A new adder (*Bitis*; Viperidae) from the Western Cape Province, South Africa

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A new species of small, terrestrial *Bitis* is described from the Western Cape Province, South Africa. It occurs in sympatry with *Bitis comuta* and *Bitis atropos* on the upper slopes and summit of the Cedarberg, and with the latter on the Swartberg. Features of scalation, colour and body form distinguish the new species from all other southern African *Bitis*. Its range extends in an arc from the northern Cape Fold Mountains, southwards into the western regions of the Little Karoo, with a possibly isolated population on the Roggeveldberg and Komsberg of the inland escarpment.

Within Africa the Viperidae is represented by two well-defined subfamilies; the night adders (Causinae) possessing enlarged colubrid-like head scales and laying eggs; and the Viperinae, which are viviparous and have fragmented head shields. The latter has undergone a number of adaptive radiations within the continent, including at least eight species of arboreal bush vipers (*Atheris*) in the rainforests of West and Central Africa (Spawls & Branch 1995). The most speciose radiation, however, occurs in terrestrial vipers of the genus *Bitis*, particularly in the mountains and deserts of the western arid regions of southern Africa. Currently, 14 species, one extinct, are recognized within the genus, which are traditionally grouped into large and small species (Golay, Smith, Broadley, Dixon, McCarthy, Rage, Schatti & Toriba 1993; Spawls & Branch 1995). The former, including *B. arietans, B. gabonica, B. nasicornis,* and *B. parviocula*, are usually considered closely related, and a number of interspecific hybrids within the group are known (e.g. *B. gabonica* × *B. arietans*, Broadley & Parker 1976; *B. nasicornis* × *B. gabonica*, Hughes 1968). However, quantitative immunological investigations by Hermann & Joger (1997) indicate that the puff adder, *B. arietans*, is not particularly closely related to the other large adders. The same authors (Hermann & Joger, 1995) also demonstrated that within the small *Bitis* species a *Bitis cornuta-inornata* subgroup (also including *B. atropos* and *B. xeropaga*) was discernable.

Many of the smaller *Bitis* species have disjunct populations and/or exhibit colour polymorphism that may be geographically consistent. Although some are relatively common in suitable habitat (e.g. the horned adder, *Bitis caudalis*), others are often rare and very localized. Among these, the status of the rare hornless 'many-horned' adders of the southern and eastern Cape (the *Bitis cornuta-inornata* complex) has been the source of much taxonomic confusion. For some years isolated specimens of unusual small adders have been collected from rocky habitats in the southern and western areas of the Cape region in South Africa. They are usually referred to the *Bitis cornuta-inornata* complex. In 1987, Branch presented a discussion of the early taxonomic history of names applied to this complex (Branch 1989). His preliminary analysis of the situation was prompted by the collection of an important series of specimens from the Cedarberg Mountains, in which two sympatric taxa could be determined. One was referable to typical *Bitis cornuta* (Daudin 1803). The other shared features with *Bitis inornata* (A. Smith 1838), i.e. greatly reduced 'horns' (elongated scales in the supraorbital region), low ventral scale counts, and a drab, reddish colouration. He noted that the resolution of the taxonomic status of the latter taxon was dependant upon the collection of further specimens. In the interim (Branch 1988a; Broadley 1990; Spawls & Branch 1995), these specimens were treated conservatively as representatives of an isolated western population of *Bitis inornata*, with the stated caveat that they may deserve specific status. Burger (1992, 1993) referred Anysberg specimens to this taxon, but also noted a specimen from the reserve that possessed small horns and a blotched pattern, and which he considered may be referable to *B. cornuta albanica*.

Dwarf adders of the genus *Bitis* are popular in the international pet trade in reptiles, and although protected by Provincial Ordinances in the Western, Northern and Eastern Cape provinces, they are known to be involved in illegal wildlife traffic. It is evident that some dwarf adders (e.g. the Namaqua dwarf adder, *B. schneideri*) are already threatened, in part, by illegal collecting for this trade (Branch 1988b). South Africa is a signator of the Rio Convention on Biodiversity, and also of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora. It is important that new, localized and endemic species be described timeously to allow for their consideration and possible inclusion in conservation legislation and action.

Following the acquisition of additional specimens of 'hornless' adders from the Cedarberg, the Little Karoo, and from intermediate localities, and comparison with recently collected topotypic material of snakes referable to *B. inornata* (A. Smith 1838), *B. atropoides* (A. Smith 1846), and *B. cornuta albanica* Hewitt 1937, subsequent analysis has allowed a fuller analysis of the situation and the recognition of a new species which is described below. A fuller description of variation within *B. atropoides* and *B. albanica*, and validation of their specific status, will be presented elsewhere (Branch, in prep.).

Character analysis

Ventral and subcaudal counts were counted using standard techniques (Dowling 1951). Scale rows were recorded anteriorly (ASR, one head length behind the neck), at midbody (MSR), and posteriorly (PSR, one head length in front of the cloaca). Rictals were defined as the number of scales occurring in diagonal series from the angle of the mouth to the preventrals. Upper and lower labials were counted for both sides (and recorded as the mean of both sides), and care was taken to count small scales sometimes hidden in the rictal region. The development of elongate scales in the supraocular region ('horns') was recorded as either absent (0), slightly more elongate than circumoculars (1), obviously elongate (2), and forming a conspicuous tuft of 'horns' (3). Snout-vent length (SVL) and tail length were recorded to the nearest millimetre. Sex was determined by dissection of the tail region to confirm the presence of the hemipenes in males. Hemipenes were everted and described according to Branch (1986). Paired dorsal blotches are often staggered (particularly on the hindbody) and irregularly fused. In some populations they are very faint or absent. Blotches were counted from the neck to the cloacal region, and were only recorded in specimens having a full series of blotches.

Bitis rubida n. sp. (Figure 1) — Red adder

Synonomy

Bitis inornata FitzSimons, 1946; Branch, 1988a–b; Burger, 1992, Burger, 1993; Spawls & Branch, 1995.
B. cornuta albanica FitzSimons, 1962; Broadley, 1990; Burger 1992; Burger, 1993.
Bitis cornuta cornuta Haacke, 1975; Visser, 1979.
Bitis caudalis (part) Visser 1979.
Bitis cornuta inornata Broadley, 1983.
Undescribed taxon Branch, 1989.
Bitis cornuta-inornata complex Burger 1993.
Bitis inornata complex Branch & Bauer, 1995.

Type material

Holotype: PEM R12582, adult male with left hemipenis everted.

Type locality: Jeep track above Farm Driehoek, Cedarberg Mountains, Western Cape Province, South Africa; 32°25'44"S, 19°12'30"E, alt. 1380 m; 3219AC. Collected 3 September 1986, S.A. Botha.

Paratypes: (six specimens) PEM R4457, adult male, near Crystal Pool, Cedarberg Mountains, Western Cape Province, South Africa; 32°20'55"S, 19°08'10"E, alt. 1340 m; 3219AC; April 1985; S.A. Botha. PEM R12583, adult male with everted hemipenes, Welbedacht, Cedarberg Mountains; 32°25'45"S, 19°11'00"E; 3219AC; October 1988; J. van Deventer. PEM R12581, subadult male with everted hemipenes, on footpath from hut to Crystal Pool, Cedarberg Mountains; 32°20'55"S, 19°06'49"E, 1320 m; 3219AC; 2 Septem-ber 1986; S.A. Botha. PEM R5048 (CDNEC 10193), adult male, Cedarberg (village), 30 km from Algeria forestry station (approx. 32°31'S, 19°16'E); 3219CB; 17 May 1990, M. Burger (dead on road). PEM R8861, adult female, 3 km N of Veepos, Groot Winterhoek Wilderness Area, Western Cape Province; 32°58'10"S, 19°03'04"E; 3219CC; 2 March 1994, J. van Deventer. SAM 46282, adult female, below Sneeuberg Hut (= Sneeukop Hut), Cedarberg, Western Cape Province; 32°20'S, 19 20'E; 3219AB; 15 October 1983.

Figure 1 *Bitis rubida* **n. sp.** showing drab colouration, reduced supraorbital 'horns', and general habitus (paratype, PEM R12581, Cedarberg). This specimen is illustrated in colour in Branch (1988a) and Spawls & Branch (1995).

Additional material

(35 specimens) TM 35115, 5 km W of Middelpos (64 km S Calvinia; Visser 1979), Calvinia District; 31°53'S, 20°11'E; 3120CC; 3 September 1968; W.D. Haacke. PEM R1197, Porterville, Western Cape Province; 3318BB; February, 1959. SAM 43874, W of Gydo Pass, Ceres District, Western Cape Province; 33°14'S, 19°16'E; 3319AB; March 1976; G. McLachlan. TM 55025, Farm Jakhals Valley, 98 Sutherland District, Western Cape Province; 32°26'S, 20°39'E; 3220BC; 28 February 1982; J. Lochner. TM 57568, Rooikloof, Sutherland District, Western Cape Province; 32°26'S, 20°39'E; 3220BC; February 1983; J. Lochner. TM 53366, Farm Klippekraal, 145 Sutherland District, Komsberg, Western Cape Province; 32°34'S ,21°05'E; 3320DB; G. Kunzi. PEM R4350-51, TM 56632-33, 3 km north of Matjiesfontein, Western Cape Province; 33°13'S, 20°36'E; 3320BA; J. Lougher. TM 19556, Matjiesfontein, Western Cape Province; 3320BA; V.F.M. FitzSimons. PEM R1191, Prince Alfreds Hamlet, Western Cape Province; 3319AD. PEM R6806, Eyerspoort Private Nature Reserve, Montagu-Barrydale District, Western Cape Province; 33°48'S, 20°41'E; 3320DC; 24 September 1988; R. Johnstone-Robertson. PEM 8267-76 (10 specimens, born in captivity, 1 February 1989), same locality details as PEM R6806. PEM R5057, Eyerspoort Private Nature Reserve, Barrydale District, Western Cape Province, 33°29'S, 20°33'E, alt. 610 m; 3320DA; R. Johnstone-Robertson. PEM R5002 (CDNEC 10098), Anysberg Nature Reserve, Western Cape Province, 3320BC; 24 April 1989; J. Vaughan. 3320BA. PEM R5014 (CDNEC 10097), Anysberg Nature Reserve, Western Cape Province; 3320; 30 April 1989, J. Vaughan. PEM R6883, Anysberg Nature Reserve, SE of Kleinspreeufontein, Western Cape Province; 33°23'01"S, 20°40'48"E; 3320BC; 5 June 1990; A Martin. PEM R8146, Anysberg Nature Reserve, Matjiesgoedberg, Western Cape Province; 3320BC; 29 February 1992; J. Vaughan. PEM

R11730 (CDNEC 11807), Anysberg Nature Reserve, Vaughanville, Western Cape Province; 33°27'53"S, 20°35'29"E; 3320BC; 3 May 1995; J. Vaughan. PEM R12301 (CDNEC 11806), Touwsfontein Nature Reserve, Western Cape Province; 33°33'10"S, 20°30'33"E; 3320DA; 25 March 1995. PEM R3671, Die Brug, Gamka Mountain Nature Reserve, Ladismith District, Western Cape Province; 33°43'48"S, 21°50'43"E; 3321DB;18 August 1980, P. W. de Kock. PEM R11261, Near Farm Kareebosdam, Little Karoo, Western Cape Province; 33°36'40"S, 21°03'57"E, 302 m; 3321CA; 12 February 1995; W.R. Branch. PEM R4347, Swartberg State Forest, Paardevlei, Western Cape Province; 33°20'59"S, 22°02'00"E, alt. 1300 m; 3320AB; 22 September 1976, W. Pienaar. TM 56634, Waterkloof, Swartberg Mountains, Western Cape Province; 33°27'S, 21°17'E; 3321AD; 7 August 1977; R.C. Boycott. TM 56635, same locality and collector as TM 56634; 6 August 1983.

Diagnosis

Bitis rubida is characterized by lacking, or having greatly-reduced, elongate scales ('horns') in the supraorbital region, and by having a drab, usually reddish, dorsal colouration. It can be distinguished from other small *Bitis* by various scutellation features. It differs from *B. xeropaga* in having fewer ASR than MSR (ASR equal to or greater in number than MSR in *B. xeropaga*; Haacke 1975), and lower ventral scale counts in both sexes (*B. xeropaga* — males 147–154, mean 151.5; females 151–155, mean 152.4; Haacke 1975). It differs from *B. atropos* in having a raised supraorbital ridge. It differs from sympatric and southern populations of *Bitis cornuta* in having lower ventral scale counts in both sexes, fewer circumorbitals, and usually 29 MSR. *Bitis cornuta* usually has 27 MSR and a slightly higher number of dorsal blotches. It also differs from *B. rubida* in always having prominent supraorbital 'horns' and usually a contrasting colour pattern of grey, white and black (reddish in a population near Lang Hoogte, 35 km east Kleinsee). *Bitis rubida* does not occur in sympatry with *B. atropoides*, which is restricted to coastal regions of the south-western Cape. The latter has much lower ventral scale counts (115–128), slightly lower subcaudal counts and rictals, usually 27 MSR, and a higher number of circumorbitals. *B. atropoides* also usually has obvious supraorbital 'horns' (although these are less well developed than in *B. cornuta*), as well as a grey-black-white colouration (that is less well defined than that of *B. cornuta*). *Bitis inornata* and *B. albanica* are restricted to the Eastern Cape Province and are well isolated from the western taxa, including *B. rubida*. The two eastern species are distinguished by having short tails in males, in which the hemipenes reach only the 6–7th subcaudal (9–10 subcaudal in the other taxa). Supraocular 'horns' are greatly reduced or absent in *B. albanica*,which also has a bold, contrasting, grey-black-white colour pattern, with fewer dorsal blotches than in the western taxa. *Bitis inornata* completely lacks supraorbital 'horns', and has a very drab yellowish-brown colouration, in which the dorsal blotches are greatly reduced or absent. The eastern taxa are allopatric and separated from one another by 150 km.

Description

Holotype PEM R12582; 309 + 35 = 344 mm; tail into body 8.83 times. Ventral scales 129, with 3 preventrals; anal entire; subcaudals 27 + spine, all divided except first three behind anal; ASR 25, MSR 27, PSR 20. Nostril surrounded by three scales; the supranasal very large, raised, semi-lunar and forming a well developed supranasal sac; two infranasals, posterior much larger than anterior. Supranasals separated transversely from one another; anteriorly from rostral by a row of three scales (all contacting the rostral), in the middle by two large, rugose scales, and posteriorly by a row of three scales. Seven scales, including first upper labial on each side, bordering the rostral; 12 scales, including circumorbitals, between the eyes at the anterior edge of the orbit; 11 right, 12 left circumorbitals; two scale rows separating circumorbitals from upper labials on each side; 13 upper labials on each side; 12 lower labials on each side, first elongate and in contact behind mental, first three pairs in contact with a pair of enlarged chin shields; 8 rictals on each side between corner of mouth and preventrals.

Head subtriangular with a rounded snout, swollen supraorbital region that bears a small group of elongate scales, and covered above with finely keeled scales which are largest between the eyes. Neck distinct and much narrower than width of head. Dorsal scales elongate, imbricate, with a rounded free end and a moderately developed keel not extending beyond the tip. Outer row of lateral scales bordering ventrals more or less as wide as long and bluntly rounded, keeled throughout length with keel tilting slightly downwards. Ventrals and subcaudals smooth, with the first three subcaudals undivided.

Everted left hemipenis divided, arms subequal to or longer than shaft; ornamentation spinose with a large nude region in the crotch between the swollen arms that extends onto the asulcal surface, which bears scattered minute spinules. Sulcus spermaticus divides distal to largest lateral spines, the branches running semi-centrifugally to the tips of the arms. Proximal region of arms spinose, distal quarter bearing large, smooth-walled calyces; no terminal awn. Lateral surface of arms and undivided shaft bearing 4–5 rows of enlarged, ossified spines that are largest on the sides, slightly proximal to the sulcal division.

In preservation (notes on live colouration noted in brackets) the dorsum is light brown (reddish) with vague darker patches (dark ochre) along the dorsolateral region. An irregular meshwork of paler scales (reddish-tan) covers the flanks. Top of head uniform light brown (reddish) extending onto the temporal region and upper labials. No obvious darker bands radiate from the eye to the lip, although the 4th upper labial on both sides is pale. Lining of mouth pinkish. Upper surface of tail with seven vague, dark (dark ochre) X-shaped bands; a series of small, pale-edged ocelli on sides of tail. Throat light cream (yellowish), with dark brown (reddish-brown) infusions on lower labials. The belly is grey (dirty cream) heavily infused with dark patches (grey-brown) particularly along the lateral borders of the ventrals, getting more extensive on the rear part of the body.

Variation in the type series

Details and meristics for the type series are summarized in Table 1. Additional variation in scutellation, etc., including that of the type series, is summarized in Table 2. Scale rows

Table 1 Meristic details for type series of *Bitis rubida*

Mus No.	Sex	SVL	Tail	TL	SVL/Tail
Holotype					
PEMR12582	M	309	35	344	8.83
Paratypes					
PEM R4457	M	294	38	332	7.74
PEM R5048	M	275	36	311	7.64
PEM R12581	M	222	28	250	7.93
PEM R12583	M	259	36	295	7.19
PEM R8861	F	320	26	346	12.31
SAM 46282	F	235	29	264	8.10

Table 2 Variation in scutellation in the *Bitis cornuta* complex. N = number, Avg = Mean, Max = Maximum, Min = Minimum, STD = Standard Deviation, F = females, M= males

	Sex	N	Avg	Max	Min	STD
Ventrals						
B. rubida	F	11	137.82	142	133	3.24
	M	22	131.82	138	126	3.47
B. atropoides	F	6	125.67	128	124	1.70
	M	6	120.33	125	115	3.35
B.cornuta	F	13	140.85	148	132	4.17
	M	18	135.50	146	127	4.13
B. inornata	F	10	134.70	138	130	2.87
	M	9	132.11	137	126	3.21
B. albanica	F	3	132.33	138	129	4.03
	M	6	124.00	131	120	3.70
Subcaudals						
B. rubida	F	11	24.09	28	15	3.26
	M	21	30.43	35	27	1.71
B. atropoides	F	7	23.29	26	20	1.75
	M	4	28.50	30	27	1.12
B. cornuta	F	10	27.20	32	25	2.23
	M	19	31.84	35	27	2.13
B. inornata	F	10	24.10	26	21	1.58
	M	9	29.11	32	26	2.23
B. albanica	F	3	23.33	26	21	2.05
	M	6	25.83	29	24	1.77
Circumoculars						
B. rubida	F	10	13.45	14.5	11	1.08
	M	15	12.83	14.5	11.5	0.91
B. atropoides	F	6	13.75	15.5	13	0.85
	M	5	14.10	15.5	13	0.80
B.cornuta	F	9	14.89	16	13.5	0.74
	M	11	15.14	16.5	13.5	0.96
B. inornata	F	9	13.00	14	11	1.03
	M	7	12.64	14	11	1.09
B. albanica	F	3	13.50	14	13	0.41
	M	6	13.83	14.5	13	0.55
Rictals						
B. rubida	F	6	8.83	10	8	0.90
	M	11	8.59	10	8	0.70
B. atropoides	F	5	8.00	9	7	0.63
	M	5	8.00	8	8	0.00
B. cornuta	F	4	10.08	11	9	0.72
	M	8	9.25	10	8	0.66
B. inornata	F	6	9.50	10	9	0.50
	M	2	8.50	10	7	1.50
B. albanico	F	3	9.33	10	9	0.47
	M	6	8.83	10	8	0.69
Blotches						
B. rubida	F	5	25.60	30	22	3.01
	M	5	24.00	26	22	1.41
B. atropoides	F	5	24.60	28	23	1.85
	M	5	22.60	23	22	0.49
B. cornuta	F	7	26.29	29	24	1.48
	M	12	26.17	30	22	2.15
B. inornata	F	1	24.00	24	24	0.00
	M	1	19.00	19	19	0.00
B. albanica	F	3	20.00	22	18	1.63
	M	6	17.67	21	15	2.29
SVL / Tail						
B. rubida	F	11	10.91	16.13	8.10	1.96
	M	20	7.94	9.62	6.75	0.70
B. atropoides	F	5	9.36	9.92	9.12	0.29
	M	5	7.63	7.86	7.14	0.30
B. cornuta	F	6	11.17	14.14	9.08	1.63
	M	12	7.63	9.14	6.58	0.85
B. inornata	F	8	10.32	11.17	9.74	0.42
	M	7	8.99	10.55	6.82	1.22
B. albanica	F	3	10.74	11.40	10.11	0.53
	M	6	8.15	9.60	7.21	0.78

vary from: ASR, 23–27 in males (mean 25.9), 25–27 in females (mean 26); MSR, 25–29 in males (mean 28.1), 27–29 in females (mean 28); PSR, 20–25 in males (mean 22.3), 21–25 in females (mean 22.5).

Colouration is variable, both within Cedarberg snakes and from adjacent populations. Some specimens (e.g. TM 53366, Komsberg) show distinct, paired, pale-centred blotches (that become staggered on the rear of the body) along the dorsolateral surface. Each blotch is darker along the backbone, lightening on the flanks. Radiating stripes from the eye to the lip are sometimes obvious (e.g. TM 56634-35, Swartberg), and a rounded black triangle, sometimes pale-centred (e.g. TM 56632, Matjiesfontein), may occur on the crown of the head.

Size

Females grow slightly larger than males; largest female (PEM R6806, Eyerspoort), 386 + 33 = 419 mm; largest male (TM 57568, Sutherland), 335 + 42 = 377 mm. Mean SVL of five largest females, 345 mm; mean SVL of five largest males, 315 mm.

Etymology

From the Latin for reddish, alluding to the general colouration of specimens, particularly from the Cedarberg region.

Distribution (Figure 2)

Found inhabiting generally higher altitudes in the northern Cape Fold Mountains and inland escarpment. The type locality in the Cedarberg lies in the north-western extremity of the range. From there it extends south along the Piketberg and Skurweberg to the vicinity of Ceres. Inland it occurs on the Roggeveldberg and Komsberg of the inland escarpment, reaching its northern limit near Middelpos. It is found at lower altitudes in the vicinity of Anysberg, with isolated records from the semi-arid plains of the Little Karoo and from higher altitudes in the adjacent Swartberg.

Habitat

Eyerspoort specimens were collected in Karroid Broken Veld vegetation among white quartzite pebbles on deep red soil. An Anysberg specimen (PEM R6883) was found in flat, mesic karroid-fynbos transitional veld (with *Pteronia incana* and *Eriocephalus* sp.) with scattered stones. Another Anysberg specimen was found in a dry river valley with deep red soil, grass hummocks and scattered sandstone boulders. The type series from the Cedarberg and additional specimens from the Swartberg occur in mountain fynbos, although possibly inhabiting more xeric northern slopes. Specimens from the inland escarpment inhabit boulder-strewn slopes in Mountain Renosterveld vegetation. The species has an altitudinal range from 302 m in the valleys of the Little Karoo to 1380 m on the Cedarberg.

Natural history

Captive specimens are active, restless climbers, that never scuffle into sand or attempt to sidewind. They have accepted skinks (*Mabuya capensis*, Anysberg), agamas (*Agama atra*, Cedarberg), lacertids (*Pedioplanis burchelli*, Cedarberg), geckos (*Pachydactylus maculatus*, Anysberg; *Afroedura karroica*, Cedarberg), a striped field mouse (*Rhabdomys pumilio*, Eyerspoort), and pink laboratory mice (Cedarberg). A very large female (PEM R6806; 387 + 32 mm), collected in Sep-

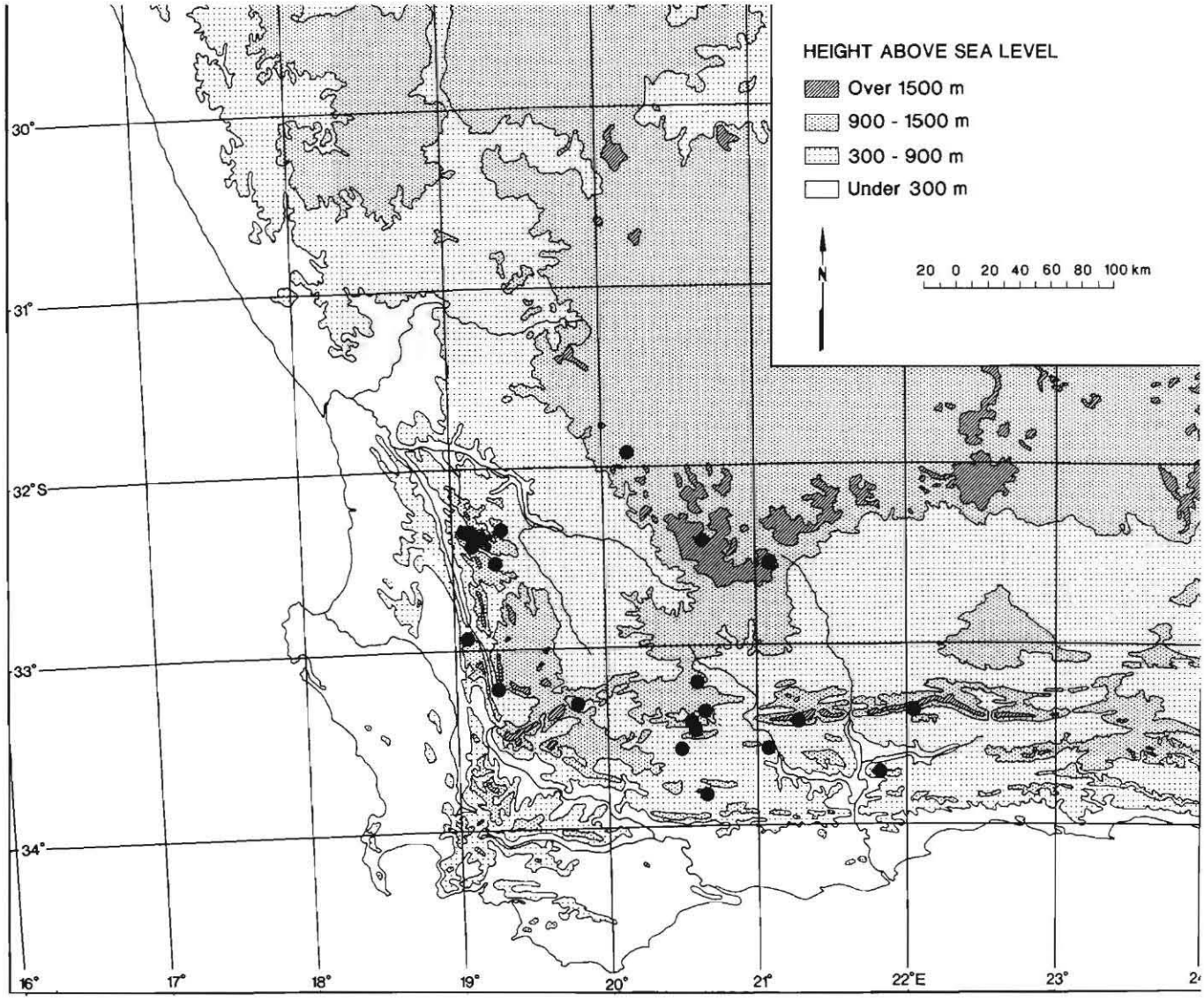

Figure 2 Distribution of *Bitis rubida* **n. sp.** in the Western Cape Province, South Africa. Star = type locality.

tember 1988, gave birth to 10 babies on 1–2 February 1989. These measured 120–138 mm TL and weighed 1.7–2.9 g; most voluntarily fed on small geckos (*Lygodactylus capensis*).

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I thank S. Botha who brought the first specimen to my attention, and whose subsequent discovery of sympatry between *Bitis cornuta* and *B. rubida* in the Cedarberg allowed resolution of a long-standing taxonomic problem. Jaco van Deventer also made great efforts to find additional specimens from the type locality. Alan Martin and Marius Burger collected many specimens from the Anysberg region, which were instrumental in allowing variation within the taxon to be assessed. I thank Dr E.N. Arnold (Natural History Museum, London) for allowing me to inspect Andrew Smith's types, and Denise Drinkrow (South African Museum, Cape Town) and Wulf Haacke (Transvaal Museum, Pretoria) for allowing me to inspect specimens in their care.

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