital cone, appendages irregularly bifid not long and finger like; shorter female tail (935-1410 compared with 1280-1760) and vulva closer to tail tip (1975-2940 compared with 2880-3480).

*Labiosimplex territoriensis* has been found only in *M. antilopinus* from the Northern Territory. A sample of 10 *M. antilopinus* collected from Mt Surprise, Queensland in 1977, was not infected with any labiostrongylin species. This suggests that the geographic distribution of *Ls. territoriensis* is limited to the Northern Territory populations of the host.

*Labiostrongylus arnhemensis* sp. nov.

**Types**

Holotype male from stomach of *Macropus bernardus* Rothschild, 1904, Jabiluka, Northern Territory (12°32'S, 132°55'E) coll. Sharman, 26.9.1979, SAM AHC 32896. Allotype female, same data, AHC 32897. Paratypes, same data 20 males, 20 females SAM AHC 6386.

*Other material examined:* from *M. bernardus* Northern Territory; 3 males, 14 females 80k South of Maningrida, (12°03'S, 134°13'E), coll. B. Murphy, 17. 7. 2003, SAM AHC 32902, 37 males, 59 females, El Sharanah SAM AHC 11145 (13° 13'S, 134° 30' E).

**Description**

Large robust worms; body with fine transverse cuticular striations. Cephalic extremity with 6 fleshy well developed lips with pulp cavities; 4 submedian lips, bilobed, ridged on outer surfaces, broader at distal end than base, bearing cephalic papillae on mid-region; 2 lateral lips, smaller, simple, bearing amphids. Two conical interlabia, 1 dorsal, 1 ventral. Buccal capsule short, cylindrical, wider than deep. Oesophagus long, clavate, about 1/6 body length. Deirids thread-like, anterior to nerve ring which encircles oesophagus at about 2/11-1/6 its length. Excretory pore posterior to nerve ring. Oesophago-intestinal diverticula well defined, longer than width of oesophagus.
Figs 52-70. Labiostrongylus arnhemensis sp. nov. from Macropus bernardus. 52. Anterior end, lateral view. 53. Cephalic end, submedian view. 54. Cephalic end, ventral view. 55. Cephalic end, lateral view. 56. Cephalic end, en face view. 57. Genital cone, dorsal view. 58. Gubernaculum, ventral view. 59. Oesophago-intestinal junction, lateral view. 60. Posterior lip of genital cone, dorsal view showing variation in appendages. 61. Posterior lip of genital cone, dorsal view showing variation in appendages. 62. Posterior lip of genital cone, dorsal view showing variation in appendages. 63. Female tail, lateral view. 64. Spicule, anterior end. 65. Spicule tip, lateral view. 66. Bursa, lateral view. 67. Female tail tip, lateral view. 68. Ovejector, lateral view showing infundibula, sphincters, vestibule and vagina vera. 69. Bursa in part, apical view. 70. Deirid, lateral view. Scale bars = 500 µm, 52, 100 µm, 53, 55, 56, 200 µm, 54, 66, 69, 50 µm, 57, 58, 60, 61, 62, 67, 400 µm, 59, 63, 68, 25 µm, 64, 65, 70.
Male

Length 44-58 (50) mm, width 1.0-1.6 (1.4) mm. Buccal capsule 148-201 (166) wide by 127-168 (150) deep. Oesophagus 8330-9350 (8750) long. Nerve ring 1460-1700 (1590), excretory pore 2040-2580 (2235), deirids 550-950 (675) from base of lips. Bursa large, ventral lobes separate; dorsal lobe longest, ventral lobes shortest. Ventro-ventral and ventro-lateral rays apposed reaching margin of bursa; externo-lateral ray arising close to lateral trunk, not reaching margin of bursa; medio-lateral and postero-lateral rays apposed, reaching margin of bursa; externo-dorsal ray arising close to lateral trunk, not reaching margin of bursa; dorsal trunk stout, giving off lateral branchlets, reaching margin of bursa, at about 1/2 its length, bifurcating at about 3/4 of its length, branchlets extending into lappets of dorsal lobe. Spicules 4080-4760 (4310) long, 1/12 body length; anterior extremities irregularly knobbed, distal tips curved, striated alae not extending to tips. Genital cone about 1/3 length of bursa, anterior lip larger conical; posterior lip reniform with paired irregular trifid appendages (Figs 56, 59-61). Gubernaculum cordate.

Female

Length 55-75 (65) mm, width 1.5-2.1 (1.8) mm. Buccal capsule 175-220 (215) wide by 150-200 (170) deep. Oesophagus 10455-11595 (11020) long. Nerve ring 1695-1965 (1820), excretory pore 1870-2635 (2295), deirids 595-870 (735) from base of lips. Body narrows at level of vulva, tail 780-1200 (975) long, tapering to conical tip, ending in knob. Vulva close to anus 2310-5805 (2885) from tail tip. Ovejector with sphincters longest, vestibule shortest element. Vagina vera somewhat sinuous 935-1615 (1210) long. Eggs not seen.

Remarks

Of the three previously described species of Labiostrongylus, L. labiostrongylus Yorke & Maplestone, 1926, L. grandis Johnston & Mawson, 1938 and L. narbalekensis Smales, 1994, Labiostrongylus arnhemensis sp. nov. is closest to L. labiostrongylus, both having spicules in the range 4000-5000 long; in the proportions of the dorsal ray and ovejector and in having the female tail ending in a knob (Smales 1994). Labiostrongylus arnhemensis differs from L. labiostrongylus in the position of the deirids, closer to the base of the lips (550-950 as compared with 1040-1280); the oesophago-intestinal diverticula not bilobed in L. arnhemensis; the dorsal lobe of the bursa longer than the lateral lobes in L. arnhemensis; the paired appendages of the posterior lip of the genital cone trifid in L. arnhemensis but up to 10 irregular projections in L. labiostrongylus; the gubernaculum cordate in L. arnhemensis, sub-rectangular in L. labiostrongylus; the female tail shorter in L. arnhemensis (780-1200 as compared with 1600-2000).

The material, SAM AHC 6386, from M. bernardus, listed by Smales (1995) as Labiostrongylus (Labiosimplex) sp. 4. has been re-examined and here determined to be L. arnhemensis. The specimens from M. bernardus, listed as L. labiostrongylus (see Smales 1995), noted by Smales (1994) as being in poor condition and having differences in the genital cone, were assigned to L. labiostrongylus pro tem. This material is here identified as L. arnhemensis.

Macropus bernardus, found only in a relatively small area of Arnhem Land is occasionally seen in company with M. antilopinus, which has a more extensive range across the monsoonal north (Calaby 1995). A third macropod, the wallaby Macropus agilis (Gould, 1842) is also widely distributed across northern Australia and the tropical east coast (Merchant 1995). Sharman collected M. agilis, M. antilopinus and M. bernardus from Jabiluka in August and September of 1979. The labiostrongylins dissected from M. agilis (SAM AHC 6420) were all, with the exception of a single immature female, identified as L. labiostrongylus (see Smales 1994). This single female, with deirids 670 from the base of the lips, and other measurements congruent with L. arnhemensis rather than L. labiostrongylus is here considered to be L. arnhemensis. Only specimens of L. territoriensis (as described above) were found in M. antilopinus and only specimens of L. arnhemensis were found in M. bernardus.

Macropus robustus is the third of the wallaroo group of kangaroos, found in Arnhem Land. No M. robustus have been collected from Arnhem Land however. The only hosts that have been examined
LABIOSTRONGYLINEA FROM KANGAROOS

from the Northern Territory were collected near Katherine, and were not infected with labiostrongylin worms. *Macropus robustus* from central Australia and tropical Queensland have, however, been host to *L. grandis* Johnston & Mawson, 1938. Additional collecting, therefore, is needed to determine whether *Labiostrongylus* species are host specific (the exception being an occasional infection where *M. agilis* are in sympathy) as now appears to be the case.

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HOST – PARASITE SPECIES CHECKLIST

List of species of the Labiostrongylinea arranged by host. This list provides an update of the host-parasite species list given in Smales (1995) and includes additional data from potoroid hosts and from the Island of New Guinea (Johnston & Mawson 1940; Smales 1982, 1997a,b, 1999) as well as from additional material registered in the South Australian Museum.

| Host                          | Parasite                          |
|-------------------------------|-----------------------------------|
| Macropodidae                  |                                   |
| *Dendrolagus bennettianus*, Bennett’s tree kangaroo | *Labiosimplex dendrolagi* |
| *Dendrolagus dorianus*, Doria’s tree kangaroo | *Dorscopsinema dendrolagi* |
| *Dendrolagus goodfellowi*, Goodfellow’s tree kangaroo | *Dorscopsinema dendrolagi* |
| *Dendrolagus inustus*, grizzled tree kangaroo | *Dorscopsinema dendrolagi* |
| *Dendrolagus lumholtzi*, Lumholtz’s tree kangaroo | *Dorscopsinema dendrolagi* |
| *Dendrolagus mbaiso*, dingiso | *Dorscopsinema mbaiso* |
| *Dendrolagus scottae*, tenkile | *Dorscopsinema dendrolagi* |
| *Dendrolagus sp.*            | *Labiosimplex novaeguineae*       |
| *Dorcopsis hageni*, white striped dorcopsis | *Labiosimplex redmondi*       |
| *Dorcopsis muelleri*, brown dorcopsis | *Paralabiostrongylus bicollaris* |
| *Dorcopsis luctuosa*, grey dorcopsis | *Dorcopsinema simile* |
| *Dorcopsulus vanheurni*, small dorcopsis | *Dorcopsinema dorcopsis* |
| *Dorcopsulus sp.*            | *Dorcopsinema simile* |
| *Lagorchestes conspicillatus*, spectacled hare wallaby | *Labiomultiplex constrictus* |
| *Lagorchestes hirsutus*, rufous hare wallaby | *Labiosimplex communis* |
|                               | *Labiosimplex sp. AHC 4965*   |
| *Macropus agilis*, agile wallaby | *Labiostrongylus labiostrongylus* |
| *Macropus antilopinus*, antilopeine wallaroo | *Labiostrongylus arnhemensis* |
| *Macropus bernardus*, black wallaroo | *Labiomultiplex uncinatus* |
| *Macropus dorsalis*, black striped wallaby | *Labiosimplex communis* |
|                               | *Labiosimplex bancroftii* |
|                               | *Labiosimplex australis* |
| *Macropus eugenii*, tammar wallaby | *Labiomultiplex eugenii* |
|                               | *Labiosimplex thomasae*   |
| Species                               | Genus                        |
|--------------------------------------|------------------------------|
| *Macropus fuliginosus*, western grey kangaroo | *Labiosimplex kungi*         |
|                                      | *Labiosimplex major*         |
|                                      | *Labiosimplex laterilabellosus* |
|                                      | *Labiosimplex occidentalis*  |
| *Macropus giganteus*, eastern grey kangaroo | *Labiosimplex kungi*         |
|                                      | *Labiosimplex major*         |
|                                      | *Labiosimplex bipapillosus*  |
|                                      | *Labiosimplex laterilabellosus* |
| *Macropus irma*, western brush wallaby | *Labiosimplex irma*          |
| *Macropus parma*, parma wallaby      | *Labiosimplex bancrofti*     |
|                                      | *Labiomultiplex sp. CSIRO N1287* |
|                                      | *Parazoniolaimus collaris*   |
| *Macropus parryi*, whiptail wallaby  | *Labiomultiplex contiguus*   |
|                                      | *Labiosimplex bancrofti*     |
|                                      | *Labiosimplex turnbulli*     |
| *Macropus robustus*, common wallaroo | *Labiostrongylus grandis*    |
|                                      | *Labiosimplex robustus*      |
|                                      | *Labiosimplex longispicularis* |
|                                      | *Labiosimplex aridus*        |
| *Macropus rufogriseus*, red-necked wallaby | *Labiosimplex australis*     |
|                                      | *Labiosimplex clelandi*      |
|                                      | *Labiomultiplex billardieri*  |
| *Macropus rufus*, red kangaroo       | *Labiosimplex longispicularis* |
|                                      | *Labiosimplex aridus*        |
| *Onychogalea fraenata*, bridled nailtail wallaby | *Labiomultiplex onychogale* |
| *Onychogalea unguifera*, northern nailtail wallaby | *Labiomultiplex onychogale* |
|                                      | *Labiomultiplex kimberleyensis* |
|                                      | *Labiosimplex thetids*       |
| *Petrogale assimillis*, allied rock-wallaby | *Labiosimplex bancrofti*     |
|                                      | *Labiosimplex flanneryi*     |
| *Petrogale brachyotis*, short-eared rock-wallaby | *Labiostrongylus labiostrongylus* |
|                                      | *Labiostrongylus nabarlekensis* |
| *Petrogale coenensis*, Cape York rock-wallaby | *Labiosimplex godmani*     |
| *Petrogale herberti*, Herbert’s rock wallaby | *Labiosimplex bancrofti*     |
| *Petrogale godmani*, Godman’s rock-wallaby | *Labiosimplex godmani*     |
| *Petrogale inornata*, unadorned rock-wallaby | *Labiosimplex bancrofti*     |
| *Petrogale lateralis*, black-footed rock-wallaby | *Labiosimplex petrogale* |
|                                      | *Labiosimplex pearsonensis*  |
Petrogale sharmani, Sharman’s rock-wallaby
Petrogale xanthopus, yellow-footed rock-wallaby

Labiosimplex centralis
Labiosimplex bancroftii
Labiosimplex sp. inquirendum

Thylogale billardieri, Tasmanian pademelon

Labiosimplex australis
Labiomultiplex billardieri

Thylogale brunii, dusky pademelon
Thylogale calabyi, Calaby’s pademelon
Thylogale stigmatica, red-legged pademelon

Labiostrongylus labiostrongylus
Labiosimplex flanneryi
Labiosimplex flanneryi
Labiosimplex communis
Labiosimplex thetidis

Thylogale thetis, red-necked pademelon

Labiomultiplex thylogale
Labiosimplex thetidis

Wallabia bicolor, swamp wallaby

Labiomultiplex uncinatus
Labiosimplex clelandi
Labiosimplex communis
Labiostrongylus labiostrongylus
Parazoniolaimus collaris

Potoroidae

Aepyprymnus rufescens, rufous bettong
Potorostrongylus aepyprymnus
Potorostrongylus temperatus

Bettongia gaimardi, Tasmanian bettong
Bettongia penicillata, brush-tailed bettong
Bettongia tropica, northern bettong

Potorostrongylus finlaysoni
Potorostrongylus woyliei
Potorostrongylus tropicus

Potorous tridactylus

Labiomultiplex potoroi
Potorostrongylus finlaysoni