

## Three new *Sisyphus* species (Coleoptera: Scarabaeidae: Scarabaeinae) from shaded vegetation in southern Africa

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**Abstract:** Descriptions are provided for three new shade-associated species in the dung beetle genus, *Sisyphus* Latreille, 1807: *Sisyphus umbraphilus* **sp. nov.**, *Sisyphus oralensis* **sp. nov.**, and *Sisyphus neobornemisszanus* **sp. nov.** All three species are illustrated by photographs of habitus, diagnostic features, and male aedeagi. A map is provided showing their geographical distributions.

**Key words:** Afrotropical Region, dung beetles, Sisyphini, Forest.

Resumo: O objetivo deste artigo é de descrever três espécies novas do gênero *Sisyphus* associadas com as formações vegetacionais fechadas na África Austral: *Sisyphus umbraphilus* **sp. nov.**, *Sisyphus oralensis* **sp. nov.**, e *Sisyphus neobornemisszanus* **sp. nov.** As imagens dos caracteres da diagnose, genitália do macho, bem como o mapa de distribuição geográfica de todas as espécies estão ilustradas.

**Palavras-chaves:** Região Afrotropical, besouros rola-bostas, Sisyphini, Floresta.

### Introduction

The dung beetle tribe, Sisyphini, is represented by three genera. *Sisyphus* Latreille, 1807 and *Neosisyphus* Müller, 1942, are widely distributed, whereas the volcanic island endemic, *Nesosisyphus* Vinson, 1946, is represented by four species restricted to Mauritius. The most widespread genus, *Sisyphus*, can be easily separated from its Afrotropical and Oriental sister genus, *Neosisyphus*. *Sisyphus* shows a complete lateral ridge on the pronotum, which extends from the anterior to the posterior margin and clearly separates the pronotal disc from the episternum, unlike in *Neosisyphus* where the ridge is incomplete (Paschalidis 1974) or absent

(Montreuil 2015a - partial revision, Afrotropical species). *Sisyphus* also bears a row of strong setae on the ventral edge of the first tarsal segment of both the meso- and meta-thoracic legs. *Sisyphus* currently comprises 43 valid species, 37 listed by Schoolmeesters (2015) and another six recently described by Montreuil (2015b). These species are recorded from the Afrotropical (28 spp.), Palaearctic (1 sp.), Oriental (12 spp.) and Neotropical (2 spp.) regions with some subdivision into six subspecies (Schoolmeesters 2015). Although the University of Pretoria (UPSA) database records a total of 12 *Sisyphus* species from southern Africa, nomenclature follows the unpublished taxonomic revision of southern African species (Paschalidis 1974), which differs in some respects to the list of officially valid species and suggests that further revision is warranted to correct errors and describe new species.

In southern Africa, *Sisyphus* is divided into two species groups according to morphology and nesting behaviour (Paschalidis 1974; Davis *et al.* 2008). The first group is represented by three, large-bodied, endemic, southeastern African species. The second group comprises mostly smaller-bodied species with distributions that are either restricted or widespread within the Afrotropical region (Davis *et al.* 2008). In this paper we describe three new southern African *Sisyphus* species, one belonging to the first species group and two to the second group. All three are associated with vegetation types offering shade.

Of the three species, two apparently close relatives were first recognized as new by Paschalidis (1974). They were designated *Sisyphus* sp. x and *Sisyphus* sp. y but still remain without formally published names and descriptions. Since 1974, they have been referenced in ecological publications using the names *Sisyphus* sp. y (e.g. Davis *et al.* 2002; Jacobs *et al.* 2010) or *Sisyphus* sp. for sp. x (Davis 1996). The third new taxon was originally described under the name *Sisyphus bornemisszanus* Endrödi, 1983. However, the type series contains two different species each represented by six individuals. The species represented by the holotype and five paratypes was previously described as *Sisyphus natalensis* Balthasar, 1968, so that *Sisyphus bornemisszanus* becomes a junior synonym (*pars*). This leaves the species represented by the allotype and a further five paratypes without a valid name or valid description. We propose the names *Sisyphus umbraphilus* for sp. x, *Sisyphus oralensis* for sp. y and *Sisyphus neobornemisszanus* for the third invalidly named species.

## Material and Methods

Specimens were examined using Zeiss dissecting microscopes. Images of the habitus were taken with a Canon EOS 550D and 100mm macro lens. Focus stacking was performed using the software Helicon Focus version 5.3. Male genitalia were photographed under a Leica M165 C microscope, using the Leica DMC 2900 digital camera.

We measured specimens from all new species of *Sisyphus*, including the following variables: total length, and the greatest width of pronotum. For each variable, we specify, in millimeters, the range (minimum, to maximum) for both sexes.

Institutions holding type material are abbreviated as follows:

**SANC:** National Collection of Insects, Plant Protection Research Institute, Pretoria, South Africa.

**TMSA:** Ditsong Museum of Natural History, Pretoria, South Africa (previously the Transvaal Museum).

**UPSA:** Department of Zoology & Entomology, University of Pretoria, Pretoria, South Africa.

## Taxonomy

**Genus:** *Sisyphus* Latreille 1807

*Sisyphus umbraphilus* Daniel & Davis **sp. nov.** (**Fig. 1a**)

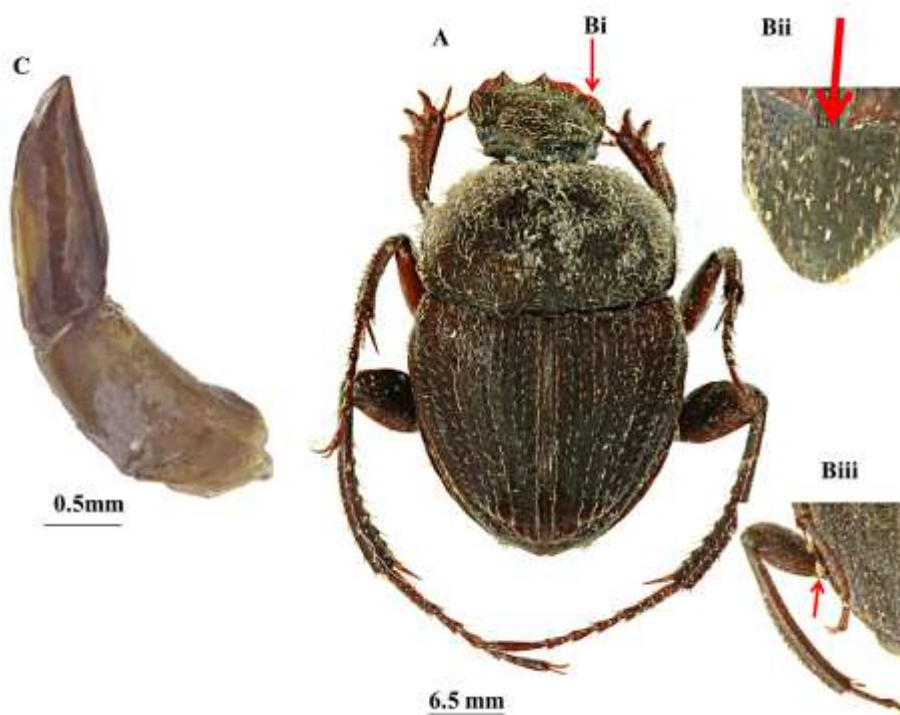
**Diagnosis:** This new species is similar to *S. oralensis* but can be distinguished from the latter by the following characters: lateral edges of genae virtually parallel; second and third abdominal epipleurae with well-developed tufts of setae; pygidium with uniformly scattered setae, except for a distinct non-setose line medially (**Fig. 1bi-iii**).

## Description

**Size: Male:** Length: 5.1–7.1 mm, width: 2.9–4.2 mm; **Female:** Length: 5.4–7.4 mm, width 3.2–4.2 mm.

**Colour:** Dark brown to black.

**Head:** Clypeus dark and punctate; anterior margin with two medial teeth and a convex lateral sinuosity between teeth and genal sutures; lateral margins of genae almost parallel, post-occipital suture not fully rounded; antennae brown.



**Figure 1.** A. *S. umbraphilus* habitus. Diagnostic characters: **Bi.** Lateral genal margins almost parallel. **Bii.** Setae absent from vertical medial line on pygidium. **Biii.** Tufts of setae on epipleurae. **C.** Aedeagus.

**Pronotum:** Convex, shiny black, densely punctate, lateral edges slightly compressed, maximum length shorter than maximum width, complete lateral prothoracic ridge between prothoracic disc and prothoracic episternum, disc showing an indistinct pattern of bare patches, some with sparse short setae, arranged within a matrix of dense, long setae (Fig. 1a).

**Elytra:** Dark brown, shiny in some individuals, ovoid posteriorly, interstriae finely punctate bearing light-coloured setae with recurved tips, epipleurae of the second and third abdominal segments each bearing a tuft of yellow setae.

**Pygidium:** Narrow with ocellate punctation and scattered setae but with a distinct medial line lacking setae.

**Sternites:** Setae arranged in rows laterally, except on first sternite where setae form a ventral row; visible meso-metasternal suture; meso- and metasternum black shiny, punctate with lateral setae; mesepimerum and metepisternum punctate and setose.

**Legs:** Profemur black, punctate, internally pubescent with a lateral row of well-developed setae in ventral view; meso- and metafemur densely punctate and setose; meso- and metatrochanter contiguous with femur, sharp tip of metatrochanter projecting away from femur; metacoxa punctate and shagreened ventro-anteriorly; protibia with three teeth and

single terminal spine; mesotibia punctate and setose with two terminal spines; metatibia densely setose, serrated laterally with two spurs; pro- meso- and metatarsus five segmented with two claws, setose laterally; first tarsal segment of the meso- and meta-thoracic legs with a row of strong setae on the ventral edge.

**Aedeagus:** Phallobase almost straight, slight angular depression immediately distal from the phallobase-paramere suture; parameres symmetrical, slightly curved inward at the tip, separated from each other by fine membranous area visible dorsally on apical edge (**Fig. 1c**).

**Etymology:** The species name reflects the shaded vegetation with which the species is associated.

**Examined material:** Holotype: (m# **SANC**): **SOUTH AFRICA**, KZN, Umfolozi 28[°] 15['] S; 31[°] 55['] E, 1-7.x. 1970, leg: Bornemissza & Aschenborn. Paratypes: (3m#, 9f# **SANC**) with the same data as holotype. (1m#, 2f# **UPSA**): **SOUTH AFRICA**, KZN, Itala Game Reserve 27[°] 27['] 53.6["] S; 31[°] 15['] 36.1["] E, 13.i.1999, leg: Chown, McGeogh & Davis. (2m# **SANC**): **SOUTH AFRICA**, KZN, Jozini 27[°] 26['] 0["] S; 32[°] 4['] 0["] E, 15.x.1978, leg: Bornemissza & Aschenborn. (7m#, 14f# **SANC**): **SOUTH AFRICA**, Gauteng, Pretoria, 35km NE of Pretoria Farm 25[°] 42['] 0["] S; 28[°] 13['] 0["] E, 12-13.xii.1983, leg: Davis. (1m# **SANC**): **SOUTH AFRICA**, KZN, Weke-Weke Stream, Shongweni Farm 29[°] 48['] S; 30[°] 43['] E, 11.xi.2010, leg: AJ Armstrong & G Van Bassouw.

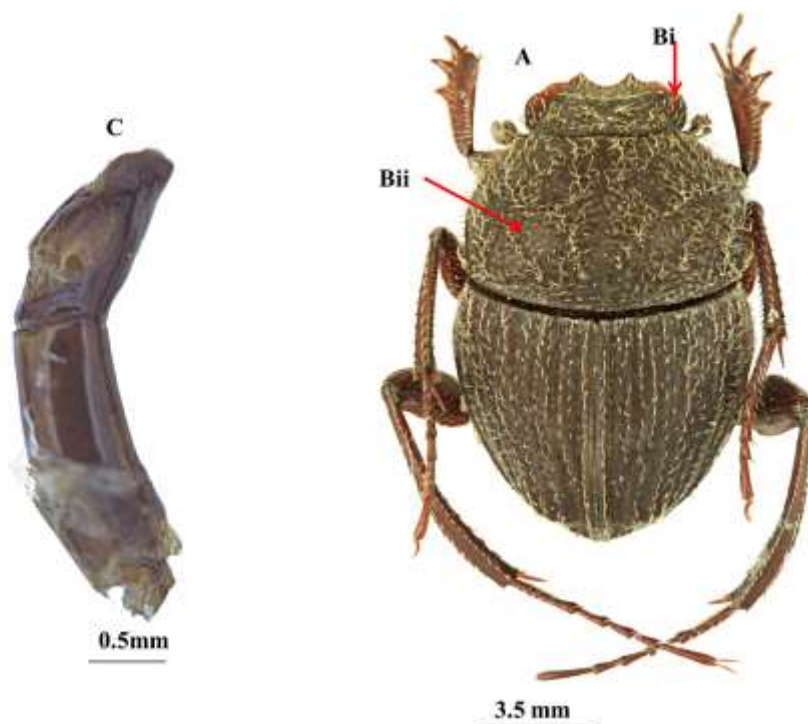
**Habitat:** This new species has been recorded in patches of dense woodland and thicket. On the bushveld near Pretoria, it was sampled only in thickets on deep sand and not in open woodland or grassland (Davis 1996). It has been recorded only from South Africa (**Fig. 4**).

*Sisyphus oralensis* Daniel & Davis **sp. nov.** (**Fig. 2a**)

**Diagnosis:** *Sisyphus oralensis* is similar to *S. umbraphilus*, but can be distinguished by the following combination of characters: genae rounded forming obtuse angle with genal suture; less dense cover of long setae on pronotal disc, not distributed uniformly but mostly arranged in a linear pattern separated by bare patches; *S. oralensis* is smaller than *S. umbraphilus* (**Fig. 2bi-ii**).

**Description:**

**Size: Male:** Length: 3.4–4.8 mm, width: 2.1–2.5 mm. **Female:** Length: 3.9–4.7 mm, width: 2.1–2.5 mm.



**Figure 2.** A. *S. oralensis* habitus. Diagnostic characters: **Bi**. Gena rounded forming obtuse angle with genal suture. **Bii**. Patterned arrangement of setae on pronotal disc separated by bare patches. **C**. Aedeagus.

**Colour:** Dark brown to black.

**Head:** Clypeus with a strong cleft between two medial teeth, deep excavation lateral to each tooth, lateral convex sinuosity between excavation and genal suture, genae rounded forming obtuse angle with genal suture; frons finely punctate and setose, post-occipital suture fully rounded and arciform, eyes reniforme with dark ocular stains, antennae brown.

**Pronotum:** Convex, dark brown, coarsely punctate; anteriorly inclined; central diameter wider than elytra; complete lateral prothoracic ridge separating prothoracic disc and prothoracic episternum; long setae of pronotal disc not uniformly spaced but forming a clear, mostly linear pattern separated by bare patches (**Fig. 2bii**).

**Elytra:** Dark brown; narrowed posteriorly; finely punctate; well-spaced; fine curled setae on interstriae.

**Pygidium:** Dark brown; strongly narrowed and "v" shaped towards apical base; finely punctate and setose.

**Sternites:** Abdominal sternites punctate with fine setae arranged in rows; meso- and metasternum black, metallic shiny, and finely punctate; mesepimerum and metepisternum: punctate with fine setae.

**Legs:** Profemur with well-developed setae laterally, punctate ventrally; meso- and metafemur brown, punctate and setose; meso- and metatrochanter contiguous with femur, forming a divergent spine at the tip in latter; pro- meso- and metatibia setose with single terminal spur, protibia with three teeth; pro- meso- and metatarsus five segmented with two claws; the first tarsal segment of the meso- and meta-thoracic legs with a row of strong setae on the ventral edge.

**Aedeagus:** Phallobase curved dorsally, forming a strong angle with parameres, visible medial line ventrally; parameres nearly symmetrical, separated by membranous area visible dorsally on apical edge; basal edges slightly excavated longitudinally both ventrally and dorsally. (Fig. 2c)

**Etymology:** We named this species *S. oralensis* because it is found on the Indian Ocean coastline of South Africa and Mozambique where it is associated with dense woodland and forest.

**Examined material: Holotype:** (m# TMSA): SOUTH AFRICA, KZN, Richard's Bay 28[°] 39['] 29.1['] S; 32[°] 15['] 19.2['] E, 27.i.2000, leg: Davis & Delport. **Paratypes:** (5m#, 8f# UPSA): SOUTH AFRICA, KZN Richard's Bay 28[°] 39['] S; 32[°] 15['] E, 26-27.i.2000, leg: Davis & Delport. (4f# UPSA; 3m#, 2f# SANC): SOUTH AFRICA, KZN, Thembe Elephant Park 27[°] 01['] S; 32[°] 24['] E, 17.xii.1996, leg: B.J. Van Rensburg. (9m#, 8f# UPSA): SOUTH AFRICA, KZN, Thembe Elephant Park 27[°] 01['] S; 32[°] 24['] E, 17.vii.1995, leg: B.J. Van Rensburg. (2m#, 3f# UPSA): SOUTH AFRICA, KZN Thembe Elephant Park 26[°] 55['] S; 32[°] 23['] E, 15-30.x.2008, leg: B.J. Van Rensburg. (2m# SANC, 1 f# TMSA): SOUTH AFRICA, KZN, Umfolozi 28[°] 15['] S; 31[°] 55['] E, 25.viii.1971, leg: Bornemissza & Insley. (1m#, 10f# SANC): SOUTH AFRICA, KZN St Lucia Est. Nat. Reserve, Dune Forest 28[°] 13['] S; 32[°] 21['] E, 27.x.1978, leg: Bornemissza. (1f# SANC): SOUTH AFRICA, KZN Ntl Kosi Bay Nature Res 26[°] 34['] S; 32[°] 28['] E, 8-11.ii.1990, leg: B. Grobbelaar. (1f# SANC): SOUTH AFRICA, KZN, Near Richards Bay, 28[°] 36['] 52['] S; 32[°] 17['] 34['] E, 27.x.1978, leg: Bornemissza. (1m# SANC): SOUTH AFRICA, KZN, Thembe Elephant Park 27[°] 01['] S; 32[°] 24['] E, 01-49.ii.1996, leg: R Stals. (5m#, 6f# TMSA): SOUTH AFRICA, KZN, Ntl Kosi Bay Nature Res 26[°] 34['] S; 32[°] 28['] E, 14.xi.2002, leg: Burguer, Harrison & Muller. (7m#, 8f# TMSA): SOUTH AFRICA, Zululand, Sodwana Bay 5km, 27[°] 21['] S; 32[°] 23['] E, 23.xi.1992, leg: Endrody-Younga. (8m#, 8f# TMSA): SOUTH AFRICA, N Zululand,

Ndumu Game Reserve 26[°] 32['] S; 32[°] 10['] E, 1.xii.1992, leg: Endrody-Younga. (30m#, 42f# **TMSA**): **SOUTH AFRICA**, N Zululand, Lake Bangazi 28[°] 04['] S; 32[°] 18['] E, 12.xii.1992, leg: Endrodi-Younga. (1m#, 2f# **TMSA**): **SOUTH AFRICA**, Zululand, St. Lúcia. Mission Rock 28[°] 13['] S; 32[°] 21['] E, 23.xi.1992, leg: Endrody-Younga. (1m#, 2f# **TMSA**): **SOUTH AFRICA**, Natal, Cape Vidal, Forest litter 28[°] 8['] S; 32[°] 33['] E, 23.i.1990, leg: J. Klimaszewski. (1m#, 2f# **TMSA**): **SOUTH AFRICA**, N Zululand, Hluhluwe Game Reserve. 28[°] 03['] S; 32[°] 02['] E, 20.xi.1992. leg: Endrody-Younga. (12m#, 30f# **SANC**); **SOUTH AFRICA**, KZN St Lucia Est. Nat. Reserve, Forest 28[°] 13['] S; 32[°] 21['] E, 24-23.i.1979, leg: NH Aschenborn. (1m#, 2f# **TMSA**): **MOZAMBIQUE**, Inhambane, Pomene, 22[°] 35['] S; 35[°] 21['] E, 04.v.1974, leg: A. Strydom. (5m#, 5f# **UPSA**): **MOZAMBIQUE**, Maputo Elephant Reserve 26[°] 39['] S; 32[°] 43['] E, 10-16.xi.2007, leg: W. Strümpher & C. Deschodt. (7m#, 10f# **SANC**): **MOZAMBIQUE**, Sofala, Dondo 19[°] 37['] S; 34[°] 45['] E. 19.i.1972, leg: Bornemissza & Kirk. (1m#, 1f# **SANC**): **MOZAMBIQUE**, Sofala, Beira 19[°] 50['] S; 34[°] 51['] E 19.i.1972, leg: Bornemissza & Kirk. (1m# **SANC**); **MOZAMBIQUE**, Sofala, Gorongosa 18[°] 57['] S; 34[°] 10['] E, 11-28.i.1972, leg: Bornemissza & Kirk.

**Habitat:** This new species is confined to dense coastal woodlands and forest from northeast South Africa to at least Central Mozambique (Inhambane, Pomene, Gorongosa, Dondo, Beira) (**Fig. 4**). Across a vegetation restoration gradient at Richards Bay, KwaZulu-Natal, South Africa, *S. oralensis* was absent from grassland cleared of forest, but present in younger and older regenerating woodland (19, 6) plus natural dune forest (14) (Davis *et al.* 2002).

**REMARKS:** Both species (*S. umbraphilus* and *S. oralensis*) exhibit little sexual dimorphism, but may be separated by meta- and mesotibia curved; the mid-ventral narrowing of the last abdominal sternite in males; compared to the lack of narrowing, and meta- and mesotibia almost straight in females,

*Sisyphus neobornemisszanus* Daniel & Davis **sp. nov.** (**Fig. 3a**)

*Sisyphus bornemisszanus* Endrödi, 1983 (*pars*)

#### **Diagnosis**

This species is close to *Sisyphus muricatus* (Olivier, 1789) and *Sisyphus fasciculatus* Boheman 1857. Like *S. neobornemisszanus*, *S. muricatus* also has tufts of setae only on the





**Figure 3:** A. *S. neobornemisszanus* habitus. Diagnostic features: B. Tufts of setae on elytra. C. Aedeagus.

elytra with uniformly distributed setae on the pronotum. However, the carinae on the head of *S. muricatus* are mostly more developed with deeper and very strong lateral emargination on the pronotum. *S. fasciculatus* is easily distinguished from *S. neobornemisszanus* by bearing black tufts of setae on both the pronotum and elytra (**Fig. 3b**).

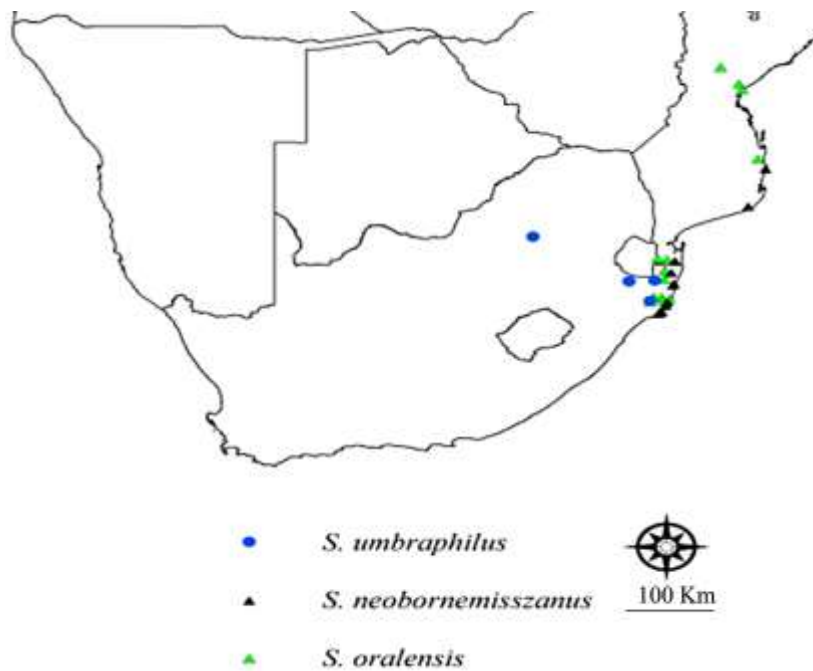
### Description

**Size: Male:** Length: 7.6–9.7 mm, width: 4.6–5.6 mm; **Female:** Length: 8.0–10 mm, width 4.4–5.62 mm.

**Colour:** Black, opaque; except mouth parts, and tarsi which are reddish brown; Antennal club dark gray or dark brown.

**Head:** Apex of clypeus broadly and deeply emarginate, bordered by two acute medial teeth and two more obtuse lateral teeth, genae angular anteriorly and curved laterally, surface of clypeus pubescent and finely punctate.

**Pronotum:** Convex with dense cover of setae, much broader than long, lateral edges curved anteriorly, narrowed posteriorly, complete lateral prothoracic ridge separating prothoracic disc and prothoracic episternum.



**Figure 4.** Map of southern Africa showing the geographic distribution of the new species: *S. umbraphilus*, *S. oralensis* and *S. neobornemisszanus*.

**Elytra:** narrowed posteriorly, interstriae 1, 3, 5, and 7 with rows of black setae arranged in tufts, interstriae 2, 4, and 6 with sparsely arranged single setae, a rudimentary row of setae along outer margin of abdominal pleurae.

**Pygidium:** V-shaped, with indistinct rows of brown setae and ocellate punctation.

**Sternites:** Six visible abdominal sternites with setae and ocellate punctures; meso- and metasternum black, shiny and pubescent with ocellate punctation; meso-metasternal suture clearly visible.

**Legs:** Profemur punctate ventrally and setose laterally; meso- and metafemur pubescent with ocellate punctation; mesotrochanter short and contiguous with femur; metatrochanter finely punctate, slightly angular and projected away from femur; Protibia with three teeth and a single terminal spurs; meso- and metatibia serrated, setose with two terminal spurs; pro-meso- and metatarsus five segmented with two claws; the first tarsal segment of the meso- and meta-thoracic legs with a row of strong setae on the ventral edge.

**Aedeagus:** Phallobase slightly curved dorsally as is common in the genus *Sisyphus*; parameres symmetrical, short, triangular, separated by membranous area dorsally, sides almost straight and slightly impressed above (**Fig. 3c**).

### Sexual dimorphism

**Female:** Lateral carina of pronotum somewhat stronger and more curved than in male; protibial teeth longer; meta- and mesotibia almost straight; last visible abdominal sternite not constricted medially. **Male:** Protibial teeth strong and short with rudimentary lateral setae; meta- and mesotibia curved; last abdominal sternite narrowed medially.

**Etymology:** Species named as *S. neobornemisszanus*, because the designated holotype was in the mixed type series of *S. bornemisszanus*.

**Examined material:** (m# **TMSA**) **Holotype:** SOUTH AFRICA, Zululand, St. Lucia 28[°] 13['] 12['] S; 32[°] 15['] 00['] E, 7.xii.1975, leg: Endrody-Younga. **Paratypes:** (1f# **TMSA**) SOUTH AFRICA, Zululand, Mission Rock, 28[°] 15['] 36['] S; 32[°] 17['] 24['] E, 7.xii.1975, legs: Endrody-Younga. (2m# **TMSA**) SOUTH AFRICA, Zululand, St. Lucia 28[°] 13['] 12['] S; 32[°] 15['] 00['] E, 28.viii.1971. leg. GF. Bornemissza. (2m# **TMSA**) SOUTH AFRICA, Zululand, St. Lucia, Estuary. 28.viii.1971, leg: GF. Bornemissza. (15m#, 13f# **TMSA**) SOUTH AFRICA, Zululand, Sodwana Bay, 5km, 27[°] 21['] 0['] S; 32[°] 23['] 24['] E, 2.xi.1992, leg. Endrody-Younga. (1f# **UPSA**) SOUTH AFRICA, KZN. Richard's Bay, 28[°] 37['] 39['] S, 32[°] 17['] 24['] E, 27.i.2000, leg: Davis & Delport. (2f#, 6m# **UPSA**) SOUTH AFRICA, KZN. Richard's Bay, 28[°] 43['] 28.5['] S; 32[°] 10['] 52['] E, 27.i.2000, leg: Davis & Delport. (5f#, 2m# **UPSA**) SOUTH AFRICA, KZN, Sileza Nature Reserve 27[°] 06['] S; 32[°] 36['] E, 03.iv.1996, leg: Van Resnburg. (1f# **UPSA**) SOUTH AFRICA, KZN, Sodwana, 27[°] 32['] S; 32[°] 41['] E, 07.iv.1989, leg: Mansfield. (2f#, 5m# **UPSA**) MOZAMBIQUE, Maputo, Elephant Maputo Reserve, 26[°] 22['] 30['] S; 33[°] 47['] 50['] E, 14-16.i.2003, leg: Scholtz & Holter. (2f# **UPSA**) MOZAMBIQUE, Maputo, Elephant Maputo Reserve, 26[°] 39['] S; 32[°] 43['] E, 10-16.xi.2007, pitfall trap, leg: Strumpher & Deschodt. (1m# **TMSA**) MOÇAMBIQUE, Inhambane, Inharrime, 24[°] 28['] 37['] S; 35[°] 01['] 49['] E, 1974, leg: Moor. (1m# **TMSA**) MOÇAMBIQUE, Inhambane, Pomene 22[°] 35['] 24['] S; 35[°] 21['] 00['] E, 2.v.1974, leg. A. Strydom.

**Habitats:** This species has been recorded in KwaZulu-Natal Province (South Africa) as well as Maputo and Inhambane Provinces (Mozambique), although records from Pomene suggest a wider distribution northwards along the Mozambique coastline (25.11 S; 33.73 E). In Maputaland, it is found within coastal sand and dune forests where the canopy is closed and the floor is open.

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