The genus *Discolaimus* in southern Africa. 2. *Discolaimus constrictus* sp. n. and *D. monoplanus* Heyns, 1963 (Nematoda: Dorylaimida)

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Discolaimus constrictus sp.n. is differentiated from *D. mucurubanus* Loof, 1964, the only other species in the genus in which the basal bulb is set off by a constriction, by its larger size, relatively shorter oesophagus, relatively shorter tail and more posteriorly situated vulva. In general appearance it more closely resembles *D. affinis* Loof, 1964, *D. similis* Thorne, 1939 and *D. silvicolus* Sauer & Annels, 1985. A large population of *D. monoplanus* Heyns, 1963 is described from Namibia. The remarkable similarity between *D. monoplanus*, *D. texanus* Cobb, 1913 and *D. brevis* Siddiqi, 1964 is pointed out, and the biometrics of all recorded populations of these three species are tabulated and briefly discussed.

Key words: Nematoda, *Discolaimus*, *D. constrictus*, *D. monoplanus*, *D. texanus*, *D. brevis*, morphology, taxonomy, Southern Africa.

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Introduction

In this second paper of the series, a new species *Discolaimus constrictus* sp.n. is described from South Africa, based on two small populations, one from KwaZulu-Natal, the other from the Golden Gate Highlands National Park in the Free State. The first large population of *D. monoplanus* Heyns, 1963, including the first two male specimens ever found, is recorded from Namibia. This species has until now been known only from three solitary female specimens, viz. the holotype from Rustenburg in the North West Province, and two others from the Kruger National Park. This new material offered the opportunity for a detailed description, and comparison with the very similar *D. texanus* Cobb, 1913 and *D. brevis* Siddiqi, 1964.

Discolaimus constrictus sp.n.

(Figs 1–18; Table 1)

Body assuming a wide-open C-shape when relaxed, with most of the curvature in the posterior half, more so in the male than in the

female. Cuticle consisting of two main layers, with minute transverse striae in the outer layer, best visible dorsally towards the tail tip. Cuticle 2 µm thick just behind the lip region, 1.5–2 µm around midbody, and 2.5–3.5 µm dorsally near tail tip. Lateral chord very narrow on anterior part of neck, broadening markedly from beginning of basal bulb to 10–12.5 µm, or about one fourth body diameter at midbody, and one third body diameter towards posterior end. Lateral pores in a single irregular line, more prominent and somewhat staggered posteriorly; numbering 96–117(106), originating from conspicuous glandular organs. Ventral and dorsal pores not seen. Hemizonid situated slightly anterior to or opposite nerve ring at 104–127 (115) µm from anterior end; nerve ring at 110–127(122) µm. Lip region typical, 1.25–1.45 times the width of the adjoining neck, its outline appearing rounded rather than angular. Amphids stirrup-shaped, the aperture 7–8 µm long, almost half the corresponding body diameter. Odontostyle 16.5–20.5(17.8) µm in length, somewhat less than the width of the lip region; 3 µm in

Figs 1-18. *Discolaimus constrictus* sp.n. 1: oesophageal region, holotype; 2: constriction in oesophagus, specimen from Golden Gate; 3: unidentified object in body cavity of specimen from Golden Gate; 4-6: anterior branch of female reproductive system of holotype, and posterior branch of two specimens from Golden Gate; 7: head end of male from Leisure Bay; 8, 9: surface view of lip region, and head end of same specimen, Golden Gate; 10-12: variation in tail shape, females from Golden Gate; 13, 14: tail of males from Golden Gate and Leisure Bay respectively; 15, 16: posterior region of males from Golden Gate and Leisure Bay respectively; 17: body posture of two females from Golden Gate and holotype from Leisure Bay; 18: body posture of males from Golden Gate and Leisure Bay.

Table 1
Biometrics of Discolaimus constrictus sp.n.

	Leisure Bay		Golden Gate			
	Holotype Female	Paratype Male	Paratypes Female		Female	Male
L (mm)	2.15	1.99	1.68	2.36	2.46	1.73
a	55	58	53	61	55	58
b	5.2	5.1	4.4	5.5	5.7	4.4
c'	1.13	1.00	1.45	1.26	1.36	1.39
c	80	71	58	81	72	54
V	59.5	-	61.9	54.2	58.5	-
Lip region width (µm)	22.0	20.5	22.0	22.5	24.5	21.3
Odontostyle (µm)	20.5	18.5	17	17	17.5	17
Odontophore (µm)	34	30	26	30	30	26
Oesophagus (µm)	410	387	377	420	407	373
Basal bulb (µm)	220	203	216	240	207	201
Basal bulb (%)	54	52.5	57	57	51	54
Tail length (µm)	27	28	29	29	34	32
Oesophageal glands :						
DO (%)	50.7	53.0	48.5	48.8	54.8	51.2
DN (%)	54.6	57.2	53.6	53.3	59.5	56.3
DO – DN (µm)	16.5	16.5	19	19	19	19
Glandularium (µm)	186	166	175	196	165	163

diameter. Stylet aperture 9–11 (9.6) µm in length, mostly slightly more than half the odontostyle length. Odontophore 26–34 (29.3) µm in length. Guiding ring inconspicuous, plicated, 7–8 µm from anterior end, 3 µm behind lip region. Anterior slender part of oesophagus with a moderate swelling around the base of the odontophore, followed by a second less prominent swelling, then narrowing to as little as 5 µm in diameter where it passes through the nerve ring, and then broadening again before it constricts rather sharply at 43–49 % of its length, before it expands abruptly to form the basal bulb. The latter has a rather constant width of 19–20 µm throughout, and is surrounded by a distinct sheath of connective tissue. Base of oesophagus surrounded by a conspicuous transparent ring, which appears like a disc-shaped structure at a closer level of focus. Cardia elongate-conoid. Dorsal oesophageal gland nucleus and its duct distinct, but none of the anterior or posterior subventral gland nuclei or their openings visible in any specimen. Intestine of both specimens from Leisure Bay packed with layer upon layer of unidentifiable material

(Fig. 4). No coelomocytes or other cellular objects seen in body cavity, except in one female from Golden Gate which contains a long multicellular object (a parasite?) posterior to the cardiac region (Fig. 3). Prerectum generally shorter than rectum; prerectum 18–24 µm, rectum 22–25 µm. Prerectum without posterior blind sac except in one male specimen (Fig. 16). Rectum somewhat sigmoidal in shape. Tail dorsally convex-conoid, the terminus bluntly rounded, and with a terminal “blind canal” in the female; two caudal papillae.

Vulva transverse; vagina perpendicular to body axis, 16–18 µm long or 40 % of the corresponding body diameter. Uterus 113 µm long in holotype female from Leisure Bay, only 52–60 µm in females from Golden Gate; without differentiated ovejector or *pars dilatata*. Oviduct 80–100 µm long, and ovary 60–90 µm. Sperm cells may be present in uterus and/or oviduct.

Male

Supplements the usual adanal pair plus four widely spaced, more or less equidistant ven-

tromedian ones. Spicules 39 μm in the male from Leisure Bay, only 32 μm in the Golden Gate specimen, measured along curved median line. Antecorpus 39 % and 44 % in Leisure Bay and Golden Gate specimens respectively. Lateral guiding pieces 7 μm in both specimens. Sperm cells in vas deferens ovoid, measuring 5–6 $\times$ 3–3.5 μm .

Diagnosis and relationships

Discolaimus constrictus sp.n. is characterised by body length about 2 mm, $c' = 1\text{--}1.45$, vulva far posterior at 54–62 %, basal bulb set off by constriction, presence of males, and males with only four widely spaced equidistant ventromedian supplements.

The only known *Discolaimus* with a constriction in the oesophagus is *D. mucurubanus* Loof, 1964, from which the new species differs in larger body size ($L = 1.73\text{--}2.46$ mm vs 1.20–1.22 mm), relatively shorter oesophagus ($b = 4.4\text{--}5.7$ vs 3.6), relatively shorter tail ($c = 54\text{--}81$ vs 40–42), more posteriorly situated vulva (54–62 % vs 44–45 %) and the more distinctly expanded lip region. [It should be noted that Andrssy (1990) transferred *D. mucurubanus* to the genus *Discolaimium*, mainly on account of its lip region being only slightly expanded. Whether to agree with this action is hard to decide, considering the unsatisfactory state of the taxonomy of the Discolaiminae, as evidenced by the frequent transfer of species to and fro between *Discolaimus*, *Discolaimium* and *Discolaimoides*, by among others Timm & Bhuijan (1963), Das *et al.* (1969), Mehdi Ali *et al.* (1973), Patil & Khan (1982) and Andrssy (1990)]. In general appearance and biometrics, and especially the relatively long conoid tail, the new species resembles *D. similis* Thorne, 1939, *D. affinis* Loof, 1964 and *D. silvicolus* Sauer & Annels, 1985. Apart from the constriction in the oesophagus, it also differs from these species in being more slender ($a = 53\text{--}61$ vs 33 in *D. affinis*, 37–42 in *D. silvicolus* and 36–51 in various descriptions of *D. similis*). Another distinguishing feature of the new species is neck length expressed as a percentage of dis-

tance of anterior end to vulva, which for *D. constrictus* is only 30–36 %, vs 50 % in *D. affinis*, 44 % in *D. similis* and 42 % in *D. silvicolus*, calculated from data in descriptions by Loof 1964, Thorne 1939, Siddiqi 1964 and Sauer & Annels 1985 respectively for the latter three species.

Remark

It should be noted that in Goodey's (1963) description of *D. major* Thorne, 1939 the basal bulb is said to be "offset from the anterior part by a distinct constriction". It is also shown in Goodey's Fig. 229a of a specimen from Surrey, England. This is in conflict with the original description by Thorne as well as descriptions by Siddiqi (1964) and Sauer & Annels (1985).

Type locality and habitat

Holotype female and one male paratype from virgin soil under grasses on a vacant site at the Ilala Cabanas, Leisure Bay, southern KwaZulu-Natal, collected J. Heyns, April 1990. Three female and one male paratypes from virgin soil under grasses at the camping site at Glen Reenen, Golden Gate Highlands National Park, Free State, collected J. Heyns, March 1985.

Type specimens

Holotype female on slide 5683, paratype females on slides 1456 and 1457, paratype males on slides 5664 and 1457, in the collection of the Rand Afrikaans University, presently incorporated in the National Collection of Nematodes, Plant Protection Research Institute, Pretoria.

Discolaimus monoplanus Heyns, 1963

Description of specimens from Namibia

(Figs 19–32; Tables 2&3)

Body of female only slightly ventrally curved when relaxed, somewhat more so in male, especially in posterior region. Cuticle 2–2.5 μm thick just behind lip region,

Figs 19-32. Namibian specimens of *Discolaimus monoplanus* Heyns, 1963. 19: oesophageal region; 20: head end; 21&22: head end of another specimen, surface view and optical section; 23&24: tail end of two females; 25: female reproductive system; 26: posterior branch of reproductive system of another female, 27: position of oesophageal gland nuclei, based on mean for ten specimens, presented according to Andrssy's system (see Andrssy, 1999 and Heyns, 2000); 28: ditto for *D. texanus* Cobb, 1913 apud Sauer & Annels, 1985 (data calculated from their Fig. 4F); 29, 30: cardiac region seen in optical section at two different levels of focus; 31: tail end of male; 32: posterior region of another male.

Figs 33-40. Anterior body end of specimens of *Discolaimus texanus*, *D. monoplanus* and *D. brevis*, various populations. 33: *D. texanus* as depicted in the original description by Cobb (1913); 34: *D. texanus* apud Thorne, as illustrated in his 1939 and 1974 publications; 35: *D. texanus* apud Sauer & Annels (1985); 36: *D. brevis* as shown in Siddiqi's (1964) original description; 37: holotype of *D. monoplanus*; 38: *D. monoplanus* apud Botha & Heyns (1990); specimen from Skukuza; 39: *D. brevis* apud De Bruin & Heyns (1992) (= *D. monoplanus*), specimen from Savuti, Botswana; 40: *D. monoplanus*, this publication, specimen from Gobabeb, Namibia (33-36 redrawn from the literature, 37-40 original drawings from the relevant specimens)

2-3 μm around midbody, and 2.5-3 μm dorsally near tail tip; with minute transverse striae, more prominent towards both extremities. Lateral chord one fourth or less body diameter, with 58 to 68 inconspicuous glandular organs, the lateral pores seldom visible. No dorsal or ventral pores seen in any specimen. Hemizonid opposite nerve ring, at 89-95(92) μm from anterior end; hemizonion at 114-122(188) μm and nerve ring at 87-95(92) μm . Lip region relatively high (6-7 μm) in relation to its width (17-20 μm); 1.21-1.41 times the width of the adjoining neck, with the outline appearing rounded rather than angular. Amphids stirrup-shaped,

their apertures 6-7 μm long, or nearly half the corresponding body diameter. Odontostyle 13-14(13.5) μm in length, or 70-82(75) % the width of the lip region; about 2 μm in diameter. Stylet aperture 7-8(7.8) μm , always slightly more than half the odontostyle length. Odontophore 19-24(21.5) μm in length. Guiding ring plicated, 6-8 μm from anterior end, about 1 μm behind lip region. Anterior slender part of oesophagus with a slight swelling around the base of the odontophore, thence of about constant diameter of 7-8 μm until it expands at 43-48(44.5) % of its length to form the basal bulb. Bulb with a thin but distinct

Table 2
Comparison of biometrics of various populations of Discolaimus texanus, D. brevis and D. monoplanus

	<i>D. texanus</i>				<i>D. brevis</i>				<i>D. monoplanus</i>				
	After Cobb	After Thorne	(1939)	(1974)	(1985)		(1964)	(1990) (1991)		After Botha & Heyns	<i>D. brevis</i> apud De Bruin & Heyns	Namibia	
	F	F	M	F	25F	M	12F	F	F	F	3F	20F	M
L (mm)	1.3	1.3	1.3	1.2	1.19(0.93-1.32)	1.07	0.90-0.99	0.79	0.84	0.91	0.80-0.97	1.06(0.95-1.16)	1.01
a	40*	35	35	36	33(28-40)	29	31-36	30.5**	32	31	31-33	34(30-38)	36
b	4.1*	4.2	4.0	3.7	4.0(3.6-4.4)	3.8	3.4-3.6	3.7	3.5	3.5	3.4-3.9	3.8(3.4-4.0)	3.5
c	48*	40-50	43	40	45(39-53)	37	44-50	32	36	35	28-39	42(36-48)	42
c'		1.1*	1.1*		1.3(1.1-1.5)	1.0	1.2-1.3*	1.4	1.3	1.3	1.2-1.7	1.2(1.0-1.4)	1.0
V	41	41		41	41(37-43)		41-45	44	45	45.5	43-44	45(43-47)	
Lip region width (µm)		19*			20*		16	17.5	15	18.5	16-17	18(17-20)	18
Amphid aperture (µm)		6*			7*		5*	6	7	5	5-7	6-7	6
Odontostyle (µm)		17*		15-16	15(14-16)	15	13-14	12	13	14.5	12-14	13.5(13-14)	13.5
Odontophore (µm)		20*			22(20-26)	26	23-26	20.5	21	23	17-25	21.5(19-24)	26
Styloid aperture (µm)		8.5*			8.8*		8.8*	7	8	9	7-9	7-8	8
Oesophagus (µm)	241	310*			340*		278*	220	232	260	220-250	277(260-290)	285
Basal bulb (µm)	145*	186*			178*		145	110	115	105	122-134	153(147-167)	156
Basal bulb (%)	60*	60*		60*	52.5*		52*	50	49.5	40.4	53-55.5	55.5(52-57)	55
Tail length (µm)	27*	28*		30*	29.5*	26*	18-21	25	23	26	19-26	26(23-28)	24
lateral glands/pores		80-85			about 80			about 54	about 60		64-67	58-68	

* Approximate figures, calculated from data in descriptions or illustrations in relevant literature

** Specimen flattened: ratio "a" corrected according to Geraert's (1961) method

Table 3
Locations of oesophageal gland nuclei in *D. monoplanus* from Namibia
and *D. texanus* from Australia

	<i>D. monoplanus</i> <i>n</i> = 10	<i>D. texanus</i> ^a
System of Loof & Coomans (1970)		
DO	54.2(53.5-55.5)	54.8
DN	57.5(56.9-57.8)	58.8
DO-DN (µm)	10 (9-12)	12.5
S1N1	73.2(72.7-73.9)	57.8
S1N2	78.8(78.1-79.7)	79.9
S2N1	86.1(85.2-86.8)	85.8
S2N2	86.6(86.3-87.2)	86.3
K	73.4(69.5-78.9)	80.2
System of Andr�ssy (1998, 1999)		
D	57.5(56.9-57.8)	58.8
AS1	36.7(34.8-38.8)	41.3
AS2	49.8(48.2-52.3)	51.5
PS1	67.0(65.2-67.9)	65.9
PS2	68.1(67.5-69.4)	67.0

^a Calculated from Sauer & Annels (1985) Fig. 4F

sheath of connective tissue which broadens to a varying degree at the base of the bulb to form a doughnut-shaped ring around the base of the cardia (the "disc-shaped structure" of Botha & Heyns, 1990). Width of basal bulb constant, but varying from 17–20 µm among specimens. All five oesophageal gland nuclei and their ducts usually distinct (Fig. 19; Table 3). Shape and size of cardia rather variable, globular or conoid. Prerectum 15–22(18) µm in length, without posterior blind sac. Rectum 15–20(17) µm in length, which is somewhat less than the anal body diameter. Tail slightly variable in shape and length, elongate convex-conoid, longer than anal body diameter, the terminus bluntly rounded. With two or three caudal papillae.

Vulva transverse; vagina perpendicular to body axis, 14–15 µm long, slightly less than half the corresponding body diameter. Uterus relatively short but variable in length (13–27 µm from vagina to sphincter muscle) without any *pars dilatata* or other differentiations, the two uteri together resembling a

large ovejector. Oviducts typical, 28–37 µm long. Ovaries from 38 µm to 70 µm long, depending on stage of development of oocytes, mostly reflexed as far as the sphincter or beyond, and lying on opposite sides of the intestine.

Male

Two males, both from Gobabeb. One with spicules 27 µm long, measured along curved median line, lateral guiding pieces 14 µm, and the usual adanal pair of supplements plus a ventromedian series of ten, the posterior-most of which is only slightly anterior to the level of the spicule head. The first six supplements are situated midventrally, while numbers seven to ten are slightly staggered on either side of the midventral line. In the other male the spicules and lateral guiding pieces measure 23 µm and 13 µm respectively, and there are thirteen ventromedian supplements of which only the posteriormost two are situated slightly off-centre, very close together. Sperm cells in vas deferens small, only 1.5 x 3.5–4 µm. Similar sperm cells observed in uteri of at least one female.

Tail shape as in female, with two caudal papillae.

Material examined

About 44 females and two males from several samples, mostly under grass in sandy soil along the Kuiseb River, east of Gobabeb in the Namib desert, collected J. Heyns and A. Coomans, 30/7/1986. Four females from soil under grass, next to the main road between Omaruru and Otjiwarongo, collected J. Heyns and A. Coomans, 16/7/1986.

Discussion

D. texanus, *D. monoplanus* and *D. brevis* are three very similar species, if not conspecific. In fact, Andrssy (1990) proposed to synonymize *D. brevis* with *D. texanus*, but did not proffer any opinion on the status of *D. monoplanus*. Comparison of the morphometrics of various populations of these three species (Table 2) reveals a possibly greater correspondence of *D. brevis* with *D. monoplanus* than with *D. texanus*. Both *D. monoplanus* and *D. brevis* differ from *D. texanus* as described by Cobb (1913), Thorne (1939, 1974) and Sauer & Annells (1985) in slightly shorter body length, more posterior location of vulva, shorter odontostyle with relatively longer aperture, and relatively shorter basal bulb.

One of the diagnostic differences between *D. brevis* and *D. monoplanus* on which Botha & Heyns (1990) relied, viz. the presence of a cardiac disc in *D. monoplanus*, and which was also one of the major considerations of De Bruin & Heyns (1992) in identifying their Botswana specimens as *D. brevis* rather than *D. monoplanus*, is now rather suspect. Re-examination of the *D. monoplanus* holotype as well as Botha & Heyns's (1990, 1991) specimens, the Botswana specimens and comparison with the new population from Namibia revealed considerable intraspecific variation of this character. Moreover, it showed that the level of focus at which any specimen is viewed drastically affects the appearance of the "cardiac disc". Compare Figs 29 & 30 of this publication

with Figs 4A & B of Botha & Heyns (1990) and Fig. 4G of De Bruin & Heyns (1992). It is my impression that there is no true cardiac disc present in *D. monoplanus*, but that the sheath of connective tissue surrounding the basal bulb broadens to a varying degree towards the base of the bulb, forming so-called "basal pockets" or in fact a doughnut-shaped ring. The Botswana specimens are therefore now regarded as belonging to *D. monoplanus* rather than *D. brevis*.

Further examination of Table 2 and Figs 33–40 shows a close correspondence of Sauer & Annells' Australian specimens with those of Cobb and Thorne, except for the lip region which appears slightly broader in comparison with the adjoining body, and more angular in shape. Amphid size and shape is basically similar in all populations, except for a distinct difference shown in Thorne's illustration (Fig. 34), where the amphidial chamber is splayed towards the aperture. However, glancing through the plates in Thorne's 1939 monograph, one notices that in a large proportion of the figures in which the amphids are illustrated they are portrayed in this fashion, especially in species with sharply constricted lip regions. See Thorne's Plate VI Figs 40, 42, 44, 45b and Plate VII Figs 46, 47. In contrast, very few other examples can be found in the literature where discolaim amphids are depicted in this way, arousing a suspicion that Thorne's may be a stylised way of rendering the amphid, to which not too much importance should be attached in the case of *D. texanus*.

The tail was unfortunately not illustrated or described by Cobb (1913). In the other populations it varies somewhat in length, with the shortest tails recorded in *D. brevis*, as well as in shape: shorter, convex-conoid and bluntly rounded in the populations from North America (Thorne), India (Siddiqi), Botswana (De Bruin & Heyns) and some Namibian specimens, while more narrowly conoid, not so bluntly rounded and dorsally convex in the holotype of *D. monoplanus*, Australian specimens (Sauer & Annells) and some specimens from Namibia.

Referring again to Table 2, it is seen that there are 80–85 lateral glands in *D. texanus*, only 54–68 in *D. monoplanus*, while for *D. brevis* it is unrecorded. Location of oesophageal glands is known only for Australian specimens of *D. texanus* and Namibian specimens of *D. monoplanus* (Figs 27, 28). No real differences are evident. One last point to be mentioned is the position of the sensilla pouch, which was illustrated by all authors except Cobb and Sauer & Annells. Thorne and Siddiqi both show it near the base of the odontostyle (Figs 34, 36) while in all populations of *D. monoplanus* except the holotype, it was found to be somewhat further posterior (Figs 38–40). In the holotype Heyns (1963) showed it opposite the anterior expansion of the oesophagus. This was suspected to be a misinterpretation, but examination of the specimen showed it to be correct (Fig. 37).

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