Dorylaimida (Nematoda) from Botswana

Sandra de Bruin and J. Heyns *

Department of Zoology, Rand Afrikaans University, P.O. Box 524, Johannesburg, 2000 Republic of South Africa

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Thirteen nematode species are recorded from Botswana. Illustrations are given for *Ecumenicus monohystera* (de Man, 1880) Thorne, 1974; *Eudorylaimus diadematus* (Cobb in Thorne & Swanger, 1936) Andrássy, 1959; *Labronema mauritiense* Williams, 1959; *Discolaimus brevis* Siddiqi, 1964; *D. major* Thorne, 1939; *Aporcelaimellus adriaani* Botha & Heyns, 1990; *A. micropunctatus* Botha & Heyns, 1990; *A. papillatus* (Bastian, 1965) Baqri & Khera, 1975; *A. parapapillatus* Botha & Heyns, 1990 and a specimen belonging to *Prodorylaimus* or to *Laimydorus*. Measurements are given for the above-mentioned species as well as for *Discolaimium simplex* Siddiqi, 1965 and *Discolaimoides bulbiferus* (Cobb, 1906) Heyns, 1963. A new *Mesodorylaimus* species viz. *M. usitatoides* is described. For the first time males are described for *A. adriaani* and *A. micropunctatus*. *Discolaimus paramajor* Coomans, 1966 is considered a possible synonym of *D. major*.

Dertien nematood spesies word uit Botswana aangeteken. Illustrasies word gegee vir *Ecumenicus monohystera* (de Man, 1880) Thorne, 1974; *Eudorylaimus diadematus* (Cobb in Thorne & Swanger, 1936) Andrássy, 1959; *Labronema mauritiense* Williams, 1959; *Discolaimus brevis* Siddiqi, 1964; *D. major* Thorne, 1939; *Aporcelaimellus adriaani* Botha & Heyns, 1990; *A. micropunctatus* Botha & Heyns 1990; *A. papillatus* (Bastian, 1965) Baqri & Khera, 1975; *A. parapapillatus* Botha & Heyns, 1990 en 'n eksemplaar wat aan *Prodorylaimus* of aan *Laimydorus* behoort. Afmetings word vir al die bogenoemdes gegee, sowel as vir *Discolaimium simplex* Siddiqi, 1965 en *Discolaimoides bulbiferus* (Cobb, 1906) Heyns, 1963. 'n Nuwe *Mesodorylaimus* spesie, naamlik *Mesodorylaimus usitatoides* word beskryf. Mannetjies word vir die eerste keer beskryf vir *A. adriaani* en *A. micropunctatus*. *Discolaimus paramajor* Coomans, 1966 word as 'n moontlike sinoniem van *D. major* beskou.

* To whom correspondence should be addressed

No comprehensive study has yet been undertaken on the nematode fauna of Botswana and apart from some isolated reports on nematodes from this region, nothing is recorded in the literature. During July and August 1989, J. Heyns and A.L. Coomans took several samples from the Chobe National Park, Moremi Wildlife Reserve as well as from the Okavango Swamps. These samples yielded specimens of about thirty nematode genera. This material is now being studied taxonomically at the Rand Afrikaans University, Johannesburg. The present paper is the first of three parts reporting on the Dorylaimida obtained during this survey.

Materials and Methods

Specimens were extracted by a modified sieving-sedimentation method (Loubser 1985), killed by gentle heat, fixed in FAA, processed into glycerine by Thorne's slow method and mounted on permanent slides. Measurements and drawings were made with the aid of a Zeiss Standard 18 research microscope equipped with a drawing tube. The body and all curved structures were measured along the median line. Oesophagus length as given in the Tables, was measured from the anterior end of the body to the base of the oesophagus. All measurements are in µm unless stated otherwise.

Slide numbers refer to the nematode collection of the Department of Zoology, Rand Afrikaans University.

Taxonomy

***Ecumenicus monohystera* (de Man, 1880) Thorne, 1974 (Figure 1; Table 1)**

Syn. *Dorylaimus monohystera* De Man, 1880
***Eudorylaimus monohystera* (De Man, 1880) Andrássy, 1959**

The first description of this species by de Man (1880) was based on female specimens from the Netherlands. It is a cosmopolitan species and has also been reported from South Africa by Heyns (1961) and by Kruger (1962) who also redescribed this species.

Fourteen female specimens corresponding to the redescription by Kruger (1962) were collected in Botswana.

Male: Not found.

New distribution records: Chobe National Park: From grasses under a solitary palm tree (*Hyphaene benguellensis*) in the north-western part of the Savuti Marsh and from grasses under mopane trees (*Calophospermum mopane*) near the Savuti Marsh, collected 27 July 1989.

Specimens: On slides RAU 5152–5156, 5178, 5198, 5199.

***Eudorylaimus diadematus* (Cobb in Thorne & Swanger, 1936) Andrássy, 1959 (Figure 2; Table 1)**

Syn. *Dorylaimus diadematus* Thorne & Swanger, 1936

The first description of *Eudorylaimus diadematus* was by Cobb in Thorne & Swanger (1936) from Jamaica, West Indies. Heyns & Lagerwey (1965) reported females from the Kruger National Park. They stated that *E. diadematus* is a very common species in southern Africa and can be easily recognized by a disc-shaped structure between the base of the oesophagus and the cardia, bulging out into the body cavity on the dorsal side. This structure was also mentioned and illustrated by Loof (1964) in specimens from Venezuela.

Ten females and ten juveniles from Botswana are similar to those recorded from the Kruger National Park by Heyns & Lagerwey (1965) and also by Botha & Heyns (1990b). In

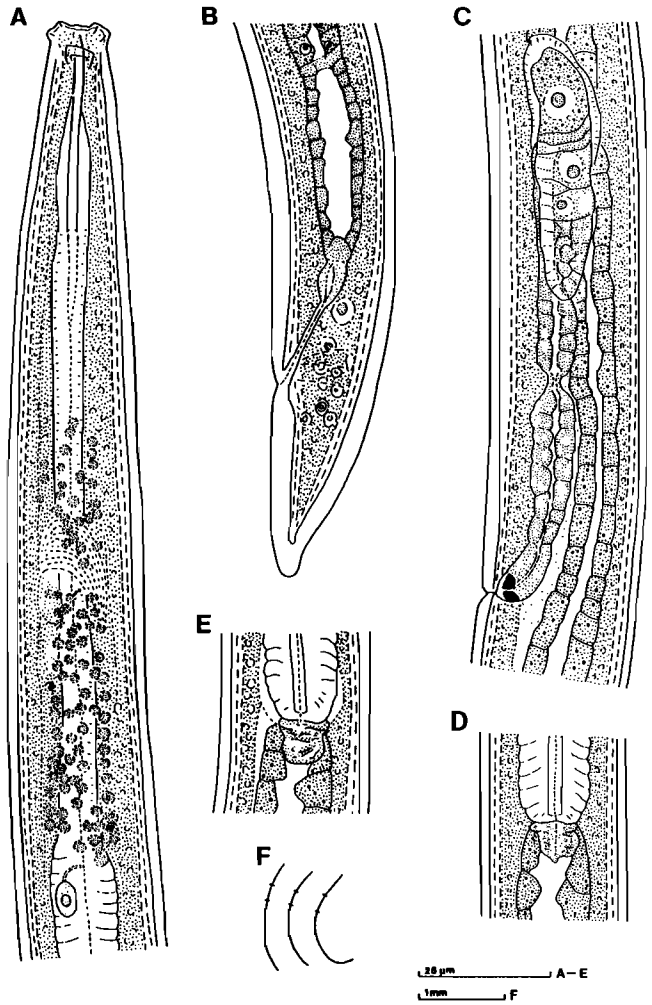

Figure 1 *Ecumenicus monohystera*. **A** Anterior region, **B** Female posterior region (caudal papillae indistinct), **C** Reproductive system, **D & E** Variation in oesophago-intestinal junction, **F** Heat-relaxed body postures.

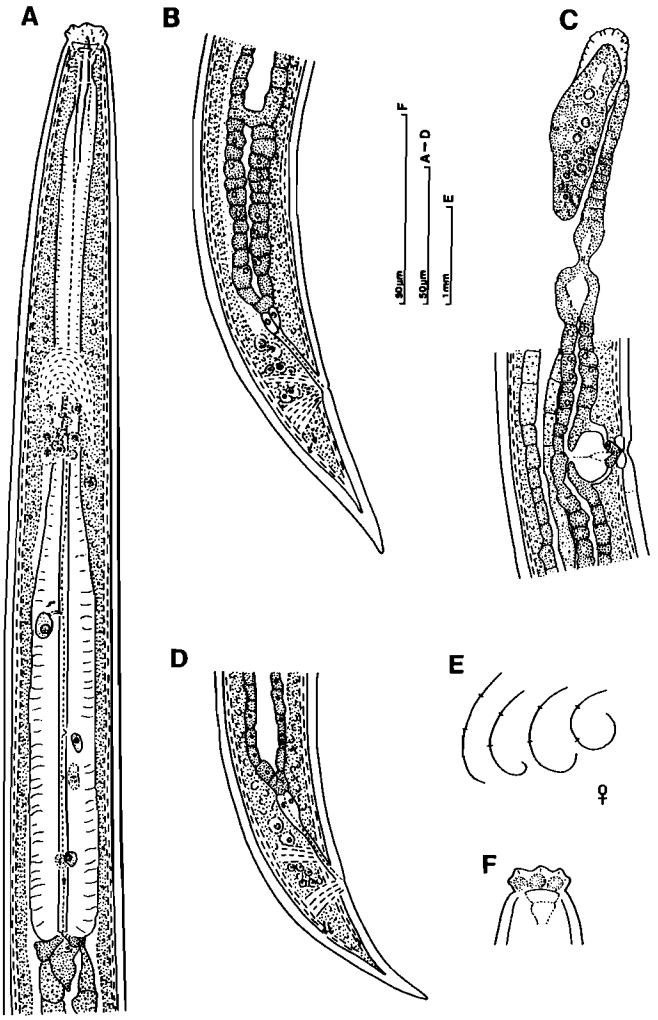

Figure 2 *Eudorylaimus diadematus*. All specimens from the Chobe National Park, except **D**, which is from the Okavango. **A** Head and neck region, **B** Female posterior region, **C** Anterior reproductive branch, **D** Variation in female posterior region, **E** Heat-relaxed body postures, **F** Variation in shape of amphid.

some of the present specimens, however, the body length is greater, the total stylet length is slightly less, the stylet aperture as a percentage of the stylet length is greater and the tail is slightly longer. In one specimen from the Chobe National Park, the amphid appears to be divided in two sections (Figure 2F).

Juvenile (Third stage) (n = 7): L = 0,85–1,04 mm; a = 22,1–26,0; b = 3,0–3,9; c = 17,0–23,2; c′ = 2,2–2,7; odontostyle = 11–15 µm; odontophore = 21–25 µm; total stylet length = 33–37 µm; replacement odontostyle = 13–16 µm; tail = 44–57 µm.

(Fourth stage) (n = 3): L = 1,13–1,44 mm; a = 27,3–34,3; b = 3,7–4,5; c = 20,9–27,2; c′ = 2,0–2,5; odontostyle = 14–15 µm; odontophore = 25–26 µm; total stylet length = 39–41 µm; replacement odontostyle = 16–17 µm; tail = 53–54 µm.

General morphology of juveniles similar to adults.

Male: Not found.

New distribution records: Among the roots of grasses under mopane trees near the Savuti Marsh in the Chobe National Park, among the roots of grasses on the northern side of the Kwai River Delta on the northern border of the Moremi Wildlife Reserve and from soil under herbs and palm trees on Boba Island (near Jedibe) in the Okavango Swamps, collected 27, 28 and 31 July 1989, respectively.

Specimens: On slides RAU 4874, 4875, 4877, 4878, 5192 and 5194–5197.

***Labronema mauritiense* Williams, 1959 (Figure 3; Table 2)**

This species was first described by Williams (1959) from sugarcane fields in Mauritius. He described the female tail as convex-conoid with the terminus blunt and usually slightly, but sometimes distinctly set off. He further reported that the male tail is similar to that of the female, except for the terminus which is less distinctly set off. Thorne (1974) reported one female and one male specimen from Nebraska and South Dakota, U.S.A. According to the illustration of the female tail it is conoid, with a small and distinctly offset terminus. The male tail is similar in shape, except that it is ventrally slightly arcuate. Botha & Heyns (1990b) reported four females and one male of this species from the Kruger

Table 1 Morphometric data of *Ecumenicus monohystera* and *Eudorylaimus diadematus*

	E. monohystera	*E. diadematus*		
	Chobe National Park	Chobe National Park	Kwai River Delta	Okavango
	14♀♀	8♀♀	2♀♀	1♀
L (mm)	1,06(1,00–1,18)	1,56(1,46–1,70)	1,26 & 1,29	1,18
a	34,6(29,2–39,3)	30,7(26,7–33,5)	30,7 & 26,3	22,7
b	4,3 (3,9–4,8)	4,0 (3,9–4,2)	3,7 & 3,7	3,6
c	31,8(27,5–38,2)	28,8(24,3–39,0)	24,7 & 28,7	34,7
c′	1,7 (1,3–2,0)	2,2 (1,7–2,5)	2,1 & 2,0	1,2
V%	37,4(35–41)	51(49–52)	52 & 52	52
Lip region width	11,2(11–12)	16(15–17)	15 & 14	17
height	4,2 (4–5)	5,4 (5–6)	5 & 4	5
Odontostyle length	11,7(11–13)	17 (17–18)	18 & 16	18
width	1,9 (1–2)	2,9 (2,5–3,0)	3 & 3	2,5
Odontophore length	20,9(18–26)	30,5(28–32)	29 & 25	36
Total stylet length	32,4(29–38)	47,6(45–49)	47 & 41	54
Stylet aperture length	3,2 (3–4)	8,6 (8–9)	9 & 9	8
% of stylet length	25,4(23–36)	50 (47–53)	50 & 56	47
Guiding ring from anterior end	6,4 (5–7)	8,9 (8–10)	8 & 7	9
Amphid aperture length	5,5 & 6,0 (n = 2)	9 (8–11)	9 & –	10
% of lip region width	49 & 54 (n = 2)	58,7(47–67)	60 & –	59
Oesophagus length	248 (230–260)	338 (250–420)	340 & 350	330
Basal bulb length	94,0(85–107)	195 (178–220)	172 & 172	153
Nerve ring from anterior end	98,8(85–106)	133 (123–143)	133 & 117	131
Lateral chord: % of body width	12,6(6–18)	16 (10–20)	22 & 24	15
Tail length	33,6(28–40)	56 (42–63)	51 & 45	34
Prerectum length	44,7(42–55)*	80 (62–92)	68 & 76	52
Rectum length	24,9(19–30)	41 (36–49)	38 & 76	38
Cuticle: neck	–	3	3 & 3	3
mid-body	–	3,3 (3–4)	3 & 5	3
anterior to anus	–	3,4 (3–4)	4 & 4	4
around tail tip	–	16,3(13–18)	17 & 11	13

* n = 11

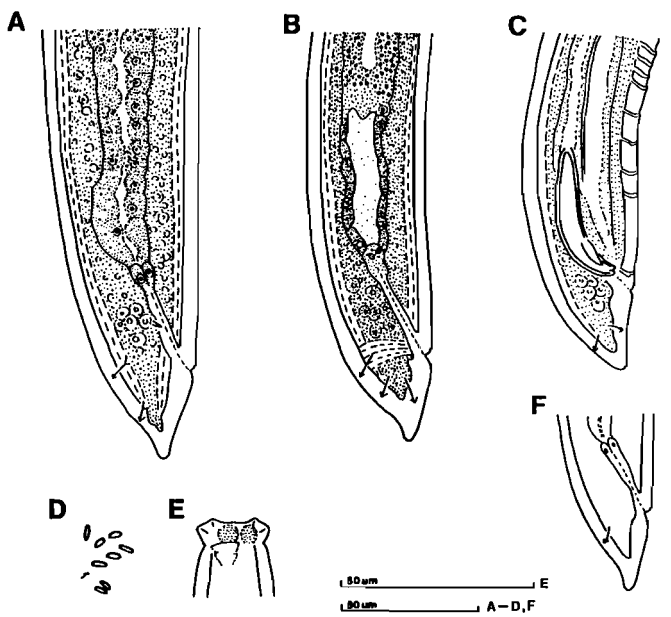

Figure 3 *Labronema mauritiense*. **A** Specimen from Moremi; **B & F** Okavango; **C–E** Kwai River. **A** Female posterior region, **B** Female posterior region, **C** Male posterior region, **D** Sperm cells, **E** Lip region and amphid, **F** Juvenile tail.

National Park, with convex-conoid and bluntly rounded tails.

One male, six females and eight juveniles collected in Botswana, are in full agreement with previous descriptions of this species. The tails of the present specimens are similar to those described by Thorne (1974), except that the digitate part is less distinctly offset in the female. The tail of the male specimen is conoid, ventrally slightly arcuate with a rounded terminus, but less rounded than that of the Mauritian and Kruger National Park specimens. According to Botha & Heyns (1990b) the amphids of both the Mauritian and Kruger National Park specimens are stirrup-shaped and divided into two parts. This is also the case in the present specimens (Figure 3E).

Juveniles (Second stage) (n = 1): L = 0,80 mm; a = 23,5; b = 3,2; c = 23,5; c′ ?; odontostyle = 14 µm; odontophore = ?; replacement odontostyle = 9 µm; tail = 34 µm.

(Third stage) (n = 3): L = 0,77–0,97 mm; a = 24,3–25,7; b = 3,0–3,5; c = 29,6–34,8 (n = 2); c′ = 1,2–1,4 (n = 2); odontostyle = 13–14 µm; odontophore = 14 µm (n = 1); total stylet length = 28 µm (n = 1); replacement odontostyle = 15–17 µm; tail = 19–26 µm.

(Fourth stage) (n = 4): L = 0,88–1,15 mm; a = 23,4–32,9; b = 3,5–4,1; c = 39,3–47,9; c′ = 1,0–1,2; odontostyle = 16–17 µm; odontophore = 21–26 µm (n = 2); total stylet length = 38–43 µm (n = 2); replacement odontostyle = 19–22 µm; tail = 22–29 µm.

General morphology of juveniles similar to adults, except

Table 2 Morphometric data of *Labronema mauritiense*

	Okavango	Moremi	Kwai River Delta	
	4♀♀	1♀	1♀	1♂
L (mm)	1,37(1,29–1,45)	1,57	1,43	1,38
a	26,9(26,0–28,2)	24,2	28,0	28,1
b	4,1(3,8–4,4)	4,7	3,97	4,1
c	51,4(46–58)	56,1	46,1	53,1
c'	0,96(0,9–1,0)	0,97	1,1	0,96
V%	56,3(55–57)	58	57	–
Lip region width	17,5(16–18)	16	18	17
Odontostyle: length	21(20–22)	19	19	20
width	3	3	3	3
Odontophore length	30,3(30–31)*	28	30	29
Total stylet length	51(50–52)*	56	49	49
Stylet aperture: length	8,7(8–9)*	8	8	8
% of stylet length	40,7(38–43)	42	42	40
Guiding ring from anterior end	12(11–13)	12	12	11
Amphid aperture: length	9,7(7–12)*	–	9	8
% of lip region width	53,7(39–66)	–	50	47
Oesophagus length	335(320–350)	360	360	340
Basal bulb length	153(140–167)	166	166	154
Nerve ring from anterior end	129(125–135)	129	129	139
Cuticle: neck	3,5(3–4)	4	3	4
mid-body	3,5(3–4)	4	4	3
anterior to anus	5,3(5–6)	5	6	4
around tail tip	14(13–15)	8	8	10
Lateral chord: % of body width	12,8(10–15)	12	18	12
Tail length	26,8(25–28)	28	31	26
Prerectum length	74(64–80)	150	100	160
Rectum length	33,8(29–40)	41	43	–
Spiculum length	–	–	–	58
Lateral guiding piece length	–	–	–	14
Number of ventromedian supplements	–	–	–	23

* $n = 3$

for the second stage juvenile and one fourth stage juvenile, where the tail terminus is rounded.

New distribution records: Among the roots of grasses on the northern side of the Kwai River Delta; at the camping site at the northern entrance gate of the Moremi Wildlife Reserve, and among the roots of a sausage tree (*Kigelia africana*), standing at the edge of the water on Boba Island in the Okavango Swamps, collected 28, 30 July and 1 August 1989, respectively.

Specimens: On slides RAU 4874, 4879, 4880, 5224, 5268–5270 and 5277.

Discolaimus brevis Siddiqi, 1964 (Figure 4; Table 3)

The original description of *Discolaimus brevis* by Siddiqi, 1964 was based on specimens from Alligarh, India. *D. brevis* closely resembles *Discolaimus monoplanus* Heyns, 1963, but according to Botha & Heyns (1990b) it can be distinguished from *D. monoplanus* by a different lip shape, shorter tail (18–21 µm *vs* 23 µm), differently shaped amphid (wineglass-shaped *vs* funnel-shaped) and by the absence of a disc-shaped structure between the oesophagus and cardia (see Figure 4A and B of Botha & Heyns 1990b).

Three female specimens from Botswana are in agreement with the description of *D. brevis* by Siddiqi, 1964, except for a slightly longer tail (19–26 *vs* 18–21 µm) corresponding in this regard also to *D. monoplanus*. In the present specimens the amphid is, however, wineglass-shaped and no disc-shaped structure is present between the oesophagus and cardia. It should be noted that Andrássy (1990) regards *D. brevis* as a synonym of *D. texanus* Cobb, 1913. Although there is remarkable agreement in measurements and general morphology, we do not feel that formal synonymy is warrented until the type specimens have been compared. Thus we prefer to call our specimens *D. brevis* because of greater correspondence to this species.

Male: Not found.

New distribution records: Among the roots of grasses under mopane trees near the Savuti Marsh in the Chobe National Park and among the roots of herbs and palm trees on Boba Island (near Jedibe) in the Okavango Swamps, collected 27 and 31 July 1989, respectively.

Specimens: On slides RAU 5200 and 5224.

Discolaimus major Thorne, 1939 (Figure 5; Table 4)
? Syn. *Discolaimus paramajor* Coomans 1966

The original description of *Discolaimus major* by Thorne (1939) was based on specimens collected from various parts in the U.S.A. and from Spain.

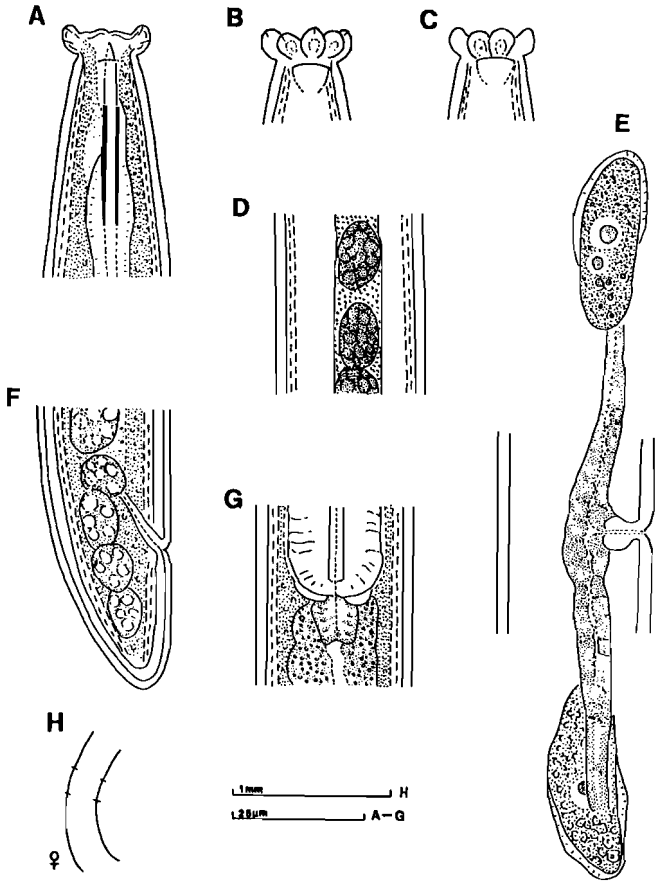

Figure 4 *Discolaimus brevis*. All specimens from Chobe National Park except C, which is from the Okavango. A Head region, B & C Shape and position of amphid, D Lateral chord with hypodermal glands, E Reproductive system, F Female tail, G Oesophago-intestinal junction, H Heat-relaxed body postures.

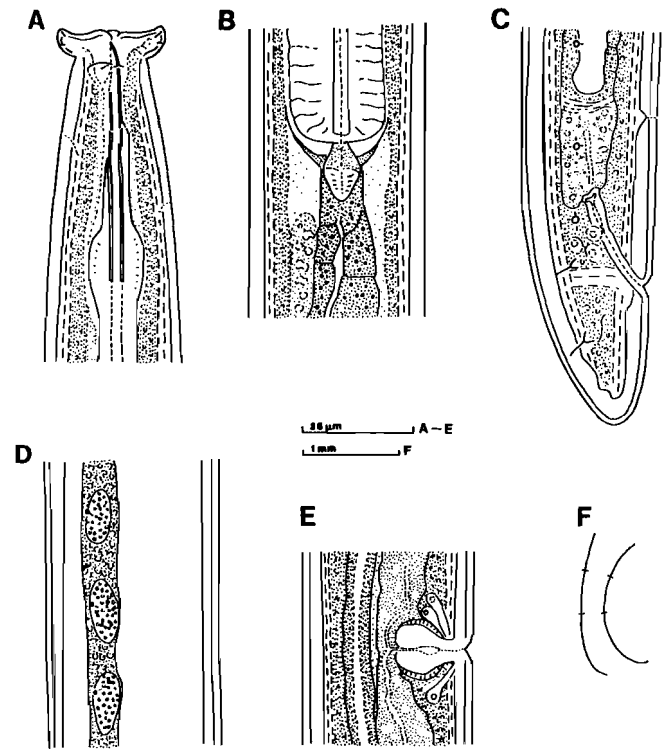

Figure 5 *Discolaimus major*. All specimens from Savuti. A Anterior region, B Oesophago-intestinal junction, C Female posterior region, D Lateral chord with hypodermal glands, E Vulva region, F Heat-relaxed body postures.

Heyns (1963) was the first to report this species from southern Africa, from Rustenburg and Nelspruit in the Transvaal and from the Modder River in the Cape Province. Further reports from southern Africa were by van der Vegte & Heyns (1963) and by Botha & Heyns (1990b), both reports from the Kruger National Park.

Five females and four juveniles, collected in the Chobe National Park, are in agreement with the description of the type population of *D. major* by Thorne (1939), as well as with other descriptions of this species. The Botswana specimens are, however, slightly shorter than those described by Thorne (1939), Heyns (1963) and Botha & Heyns (1990b) viz. 1,62–1,64 mm *vs* 1,83–2,24 mm; 1,73–2,40 mm and 1,93–2,20 mm, respectively. Sauer & Annells (1985) also reported shorter specimens from Australia viz. 1,45–1,88 mm. They were the first to report males of this species and mentioned the presence of large cells in the cardia region and a post rectal (caudal) blind sac in some of the Australian specimens. The large cells are absent in the Botswana specimens, but a weakly developed post rectal sac could be seen in most of the specimens. Loof & Coomans (1970) gave a report on the location of the oesophageal gland nuclei in 22 females of *D. major*. The position of the nuclei in the Botswana specimens (n = 3) agrees fully with that given by Loof & Coomans, viz. oesophagus widens at 41–43%; DO lies 26–23 µm behind the latter level; distance DO–DN = 13–16 µm; DO = 48–52%; DN = 53–56%; S_1O = 83%; S_1N_1 = 83% (n = 1); S_1N_2 = 84% (n = 1); S_2O = 92–93%; S_2N_1 = 89–90% (n = 2); S_2N_2 = 89% (n = 2).

Male: Not found.

Juvenile: (?Second stage) (n = 1): L = 1,06 mm; a = 36,6; b = 3,8; c = 37,9; c′ = 1,4; odontostyle = 14 µm; odontophore = 23 µm; total stylet length = 37 µm; replacement odontostyle = 10 µm; tail = 30 µm.

(?Third stage) (n = 3): L = 1,30–1,40 mm; a = 37,1–37,8; b = 3,8–4,0; c = 43,3–50,3; c′ = 1,3–1,4; odontostyle = 15–17 µm; odontophore = 26–29 µm (n = 2); total stylet length = 43–45 µm (n = 2); replacement odontostyle = 18–20 µm; tail = 27–28 µm.

General morphology similar to adults, except no post rectal sac could be seen.

Remark: D. major closely resembles *Discolaimus paramajor* Coomans, 1966 regarding body length and all other morphometrical data as well as morphological features (see Table 4). According to Coomans (1966), *D. paramajor* can be distinguished from *D. major* by the presence of males, prerectum with caudal blind sac and by three pairs of caudal pores in the female tail (two in *D. major*). Sauer & Annells (1985), however, reported specimens with two or three pairs of caudal pores. In the Botswana specimens only two pairs are conspicuous, except in one specimen where three pairs could be seen.

Considering the wide distribution of *D. major*, the fact that males have now been found by Sauer & Annells as well

Table 3 Morphometric data of *Discolaimus brevis* and *Discolaimoides bulbiferus*

	D. brevis			*D. bulbiferus*		
	Chobe National Park 2 ♀♀	Okavango 1 ♀	Serondella 4 ♀♀	Savuti Marsh 1 ♀	Moremi Game Reserve 1 ♀	Okavango 1 ♀
L (mm)	0,97	0,80	1,60(1,53–1,63)	1,36	1,44	1,46
a	31,3 & 32,3	33,3	52,4(47,8–55,9)	59,1	45,0	48,7
b	3,9	3,4	5,2(4,9–5,4)	4,3	4,6	4,4
c	37,8 & 38,8	27,6	38,3(36,4–40,8)	–	36,9	29,2
c'	1,2 & 1,3	1,7	2,5(2,3–2,5)	–	2,2	2,7
V%	43	44	45,5(43–48)	49	49	43
Lip region width	17	16	11,5(11–12)	9	12	12
height	–	–	4	4	3	4
Odontostyle: length	12 & 14	12	11(10–12)	10	12	12
width	2 & 1,5	2	1,5(1–2)	1	1,5	1,5
Odontophore length	25 & 19	17	17,8(13–20)	18	20	–
Total stylet length	37 & 33	29	28,8(24–32)	28	32	–
Stylet aperture: length	7 & 9	8	5,5(5–7)	5	6	6
% of odontostyle	58 & 64	67	49,5(45–58)	50	58	50
Guiding ring from anterior end	– & 6	6	5(4–6)	4	6	–
Amphid aperture length	– & 5	7	5,5(5–6)	–	–	–
% of lip region width	– & 29	44	50(45–55)*	–	–	–
Oesophagus length	250	220	305(300–310)	320	310	330
Basal bulb length	133 & 134	122	160(155–164)	173	161	148
Nerve ring from anterior end	80 & 81	71	99,8(95–113)	94	157	119
Lateral chord: % of body width	44 & 27	25	16,8(13–21)	17	16	20
Tail length	26 & 25	19	41,8(40–43)	–	39	50
Prerectum length	–	17	14	–	29	–
Rectum length	15	12	19(15–24)	–	27	20
G1	71 & 72	55	102(85–118)	112	102	–
G2	66	58	102(78–115)	114	99	–
Anterior ovary length	35	28	46,5(45–48)	44	39	–
Posterior ovary length	39 & 38	39	50(45–55)	–	54	–

* $n = 2$

as the presence of a post rectal sac and three caudal pores, we suspect that *Discolaimus paramajor* may be a synonym of *D. major*. However, we refrain from formally proposing such synonymy, since the type material of these two species has not been examined.

New distribution records: Among the roots of grasses under an *Acacia* tree at Serondella, close to the Chobe River and among the roots of grasses under mopane trees near the Savuti Marsh, both in the Chobe National Park, collected 26 and 27 July 1989, respectively.

Specimens: On slides RAU 5142, 5144, 5149, 5150 and 5197–5199.

Discolaimium simplex Siddiqi, 1965

Measurements: Female ($n = 1$): L = 1,57 mm; a = 35,7; b = 3,65; c = 46,2; c' = 1,4; V = 43%; odontostyle = 20 µm; odontophore = 33 µm; total stylet length 53 µm; tail = 34 µm.

A single female from Botswana is in full agreement with the original description of *Discolaimium simplex* by Siddiqi 1965.

Brief description: Lip region 23 µm wide. Amphid stirrup-shaped; its aperture 13 µm wide or 57% of lip region width. Guiding ring 11 µm from anterior end. Oesophagus 430 µm long; basal bulb 270 µm long. Oesophageal gland nuclei indistinct. Nerve ring 112 µm from anterior end. Lateral field 20% of corresponding body width; fairly large hypodermal glands present. Reproductive system as in original description. Rectum 75 µm long. Prerectum indistinct. Tail as in original description; caudal papillae inconspicuous.

Remark: Andrássy (1990) suggested that *D. simplex* may be a synonym of *Discolaimium mucurubanum* (Loof, 1964) Andrássy, 1990. For the same reasons as given under *D. brevis* we prefer to regard our specimens as *D. simplex*.

Male: Not found.

New distribution records: Among the roots of herbs and palm trees, Boba Island (near Jedibe) in the Okavango Swamps collected 31 July 1989.

Specimen: On slide RAU 5215.

Discolaimoides bulbiferus (Cobb, 1906) Heyns, 1963 (Table 3)

The original description of *Discolaimoides bulbiferus* was by Cobb (1906) from Hawaii. Thorne (1939) gave a redescription from topotypes collected from a pineapple field in Hawaii. Heyns (1963) was the first to report this species from southern Africa. Loof (1964) described eleven females as well as the first male of this species from Venezuela. Das, Khan & Loof (1969) studied the topotypes and gave some additional data to that of Thorne (1939). According to

Table 4 Morphometric data of some populations (females only) of *Discolaimus major* and of *Discolaimus paramajor*

		D. major						
	D. paramajor Coomans (1966) Congo 6♀♀[x]	Thorne (1939) Utah ?♀*	Coomans (1966) Utah 18♀♀	Heyns (1963) Transvaal & Cape ?♀♀	Botha & Heyns (1990b) Kruger National Park 3♀♀	Sauer & Annells (1985) Australia 25♀♀	Present specimens from Botswana Serondella 4♀♀	Savuti Marsh 1♀
L (mm)	1,64(1,34–1,98)	1,9–2,5	1,83–2,24	1,73–2,40	1,93–2,20	1,71(1,45–1,88)	1,63(1,62–1,64)	1,65
a	30,5(26–35)	33	–	29–38	39–44	33(27–41)	40,8(39,0–41,8)	41,3
b	3,8(3,4–4,3)	4,0–4,7	3,7–4,6	3,4–4,5	4,2–4,5	4,2(3,8–4,5)	4,0(3,8–4,2)	4,1
c	55(45–72)	67–83	–	74–76	71–85	81(73–91)	53,2(49,7–54,6)	51,6
c'	[0,7 & 0,8]	–	–	–	0,88–1,0	0,9(0,8–1,0)	1,2(1,2–1,3)	1,3
V%	49,3(45–52)	52	49,5–55	51–56	47–55	52,5(49–56)	51,5(50–53)	51
Lip region width	29(27–32)	–	–	–	24–30	[28,2]	24,5(23–26)	25
Odontostyle length	26,3(25–28)	–	25–29	–	20–22	27–28[xx]	19,5(19–21)	19
width	[3,5]	–	–	–	3–3,5	[3,5]	2,8(2–3)	3
Odontophore length	43,3(40–48)	–	38–48	–	35,5–42,5	34(32–36)	33,5(32–35)	36
Total stylet length	69(65–74)	–	66–74	–	55,5–64,5	–	53(51–54)	55
Stylet aperture length	[10 & 12]	–	–	–	–	[14]	10,5(10–11)	11
% of stylet length	[50 & 55]	–	–	–	55–58	[63]	54(52–58)	58
Guiding ring from anterior end	[15,3]	–	–	–	7,5–10,0	[10]	8,3(7–10)	7
Amphid aperture length	[8,2]	–	–	–	7–9	[5,9]	8,3(7–9)	7
% of lip region width	[29]	–	–	–	–	[21]	33,8(30–38)	28
Oesophagus length	–	–	–	–	435–520	[406]	413(390–430)	400
Basal bulb length	–	–	–	–	223,5–328	[234]	252(234–282)	228
Nerve ring from anterior end	–	–	–	–	–	[142]	122(117–130)	123
Lateral chord % of body width	–	–	–	–	–	[25]	18,3(15–21)	23
Tail length	28–33	–	24–33	–	23–31	[21,2]	30,8(30–33)	32
Prerectum length	–	–	–	–	34	–	21(17–23)	33
Rectum length	–	–	–	–	22–34	[16,5]	25,3(23–28)	27

[ ] = Calculated from original figure; * = combination of two populations (Lewiston and Salem), specimens from the original collection of G. Thorne; [x] = paratypes; [xx] = no average given.

these authors the dorsal gland nucleus lies far behind the beginning of the widening of the oesophagus (18 µm in the topotype; 22–29 µm in the Venezuela specimens).

Eight female and two juvenile specimens from Botswana are in complete agreement with the descriptions by Heyns (1963), Loof (1964) and by Das *et al.* (1969). The distance of the dorsal gland nucleus from the beginning of the widening of the oesophagus is, however, somewhat greater, viz. 40 µm or at 60% of oesophageal length (n = 2).

Juvenile: (Fourth stage) (n = 2): L = 1,26 & 1,34 mm; a = 43,4 & 46,2; b = 4,7 & 5,2; c = 31,5 & 29,8; c' = 2,2 & 2,8; odontostyle = 11 & 10 µm; odontophore = 19 & 17 µm; total stylet length = 30 & 27 µm; replacement odontostyle = 13 & 10 µm; tail = 40 & 49 µm. General morphology similar to adults.

Male: Not found.

New distribution records: Among the roots of grasses under an *Acacia* tree at Serondella close to the Chobe River and among the roots of grasses under mopane trees near the Savuti Marsh Chobe National Park; among the roots of grasses under large mopane trees at the camping site near the northern entrance gate of the Moremi Wildlife Reserve and among the roots of herbs and palm trees, Boba Island (near Jedibe) in the Okavango Swamps, collected 26, 27, 30 and 31 July 1989, respectively.

Specimens: On slides RAU 5130, 5142, 5149, 5150, 5202 and 5211.

Aporcelaimellus adriaani Botha & Heyns, 1990 (Figure 6; Table 5)

Botha & Heyns (1990a) described *Aporcelaimellus adriaani* from seven females collected at the Tsokwane picnic area, Kruger National Park.

Two females, three juveniles and for the first time three male specimens to be found of *A. adriaani* were collected in the Okavango Swamps. These are in agreement with the type population of this species. The body length as well as a and c-ratios of the present specimens are somewhat greater (1,63–1,88 mm *vs* 1,23–1,49 mm; 42,3–45,9 *vs* 23–30 and 63,9–74,0 *vs* 42–58 respectively). The rectum (discernible in only one of the Botswana specimens) is also longer (38 µm *vs* 26–30 µm).

Female: General description for female as in original description. Lateral body pores discernible, however, though small; arranged in a single row. Dorsal and ventral pores obscure. Odontophore not thickened at its base. No disc could be seen between oesophagus and cardia. Anterior and posterior reproductive branches 254 and 264 µm; anterior and posterior ovaries 117 and 82 µm long, respectively (n = 1). Vagina occupying 32% of corresponding body diameter (n = 1). Sperm cells present in both uteri of one specimen.

Table 5 Morphometric data of *Aporcelaimellus adriaani* and *Aporcelaimellus papillatus*

	A. adriaani Present specimens Okavango		*A. papillatus* Thorne & Swanger (1936) Broadmoor, England		*A. papillatus* Present specimens Chobe National Park	
	2♀♀	3♂♂	1♀	1♂	2♀♀	2♂♂
L (mm)	1,65 & 1,88	1,70(1,63–1,79)	2,8	2,4	2,20 & 2,14	2,12 & 2,23
a	43,4 & 45,9	43,7(42,3–44,8)	30	28	40,0 & 40,4	41,6 & 42,9
b	4,2 & 4,9	4,6 (4,1–5,1)	4,3	4,1	4,5 & 4,2	4,4 & 4,8
c	– & 67,1	68,5(63,9–74,0)	67	59	75,9 & 64,8	75,7 & 92,9
c′	– & 1,12	1,01(0,88–1,12)	[0,9]	[0,8]	0,9 & 0,97	0,85 & 0,8
V%	54 & 55	–	49	–	49 & 49,5	–
Lip region width	13 & 12	12,7(12–13)	[16]	–	15 & 16	17 & 16
height	5 & 5	5	[5]	–	5 & 5	4 & 5
Odontostyle length	13 & 12	11,3(11–12)	[21]	–	16 & 16	15 & 14
width	3 & 3	3	[3,5]	–	3 & 4	3 & 4
Odontophore length	24 & 18	23 & 17*	–	–	27 & 26	26 & 27
Total stylet length	37 & 30	34 & 28*	–	–	43 & 42	41 & 41
Stylet aperture length	7 & 7	7	[11]	–	9 & 9	8 & 8
% of odontostyle	54 & 58	62 (58–64)	[52]	–	56 & 56	53 & 57
Guiding ring from anterior end	7 & 5	5 & 6*	[10]	–	8 & 7	8 & 8
Amphid aperture length	7 & –	7	[9]	–	8(n = 1)	9(n = 1)
% of lip region width	54 & –	54x	[60]	–	53(n = 1)	56(n = 1)
Oesophagus length	390 & 380	373(350–400)	–	–	480 & 510	480 & 460
Basal bulb length	180 & 167	180(161–205)	–	–	–	–
Nerve ring from anterior end	113 & 130	123(121–126)	–	–	150 & 140	144 & 145
Lateral chord % of body width	11 & 17	14,7(11–18)	–	–	18 & 13	16 & 10
Tail length	– & 28	25(22–28)	[23]	[20]	29 & 33	28 & 24
Prerectum length	– & 92	163 & 188	–	–	191(n = 1)	–
Rectum length	– & 38	–	[36]	–	40 & 43	–
Spiculum length	–	43,7(43–45)	–	[52]	–	57 & 61
Lateral guiding piece length	–	10 & 11	–	[10]	–	15 & 17
Number of ventromedian supplements	–	5	–	8	–	5 & 5

* n = 2; x = 1; [ ] = calculated from original figures

No eggs present. Tail conoid, bluntly rounded with two pairs of caudal papillae.

Male: Description as for female with the following differences. Heat-relaxed body slightly to more strongly ventrally curved, especially in posterior region. Reproductive system diorchic, testes opposed and outstretched with a common spermoduct, no muscular ejaculatory duct present. Spermoduct merging with alimentary canal 40–42 µm anterior to cloacal opening. Anterior and posterior testes 142 µm and 115 µm long, respectively (n = 1). Sperm cells spindle-shaped, 7–9 µm long. Spicules relatively short, arcuate. Each spiculum with a distinctly wrinkled area in the spicular sheath in one specimen (Figure 6C). Lateral guiding pieces slender, distally bifurcate. One pair of adanal supplements situated close to cloacal opening. Ventromedian supplements five in number, mammiform. First two supplements contiguous, others non-contiguous (Figure 6F and H). Tail similar to that of female, slightly ventrally curved in one specimen with two pairs of caudal papillae.

Juvenile: (Fourth stage) (n = 3): L = 0,86–1,11 mm; a = 23,8–37; b = 2,9–3,9; c = 31,9–46,3; c′ = 1,3–1,4; odontostyle 9–12 µm; replacement odontostyle = 9–13 µm; tail = 24–27 µm.

General morphology similar to adults. Odontophore obscure in all specimens.

Remark: One male specimen from the Chobe National Park (from Serondella) is morphologically similar to *A. adriaani* but has a wider lip and neck region, smaller c-ratio, shorter testes and more ventromedian supplements. L = 1,34 mm; a = 41,9; b = 3,9; c = 53,6; c′ = 1,8; lip region width = 20 µm; odontostyle = 13 µm; odontophore = 24 µm; total stylet length = 37 µm; stylet aperture as % of odontostyle = 46; guiding ring from anterior end = 8 µm; lateral chord as % of body width = 19; prerectum 112 µm; tail length = 25 µm; anterior testis = 95 µm; posterior testis = 75 µm; spiculum = 37 µm; lateral guiding piece = 9 µm; number of ventromedian supplements = 10.

New distribution records: Chobe National Park: Juveniles (n = 2): among the roots of grasses next to an *Acacia* tree at the Lamont ruins, and among the roots of grasses under mopane trees near the Savuti Marsh. Adults and one juvenile: from brackish soil among the roots of grasses on Boba Island in the Okavango Swamps, collected 26, 27 and 28 July 1989, respectively.

Specimens: On slides RAU 5150, 5191–5192, 5236, 5238–5241.

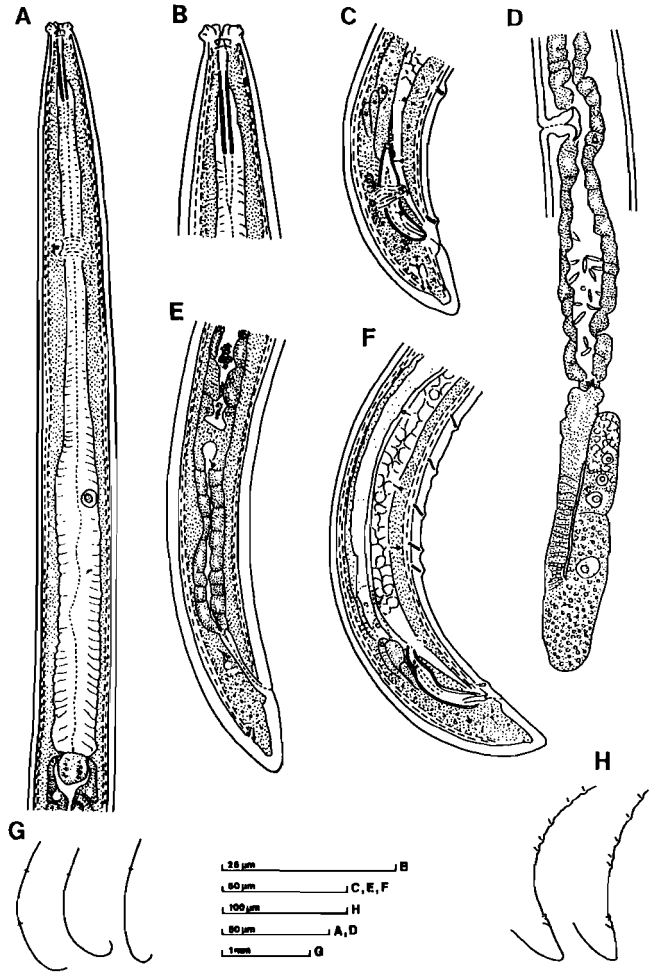

Figure 6 *Aporcelaimellus adriaani*. Specimens from Boba Island. **A** Head and neck region, **B** Head region, **C** Male posterior region, **D** Posterior reproductive branch of female, **E** Female posterior region, **F** Male posterior region, **G** Heat-relaxed body postures, **H** Variation in arrangement of supplements.

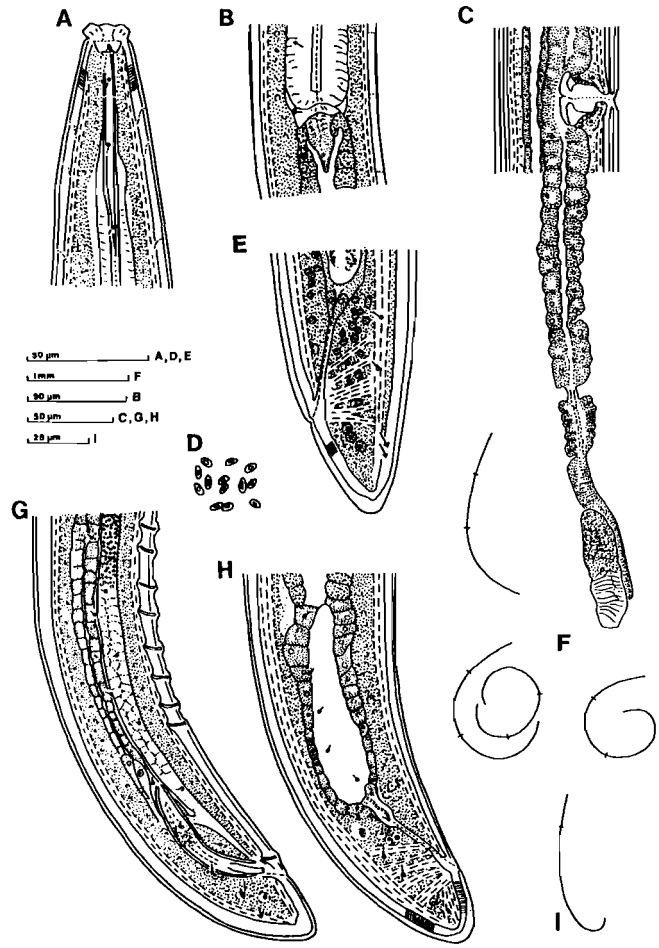

Figure 7 *Aporcelaimellus micropunctatus*. **A-E** Specimens from Chobe National Park, **G & H** Specimens from the Okavango. **A** Head region, **B** Oesophago-intestinal junction, **C** Posterior reproductive branch of female, **D** Sperm cells, **E** Female posterior region, **F** Heat-relaxed body postures of female (specimens of both populations), **G** Male posterior region, **H** Female posterior region, **I** Heat-relaxed body posture of male.

Aporcelaimellus micropunctatus Botha & Heyns, 1990 (Figure 7; Table 6)

Botha & Heyns (1990a) described *Aporcelaimellus micropunctatus* from the Kruger National Park, collected among the roots of unidentified grasses.

Twelve females, three juveniles and the first three male specimens to be found of *A. micropunctatus* were collected from the Okavango Swamps and Chobe National Park. These are in almost complete agreement with the type population of *A. micropunctatus*.

Female: Heat-relaxed body slightly to very strongly ventrally curved in the shape of a letter C to almost a complete circle in one specimen. Cuticle as in original description; 4–7 µm thick on the neck, 5–8 µm at mid-body, 5–7 µm around the tail tip. Body pores distinct. Lateral pores 15–17 to base of oesophagus, 11–18 between oesophagus and vulva and 19–28 between vulva and anus; not diverging into two rows as mentioned in the original description. (Examination of the holotype, however, revealed only one row). Ventral pores 11–16 to base of oesophagus, 4–11 between oesophagus and vulva and 8–12 between vulva and anus. Dorsal pores 7–8, limited to anterior oesophageal region.

Lip region, amphid and stylet similar to that in original description. No rudimentary excretory pore seen in Botswana specimens. Oesophago-intestinal disc rather distinct in all specimens except in one female from the Chobe National Park. Hemizonid opposite nerve ring, 150–174 µm from anterior end. Tail conoid, bluntly rounded, two pairs of caudal papillae present.

Anterior and posterior reproductive branches 165–280 µm and 132–250 µm long, respectively. Anterior and posterior ovaries 67–250 µm and 78–133 µm long, respectively. Sphincter muscle distinct. Vagina strongly muscular, occupying 27–32% of the corresponding body width. Vulva lips sclerotized. No eggs or sperm cells observed.

Male: Male similar to female, except heat-relaxed body ventrally slightly curved, with posterior region more ventrally curved. Cuticle 4–5 µm on neck, 7–9 µm at mid-body, 8–15 µm around the tail tip; 'punctations' conspicuous towards tail end. Lateral pores 22–25 to base of oesophagus region and 95–100 between oesophagus and anus; small,

Table 6 Morphometric data of *Aporcelaimellus micropunctatus*

	Chobe National Park			Okavango	
	Serondella		Savuti Marsh	Boba Island	
	4♀♀	1♂	1♀	7♀♀	2♂♂
L (mm)	2,10(1,80–2,39)	2,84	2,42	2,38(1,88–2,64)	250 & 258
a	27,2(25,0–31,9)	41,8	24,7	28,7(22,8–34,2)	32,1 & 34,4
a′	30,5(27–31,9)	–	33,6	34,4(25,7–38,3)	38,5 & 39,7
b	3,87(3,46–4,35)	4,9	3,9	4,0(3,7–4,3)	4,63 & 51,6
c	53,0(40,9–63,2)	83,5	65,4	75,2(66,5–86,2)	75,8 & 83,2
c′	1,0(0,8–1,2)	0,77	0,9	0,76(0,7–0,9)	0,8 & 0,8
V%	54,1(52,3–55,8)	–	58	52,9(49,8–56,0)	–
Lip region width	18,8(17–20)	18	19	21,3(20–23)	21 & 22
height	6(5–7)	6	6,5	6,3(6–7)	6,5 & 6,5
Odontostyle length	20,5(20–21)	21	20	21,4(19–22)	22 & 23
width	4,3(4–5)	5	4,5	4,4(4,0–5,5)	5 & 5
Odontophore length	39(36–44)	40	43	40(39–42)	38 & 35
Total stylet length	59,5(56–64)	61	63	61,4(59–64)	60 & 58
Stylet aperture length	10,3(11–13)	10	13	13,3(12–15)	14 & 16
% of odontostyle length	58,5(52–65)	48	65	62(59–68)	64 & 69
Guiding ring from anterior end	13(12–14)	10	12	12,6(10–15)	10 & 11
Amphid aperture length	10,3(10–11)	–	10	10,8(10–11)	12 & 13
% of lip region width	55(50–61)	–	53	50,3(45–52)	57 & 59
Oesophagus length	540(520–570)	580	620	601(490–690)	540 & 500
Basal bulb length	260–270*	255	–	297(230–350)	260 & 240
Nerve ring from anterior end	175(166–185)	169	192	183(161–202)	165 & 164
Lateral chord % of body width	13,8(12–16)	10	15	9(7–11)	4 & 8
Tail length	40(34–44)	34	37	31,9(26–38)	33 & 31
Prerectum length	105(71–129)	–	120	121(77–138)	222 & 247
Rectum length	54,5(51–56)	–	59	57(40–63)	– & –
Spiculum length	–	79	–	–	82 & 87
Lateral guiding piece length	–	18	–	–	24 & 22
Number of ventromedian supplements	–	9	–	–	7 & 8

* $n = 2$

close together, diverging just before anteriormost ventromedian supplement. Ventral pores 11–15 to base of oesophagus, 38–39 between oesophagus and anteriormost ventromedian supplement. Dorsal pores eight (n = 1), limited to anterior oesophageal region.

Reproductive system diorchic, testes opposed and outstretched with common spermoduct. No muscular ejaculatory duct present. Spermoduct merging with alimentary canal 63 µm anterior to cloacal opening. Anterior and posterior testes 380–490 µm long, respectively. Sperm cells distinct, ovoid, about 6 µm long. Spicules rather slender. Lateral guiding pieces slender with bifurcated termini. In one specimen two and in another, three ejaculatory glands could be seen; inconspicuous in third specimen. One pair of adanal supplements situated close to cloacal opening, mammiform and non-contiguous. Rectal glands distinct in two specimens, their ducts inconspicuous. Tail shape similar to that of female, with two pairs of caudal papillae.

Juvenile: (Fourth stage) (n = 2): L = 1,91 & 2,06 mm; a = 25,8 & 31,7; b = 3,7; c = 63,7 & 66,5; c′ = 0,7–0,9; odontostyle = 20 & 21 µm; odontophore = 35 µm; total stylet length = 55 & 56 µm; replacement odontostyle = 23 & 24 µm; tail 30 & 31 µm.

(Third stage) (n = 1): L = 1,55 mm; a = 22,1; b = 3,7; c = 53,4; c′ = 0,9; odontostyle = 17 µm; odontophore = 25 µm; total stylet length = 43 µm; replacement odontostyle = 20 µm; tail = 29 µm.

New distribution records: Chobe National Park: Among the roots of grasses under an *Acacia* tree at Serondella, close to the Chobe River, and from grasses under a solitary palm tree in the north-western part of the Savuti Marsh. Three samples taken on Boba Island, near Jedibe, viz. among the roots of herbs and palm trees; from brackish soil among the roots of grasses, and among the roots of a sausage tree *(Kigelia africana)*, standing at the edge of the water, collected 26, 30 July and 1 August 1989, respectively.

Specimens: On slides RAU 5114, 5147, 5125, 5174, 5175, 5220–5222, 5240 and 5280.

Aporcelaimellus papillatus (Bastian, 1865) Baqri & Khera, 1975 (Figure 8; Table 5)

Syn. *Dorylaimus papillatus* Bastian, 1865

The first description of this species was by Bastian (1865) from female specimens collected at Broadmoor, Berks, England. Bastian gave a very short description with an illustration of only the neck region and tail. Thorne & Swanger (1936) described both females and males from various localities in Europe and Woods Hole, Massachusetts, U.S. A.

Two female and two male specimens from the Chobe

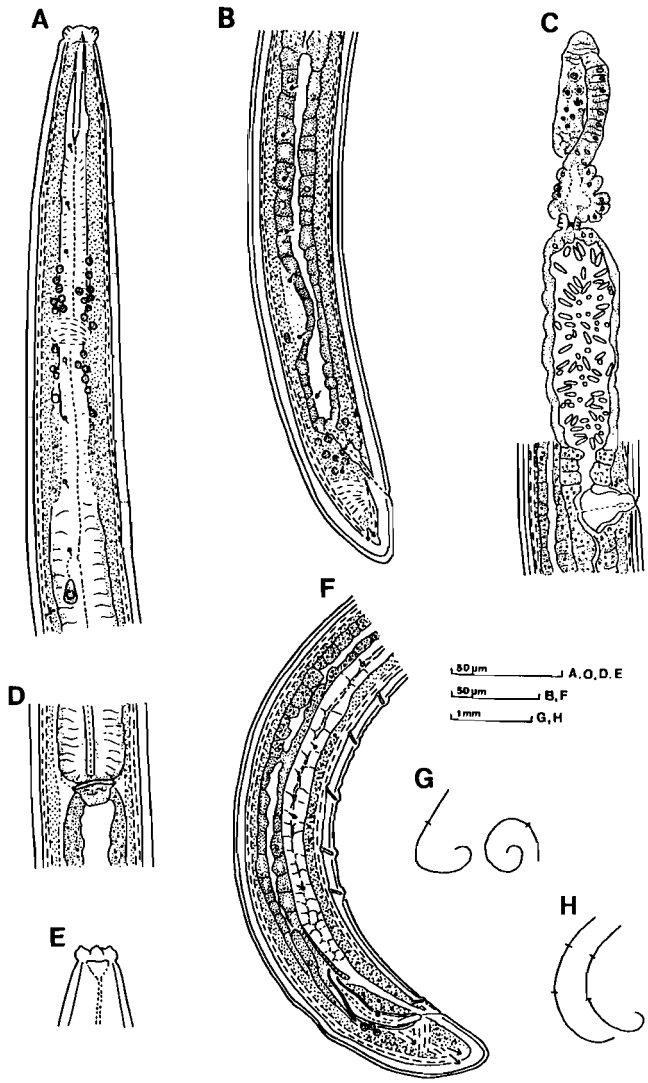

Figure 8 *Aporcelaimellus papillatus*. **A** Anterior region, **B** Female posterior region, **C** Anterior reproductive branch of female, **D** Oesophago-intestinal junction, **E** Shape and position of amphid, **F** Male posterior region, **G** Heat-relaxed body postures of males, **H** Heat-relaxed body postures of females.

National Park, are for the first time recorded from southern Africa. These specimens are very similar to those described by Thorne & Swanger (1936). They differ, however, in the somewhat shorter odontostyle, longer spicules, longer lateral guiding pieces and slightly less ventromedian supplements (see Table 5).

Brief description: *Female* (n = 2): Heat-relaxed body ventrally curved in an open letter C or in an incomplete figure six. Cuticle 3 and 4 µm on neck; 4 µm at mid-body; 10 µm around tail tip. No 'punctations' seen. Dorsal and ventral body pores indistinct. Lateral pores not very prominent, a single row and irregularly spaced; 12–13 to base of oesophagus, 19–16 between oesophagus and vulva, 25–37 between vulva and anus. Lip region offset. Lips angular with distinct papillae. Amphid funnel-shaped, in lateral view appearing to be transversely divided into two sections. Guiding ring single, unsclerotized. A disc-like structure present between oesophagus and intestinum. Intestine with four cells in circumference. Tail convex-conoid, bluntly rounded, with two pairs of caudal papillae.

Reproductive system didelphic, amphidelphic. Vulva a transverse slit, lips without sclerotization. Distinct sphincter muscle between *pars dilatata uteri* and *pars dilatata oviductus*. Sperm cells present in uteri.

Male: (n = 2). Similar to female, except heat-relaxed body more strongly curved. 'Punctations' could be seen on cuticle in one specimen. Lateral pores 14 to base of oesophagus, 52–64 between oesophagus and anus; diverging just anterior to level of anteriormost ventromedian supplement in one specimen, at level of germinal zone of posterior testis in the other specimen. Reproductive system diorchic, testes opposed; anterior and posterior testes 328–330 µm, and 304–324 µm long, respectively. Common spermoduct present, merging with alimentary canal 150 µm (n = 1) anterior to cloacal opening. No muscular ejaculatory duct present. Sperm cells elongate–ovoid; about 7 µm long. Spicules slender. Lateral guiding pieces slender, termini not bifircate. One pair of adanal supplements situated close to cloacal opening. Ventromedian supplements mammiform, non-contiguous, widely spaced; five in number. Tail shape as in female, with two pairs of caudal papillae.

Remark: A. papillatus and *A. obtusicaudatus* (Bastian, 1865) Altherr, 1968 are two closely related species. They were both described from England by Bastian (1865) in the same publication. The main differences between these species were size and also tail shape. Thorne & Swanger (1936) maintained the two species, apparently on the basis of tail shape. There were numerous reports of both species in the literature, but apparently also much uncertainty about the identity of both. Baqri & Coomans (1973) found great variation in populations from the Virunga National Park, Zaire, also in size and tail shape, which may indicate synonymy of the two species. Until this situation is resolved by a thorough study, we regard our specimens as *A. papillatus*, mainly because of large size and tail shape.

New distribution records: From soil among the roots of grasses under an *Acacia* tree at Serondella, close to the Chobe River in the Chobe National Park, collected 26 July 1989.

Specimens: On slides RAU 4839 and 4842.

Aporcelaimellus parapapillatus Botha & Heyns, 1990 (Figure 9; Table 7)

Botha & Heyns (1990a) based their description of this species on three female and three male specimens collected among the roots of unidentified grasses near the look-out at Engelhard Dam in the Kruger National Park.

Three female, three male and two juvenile specimens from the Chobe National Park and Okavango Swamps, are in agreement with the type population of *A. parapapillatus*. The Botswana specimens, however, are somewhat longer, have a slightly greater total stylet length, slightly longer tails and fewer ventromedian supplements.

Brief description: *Female:* Heat-relaxed body varying from only slightly ventrally curved to more strongly ventrally curved in almost a complete circle or incomplete figure six. Cuticle 4–5 µm thick on neck; 6–9 µm at mid-body; 7–12 µm around the tail tip. Lateral pores distinct, a single row,

Table 7 Morphometric data of *Aporcelaimellus parapillatus*

	Botha & Heyns (1990) Kruger National Park			Present specimens			
				Chobe National Park		Okavango	
	Holotype♀	2♀♀	3♂♂	1♀	2♂♂	2♀♀	1♂
L (mm)	2,51	2,11 & 2,40	2,27–2,38	2,57	2,49 & 2,59	2,61 & 2,79	2,62
a	33	32 & 29	24–32	36,2	33,6 & 32,4	37,8 & 31,3	34,9
b	4,4	3,9 & 4,9	4,2–4,5	3,9	4,3 & 4,2	5,1 & 4,7	4,9
c	71	62 & 75	60–64	95,2	80,3 & 60,2	70,1 & 68,0	60,9
c′	0,92	0,98 & 0,86	0,95–0,98	0,6	0,72 & 0,82	0,8 & 0,9	0,9
V%	52	55 & 56	–	54,8	–	52,2 & 54,1	–
Lip region width	19,5	20	18–20	20	20 & 20	21 & 23	23
height	–	[7,6]	–	6	7 & 6	8 & 7	8
Odontostyle length	19	18	16–18,5	19	19 & 19	22 & 21	22
width	4,5	5 & 4,5	4–5	4,5	5 & 5	5 & 5	5
Odontophore length	32	32	26,5–36	38	37 & 38	37 & 38	36
Total stylet length	51	50	44–54,5	57	56 & 57	59 & 59	58
Stylet aperture length	13	12	11–12,5	9,5	8 & 9	15 & 15	14
% of stylet length	68	67	68–69	47	42 & 47,4	68 & 71	63,6
Guiding ring from anterior end	9,5	10,5 & 9	8–10	12	9 & 7	13 & 13	13
Amphid aperture length	9	9	9–10	12	9 & –	– & 12	10
% of lip region width	–	–	–	60	45 & –	– & 52	43,5
Oesophagus length	570	530 & 490	540–555	650	580 & 610	510 & 590	540
Nerve ring from anterior end	–	[171]	–	178	163 & 168	167 & 187	–
Lateral chord % of body width	–	–	–	5,6	8,1 & –	5,7 & 6,7	9,3
Tail length	35,5	33,5 & 32	36–37,5	27	31 & 43	33 & 41	43
Prerectum length	173	136 & 147	139(*n* = 1)	244	262 & –	146 & 88	–
Rectum length	48	46 & 47	62(*n* = 1)	51	57 & –	50 & 58	–
Spiculum length	–	–	80–88	–	75 & 83	–	89
Lateral guiding piece length	–	–	19–23	–	17 & –	–	22
Number of ventromedian supplements	–	–	15–17	–	10 & –	–	10

irregularly spaced, diverging just before anus in the Okavango specimens, not diverging in the Chobe National Park specimen; 23–34 to base of oesophagus, 36–39 between oesophagus and vulva, 51–59 between vulva and anus. Ventral pores 13–19 to base of oesophagus (*n* = 2), 19–20 between oesophagus and vulva (*n* = 2), 25–27 between vulva and anus. Dorsal pores eight, limited to anterior oesophageal region (*n* = 1).

Lip region offset. Amphid funnel-shaped; not divided into two sections. Odontostyle and odontophore as in original description. Guiding ring single, unsclerotized. Excretory pore not seen. Hemizonid distinct in one specimen; just anterior to nerve ring. Oesophago-intestinal disc absent. Intestine six cells in circumference. Tail conoid, bluntly rounded; somewhat shorter in one specimen. Two pairs of caudal papillae present in two specimens; three pairs in third specimen.

Reproductive system as in original description. Sperm cells present in uteri as well as in oviducts in one specimen.

Male: Similar to female. Heat-relaxed body only slightly ventrally curved, posterior part not as strongly curved as in the type specimens. Lateral hypodermal glands distinct; lateral pores irregularly spaced, a single row diverging into two rows just anterior to level of anteriormost ventromedian supplement; 24 to base of oesophagus, 78 between oesophagus and anteriormost ventomedian supplement and 19 from there to anus.

Reproductive system as in original description; anterior and posterior testes 240–332 µm and 200–321 µm long, respectively. Common spermoduct present, merging with alimentary canal 63 µm (*n* = 1) anterior to cloacal opening. No muscular ejaculatory duct present. Sperm cells ovoid; about 4 µm long. Spicules long and slender; spicular sheath with distinctly wrinkled area in one specimen. Lateral guiding pieces slender, termini not bifurcate. Adanal pair of supplements situated close to cloacal opening. Ventromedian supplements mammiform; non-contiguous, but close together; 10 and 11 in number. Tail shape as in female, with three pairs of caudal papillae.

Juvenile (Third stage) (*n* = 2): L = 1,15 & 1,33 mm; a = 24,5 & 23,8; b = 3,5 & 3,3; c = 33,8 & 42,9; c′ = 1,3 & 1,1; odontostyle = 14 & 15 µm; odontophore = 24 & 29 µm; total stylet length = 38 & 44 µm, replacement odontostyle = 17 & 19 µm; tail = 34 & 31 µm.

General morphology of juveniles similar to adults. Disc-like structure between oesophagus and intestinum present in one specimen.

Remark: A. parapapillatus is very close to *A. papillatus* (Bastian 1865) Baqri & Khan, 1975. According to Botha & Heyns (1990a), it can be distinguished from *A. parapapillatus* by the more posterior vulva position and greater number of ventromedian suppplements. With the discovery of the new populations of *A. papillatus* from Botswana, further differences became evident. *A. parapapillatus* differs from *A. papillatus* also by the wider lip region (18–23 µm *vs* 15–17 µm); greater lip region height (6–8 µm *vs* 4–5 µm);

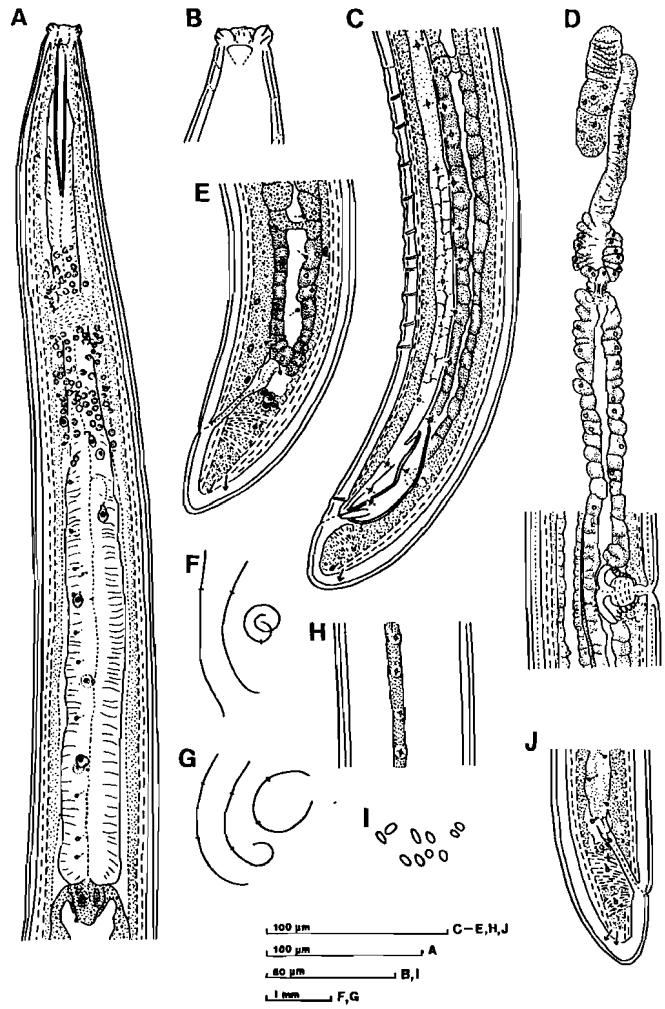

Figure 9 *Aporcelaimellus parapapillatus*. **A, B, D, E & J:** Specimens from the Okavango; **C & H** specimen from Chobe National Park. **A** Head and neck region, **B** Shape and position of amphid, **C** Male posterior region, **D** Anterior reproductive branch of female, **E** Female posterior region, **F** Heat-relaxed body postures of males, **G** Heat-relaxed body postures of females, **H** Lateral chord, **I** Sperm cells, **J** Variation in female tail.

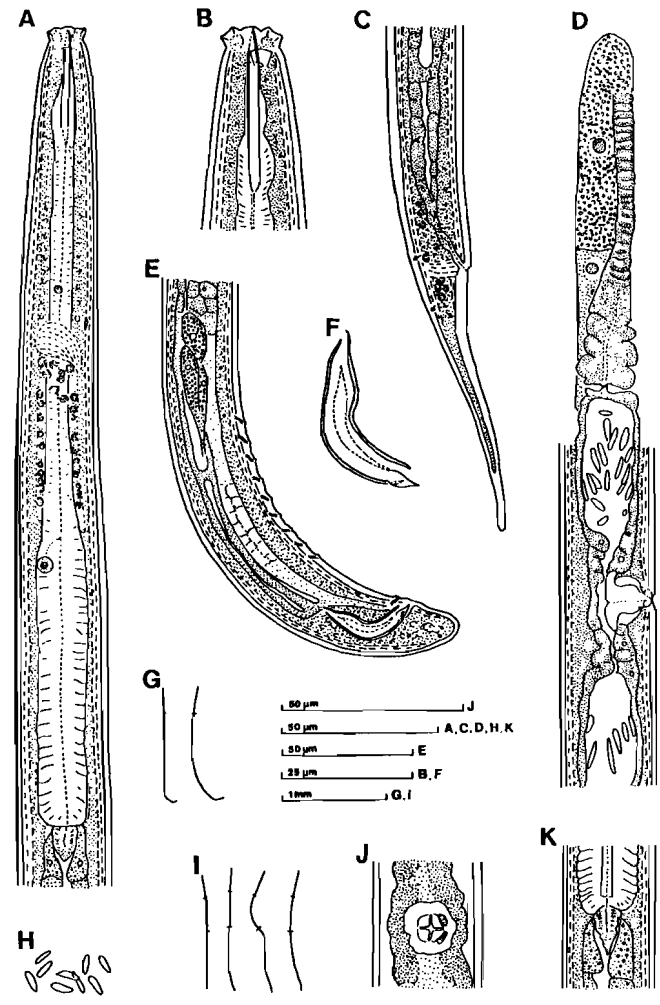

Figure 10 *Mesodorylaimus usitatoides* spec. nov. **A** Head and neck region, **B** Head region, **C** Female posterior region, **D** Anterior reproductive branch of female, **E** Male posterior region, **F** Spiculum and lateral guiding piece, **G** Heat-relaxed body postures of males, **H** Sperm cells, **I** Heat-relaxed body postures of females, **J** *En face* optical section through vagina, **K** Variation in oesophago-intestinal junction.

longer odontophore (26,5–38 µm *vs* 26–27 µm); longer tail (27–48 µm *vs* 20–29 µm), longer rectum (46–62 µm *vs* 36–40 µm); longer spicules (73–89 µm *vs* 52–61 µm); somewhat longer and differently shaped sperm cells (ovoid *vs* elongate-ovoid).

New distribution records: Among the roots of grasses under an *Acacia* tree at Serondella, close to the Chobe River, Chobe National Park, and from soil under herbs and palm trees on Boba Island (near Jedibe) in the Okavango Swamps, collected 26 and 31 July 1989, respectively.

Specimens: On slides RAU 5114, 5148, 5220, 5222, 5223 and 5225.

***Mesodorylaimus usitatoides* spec. nov. (Figure 10; Table 8)**

Description: *Female:* Body of medium length and relatively slender. Heat-relaxed body posture almost straight or only slightly ventrally curved. Cuticle with minute radial striations. Lateral chord varying from about one sixth to one third the corresponding body width. Body pores indistinct.

Lip region offset by a constriction. Lips partly amalgamated. Labial papillae rather protruding, resulting in the lips having an angular appearance; number and arrangement of papillae typically dorylaimoid. Amphid aperture conspicuous in only one specimen; a wide slit, slightly less than one half the lip region width; situated at level of constriction between lip region and adjoining body. Fovea funnel-shaped. Amphideal fusus with sensilla not visible.

Length of odontostyle about equal to lip region width. Stylet aperture about one third and one half the odontostyle length. Guiding ring single, sclerotized. Odontophore 1,6 to 1,7 times the odontotstyle length. Nerve ring distinct, encircling anterior slender part of oesophagus about midway; numerous nerve cells visible, mostly behind nerve ring. Hemizonid conspicuous in all but two specimens, situated at level of nerve ring. Hemizonion not seen. Anterior slender part of oesophagus less muscular than basal expanded part; broadened around posterior half of odontophore. Oesophagus widening at 56 (51–61)% from anterior end. Oesophage-

Table 8 Morphometric data of *Mesodorylaimus usitatoides* sp. nov.

	Holotype	Paratypes	
	♀	7♀♀	5♂♂
L (mm)	1,14	1,23(1,17–1,29)	1,20(1,14–1,32)
a	40,7	41,0(39,0–46,3)	38,7(37,4–40,4)
b	4,6	4,8(4,5–5,2)	4,8(4,4–5,1)
c	13,7	14,6(12,5–18,4)	75,4(72,5–81,4)
c′	4,6	4,8(3,7–5,7)	0,82(0,7–0,9)
V%	53	49,4(47–53)	–
Lip region width	12	10,9(10–11)	10,8(10–11)
height	4	3,8(3–4)	3,6(3–4)
Odontostyle length	13	13,3(13–14)	12(11–13)
width	2,0	1,9(1,0–2,5)	1,8(1,0–2,0)
Odontophore length	19	18(17–19)	18,4(17–20)
Total stylet length	32	32,3(30–38)	30,4(29–32)
Stylet aperture length	4	5(4–6)	4,6(4–6)
% of stylet length	38	40(31–50)	38(33–46)
Guiding ring from anterior end	7,5	7,3(7–8)	6,8(6–7)
Amphid aperture length	7	6(n = 1)	6(5–7)*
% of lip region width	56	55(n = 1)	56,7(45–70)*
Oesophagus length	250	259(240–280)	252(240–260)
Nerve ring from anterior end	100	96(89–107)	93,6(88–100)
Lateral chord % of body width	28	21,4(16–27)	25,8(17–30)
Tail length	83	85,5(70–103)^x	16(14–18)
Prerectum length	43	49,4(45–55)°	71(64–79)
Rectum length	28	27,8(25–30)°	35,5(34–37)
Spiculum length	–	–	33,4(31–36)
Lateral guiding piece length	–	–	6,6(5–9)
Number of ventromedian supplements	–	–	8,4(7–10)

° n = 5; * n = 3; ^{x} n = 6

al gland nuclei and their outlets obscure, except dorsal gland nucleus and outlet conspicuous in one specimen; situated at 67% and 64% of oesophagus length, respectively. Cardia elongate–conoid, 13,4 (10–16) µm long and 9 (7–10) µm wide; anterior third appearing more strongly muscular, giving the impression of a disc-like structure in some specimens.

Intestinal wall containing numerous yellow granules; individual cells obscure. Prerectum length 2,8 (2,4–3,2) (n = 5) times the anal body diameter. Rectum 1,6 (1,3–1,8) (n = 6) anal body widths long. No rectal glands seen. Tail elongate–conoid, dorsally slightly curved at about middle. Tail tip rounded. Hyaline part 18,7 (17–20) (n = 7) long, or cytoplasmic core occupying 77 (73–83)% (n = 7) of tail length. Caudal papillae not always conspicuous; two or three pairs.

Reproductive system didelphic-amphidelphic, posterior branch slightly better developed; the anterior and posterior branches 184 (168–204) µm and 196 (177–230) µm long or occupying 14,9 (13,4–15,8)% and 15,9 (14,1–19,6)% of total body length, respectively. Ovaries reflexed; anterior and posterior ovaries 89 (60–152) µm and 105 (76–107) µm long, respectively. Oviduct and *pars dilatata oviductus* well developed. Sphincter muscle between *pars dilatata oviductus* and uterus present, however not very evident. No distinct *pars dilatata uteri* present. Uteri always broadened and filled with numerous sperm cells, apparently serving as a spermatheca. Sperm cells also present in *pars dilatata oviductus* in one specimen. Vagina occupying 44 (37–51)% of the corresponding body diameter; thick-walled. Vulva a transverse slit with weakly sclerotized lips. No uterine eggs observed.

Male: Description as for female with the following differences. Ventral curvature of body more pronounced in tail region. Reproductive system diorchic, testes opposed and outstretched, with common spermoduct. No muscular ejaculatory duct present. Spermoduct merging with alimentary canal 35 (34–37) µm (n = 4) anterior to cloacal opening. Sperm cells elongate–ovoid to spindle-shaped; 6–9 µm long. Three pairs of ejaculatory glands prominent anterior to supplements. The course of their ducts could not be followed. Spicules arcuate, well developed. Lateral guiding pieces almost 'V'-shaped, short and stout. Supplements mammiform, 'flattened'; consisting of an adanal pair and a row of 7–10 contiguous ventromedian ones. No rectal glands observed. Tail short, conoid, ventrally slightly curved, the terminus bluntly rounded. Two or three pairs of caudal papillae present.

Juvenile: (Third stage) (n = 2): L = 0,71 & 0,72 mm; a = 35,5 & 34,3; b = 4,7 & 3,8; c = 10,5 & 10,9; c′ = 6,0 & 5,5; odontostyle = 9 µm; odontophore = 14 µm (n = 1); total stylet length = 23 µm (n = 1); replacement odontostyle = 10 & 9 µm; tail = 67 & 66 µm; cytoplasimic core as % of tail length = 19 & 12.

(Fourth stage) (n = 10): L = 0,89–1,09 mm; a = 32,9–40,8; b = 3,8–4,5; c = 11,5–16,9; c′ = 3,9–6,0; odontostyle = 9–11 µm; odontophore = 15–19 µm (n = 6); total stylet length = 25–29 µm (n = 6); replacement

odontostyle = 11–13 µm; tail 62–100 µm; cytoplasmic core as % of tail length = 11–23.

General morphology similar to adults except sexual dimorphism not present.

Type locality and habitat: From brackish soil among the roots of grasses, Boba Island in the Okavango Swamps, collected 1 August 1989.

Type specimens: Holotype: Female (second specimen left) on slide RAU 5239.
Paratypes: Seven females on slides RAU 5232, 5234, 5235 and 5239 and five males on slides RAU 5233 and 5239.

Diagnosis: Mesodorylaimus usitatoides can be recognized by the following characters: medium sized body; offset lip region; protruding labial papillae; transverse vulva; elongate–conoid female tail; short spicules and rather short, stout and V-shaped lateral guiding pieces.

Relationships: M. usitatoides is very close to *Mesodorylaimus usitatus* Basson & Heyns, 1974, but has a definite offset lip region compared to the almost confluent lip region of *M. usitatus*, differently shaped female tail, contiguous supplements (non-contiguous in *M. usitatus)* and longer sperm cells (*M. usitatoides* = 6–9 µm; *M. usitatus* = 5,4–6,1 µm).

It is also similar to *Mesodorylaimus musae* Geraert, 1962 differing in the greater c-ratio (female: 13,3–18,4 *vs* 4,8–7,65; male: 72,5–81,4 *vs* 35,4–58,6; shorter female tail (70–103 µm *vs* 161 µm); more offset lip region and slightly longer males (1,14–1,32 mm *vs* 0,7–1,1 mm).

M. usitatoides also resembles *Mesodorylaimus bastiani* (Bütschli, 1873) Andrássy, 1959. It can be distinguished from the topotypes described by Loof (1969), by its slightly shorter body (female: 1,17–1,29 mm *vs* 1,60–1,64 mm; male: 1,14–1,32 mm *vs* 1,47–1,73 mm); more anteriorly situated vulva (47–53% *vs* 53–60%); shorter female tail (14–18 µm *vs* 24,1 µm); shorter spicules (31–36 µm *vs* 43–44 µm); more offset lip region and more protruding labial papillae ('hardly protruding' in *M. bastiani*).

The new species can also be compared with *Mesodorylaimus parasubulatus* (Meyl, 1954) Andrássy, 1959, but has a somewhat greater body length and longer tail in the female (1,14–1,29 mm and 70–103 µm *vs* 0,9 mm and 54 µm); slightly longer odontostyle (11–14 *vs* 8,8 µm) and differently shaped lateral guiding pieces (narrower and more cylindrical in *M. parasubulatus).*

?*Prodorylaimus/Laimydorus* species (Figure 11)

A single female from the Okavango Swamps, has characteristics of *Prodorylaimus* as well as *Laimydorus*. These genera can only be distinguished on the basis of the tail shape of the male specimens (long and filiform in *Prodorylaimus*, short and rounded in *Laimydorus*). According to Loof (1985) all monosexual species (not belonging to the related genus *Mesodorylaimus* should be included in *Prodorylaimus*. Since sperm cells are present in the uteri of the present specimen it obviously does not belong to a monosexual species, and could thus be either *Prodorylaimus* or *Laimydorus*. However, since the male was not found, it cannot be determined to which of the two genera it belongs.

Measurements: *Female: (n* = 1): L = 2,32 mm; a = 43,8; b = 5,0; c = 5,3; c′ = 12,3; V = 44,5%; lip region width = 16 µm; lip region height = 6,5 µm; odontostyle length = 25 µm; odontostyle width = 3 µm; odontophore length = 29 µm; total stylet length = 54 µm; tail length = 437 µm.

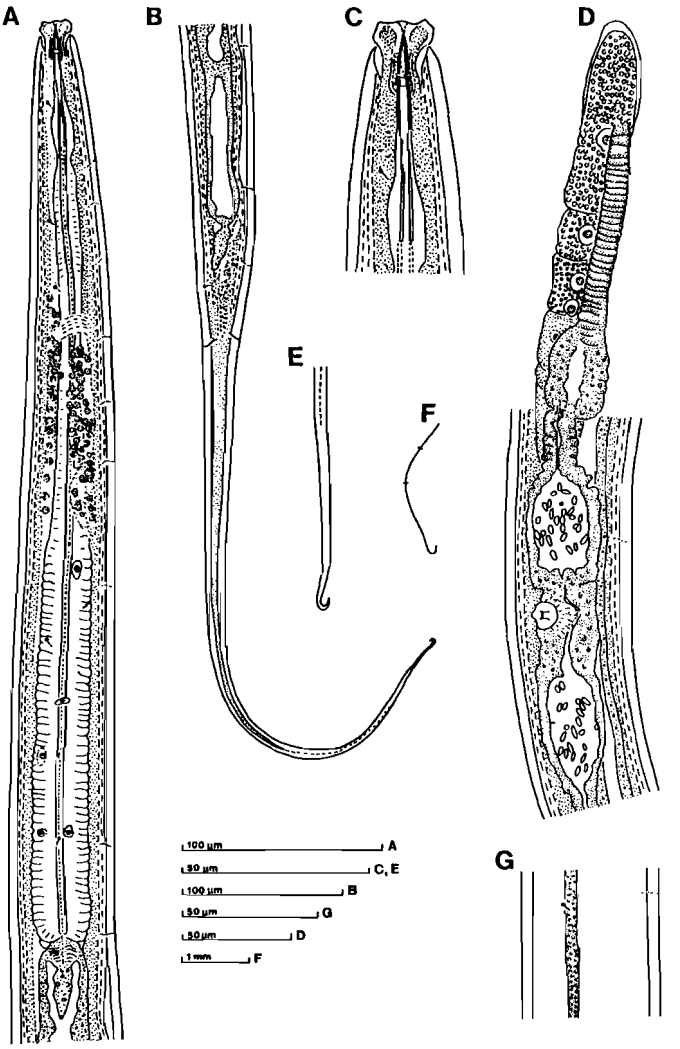

Figure 11. *Prodorylaimus/Laimydorus* species. **A** Head and neck region, **B** Female posterior region, **C** Head region, **D** Anterior reproductive branch, **E** Tail end, **F** Heat-relaxed body posture, **G** Lateral chord.

Description: Heat-relaxed body posture ventrally curved in a widely open letter C. Cuticle with minute striations; 3 µm wide on neck, 5 µm wide at midbody, 5 µm wide at level of anus. Lateral chord 9% of the corresponding body width. Lateral body pores distinct, distributed over entire body length; seven in number up to oesophagus, eight between oesophagus and vulva, 10 between vulva and anus. Ventral body pores conspicuous in neck region, sometimes visible over rest of body. Dorsal pores indistinct.

Lip region apparently slightly offset. Lips partly amalgamated; labial papillae rather protruding, resulting in an angular lip region appearance. Amphids situated at level of constriction between lip region and adjoining body.

Length of odontostyle about one and a half times lip region width. Stylet aperture 36% of odontostyle length. Odontophore almost equal in length to odontostyle. Guiding ring double; 20 µm from anterior end. Nerve ring encircling oesophagus at 154 µm from anterior end; numerous nerve

cells visible. Hemizonid not seen. Oesophagus broadened around posterior half of odontophore, followed by a constriction, then widening again to form anterior slender part. Basal bulb occupying 44% of total oesophagus length. Oesophageal gland nuclei and outlets distinct; positions as percentage of oesophagus length are the following: DO = 57%; DN = 60,2%; S_1O_1 & S_1N_1 = 74,6%; S_1O_2 & S_1N_2 = 80,4%; S_2O_1 = 89,8%; S_2N_1 = 87,8%; S_2O_2 = 89,8%; S_2N_2 = 88,2%. Cardia elongate–conoid; 33 µm long, 9 µm wide.

Intestine four cells in circumference. Prerectum 98 µm long or 2,8 times the anal body diameter. Rectum 42 µm, or 1,2 anal body widths long. Tail long, ending in a recurved and arcuate terminus (Figure 11E). Cytoplasmic core 381 µm long or occupying 87% of tail length; hyaline part 56 µm. Two pairs of caudal papillae present.

Reproductive system didelphic-amphidelphic. Anterior and posterior branches 275 µm and 292 µm long, respectively. Ovaries reflexed, well developed; anterior and posterior ovaries 211 µm and 225 µm long, respectively. Oviduct and *pars dilatata oviductus* distinct. Sphincter muscle between *pars dilatata oviductus* and uterus weakly developed. No *pars dilatata uteri* present. Uteri filled with numerous sperm cells; latter also present in posterior *pars dilatata oviductus*. Vulva appearing to be longitudinal. No uterine eggs present.

Male: Not found.

Locality and habitat: Among the roots of a sausage tree (*Kigelia africana*) standing at the edge of the water on Boba Island in the Okavango Swamps, collected 1 August 1989.

Specimen: On slide RAU 5267.

Diagnosis: Prodorylaimus/Laimydorus sp. has a medium body length; rather long tail with the tail terminus recurved and arcuate; double guiding ring; odontophore almost equal in length to odontostyle and longitudinal and pre-equatorial vulva.

Relationships: Prodorylaimus/Laimydorus sp. resembles the following *Prodorylaimus* species:

P. paralongicaudatus (Micoletzky, 1925) Andrássy, 1959. *Prodorylaimus/Laimydorus* sp. comes very close to the Kenyan specimens (Nairobi, Thika and Mugaga) found by Loof (1985), but differs in the somewhat longer tail (437 µm *vs* 175–266 µm), greater cytoplasmic core percentage (87% *vs* 60–69%) and differently shaped sperm cells (ovoid *vs* more elongate–ovoid).

P. picardi (Altherr, 1963) Loof, 1985. Prodorylaimus/Laimydorus sp. is longer (2,32 mm *vs* 1,46 mm), has a greater a-ratio (43,8 *vs* 35), somewhat greater b and c-ratios (5,0 *vs* 4,3 and 5,3 *vs* 4,4); longer tail (437 µm *vs* 330 µm) and has sperm cells in the uteri *vs* no sperm cells in *P. picardi*.

P. vixamictus (Andrássy, 1962) Loof, 1985. *Prodorylaimus/Laimydorus* sp. has a greater a-ratio (43,8 *vs* 32,2–34,8), shorter odontostyle (25 µm *vs* 30–31 µm) and smaller lip region width (16 µm *vs* 21 µm).

Prodorylaimus/Laimydorus sp. also resembles the following *Laimydorus* species:

L. cryptosperma (Loof, 1969) Loof, 1985. *Prodorylaimus/Laimydorus* sp. has a greater a-ratio (43,8 *vs* 28–38), smaller c-ratio (5,3 *vs* 10–12), longer tail (437 µm *vs* 60–70 µm), shorter odontophore (29 µm *vs* 33–35 µm), greater c′-ratio (12,3 *vs* 6–7) and differently shaped sperm cells in the uteri (ovoid *vs* elongate–ovoid).

L. parafecundus (De Coninck, 1935) Loof & Coomans, 1986. *Prodorylaimus/Laimydorus* sp. is shorter (2,32 mm *vs* 2,77–2,93 mm), has a greater a-ratio (43,8 *vs* 36–39), shorter odontostyle (25 µm *vs* 41–46 µm) and somewhat shorter tail (437 µm *vs* 523–637 µm).

Acknowlegements

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