

Original article

## A new species of rupicolous *Cordylus Laurenti* 1768 (Sauria: Cordylidae) from Northern Mozambique

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**Abstract.**—A new rupicolous girdled lizard, *Cordylus meculae* Branch, Rödel & Marais, is described from Serra Mecula in the Niassa Game Reserve, northern Mozambique. Morphologically it is closest to *C. rhodesianus* - which is restricted to the Eastern Highlands of Zimbabwe (850 km south) - but has more rugose head shields, a wider rostral and grey colouration. Although geographically closer to *C. nyikae* (found 450 km to the west, across the Rift Valley region and Lake Malawi) it differs in numerous features, including details of scalation and nostril position. It differs from arboreal *C. tropidosternum* in having smooth gular and ventral scalation in adults, a more centrally positioned nostril, dorso-ventrally flattened head and body, blotched colour pattern, and rock-living habits. It is the second, and only rupicolous species of *Cordylus* recorded from northern Mozambique.

**Key words.**—Cordylidae, *Cordylus*, new species, Mozambique.

Girdled lizards (Family Cordylidae) are endemic to sub-Saharan Africa, with the greatest radiation and diversity occurring in southern Africa. *Cordylus Laurenti* 1768 is the most speciose genus in the family, with no less than 30 of the 34 species found in southern Africa. Due to its nomenclatural ramifications, the inclusion of *Chamaesaura* Schneider 1799 and *Pseudocordylus* A. Smith 1838 in *Cordylus* as proposed by Frost *et al.* (2001) is deferred pending fuller species coverage. Although the genus *Cordylus* has been well studied in the subcontinent (e.g., Mouton 1986; Mouton & Van Wyk 1989, 1990, 1994), northern taxa received attention only recently, with the recognition of several new species (Broadley & Mouton 2000; Broadley & Branch 2002).

Despite their prevalence in rocky habitats in southern Africa, rupicolous *Cordylus* north of the Zambezi River occur in only a few, well-

isolated populations. *Cordylus nyikae* Broadley & Mouton 2000 is endemic to the Nyika Plateau in northern Malawi (Broadley & Mouton 2000), whilst *C. beraduccii* Broadley & Branch 2002 occurs in the Maasai Plains of the Kenya-Tanzania border, and *C. rivaie* (Boulenger 1896) is restricted to the Sidamo Province of southern Ethiopia (Broadley & Branch 2002). Mouton & Oelofsen (1988) postulated a cool-temperate origin for the genus. The isolated northern populations in tropical Africa, i.e., *C. ukingensis* (Loveridge 1932), *C. tropidosternum* (Cope 1869) and *C. beraduccii*, and subtropical Africa, i.e., *C. nyikae*, *C. rhodesianus* (Hewitt 1933), *C. jonesi* (Boulenger 1891) and *C. angolensis* (Bocage 1895), thus represent an unresolved zoogeographical enigma.

Hence it was unexpected when a population of rupicolous girdled lizards was discovered

among the summit rock outcrops of Serra Mecula, a small, isolated mountain range in the Niassa Game Reserve (NGR), northern Mozambique. The specimens, collected during a herpetological survey (October–November 2003) of NGR organized by the Sociedade para e Gestão e Desenvolvimento da Reserva do Niassa (SGDRN), can be distinguished morphologically from all other *Cordylus*, and are thus described as a new species.

## MATERIALS AND METHODS

Specimens were deposited in the Port Elizabeth Museum (PEM), South Africa. Fuller details of the collecting localities, habitats, and associated herpetofauna are presented elsewhere (Branch *et al.*, in press). Additional comparative material was examined during an earlier review of *Cordylus tropidosternum* and other East African forms (for specimens see appendix in Broadley & Branch 2002). Institutional acronyms follow Leviton *et al.* (1985). Character analysis follows that of Broadley & Branch (2002). Head length was measured to the posterior edge of the upper temporals; head width is the maximum distance across the temporal region; and head depth was taken at the mid-point of the eye.

### SYSTEMATICS

(Reptilia: Squamata: Cordylidae)

*Cordylus meculae* Branch, Rödel & Marais

**sp. nov.** Mecula Girdled Lizard (Figs 1–2).

*Holotype*.—PEM R16166, an adult female from the summit rock outcrops of Serra Mecula, Niassa Game Reserve, Niassa Province, northern Mozambique (12° 03' 11" S, 37° 38' 49" E; 1029 m a.s.l.) collected by W. R. Branch, M.O. Rödel and J. Marais on 27 October 2003.

*Allotype*.—PEM R16163, an adult male, same collecting details as the holotype.

*Paratypes*.—Seven specimens: PEM R16164–5, same data as holotype; PEM R16180, R16182, Serra Mecula (12° 02' 25" S, 37° 38' 32" E, approxim. 1200 m a.s.l.), 29 October 2003; PEM R16198, Serra Mecula (12° 03' 30" S, 37° 38' 22" E, approxim. 1100 m a.s.l.); PEM R16202–3, western slopes of Serra Mecula (12° 02' 46" S, 37° 37' 21" E, 643 m a.s.l.), 1 November 2003. All collected by W.R. Branch, M.O. Rödel and J. Marais.

*Diagnosis*.—A large, rupicolous species with head and body depressed. Morphologically closest to *C. rhodesianus* and *C. nyikae*, but distinguished from most southern African *Cordylus* species (including the *C. warreni* complex, but not *C. cataphractus* or *C. vittifer*) by contact of the nasals and prefrontals; from *C. giganteus*, the *C. warreni* complex, and many specimens of *C. tropidosternum* from Tanzania and northern Mozambique, by contact of the nasal scales (Lang 1991; Broadley & Branch 2002); from other East African species in having a relatively wider and deeper head (narrower but deeper in *C. ukingensis*, Broadley & Branch 2002); from *C. beraduccii* in having smooth gular scales, a higher number of transverse gulars (16–22 in *C. beraduccii*), subcycloid to subrectangular lateral scales with the keels and mucrones directed diagonally upwards and set in granular skin (lateral scales juxtaposed with horizontal keels in *C. beraduccii*), and greater size; from *C. ukingensis* by the lower medial position of the nostril, smooth gulars, higher number of transverse gulars (15–16 in *C. ukingensis*), greater body size and rupicolous habits; from *C. tropidosternum* by the lower medial position of the nostril, smooth gulars, and having the 2<sup>nd</sup> and 3<sup>rd</sup> supraoculars largest (first three subequal in *C. tropidosternum*), and rupicolous habits; from *C. nyikae* by having serrated posterior margins to the dorsal scales (smooth in *C. nyikae*), lower number of transverse dorsals (27–30 in *C. nyikae*), slightly higher number of longitudinal dorsals and laterals (19–23 in *C. nyikae*), in always having the

prefrontals in contact (often separated by frontal-frontonasal contact or presence of an azygous shield in *C. nyikae*), in having a wider rostral (twice as broad as deep in *C. nyikae*); and in having non-swollen nasals, with the nostril more centrally placed and usually well separated from the first supralabial; from *C. rhodesianus* by having more rugose head shields (finely rugose to relatively smooth in *C. rhodesianus*), a wider rostral (nearly three times as broad as deep in *C. rhodesianus*), interparietal rarely elongated forward to contact frontoparietals, and greyish dorsal colouration (yellow-brown to blackish in *C. rhodesianus*); and from *C. rivaie* in having a relatively small interparietal that does not separate the anterior parietals, no median subtriangular occipital, by contact of the prefrontals, separation of the interparietal/frontoparietals, smooth gular scales, subcycloid to subrectangular lateral scales with the keels and mucrones directed diagonally upwards and set in granular skin (lateral scales juxtaposed with horizontal keels in *C. rivaie*), few subdigital lamellae below the fourth toe (14-17 in *C. rivaie*), higher number of transverse gulars (16-19 in *C. rivaie*), weakly developed femoral pores in females, and generation glands present in males only.

*Description (allotype and paratype variation shown in parentheses if different from holotype).*—Head and body depressed. Head 1.11 times as long as broad (1.11; range 1.11-1.27, mean 1.18) with upper head shields coarsely rugose (Fig. 1). Nasals large, in broad contact; frontonasal rhomboid, separated from the frontal and loreals by the prefrontals which are in broad contact with one another and with the nasals, loreal and preocular (in R16198 the preocular is very large on both sides, contacting the nasal and separating the loreal from the prefrontal); frontal in contact with first and second supraoculars, followed by a pair of frontoparietals in median contact; two pairs of parietals (anterior pair slightly smaller than posterior pair) enclosing a lozenge-shaped interparietal

(in contact anteriorly with frontoparietals in R16180); a row of six rugose, but non-spinose occipitals (in R16180 the central pair of occipitals are elongate and fused with adjacent scales in the first row of dorsals). Four supraoculars, 2<sup>nd</sup> and 3<sup>rd</sup> largest, and three supraciliaries. Nostril (Fig. 1) pierced towards postero-inferior margin (more centrally placed in allotype and R16202), separated from first labial by a narrow rim (in contact on right side in R16180). Loreal separated from anterior supraocular and first supraciliary by contact of preocular and prefrontal; lower eyelid with vertical septa; two suboculars, widely separated from the lip. Rostral 2.8 times as broad as deep (3.13; range 2.31-3.13, mean 2.71; vertical cleft in rostral of R16163); supralabials six (left) and seven (right) (six on both sides in all paratypes), 5<sup>th</sup> the largest; infralabials six; sublabials five, 4<sup>th</sup> the largest and first pair in contact behind mental. Mental approximately 1.5 times as broad as long; gulars smooth (faintly keeled in subadults R16203 and R16184), barely mucronate, slightly imbricate anteriorly, enlarged and forming transverse rows posteriorly, 23 (24, 22-25) between ventral edge of ear openings.

Dorsal scales rectangular, rugose and obtusely keeled, serrate posteriorly on sides but smooth edged along backbone; laterals subcycloid to subrectangular, with keels and mucrones directed diagonally upwards and set in granular skin; dorsals (including laterals) in 25 (25, 25-27) transverse and 24 (22, 22-25) longitudinal rows; ventrals squarish, smooth (weakly keeled on 2-3 most lateral rows in subadults R16203 and R16184) and mucronate, in 24 (24, 25-29) transverse and 12 (14 in R16164) longitudinal rows; a pair of enlarged precloacal plates, bordered laterally by a smaller enlarged pair, is followed by a row of very small scales.

Scales on limbs above large, strongly keeled and spinose; scales under 4<sup>th</sup> toe 14 (13, 11-14); femoral pores 6 (6-7, 5-7, small and poorly

developed in females); generation glands on the thigh absent (15-15 in allotype, 12-18 in all males); tail with single whorls of large, elongate, strongly keeled, spinose and serrated scales, with spines directed backwards and longest superolaterally.

Dorsum dark brown with paler infuscations, particularly on flanks, with scattered cream to yellow fleck concentrated in the neck region. Head almost black with scattered yellow flecks; labials cream coloured, with some infuscation, extending onto neck to forelimb insertion. Ventrums uniform buff, the generation glands cream to yellow. Tail pale brown, lighter on sides and below. Limbs dark brown, paler below and on soles. Two paratypes (R16202-03), both collected in rock cracks near to the ground, have redder bodies that are probably discoloured by the surrounding soil.

The allotype and paratypes R16164-5, 16198, and 16202-3 have small ventral incisions for the collection of liver tissue for genetic analysis and investigation of reproductive condition.

Measurements for the type series are given in Table 1. Data are presented as mean  $\pm$  standard deviation. In *C. meculae* head width as a percentage of head length ranged from 78.3 to 89.6% ( $84.7 \pm 4.18$ ,  $N = 9$ ); head depth / head length 41.2-46.3% ( $43.8 \pm 1.78$ ,  $N = 9$ ); and head depth / head width 47.7-54.6% ( $51.8 \pm 2.29$ ,  $N = 9$ ). There may be variation due to ontogenetic growth and sexual dimorphism (adult males usually have the broadest heads). With the exception of the deep head of *C. ukingensis*, *C. meculae* appears to have a relatively wider and deeper head than other East African *Cordylus* (Broadley & Branch 2002). The original tail as a percentage of snout-vent length (95-110%) was similar to most other *Cordylids*, except that it was longer than *C. ukingensis* and shorter than *C. beraduccii* (Broadley and Branch 2002).

*Etymology*.—Named after Serra Mecula, Niassa Game Reserve, northern Mozambique, the type, and only known, locality. The specific epithet is treated as a noun in apposition.

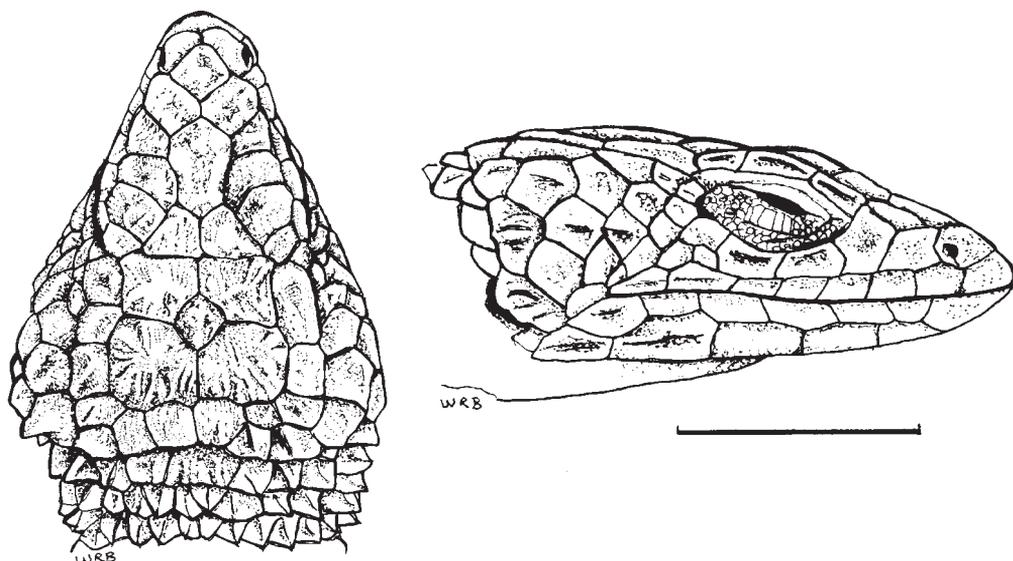


Figure 1. *Cordylus meculae* sp. nov.: dorsal (left) and lateral (right) views of the head of the holotype (PEM R16166). Scale = 10 mm.



Figure 2. The Mecula Girdled Lizard, *Cordylus meculae*, **sp. nov.** (Holotype PEM R16166)

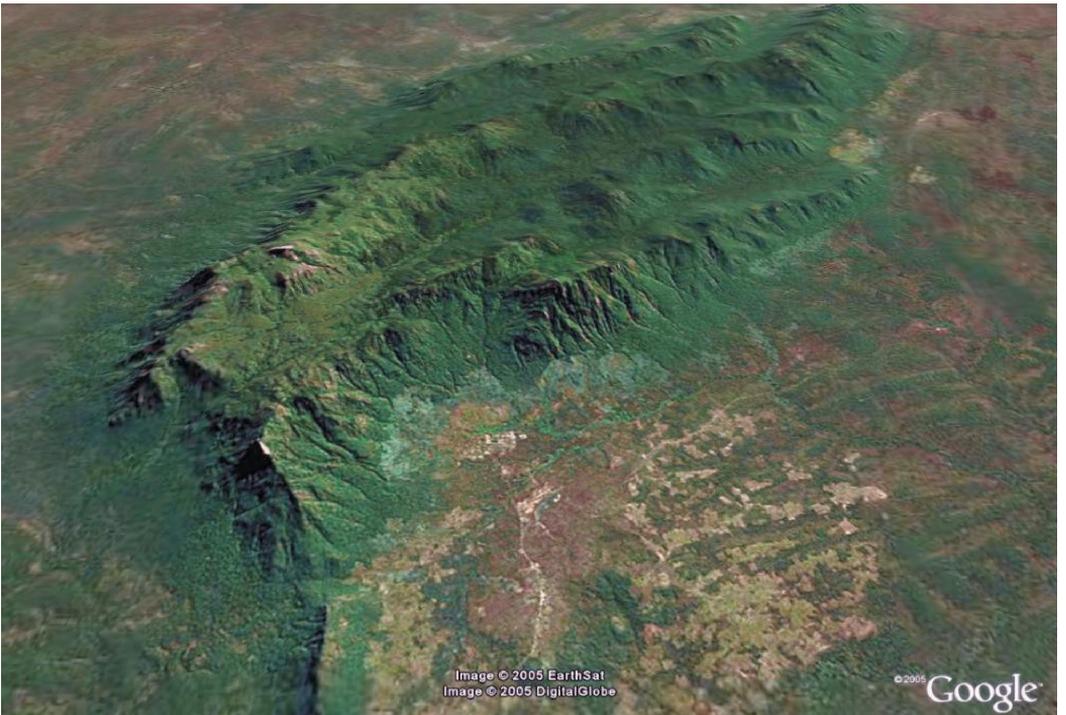


Figure 3. Serra Mecula in the Niassa Game Reserve, northern Mozambique. The type series was collected among the exposed rocks on the summit (left centre).

Table 1. Measurements (mm) for the type series of *Cordylus meculae* sp. nov.

Number (PEM R)	Sex	SVL	Tail length	Head width	Head length	Head depth
Holotype 16166	♀	94	94	19.9	25.0	10.3
Paratype 16198	♀	93	77	19.3	22.3	10.3
Paratype 16180	♀	91	75	19.5	22.1	9.3
Paratype 16165	♀	90	90	17.7	22.6	9.6
Paratype 16164	♀	86	90	17.8	22.0	9.7
Paratype 16203	♀	62	59	14.0	16.7	7.2
Allotype 16163	♂	83	84	19.0	21.2	9.3
Paratype 16202	♂	83	92	18.2	22.9	9.4
Paratype 16182	♂	62	—	14.1	16.5	7.5

*Size*.—Largest female (R16166),  $94 + 94 = 188$  mm; largest male (R16202)  $83 + 92 = 175$  mm. The species is of comparable size to *C. tropidosternum*, *C. nyikae*, *C. jonesii* and *C. rhodesianus*, but larger than *C. ukingensis* and *C. beraduccii* (Broadley & Branch 2002). Size distribution for the sexes in the small series available supports the observation that females of East African species are usually larger than males (Broadley & Branch 2002).

*Distribution*.—Presently known only from the summit and upper slopes of Serra Mecula in the Niassa Game Reserve, northern Mozambique (Fig. 3).

*Habitat*.—*Cordylus meculae* inhabits crevices in granitic rock in bracken-dominated summit grasslands (1029-1200 m a.s.l.), and in similar rock cracks in dry Miombo woodland on the upper slopes of the mountain (643 m a.s.l.). It is often found in association with the Giant Plated Lizard (*Gerrhosaurus validus*), the geckos *Hemidactylus platycephalus* and *H. mabouia*, and the skinks *Trachylepis margaritifer* and *T. varia* (Branch *et al.*, in press).

*Breeding*.—All five large females (>86 mm SVL), including the un-dissected holotype, were gravid. PEM R16164 (86 mm SVL) contained two large yolked follicles (25 x 13 mm), one in each oviduct, with well-developed embryos that appeared almost fully developed;

R16165 (90 mm SVL) and R16198 (93 mm SVL) both contained three similar embryos with yolk (two in left oviduct and one in right). The small female R16203 (62 mm SVL) was not sexually mature, while the two large males (R16163 and R16202, both 83 mm SVL) had turgid testes with full, convoluted vas deferens indicating the presence of sperm. All sexually mature females were gravid and embryos were of similar size and development. This indicated that reproduction was synchronised for birth to occur soon after the onset of the summer rains. Most females therefore probably breed annually. Clutch size (2-3 young) is low compared to *C. tropidosternum* of comparable size (up to five young), but similar to *C. nyikae* in number of young (2-4) and reproductive timing (all nine females in the type series of *C. nyikae* contained well-developed embryos in early November; Broadley & Branch 2002).

*Relationships*.—*Cordylus meculae* shows its greatest morphological affinity with *C. nyikae* and *C. rhodesianus*. The former, from the Nyika Plateau and Misuku Hills in northern Malawi, is the closest rupicolous neighbour (approximately 450 km WNW of Serra Mecula). Populations are separated by the intervening rift valley and Lake Malawi. *Cordylus rhodesianus* is endemic to the eastern highlands of Zimbabwe and adjacent Mozambique, 850 km SSW of Serra Mecula. A comprehensive molecular phylogeny of

*Cordylus* and its relatives is currently in preparation (Whiting, Mouton, Bauer and Branch, in prep.).

*Remarks.*— Loveridge (1944) referred *Cordylus parkeri* (type locality: Amatongas, 19° 09' S, 33° 47' E) to the synonymy of *C. tropidosternum*, a decision that was followed by Broadley and Branch (2002). This is supported by its keeled gulars and lateral ventrals, infero-posterior position of the nostril, and greyish-brown body with pale dorso-lateral stripes (Cott 1934). These features serve to assign it to the synonymy of *C. tropidosternum* and distinguish it from *C. meculae*. The status of the poorly-known *C. angolensis* Bocage 1895 remains problematic. Broadley (1971) considered it a synonym of *C. tropidosternum*. Loveridge (1944) noted that Bocage's type description of *C. angolensis* lacked detail, and the types have subsequently been destroyed. However, the colouration and various features of scalation in *C. angolensis*, i.e., 27-28 transverse rows of dorsals and 14 longitudinal rows of ventrals, are unusual in *C. meculae*. Given the large geographic distance between the two taxa they are unlikely to be conspecific, but this can only be resolved with the collection of additional material.

## DISCUSSION

Serra Mecula is a small, incised range rising to 1442 m a.s.l. It is the highest point in the NGR. The mountain plateau, at around 800-1000 m a.s.l., contains a number of habitats not found elsewhere in the NGR or surrounding region. It is covered with fire-maintained sub-climax grassland with bracken and scattered shrubs and small trees, especially *Strychnos spinosa*. Bedrock expanses and rock outcrops are extensive, whilst dense forest or woodland is found along the deeply incised streams that drain centrally along the bisected range, with small patches of evergreen moist forest (1-5 ha in

size) at higher altitude (1000-1300 m) or associated with gullies below the larger peaks. These contain tree species commonly associated with the eastern African escarpment from Ethiopia to South Africa. Timberlake *et al.* (2003) concluded that Serra Mecula was an outlier of upland or montane vegetation associated with the Afromontane archipelago.

Affinities between the montane herpetofauna of Serra Mecula and those of the Afromontane isolates in Zimbabwe (Eastern Highlands) and Malawi (Mount Mulanje in the south and Nyika Plateau in the north) include the disjunct distributions of *Lygodactylus angularis*, *Melanoseps* sp., and *Scolecormorphus kirkii* (Branch *et al.*, in press). A surprising difference is the absence of *Cordylus* on Mt Mulanje. Although much systematic and conservation interest has focused on the Eastern Arc Mountains of Tanzania, the relationships of the many montane endemics of these mountains with populations to the south have been neglected. Serra Mecula, although smaller in stature and status than its more famous Tanzanian neighbours, remains an important Afromontane outlier.

Human settlements are not excluded from the NGR and a District Centre (Mecula), with an estimated human population of 12 000, occurs on the eastern foothills of Serra Mecula. As a consequence the evergreen forest patches on the summit and river valleys suffer high levels of resource extraction from the burgeoning human population (see Fig. 3. lower centre). The incidence of human-induced fire in the NGR is also very high, much higher than natural fire regimes. In 2002, 35.2% of the NGR was affected by patchy cool fires, 16.8% by hot fires (in which trees are burnt), and only 48% of the reserve was unaffected by fire (Craig & Gibson 2002). The conservation priorities in the NGR are understandably directed towards protection of the megafauna, and in developing land use strategies that allow large mammals

and humans to live in close proximity. However, the protection of the biologically important small fauna and flora of Serra Mecula is also urgently needed.

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