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A conservation and floristic assessment of poorly known species rich quartz–silcrete outcrops within Rûens Shale Renosterveld (Overberg, Western Cape), with taxonomic descriptions of five new species

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ABSTRACT

Quartz fields are islands of distinct vegetation in southern Africa. Such habitats differ from surrounding shale substrate in geomorphological and climatic attributes, and are dominated by a predominantly succulent flora with between 14% and 91% endemism. Previous studies have identified and surveyed quartz fields within the Succulent Karoo biome, but little is known about the Overberg quartz–silcrete fields located in the Renosterveld vegetation (Fynbos biome). This study maps the occurrence of quartz–silcrete fields in the Overberg (Eastern and Central Rûens Shale Renosterveld) and investigates if such fields support distinct vegetation compared with surrounding shales. Forty-seven plant species were recorded, 19 of which are endemic to the quartz–silcrete patches, including several newly discovered species in vascular plant families Cyperaceae (*Ficinia*), Iridaceae (*Hesperantha*) and Fabaceae (*Aspalathus*, *Otholobium*, *Polhillia*, *Xiphotheca*). Five species among these are described in this paper: *Aspalathus quartzicola C.H.Stirt. & Muasya*, *Aspalathus microlithica C.H.Stirt. & Muasya*, *Ficinia overbergensis Muasya & C.H.Stirt.*, *Otholobium curtisiae C.H.Stirt. & Muasya*, and *Polhillia curtisiae C.H.Stirt. & Muasya*. Detailed floristic composition of 25 quartz fields is surveyed, together with their conservation status. The Overberg Quartzveld is a critically endangered vegetation type that is the sole locality for 18 Red Listed plant species; which include seven new taxa. It is a distinct vegetation unit embedded within Rûens Shale Renosterveld in the eastern Overberg region of South Africa. These quartz patches have been overlooked in the past and we emphasize the need for further research and conservation attention of these habitats.

1. Introduction

Renosterveld is the broad term used to describe one of the distinct vegetation types found within the Fynbos Biome. It is very distinct from Fynbos — the main difference is that it generally lacks, with some exceptions, the three distinct fynbos elements (proteas, ericas and restios) and that it tends to be dominated by a combination of asteraceous shrubs and C_3 grasses (Rebelo, 1995). It occurs on relatively fertile soils and is one of the richest plant communities in the world, due to its extraordinary bulb diversity (Cowling, 1983) and high levels of endemism. However it is a severely threatened vegetation type (Kemper et al., 1998; von Hase et al., 2003), facing a very real risk of functional extinction, due to severe levels of transformation and fragmentation.

Mucina and Rutherford (2006) recognised 119 vegetation types within the Fynbos Biome — of which 29 are 'renosterveld' types. These comprise shale renosterveld (19 types), granite renosterveld (3), dolerite renosterveld (2), alluvium renosterveld (2), silcrete renosterveld (2) and limestone renosterveld (1). In the Overberg region of the Western Cape, there are four renosterveld types: Western-, Central- and Eastern-Rûens Shale Renosterveld and Rûens Silcrete Renosterveld. The word 'rûens' is derived from the Dutch word 'ruggens,' meaning 'hilly,' which was used to describe the undulating, fertile lowlands of the Overberg. All four of these vegetation types are listed as *Critically Endangered* (SANBI and DEAT, 2009), with Eastern Rûens Shale (ERS) Renosterveld comprising the largest, most intact extant remnants (about 10% of the original extent remains). The Overberg renosterveld is scattered across a vast landscape of transformed lands (grain fields and artificial pasture) and almost all of it occurs on privately-owned land. Thus, the biggest threats facing renosterveld today are the continued (illegal) conversion of virgin land into productive farm camps and poor management (particularly grazing and fire management) of the remnants.

Southern Africa has a complex geomorphological history and there is evidence to suggest that the unparalleled floral diversity of the Cape Flora was in fact determined by these historical processes. Cowling et al. (2009) suggest that moderate uplift during the early and late Miocene significantly increased the topo-edaphic heterogeneity of the Cape, resulting in the formation of several 'new' habitats available

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for plant colonization. In the Overberg region, the old African surface was capped by silcrete duricrusts, probably deposited in the early Palaeocene. Two major uplift events associated with tectonic movement occurred in the Cape: first in the early Miocene and second in the late Miocene/early Pliocene. In the lowlands almost all the silcrete duricrusts, as well as the kaolinised soils below them, were eroded to reveal the extensive tracts of shales and Cretaceous sediments, rendering a far richer and more fertile soil system compared with that of the abutting mountain habitats (Cowling et al., 2009). Today, only small remnants of the original silcrete-capped African surface are preserved in the Cape Lowlands, in the form of quartz–silcrete koppies (hillocks), mostly in the eastern region of the Overberg. The low-lying, clay-based, fertile soils essentially comprise various types of renosterveld, while the silcrete outcrops may be present in some areas. However, these systems have been significantly transformed for agriculture, with less than a tenth of the original system being represented in the landscape today.

Until fairly recently, the renosterveld lowlands of the Overberg have been largely ignored by local botanists, with some exceptions (e.g. Chris Burgers, Bruce Beyers, Nick Helme). However, botanical surveys undertaken over the last 5 years have revealed a suite of undescribed endemic species within this vegetation type. Many of these species occur only on quartz patches on silcrete outcrops in ERS Renosterveld. Mucina and Rutherford (2006) describe this veld type as occurring on 'moderately undulating hills and plains supporting small-leaved low to moderately tall grassy shrubland, dominated by renosterbos.' They make mention of the thin layer of calcrete found covering some parts of the veld in its southern limits, as well as the thicker deposits which support mesotrophic asteraceous 'fynbos', but make no mention of the quartz–silcrete outcrops which are so characteristic of this vegetation type.

In their paper which examined the community structure on quartz patches in the Succulent Karoo biome, Schmiedel and Jürgens (1999) state that quartz fields are clustered into six main regions in arid- to semi-arid southern Africa and that these are characterised by 'dwarf and highly succulent growth forms, which contrast strongly with the shrubby vegetation of the surroundings.' In her PhD thesis, Schmiedel (2002) makes reference to some quartz patches occurring in a transformed landscape south of the Langeberg mountains (which is the most northeastern extent of the ERS Renosterveld), which are characterised by *Gibbaeum haagei*, but states that, 'the quartz fields south of the Langeberg can be regarded as (relicts of) a fairly species-poor quartz field phytochorion.' Here, we challenge this statement and test whether the levels of endemism on quartz–silcrete patches within ERS Renosterveld are on a par with those found in the arid- and semi-arid regions further north.

Despite being more extensive and detailed than ever before, current-day vegetation maps are still relatively broad, when one considers local microclimates, and thus micro-habitats, which are present in so many vegetation types. For example, a particular fynbos type may also contain wetland, thicket, and/or riparian vegetation, but this is difficult to capture on a vegetation map, due to the small-scale mapping that would be required to achieve this. In the eastern part of the Overberg region, the remnant renosterveld is dotted with quartz–silcrete outcrops, containing several rare and endemic plants, including some recently-discovered species (described in this paper). These quartz habitats have not been formally described, although their high levels of endemism and rarity are increasingly recognised amongst local botanists (pers. obs. O. Curtis). Observations suggest that the communities on the quartz–silcrete patches within ERS Renosterveld appear distinct, begging the question: do these patches warrant being recognised as a distinct vegetation unit and if so, at what level? We have undertaken a systematic botanical inventory of the ERS Renosterveld to identify and characterise the floristic composition of the quartz–silcrete patches. In this study, we map location of the quartz patches, investigate the levels of endemism, and describe five new species found on these patches. This has relevance for conservation planning and development applications.

2. Materials and methods

2.1. Study site

We conducted our field work in the Eastern Rûens Shale Renosterveld of the eastern Overberg, restricting our surveys to the renosterveld fragments located north of Bredasdorp, south of Swellendam, east of Riviersonderend and west of Heidelberg. Eastern Rûens Shale Renosterveld is found between the coastal limestone and sandstone belt in the south and the southern foothills of the Langeberg Mountain in the north, from Bredasdorp and the Breede River area near Swellendam to the Heidelberg region (Mucina and Rutherford, 2006).

Quartz–silcrete patches are restricted to the silcrete outcrops on the Bokkeveld Group Shale-derived clay and loam within ERS Renosterveld, between the Bredasdorp and Swellendam/Heidelberg regions. While ERS Renosterveld has an altitudinal range of 40–320 m a.s.l., quartz patches within this are restricted to >180 m a.s.l. Average rainfall for ERS Renosterveld is 384 mm per annum, with an essentially even distribution, apart from a slight low from December to February (Mucina and Rutherford, 2006), while mean daily temperatures range from 5.9 °C (min, July) to 26.9 °C (max, January) (Mucina and Rutherford, 2006). Quartz patches fall within a similar climate, although these tend to occur within the drier parts of the ERS Renosterveld.

2.2. Vegetation surveys

We used GIS and satellite mapping to assist in selecting quartz patches and surveyed a representative and even spread sample. We recorded all vascular plants present, with particular emphasis on taxa which from our reconnaissance visits showed predominant presence on quartz, namely: i) succulents (including Aizoaceae and Crassulaceae), ii) legumes (Fabaceae) iii) sedges (Cyperaceae) and iv) restios (Restionaceae). We noted whether or not these were growing on quartz–silcrete outcrops only, or whether they were present on both the quartz–silcrete patches and the lower slopes of ERS Renosterveld. We also recorded any additional rare or endemic species, as well as some dominant, common species, present on the quartz–silcrete outcrops.

2.3. Taxonomy

Field plant identification was done using reference taxonomic literature and confirmed with reference to well curated herbaria (BOL, NBG). Voucher specimens for all species encountered were prepared in the field and deposited at BOL. For the five taxa in Cyperaceae and Fabaceae new to science, a comparative morphological study of available herbarium specimens was undertaken (BOL, K, NBG, and PRE; acronyms follow Index Herbarium, http://sciweb.nybg.org/science2/IndexHerbarium.asp). Taxonomic descriptions are made following standard approaches and naming in accordance to the Melbourne Code of 2012 (McNeill and Turland, 2011).

3. Results

3.1. Vegetation surveys

We surveyed 25 quartz–silcrete patches (Fig. 1). Species in each patch were recorded and assessed whether they either occurred across a suite of other habitats ('generalists') or were restricted to the quartz–silcrete outcrops (Table 1). The Red Data Status of all species including the new species described in this paper was also assessed (Raimondo et al., 2009) (Table 1).

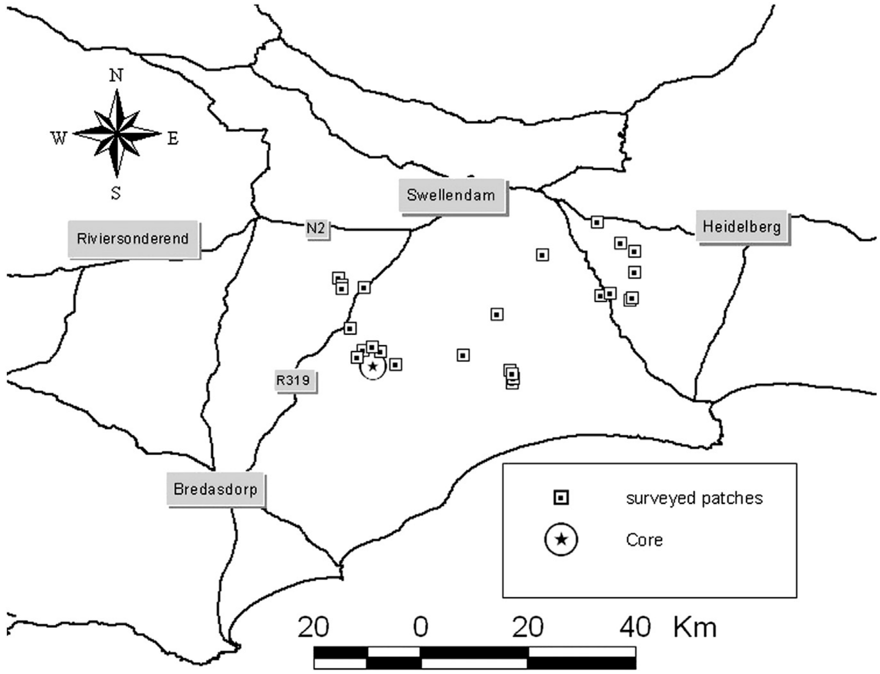

Fig. 1. Map denoting the quartz–silcrete patches surveyed. The 'core' area north of De Hoop Nature Reserve, comprises the highest levels of species richness recorded in this study, as well as several newly-described species.

A distinct community is present on quartz–silcrete outcrops in the Eastern Rûens Shale Renosterveld of the Overberg, and typically comprises *Gibbaeum haagei*, *Elegia verreauxii*, *Mesembryanthemum longistylum*, *Acrodon deminutus*, *Amphithalea violacea*, *Relhania garnotii*, *Ficinia overbergensis*, *Otholobium curtisiae*, and *Aspalathus quartzicola* (the latter three are described under Section 3.2 as new species). In addition to this community, other quartz–silcrete specialists occur at less regular intervals (Table 1). Out of the 47 species recorded, 19 occur on quartz–silcrete patches only.

We selected a point on the map which represented the highest levels of species richness (GRS, PK1, PK2, NY1, NY2, HWK; Table 1) and most 'typical' quartz–silcrete habitats and measured the distance from this 'core' to each of the surveyed patches. The number of species recorded (with emphasis on quartz–silcrete patches) declined significantly, with an increasing distance from the core, when all 47 species were used in the analysis (Fig. 2) ($R = -0.55$, $t(N-2) = -3.17$, $N = 25$, $P = 0.004$), as well as when only the species listed as 'threatened' (23 species) were used ($R = -0.47$, $t(N-2) = -2.53$, $N = 25$, $P = 0.02$), although this result was weaker. This suggests that levels of species richness are highest at the core, which centres on the renosterveld cluster north of the limestone ridge in De Hoop Nature Reserve (Fig. 1), hereafter referred to as the 'De Hoop–Rûens Cluster'.

The De Hoop–Rûens Cluster also contains several species new to science (included in these analyses) which, to date, have only been recorded on one site within this core and were described recently or are in press (e.g. *Xiphotheca rosmarinifolia* Schutte-Vlok (2011), *Hesperantha* sp. nov. *Goldblatt & Porter 13729* (NBG, holo.; K, MO, PRE, iso.) (P. Goldblatt, pers. comm.), and *Polhillia curtisiae* (described under 3.2)). Thus, from a conservation-planning perspective, this area is pre-eminent on conservation priority. Of the 47 species recorded, the cluster lacks only four species, two of which appear to have a restricted range northeast of this cluster (*Polhillia* sp. nov. cf. *pallens* (*Vulnerable*) and *Liparia striata* (*Endangered*)). This strengthens the arguments for conservation planning based on GIS-mapping, which is currently being used as a guide for conservation authorities and NGOs in the region (von Hase et al., 2003).

A Bray–Curtis resemblance matrix demonstrated that similarity varied between 15% and 89%, reiterating the highly variable floristic composition of these habitats (Appendix 1). This trend appears typical across renosterveld in the Overberg, where current research using 10 × 10 m plots has shown that similarity indices can vary between 3% and 64%, where the maximum distance apart is only 32 km (O. Curtis, Unpublished results). The six sites (Potteberg 2 & 4, Nysty 1, Plaatjieskraal 1 & 2 and Haarwegskloof) forming the cluster with the highest number of species recorded in the study share between 57% and 89% similarity (Appendix 1).

3.2. Taxonomy

3.2.1. Otholobium curtisiae

C.H.Stirt. & Muasya, sp. nov., is similar to *Otholobium pictum* C.H.Stirt., but differs in its resprouting habit (with multiple low stems vs. shrubs in *O. pictum*), terminal leaflet shorter than laterals (vs. leaflets equal in length), straight mucro (vs. recurved mucro), pediculate inflorescences with 6–9 flowers per shoot (vs. densely spicate inflorescence with 20–30 triplets of flowers), oblong flower triplet bracts (vs. broadly ovate bracts), and warty fruits. Type: South Africa, Western Cape Province, Bredasdorp Dist., Plaatjieskraal farm, upper slopes of Sonderkoskop (3420 AD), S 34°18′39.15″ E20°17′52.29″, 7 Dec 2012, *Curtis 57* (BOL, holo!; K, NBG, PRE, iso!).

Mounded to spreading shrubs up to 50–100 (200) mm tall, resprouter. Stems erect off basal rhizomes, branched near base, 5–10 mm thick, brown, bark split vertically encrusted with old urn-shaped pustules and thickened persistent stipule scars. Young shoots purplish green, hispid (mixture of short and long hairs). Flowering shoots clustered in the upper two axils of the new season's growth, densely white hispid, with large urn-shaped pustules concentrated below leaves. Leaves digitately trifoliolate. Stipules 1.5–1.7 × 1.0 mm, narrowing and shortening up the shoot, scarcely fused to the base of the petiole, subulate, glabrous, margins scarcely ciliate, densely encrusted with orange glands especially at the base. Leaflets (5) 7–12 × 2.5–3.0 mm, flat, veins and areoles clearly visible; oblanceolate to oblong, somewhat falcate, apex acuminate,

Table 1
List of species recorded in the study (arranged alphabetically according to family), with corresponding Red Data status (CR = *Critically Endangered*, EN = *Endangered*, VU = *Vulnerable*, NT = *Near-Threatened*, LC = *Least Concern* — Raimondo et al., 2009), as well as whether they are quartz specialists (*). Numbers in the top row indicate the site number. Key to farm names: AB = Aandblom, D = Dipka, GRS = Goereesoe, GK = Grootkloof, HWK = Haarwegskloof, K = Koppies, NKH = Niekerkshek, NKM = Napkysmond, NY = Nysty, OK = Oudekraal, PB = Potteberg, PK = Plaatjieskraal, UIT-Uitvlugt, UVS = Uitvlugt school, VST = Voorstekop, WGM = Welgemoed, and ZK = Zandkraal.

Species	Family	Status	AB	D1	GK	GRS	HWK	K1	K2	NKH	NKM	NY1	NY2	OK1	OK2	PB1	PB2	PB3	PB4	PK1	PK2	UIT1	UIT2	UVS	VST	WGM	ZK
Acrodon deminutus Klak	Aizoaceae	*VU**	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1	1	0	0	0	0	1	0
Brownthanthus fraternus Klak	Aizoaceae	*EN**	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Delosperma asperulum (Salm-Dyke) L.Bolus	Aizoaceae	*LC*	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	1	1	1	1	1	1
Drosanthemum parvifolium (Haw.) Schwantes	Aizoaceae	*LC*	1	0	0	1	1	1	0	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0	1	1
Drosanthemum quadratum Klak	Aizoaceae	*EN**	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0
Gibbaeum haagei Schwantes	Aizoaceae	*EN**	1	1	1	1	1	1	1	0	0	1	0	1	0	0	0	0	0	1	1	0	1	0	1	1	0
Glottiphyllum cf. *depressum* (Haw.) N.E.Br.	Aizoaceae	*LC*	1	0	1	0	0	0	1	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	0	0	1
Mesembryanthemum longistylum DC.	Aizoaceae	*LC*	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	1	0	1	0
Trichodiadema gracile L.Bolus	Aizoaceae	*LC*	0	0	0	0	1	1	0	0	1	1	1	0	1	0	1	0	0	1	0	0	1	0	0	0	0
Notobubon striatum (Thunb.) Magee	Apiaceae	*NT**	0	0	1	1	1	0	0	1	0	1	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0
Asparagus capensis L.	Asparagaceae	*LC*	1	0	0	0	1	0	0	0	0	1	0	0	0	1	1	1	1	1	0	1	1	1	0	0	0
Cymbopappus adenosolen (Harv.) B.Nord.	Asteraceae	*LC*	0	1	1	0	0	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	0	0	1	1	0
Elytropappus rhinocerotis (L.f.) Less.	Asteraceae	*LC*	0	1	1	0	1	0	1	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	0	0	0
Metalasia acuta Karis	Asteraceae	*LC*	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	1	0	0
Oedera squarrosa (L.) Anderb. & Bremer	Asteraceae	*LC*	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0
Oedera uniflora (L.f.) Druce	Asteraceae	*LC*	0	0	0	1	0	1	1	0	1	1	0	1	1	1	1	1	1	0	0	0	0	1	0	0	1
Relhania garnotii (Less.) Bremer	Asteraceae	*VU**	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1
Triperis tomentosa (L.f.) Less.	Asteraceae	*LC*	0	0	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0	1	0	0	0	1	0	0	0
Adromischus triflorus (L.f.) Berger	Crassulaceae	*LC*	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Crassula muscosa L.	Crassulaceae	*LC*	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Crassula nudicaulis var. platyphylla L.	Crassulaceae	*LC*	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1	1
Crassula tetragona L.	Crassulaceae	*LC*	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Ficinia gordongrayae Muasya & C.H.Stirt.	Cyperaceae	*NT**	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0
Erica venustiflora subsp. glandulosa E.G.H.Oliv.	Ericaceae	*VU*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Clutia govaertsii Radcl.-Sm.	Euphorbiaceae	*LC**	1	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	0	1	0
Amphithalea ericifolia (L.) Eckl. & Zeyh.	Fabaceae	*LC*	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Amphithalea violacea (E.Mey.) Benth.	Fabaceae	*LC*	0	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	1	0
Aspalathus incurvifolia Vogel ex Walp.	Fabaceae	*LC*	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Aspalathus microlithica C.H.Stirt. & Muasya	Fabaceae	*VU**	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Aspalathus mundiana Eckl. & Zeyh.	Fabaceae	*LC*	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0
Aspalathus quartzicola C.H.Stirt. & Muasya	Fabaceae	*VU**	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	0	1	1	0	0	0
Aspalathus smithii R. Dahlgren	Fabaceae	*EN**	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0
Liparia striata A.L.Schutte	Fabaceae	*EN**	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
Otholobium curtisiae C.H.Stirt. & Muasya	Fabaceae	*EN**	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0
Polhillia cf. *pallens* C.H.Stirt.	Fabaceae	*EN*	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polhillia curtisiae C.H.Stirt. & Muasya	Fabaceae	*CR**	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xiphotheca guthrei (L.Bolus) A.L.Schutte & B.-E.Van Wyk	Fabaceae	*EN*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0
Xiphotheca rosemarinifolia A.L.Schutte	Fabaceae	*CR**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Bobartia longicyma subsp. microflora J.B.Gillett	Iridaceae	*NT*	1	0	0	1	1	0	0	1	0	1	1	0	0	0	0	0	0	1	1	1	1	1	0	1	0
Hesperantha sp. nov. Goldblatt & J.C.Manning	Iridaceae	*CR**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Hermannia trifoliata L.	Malvaceae	*LC*	0	0	1	1	1	1	1	0	0	1	1	1	0	0	1	0	1	1	1	0	0	0	0	0	0
Merxmuellera sp.	Poaceae	*LC*	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Pentaschistis eriostoma (Nees) Stapf	Poaceae	*LC*	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1
Leucadendron coriaceum E.Phillips & Hutch.	Proteaeceae	*EN**	1	0	1	1	0	0	0	1	0	1	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0
Elegia recta (Mast.) Moline & H.P.Linder	Restionaceae	*NT*	0	0	0	1	1	0	1	0	0	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0
Elegia verreauxii Mast.	Restionaceae	*VU**	0	0	1	1	1	0	0	1	0	1	0	0	0	0	1	1	1	1	1	0	0	0	0	0	1
Acmadenia macropetala (P.E. Glover) Compton	Rutaceae	*VU**	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0

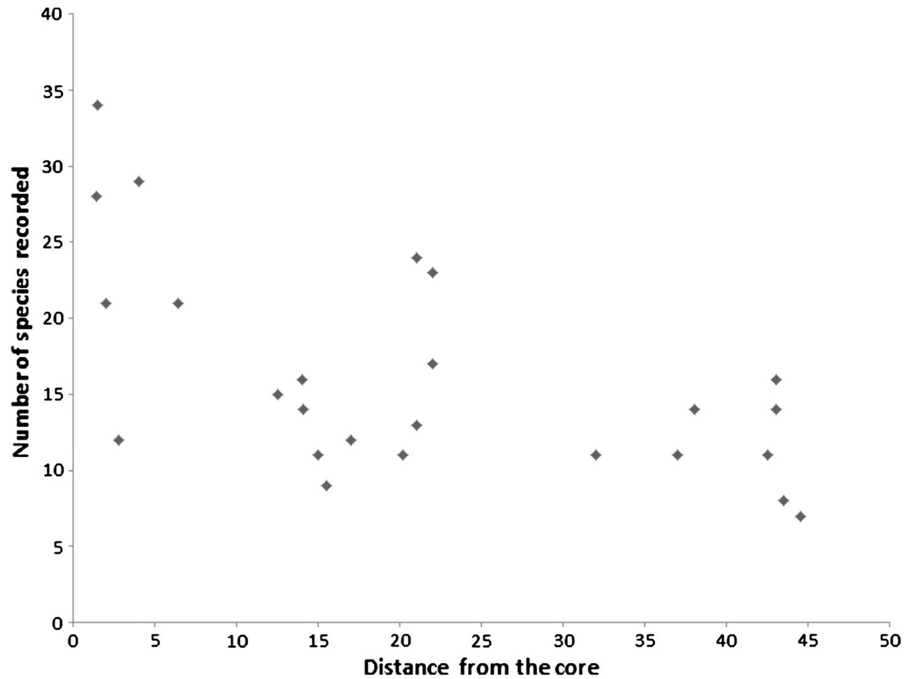

Fig. 2. The negative correlation between the number of sampled species recorded on quartz–silcrete outcrops and the distance from the core site ($R = -0.55$, $t(N-2) = -3.17$, $N = 25$, $P = 0.004$).

base cuneate; mucro straight in older leaves, recurved mucronate in basal leaves; laterals glabrous, margins sparsely appressed scabrid, longer than terminal leaflet, slightly asymmetrical, glands denser on lower surface, raised; petioles 0.5–1.0 mm long, gland encrusted. Inflorescences 1 or 2 axillary, capitate, with 1 or 2 triplets of flowers; each triplet subtended by a single 4 × 2 mm, oblong, pubescent, glandular bract; pedunculate, 2–3 mm long. Flowers 10 mm long, white; pedicel 2–3 mm long; bract filiform, densely hairy, 1 mm long. Calyx 9 mm long; upper four teeth equal, 5 × 2 mm, keel tooth 7 × 3 mm; vexillar teeth scarcely connate, teeth covered in small and large glands, densely white pilose outside; tube 2 mm deep. Standard 10 × 6.0 mm, blade elliptic, white with a large central 4 × 2 mm wide purple nectar guide, slightly auriculate, apex acute, appendages absent; claw 0.5 mm long. Wing petals 9 × 2.5–2.6 mm, longer than the keel, auriculate, cultrate but tips billowy and incurving, midline of blade sharply upcurved; claw 3 mm long; sculpturing upper basal, upper central and upper left distal comprised of 30–55 irregularly parallel lamellae. Keel blades 7 × 4 mm, apex rounded, apex purple on inner face; claw 3 mm long. Androecium 7 mm long; vexillar stamen 6.0–6.5 mm long, attached at base only. Pistil 7 mm long; ovary 2.5 mm long, papillose, glabrous; gynophore 0.5 mm long; style glabrous, 0.5 mm thick at the point of flexure, height of curvature stigma 1.5 mm, incurved. Fruits 4 × 2 mm, glabrous, densely glandular, papery thin; seeds unknown. Fig. 3.

3.2.1.1. Etymology. The specific epithet honours Odette Curtis (born 1978) from Napier who has done much to champion the protection of the rare and threatened Overberg Renosterveld, and who first discovered this species.

3.2.1.2. Diagnostic characters. Otholobium curtisiae can be diagnosed by its resprouting habit; seasonal shoots blackish on upper surface covered in urn-shaped pustules; leaflets digitately trifoliolate, sub-petiolate, flat, dark green, glabrous, veins clearly visible, terminal shorter than laterals; inflorescence pedunculate, 3–9-flowered, axillary, each triplet subtended by a broadly oblong bract; flowers white with a large purple nectar guide, bracts filiform, hairy; standard elliptic; calyx shaggy, white haired, accrescent; fruits glabrous, glandular. *O. pictum* C.H.Stirt. is distinguished from *O. curtisiae* by its erect 2 m tall shrubby habit with flat, densely nigro-punctate leaflets; densely spicate inflorescences with 20–30 triplets of white flowers, each triplet subtended by a broadly ovate bract; broadly elliptic standards, and shaggy calyces.

We are including an anomalous specimen in *O. curtisiae* collected at Fouriesberg in the Outeniqua Mountains (*Jan Vlok 367*, PRE), that requires further investigation in the field. The specimen has similar leaves and accrescent calyces but lacks petals. It matches no other species in the genus and may represent a distinct species.

3.2.1.3. Distribution and habitat. Otholobium curtisiae, a distinctive endemic of the Overberg Quartzveld (Fig. 4), was first collected in 2010. Given the inaccessibility of the terrain and the scattered remnants of ERS Renosterveld it is not surprising that no previous collections had been made. *Otholobium curtisiae* occurs at an altitude of 250–300 m on quartzitic outcrops within a fragmented landscape of ERS Renosterveld. Flowering takes place during August and September.

3.2.1.4. Conservation status. Otholobium curtisiae is locally uncommon and none of its known distribution occurs in a protected area and thus far, it has only been recorded from six sites. Its distribution is tied to that of the quartz patches and, as discussed, these patches occur within a habitat type listed as *Critically Endangered*. Thus, as with most quartz–silcrete endemics within the ERS Renosterveld, this species is not immune to the deleterious effects of fragmentation. We therefore assess this species to be *Endangered* under the South African Red list categories and criteria (Raimondo et al., 2009).

3.2.1.5. Additional specimens examined. 3420 (Bredasdorp): Goereesoe Farm (—AD), 26 Nov 2011, *Stirton, Muasya & Curtis 13565* (BOL, NBG); 7 Dec 2011, *Stirton, Muasya & Curtis 13587* (BOL, NBG); Sonderkoskop, Plaatjieskraal Farm, (—AD), 7 Dec 2011, *Stirton, Muasya & Curtis 13595* (BOL, NBG).

3.2.2. Aspalathus quartzicola

C.H.Stirt. & Muasya, sp. nov., is similar to *Aspalathus incompta* Thunb. and *Aspalathus acutiflora* Dahlg., but differs in its spreading mat-like habit, glabrous leaves, white flowers with pink tips, subulate

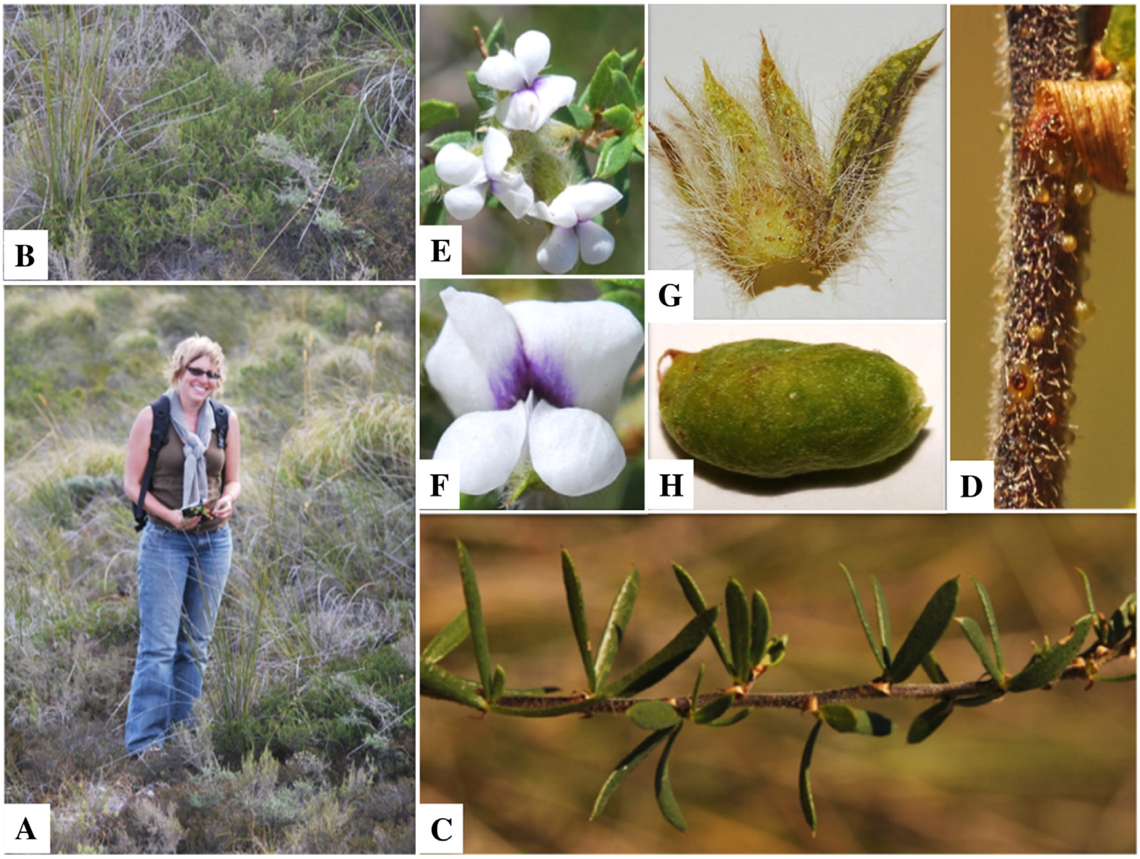

Fig. 3. *Otholobium curtisiae*: (A) habit; (B) flowering shoot; (C) leafy shoot; (D) fruiting shoot; (E) flower; (F) fruit; (G) stem; (H) branching pattern.

linear calyx teeth, splayed white wing petals, white keel with dark purple to violet tips, four ovules and glabrous ovary. Type: South Africa, Western Cape Province, Bredasdorp Dist. 16 Sep.1979, *Burgers 2262* (NBG, holo!).

A prostrate mat-like shrub to 20 mm tall, with a gnarled stem up to 30 mm thick; resprouter. Branches closely packed, dense, hugging the ground; young branches minutely and sparsely scabrous. Leaflets linear, tubular, 3.5–4.0 × 0.2–0.3 mm, succulent, erect, glabrous, arranged in dense clusters on short brachyblasts. Inflorescences 1- or 2-flowered, terminal on short shoots arising along each branch. Flowers 8–9 mm long, white, standing proud of leaf clusters, pedicel 1 mm long; bract 0.7–0.8 × 1 mm, tooth-like, at base of peduncle,

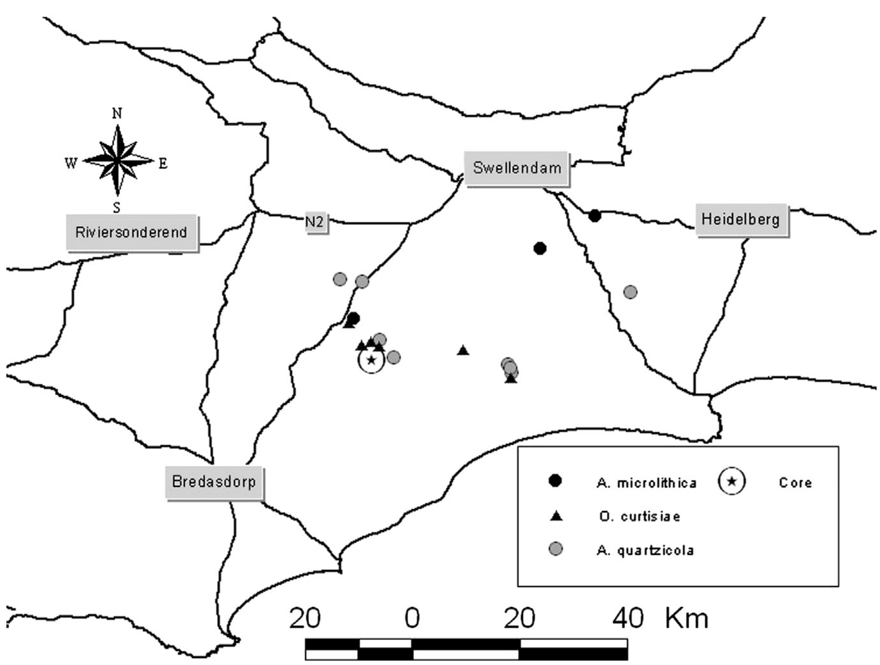

Fig. 4. Distribution map of *Otholobium curtisiae*, *Aspalathus quartzicola* and *A. microlithica*, based on surveys in this study.

tip black-haired; bracteoles 1 × 0.5 mm, at top of peduncle, tip black-haired. Calyx campanulate, glabrous; teeth sharply demarcated from tube, subulate-linear, terete, 1 mm long, stiff, green; tube 2 mm long, longer than teeth, pale yellow. Petals white. Standard blade broadly ovate, 4 × 3–5 mm, glabrous with acute somewhat incurved and thickened apex, auricles prominent; remains attached in fruit; claw 1.5 mm, broad, straight. Wing blades 4 × 2 mm, glabrous, white, held erect like fairy wings, upper margin inrolled; petal sculpturing present, indistinct, lamellate along upper inrolled thickened edge; claw 3 mm, straight. Keel petals 3.5 × 1.8–2.0 mm, blades fused, claw 3 mm long, ribbon-like; white, tips purple to violet; blade glabrous, auriculate, pocketed, upper margin almost straight, lower convex. Hypanthial disc present, 2 mm high, prominent. Androecium 6 mm long, 5 basifixed anthers, 5 versatile. Pistil 4.5 mm long; ovary 1.5 mm long, glabrous, stipe 0.5 mm long, ovules 4; style upcurved 1.6 mm near end from point of flexure. Fruits 7–8 × 3 mm, borne erect, obliquely ovate, glabrous, glossy, apex acute, reticulately veined, bright green when young, pale brown when mature; seeds 2.0–2.3 × 1.8–2.0 mm, tan with dark brown blotches. Fig. 5.

3.2.2.1. Etymology. The specific epithet alludes to its restriction to quartzitic outcrops in ERS Renosterveld.

3.2.2.2. Diagnostic characters. Aspalathus quartzicola is a very distinctive species that falls into Dahlgren's (1988) Group 22: *Pingues*. The species is characterised by its spreading mat-like habit, glabrous leaves, white flowers with pink keel tips, subulate linear calyx teeth, splayed erect white wing petals, glabrous ovary with four ovules, and glabrous fruits. It is most similar to *Aspalathus acutiflora* Dahlg. and *A. incompta* Thunb., which also occur in the Overberg region. *Aspalathus acutiflora* is distinguished from *A. quartzicola* by its erect or ascending habit to 1 m tall, short-villous young shoots, lack of bracteoles, densely puberulous calyx, light yellow petals with a purple standard midrib, sericeous ovary with 2 ovules, and sericeous pods. *A. incompta* differs in its procumbent habit, pubescent leaves, light or bright yellow petals, hairy ovary with 2 ovules, cultrate wing petals with lunate petal sculpturing, and short partly pubescent ovary with 2 ovules.

The following key helps distinguish these three species which have been commonly misplaced in herbaria.

1. Plants mat-like, up to 1 m across; leaves glabrous; flowers white with purple to violet keel tips; ovary glabrous, with 4 ovules........................ *A. quartzicola*.

1* Plants procumbent to erect; leaves pubescent; flowers yellow; ovary partly sericeous, with 2 ovules .... 2.

2. Young branches short pubescent; bracteoles tooth-like; calyx sericeous; standard puberulous on upper half of back .... *A. incompta*.

2* Young branches short villous; bracteoles lacking; calyx subglabrous or sparsely puberulous; standard glabrous .... *A. acutiflora*.

3.2.2.3. Distribution and habitat. Aspalathus quartzicola is restricted to flat areas on white quartz pebble patches in Eastern Rûens Shale Renosterveld between 170 and 300 m (Fig. 4). Flowering is from August to September. *Helme 1759* reports that the flowers are sweet-smelling and pollinated by honey-bees.

3.2.2.4. Conservation status. Aspalathus quartzicola is locally common, but none of its distribution occurs in a protected area. However, the species is a habitat specialist, occurring exclusively on quartzitic outcrops. Although these are uncultivated, over-grazing remains a real threat which could be mitigated by fencing off some of the areas as a means of controlling livestock access to these sensitive habitats.

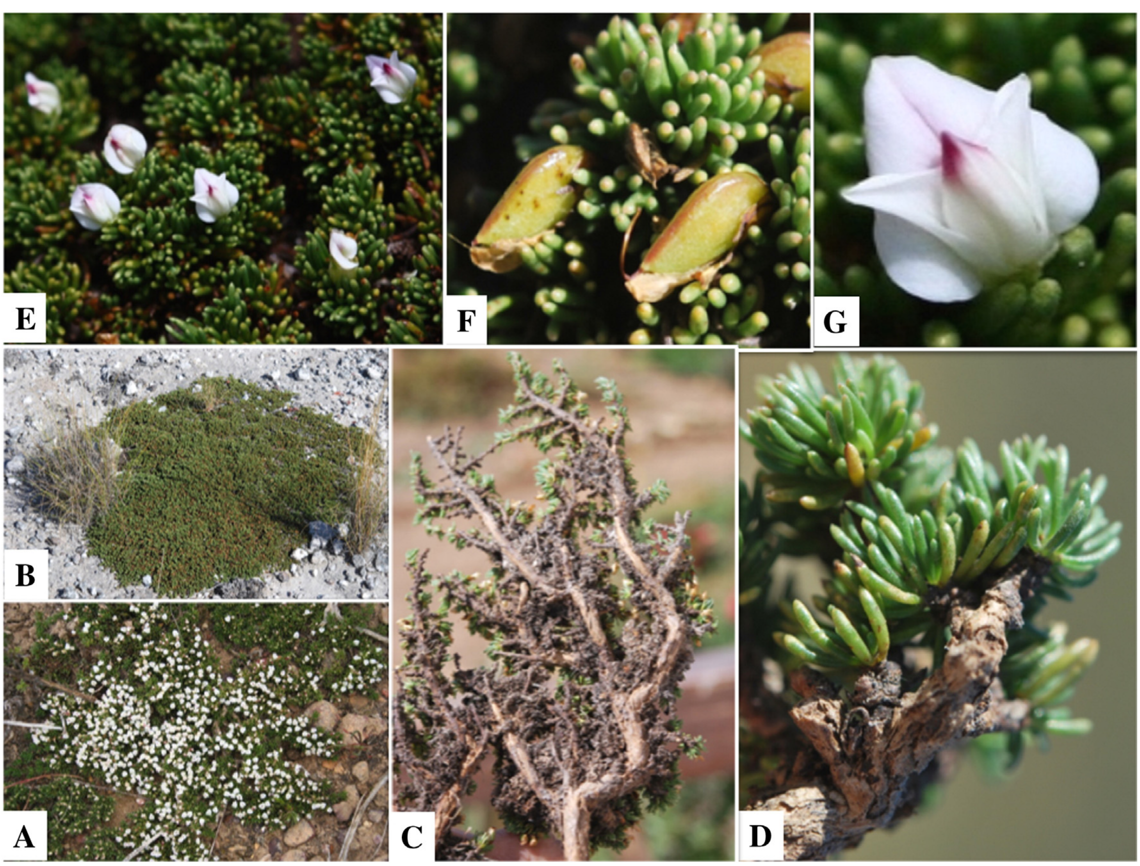

Fig. 5. *Aspalathus quartzicola*: (A, B) habit; (C) abaxial surface, shoot; (D) adaxial surface, shoot; (E) flowering shoot; (F) fruiting shoot; (G) flower.

We therefore assess this species to be *Vulnerable* under the South African Red list categories and criteria (Raimondo et al., 2009).

3.2.2.5. Additional specimens examined. —3420 (Bredasdorp): Swellendam, after road to Protem (—AB), 11 Feb 2010, *Tyambetyu & Stoll 4258* (NBG); Vreda farm, 40 km from Bredasdorp to Swellendam (—AC), 21 Oct 1976 (NBG); Saddle WNW of Spitzkop, hills E of Vrede, Bredasdorp–Swellendam road (—AD), 22 Aug 2000, *Oliver 11582* (NBG); Sonderkoskop, Plaatjieskraal farm (—AD), 7 Dec 2011, *Stirton, Muasya & Curtis 13596* (BOL, NBG, PRE); Plaatjieskraal (—AD), 1 Oct 2011, *Stirton & Curtis 13726* (BOL); Nysty farm, Bredasdorp region (—AD), 27 Nov 2011, *Muasya, Stirton & Curtis 6340* (BOL); Goereesoe Farm (—AD), 7 Dec 2011, *Stirton, Muasya & Curtis* 13586 (BOL); Farm Luipardskop 53, about 12 km NW of Wydgelee, slopes between Suikerkankop, Kraaiheuwel and Rooikop Trig. Beacon 157, 10 Sept 2000, *Helme 1759* (NBG); De Hoop Nature Reserve, Potberg (—BC), 1 Nov 1984, *Scott 472* (NBG).

3.2.3. Aspalathus microlithica

C.H.Stirt. & Muasya, sp. nov., is similar to *Aspalathus retroflexa* L. but differs in its dense spreading mat-like habit, strigo-villous vestiture, prostrate woody stems, stiff leaves, condensed floriferous branches, bright yellow sessile flowers turning orange to red, purple-veined calyx, obtuse keel, and linear oblong wing petals with infolded thickened upper edge and well-developed sculpturing. Type: South Africa, Western Cape Province, Bredasdorp Dist., Goereesoe Farm (3420AB), 7 Dec 2011, *Muasya, Stirton & Curtis 6301* (BOL, holo!; NBG, iso!).

Prostrate mat-like shrub, 10–20 mm tall, with a gnarled stem 5–8 mm thick; resprouter. Branches closely packed, dense, hugging the ground; young branches appressed short white strigo-villous. Leaflets 3.1–3.5 × 0.5–0.7 mm, linear-subulate, terete, apiculate, succulent, bright green, erect to spreading, glabrous, arranged in dense clusters of 9–12 leaflets on short alternately arranged brachyblasts. Inflorescences 1(2)-flowered, terminal on short shoots. Flowers 5–6 mm long, sessile, dark yellow, standing proud of leaf clusters; pedicel absent; bract 1 × 0.5 mm, naviculate, green, acuminate, densely villous inside; bracteoles 0.5 mm × 0.3 mm, pale green, situated just above bracts on base of tube. Calyx campanulate, strigo-villous; teeth 2.5 mm long, linear-subulate, terete, carnose, bright green, distinctly demarcated from tube, acuminate, identical to leaflets; tube 2.5 mm long, same length as teeth, pale yellowish green and purple veins with white appressed strigose hairs. Petals bright yellow, turning orange to red with age. Standard blade broadly ovate, 5.0 × 5 mm, glabrous with acute somewhat incurved and thickened purple apex, yellow turning orange, auricles absent; claw 1.5 mm, broad and flattish, straight. Wing blades 4.0 × 0.5 mm; blade 3.0–3.5 mm long, glabrous, yellow, upper margin inrolled with a thickened edge; claw 1.5 mm, upcurved; petal sculpturing present, distinct, lamellate near auricles becoming lunate towards centre, lamellate, upper basal and upper left central, comprised of 3–4 rows of up to 9 lunate pockets. Keel petals 5.0–5.5 × 2.5 mm, blades fused, scarcely auriculate, micropapillate along margin towards the claw, pocketed, lunate, upper margin concave–convex, lower convex, obtuse, hyaline below becoming pale yellow in upper parts, turning reddish brown with age; claw 1.0–1.5 mm long. Hypanthial disc present. Androecium 4 mm long, 5 basifixed anthers, 5 versatile. Pistil 4.5 mm long; ovary 1.5 mm long, strigose on upper margin of straight part of style, ovules 2; style upcurved, height of flexure 2 mm. Pods and seeds unknown. Fig. 6.

3.2.3.1. Etymology. The specific epithet *microlithica* alludes to the white strigose hairs on the purple stripes of the calyces, which is a unique feature in *Aspalathus*. However, the idea for the name came from seeing pictures of Late Pleistocene microlithic silcrete assemblages (Orton, 1988) that looked similar to the calyx hairs and also echoed the many small quartzite pebbles that cover the silcrete outcrops in which the species inhabits.

3.2.3.2. Diagnostic characters. Aspalathus microlithica is a very distinctive species that falls into Dahlgren's (1988) Group 32: *Teretilobae*. The species is characterised by its dense spreading mat-like habit, strigo-villous vestiture, thick twisted prostrate woody stems, stiff leaves, condensed floriferous branches, bright yellow sessile flowers turning orange to red, purple-veined calyx, obtuse keel, linear oblong wing petals with infolded thickened upper edge and well-developed sculpturing. It is most similar to *A. retroflexa* L. which occurs more to the west. *A. retroflexa* is distinguished from *A. microlithica* by decumbent or procumbent to semi-erect sparingly branched habit, white villous, tomentose or puberulous vestiture, long floriferous branches with dispersed internodes, tomentose calyx, light yellow petals with a purple standard midrib, green calyces, sericeous ovary, and sericeous pods. *A. incompta* differs in its procumbent habit, pubescent leaves, light or bright yellow petals, cultrate wing petals with lunate petal sculpturing, and short partly pubescent ovary with 2 ovules.

3.2.3.3. Distribution and habitat. Aspalathus microlithica was only recorded in three of the 25 studied outcrops of silcrete and quartz patches in Eastern Rûens Shale Renosterveld between 170 and 300 m (Fig. 4), although it was found subsequently at other sites further northeast. Flowering takes place during October and November.

3.2.3.4. Conservation status. Although *A. microlithica* is locally common, none of its distribution occurs in a protected area. However, the species is a habitat specialist, occurring exclusively on quartzitic outcrops. Although these are uncultivated, over-grazing remains a threat which could be mitigated by fencing off some of the areas as a means of controlling livestock and ostriches access to these sensitive habitats. We therefore assess this species to be *Vulnerable* under the South African Red list categories and criteria (Raimondo et al., 2009).

3.2.3.5. Additional specimens examined. —3420 (Bredasdorp): Swellendam, after road to Protem (—AB), 11 Jan 2010, *Tyambetyu & Stoll 4358* (NBG); Vreda farm, 40 km from Bredasdorp to Swellendam (—AC), 21 Oct 1976 (NBG); Saddle WNW of Spitzkop, hills E of Vrede, Bredasdorp–Swellendam road (—AD), 22 Aug 2000, *Oliver 11582* (NBG); Farm Luipardskop 53, about 12 km NW of Wydgelee, slopes between Suikerkankop, Kraaiheuwel and Rooikop Trig. Beacon 157, 10 Sep 2000, *Helme 1759* (NBG); Goereesoe Farm (—AD), 7 Dec 2011, *Stirton, Muasya & Curtis 13588* (BOL); Goreesoe Farm en route to Bredasdorp, 26 Nov 2012, *Stirton, Muasya & Curtis 13564* (BOL); 26 Nov 2011, *Muasya, Stirton & Curtis 6301* (BOL); Sonderkoskop, Plaatjieskraal, 7 Dec 2012, *Stirton, Muasya & Curtis 13600* (BOL); De Hoop Nature Reserve, Potberg (—BC), 1 Nov 1984, *Scott 472* (NBG); Skeiding Farm (—DD), 3 Feb 2013, *Stirton & Curtis 13796* (BOL).

3.2.4. Polhillia curtisiae

C.H.Stirt. & Muasya, sp. nov., is similar to *P. pallens* C.H.Stirt., but differs in its more open habit, yellowish green branchlets turning brown with age, broader partly conduplicate obovate leaflets with densely hairy margins and green upper leaf blades, patently hairy calyces, and shorter more pilose 5–7-seeded shaggy pods. Type: South Africa, Western Cape Province, Bredasdorp Dist., Haarwegskloof Farm (3420AB), 12 Oct 2011, *Stirton, Muasya & Curtis 13361* (BOL, holo!; NBG, iso!).

Erect, multi-stemmed shrubs up to 500 mm high, resprouter. Leaflets 5–7 × 3 mm wide, obovate but usually partly conduplicate giving an open tubular appearance, flatter in younger plants, straight sometimes arcuate, densely villous-sericeous, terminal leaflet same size as laterals or slightly longer. Stipules 25–30 mm long, fused, villous with longer patent pilose hairs. Inflorescences 1- or 2-flowered. Flowers 10–11 mm long, yellow, ebracteolate; pedicel 2.5 mm long, tapering. Calyx 5 mm long, including tube 3 mm long, vexillar teeth broadly triangular, 1.5 mm long, almost equally broad at base, lateral and keel lobes mutually coherent to a lip, fused for two thirds of their

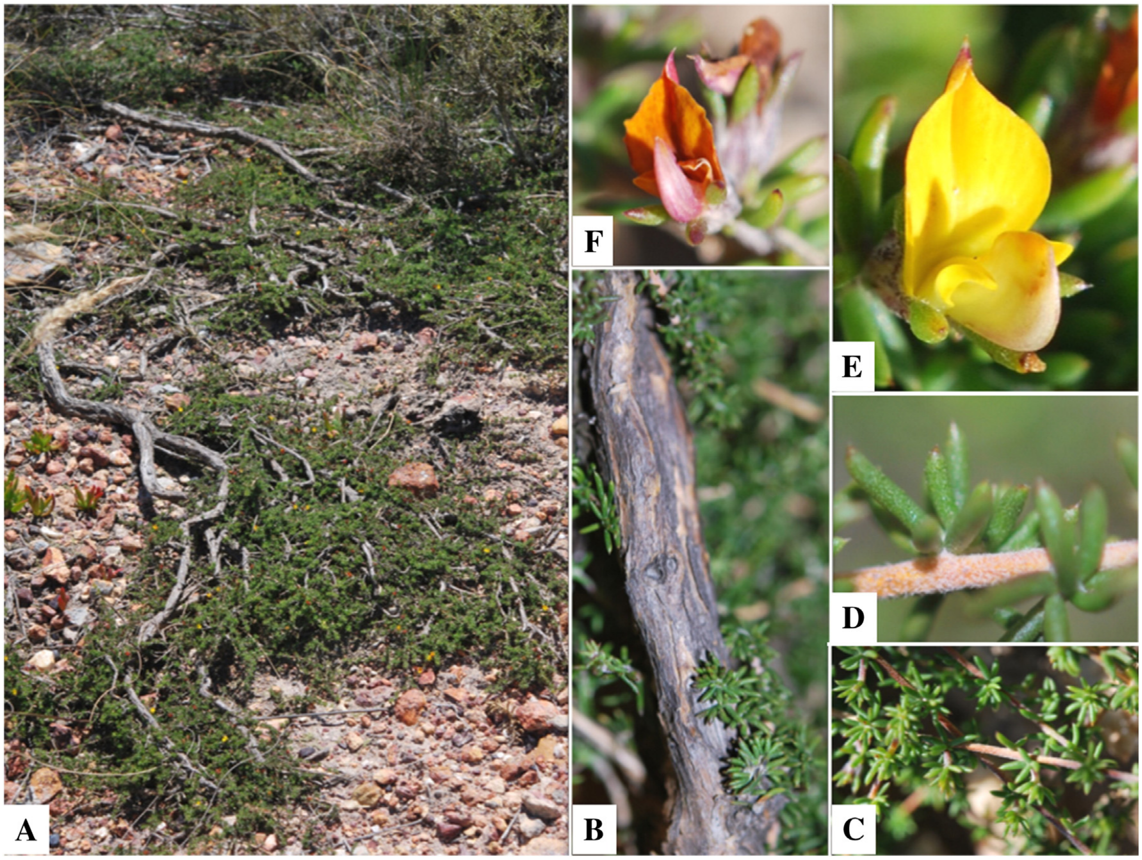

Fig. 6. *Aspalathus microlithica*: (A) habit; (B) stem; (C) leafy shoot; (D) leaves; (E) young flower; (F) old flower.

length, smaller and shorter than vexillar teeth, densely villous, glabrous inside. Standard 10 × 10 mm; blade emarginate, sericeous on back, glabrous inside; claw 3 mm long, narrow. Wing petals 10 × 4 mm wide, blade 7 mm long, curved, strongly auriculate, broadly cultrate, widest in middle, thickened with upper margin inrolled, longer than keel petals; sculpturing upper basal and left central, strongly lamellate–lunulate, claw 4 mm long. Keel petals 8–9 × 2.5–3.0 mm long, auriculate, pocketed, hairy in bottom half; claw 4 mm long. Androecium 9 mm long, stamens sheathed, open on upper side, anthers dimorphic, 5 alternately elongate and basifixed plus 5 short and versatile. Pistil 7 mm long, ovary 5 mm long, linear, flattened, sessile; ovules 5–7; golden shaggy; style forward sloping to erect, height of curvature of style 2.5 mm. Fruits 20–28 × 5–7 mm, undulating, densely covered in long patent silver shaggy hairs, upper margin purplish in fresh state; indehiscent; seeds 10–15 × 8–10 mm, brown. Fig. 7.

3.2.4.1. Etymology. The specific epithet honours Odette Curtis (born 1978) from Napier who has greatly increased our knowledge on the distribution of *Polhillia* in Renosterveld and who first discovered this species.

3.2.4.2. Diagnostic characters. The species is characterised by its looser more spreading habit, yellowish green upper branchlets turning brown with age, broader (5–7 × 3 mm) partly conduplicate obovate leaflets with densely hairy margins and green upper leaf blades, patently hairy pale green to pink flushed calyces, and with shorter (4× length of leaflets) more pilose 5–7 seeded shaggy fruits. It is most similar to *P. pallens* which is a more compact, multi-stemmed shrub with greyish brown branchlets turning charcoal grey with age, conduplicate narrowly arcuate leaflets with evenly haired silvery leaf margins and leaf blades, mostly appressed hairy yellowish green calyces, and with longer (6× length of leaflets), 8–10 seeded less shaggy pods.

3.2.4.3. Distribution and habitat. Polhillia curtisiae is restricted to a single locality on a dry north-facing aspect on a white quartz pebble patch at Haarwegskloof Farm in Eastern Rûens Shale Renosterveld between 230 and 242 m (Fig. 8). Powdery kaolinitc soils are particularly deep on this site. Flowering takes place from May to July with fruit shed in August to September.

3.2.4.4. Conservation status. This species is only known from one site, despite concerted efforts to find more populations. We therefore assess this species to be *Critically Endangered* under the South African Red list categories and criteria (Raimondo et al., 2009). Only 28 individuals of various ages were counted in November 2012. It appears from the age of the individual resprouting plants that there is limited recruitment following fires.

3.2.4.5. Additional specimens examined. —3420 (Bredasdorp): Haarwegskloof Farm (—AB), 2 Dec 2011, *Stirton, Muasya & Curtis 13461* (BOL, NBG).

3.2.5. Ficinia overbergensis

Muasya & C.H.Stirt. sp. nov., similar to *Ficinia quartzicola*, differing in leaves (with well-developed blades vs. blades reduced to lobes), and involucral bracts (leafy vs. culm-like). Type: South Africa: Western Cape: Bredasdorp Dist., Plaatjieskraal (3420 AD), S34°18′38″ E20°17′486″, 30 Sep 2012, *Stirton, Muasya & Curtis 13727* (BOL, holo!; K, NBG, PRE, iso!).

Perennial, forming clumps to 300 mm diameter, base hardened, without obvious rhizome. Culm 50–160 mm tall, 0.3–0.6 mm thick, glabrous. Leaf sheath 7–19 × 1.5–2.2 mm, glabrous, not papery, wine-red, sticky. Leaf blade 26–55 × 0.3–0.9 mm, channelled, glabrous except for scabrid margins towards apex. Involucral bract 2 or 3, leaf-like, 10–29 × 0.4–0.6 mm, margin scabrid towards apex.

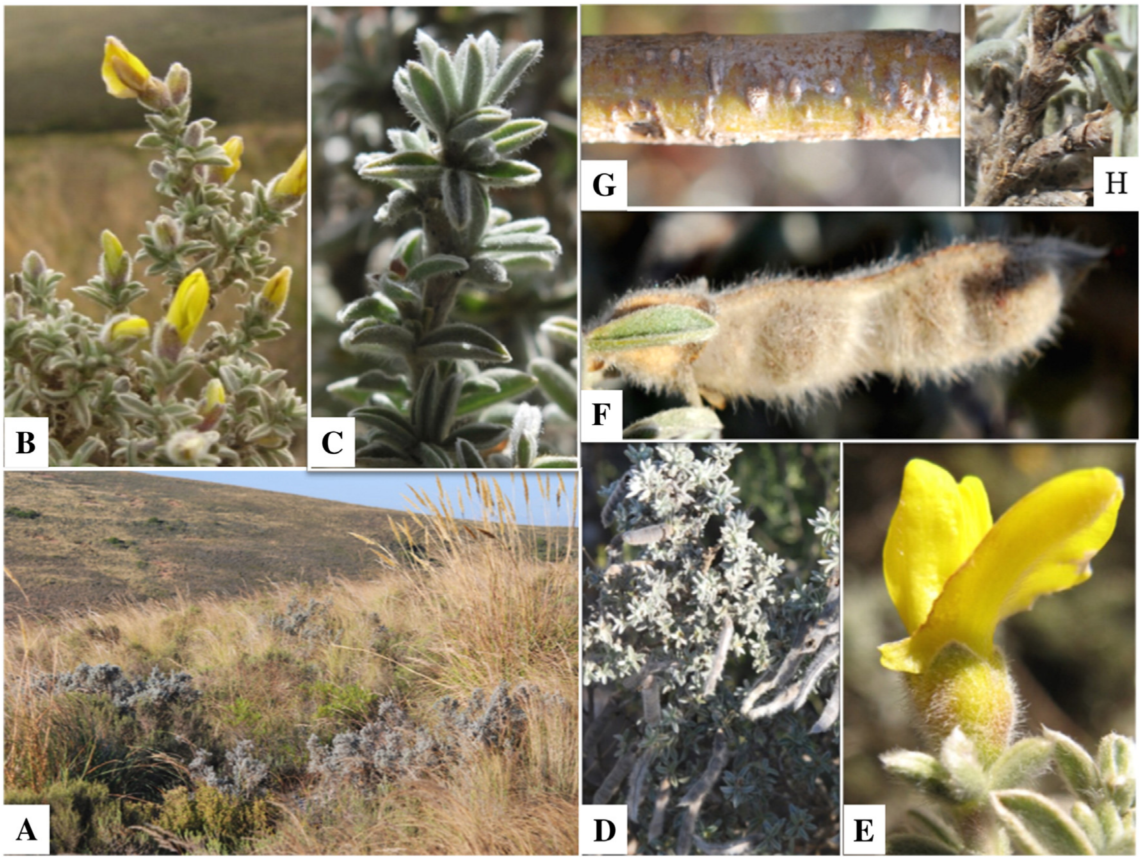

Fig. 7. *Polhillia curtisiae*; (A, B) habit; (C) leafy shoot; (D) stem; (E) flower; (F) pod; (G, H) stem.

Inflorescence capitate, 4–8 × 2.4–5.7 mm, with 3–6 spikelets. Spikelets 3.9–6.4 × 1.6–2.5 mm, terete, dark brown. Glumes 2.7–3.8 mm long, acute, with a mucro to 0.3 mm long; margins entire. Style trifid. Stamens 3, anthers crested. Nutlets 1.5–2.0 × 0.8–1.0 mm, brown, minutely papillose; hypogynous disc to 0.8 mm long, cupular, 3-lobed. Fig. 9.

3.2.5.1. Etymology. The specific epithet refers to the Overberg region where the taxon is endemic.

3.2.5.2. Diagnostic characters. Ficinia overbergensis has morphological and ecological similarity to *Ficinia quartzicola* Muasya & N.E.Helme. Both taxa grow in quartz substrate but are geographically separated

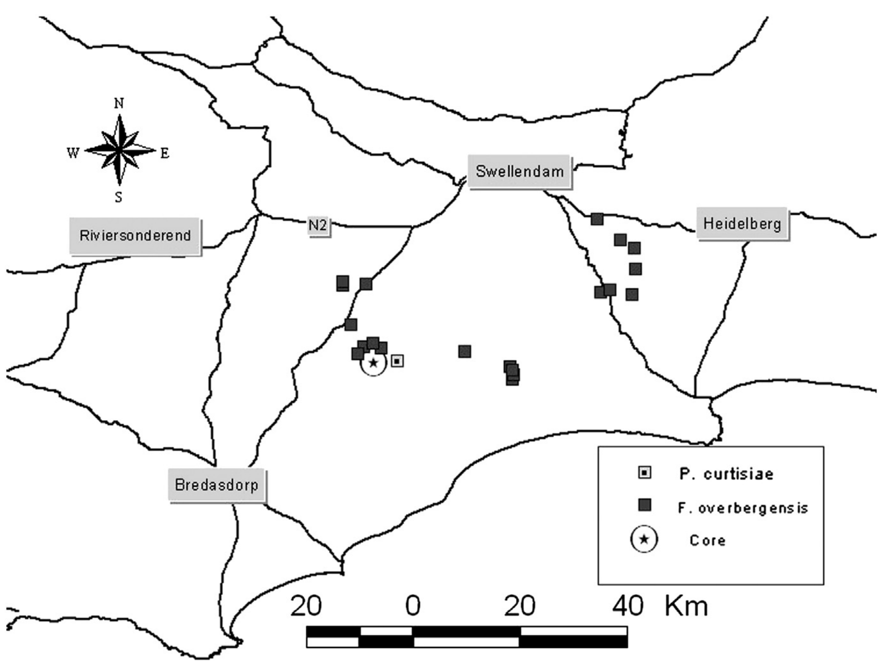

Fig. 8. Distribution map of *Ficinia overbergensis* and single location for *Polhillia curtisiae*, based on surveys in this study.

Fig. 9. *Ficinia overbergensis*: (A) habit; (B) leafy culm; (C) inflorescence; (D) glume. All drawn from *Von Witt CR6010* by K-L Kilian.

with *F. quartzicola* only known from the Knersvlakte (Muasya et al., 2012), where it forms tufts of similar size. Morphologically, the species share sticky leaf sheaths, but *F. quartzicola* forms tough tufts (stuck together tightly) with rigid culms that lack leaf blades. The inflorescence of *F. overbergensis* is capitate with 2 or 3 leafy involucral bracts and 3–6 spikelets whereas *F. quartzicola* has a pseudolateral to capitate inflorescence with 5–10 spikelets and where the involucral bract is stem-like.

3.2.5.3. Distribution and habitat. F. overbergensis is currently known from the Eastern Rûens Shale Renosterveld occurring on quartz–silcrete patches (Fig. 8). It also grows on silcrete substrates where quartz is not strongly exposed, and extends to lower altitudes (to 10 m a.s.l.).

3.2.5.4. Conservation status. This taxon is currently known from scattered localities in the Overberg, all under private ownership, with several currently used as grazing for sheep. Although there are no threats evident at any site, overgrazing could be a potential threat, and it is estimated to comprise fewer than 100 tufts at each site, and it is thus very likely that the total area of occupancy is less than 1 km^2. We therefore assess this taxon as *Near Threatened* (Raimondo et al., 2009).

3.2.5.5. Additional specimens examined. 3420 (Bredasdorp): Haarwegskloof, N of Plaatjieskraal, near San Souci, 29 Aug 2008, *Von Witt 6010* (BOL, NBG); Cape Agulhas–Elim Murram road, 24 Jan 2009, *Muasya & Muthama 4354* (BOL); Goereesoe, off Bredasdorp–Swellendam road, 7 Dec 2011, *Muasya, Stirton & Curtis 6333* (BOL); Goereesoe, 30 Aug 1962, *Acocks 22669* (BR, PRE); Rooi Vlei, off Bredasdorp–Swellendam Road, 30 Sep 2012, *Muasya, Stirton & Curtis 6596* (BOL); Swellendam Road, 30 Sep 2012, *Muasya, Stirton & Curtis 6596* (BOL); Plaatjieskraal, 7 Dec 2011, *Muasya, Stirton & Curtis 6342* (BOL); Plaatjieskraal, 30 Sep 2012, *Muasya, Stirton & Curtis 6599* (BOL); Nysty Farm, 40 km N. of Bredasdorp, along San Souci Road, 2 Dec 2011, *Stirton & Curtis 13450* (BOL).

4. Discussion

4.1. Is Overberg Quartzveld a hotspot of endemism and should it be recognised as a distinct vegetation unit?

From the data we have presented it is clear that the quartz patches occurring on silcrete outcrops in ERS renosterveld comprise distinct plant communities and are hotspots of endemism. This was not recognised by Schmiedel (2002) although she did recognise *Gibbaeum haagei* as an endemic and characteristic species of the quartz habitats. A relatively small number of surveys within these patches have revealed a suite of new species and it is likely that further surveys will reveal more new discoveries. With up to 19 endemic species, quartz–silcrete patches in ERS Renosterveld display higher levels of endemism than the quartz fields of the Little Karoo (10 endemic species), but lower than in the Knersvlakte which displays exceptionally high levels of endemism (39 endemic species) (Schmiedel and Jürgens, 1999). Unlike the quartz fields of the Succulent Karoo which are dominated by nanochamaephytes (succulent dwarf shrubs <5 cm — Schmiedel and Jürgens, 1999) and contain no shrubs or trees >50 cm tall, the Overberg's quartz patches comprise a high diversity of species from different family groups, including a notable number of legumes (Fabaceae), as well as several grasses and asteraceous shrubs over 50 cm in height. This may be due to the more fertile soils and higher rainfall to which the Overberg's patches are subject, when compared with their Karoo counterparts.

Clutia govaertsii is currently described as occurring between Albertinia and Brak Rivers on stony gravel slopes (Goldblatt and Manning, 2000) and is listed as *Least Concern* (Raimondo et al., 2009). However, our study has demonstrated that this species appears to be a quartz/silcrete endemic within ERS Renosterveld. We therefore recommend that the ecology and threat status of this *Clutia* be investigated further and considered for listing as *Near Threatened* or *Vulnerable* in the near future.

4.2. How to deal with microhabitats within broad vegetation types

Currently, routine vegetation classification methods (Mucina and Rutherford, 2006) do not include vegetation anomalies or microhabitats within existing vegetation types. While we acknowledge that revising the system to include the many different micro-vegetation types might be a lengthy and complicated process, it is important that we at least acknowledge these distinct habitats that are currently lumped under the same description as the more wide-spread habitat in which they occur.

Quartz–silcrete patches are not the only micro-vegetation types within ERS Renosterveld: this system also contains thicket, fynbos and riparian systems — all currently not recognised within this vegetation type. We therefore recommend that a different and more detailed approach to vegetation mapping is considered in the future, so that these area-specific vegetation types can be recognised when describing vegetation at the landscape-level. This is of particular relevance when generating conservation plans where the maintenance of biodiversity at the landscape level is the primary objective. If this approach is taken, we further recommend that the quartz–silcrete patches in ERS Renosterveld are recognised as a distinct vegetation type, namely Overberg Quartzveld, and that this is listed as *Critically Endangered*, given that this vegetation is completely restricted to outcrops within an existing *Critically Endangered* vegetation type, is vulnerable to poor livestock management, and is not represented in any protected area. However, we stress that it is the nature of their distinctness, size and location that makes it possible to identify and manage them practically.

While it is clear that Overberg Quartzveld is a distinct plant community, it is still uncertain at what level it might be recognised. Further studies are needed of all of the quartzveld patches, as well as other distinct vegetation types which occur in a scattered fashion within a broader habitat, in the Cape Floristic Region before this question can be resolved. Also, if this community were to be recognised as a separate vegetation type, it would not be difficult to map, as the quartz patches are fairly easy to identify from satellite imagery. However, this approach might not be a viable one for all 'micro-habitats' or special vegetation units within broader vegetation units, as mapping habitats that are less distinguishable on available satellite imagery may not be as viable.

4.3. Management of Overberg Quartzveld

Although very few palatable species occur in Overberg Quartzveld, many of the endemics are highly susceptible to the deleterious effects of heavy trampling by livestock (sheep, cattle & ostriches) and therefore, livestock management is an essential component of keeping these patches intact. This essentially involves fencing remnants off from productive lands. However, this management intervention is important for the maintenance of lowland renosterveld generally but is an expensive outlay for a landowner and most are unable to carry these costs (O. Curtis pers. obs). Inappropriate fire regimes will also be detrimental to the future of these patches, which probably would have escaped fire due to their more open, rocky habitat and they are therefore not as fire-adapted as the grassier renosterveld surrounding the outcrops. Certainly, some species are slow maturing, such as *Relhania garnotii*, which is believed to require 20 years to reach maturation (Raimondo et al., 2009) and thus we caution against the use of frequent fires within this renosterveld region. Conversely, some species, such as *Xiphotheca rosmarinifolia*, only flower after a fire (Schutte-Vlok, 2011) and we suspect this might also be the case for *Otholobium curtisiae*.

It is important to remember that these quartz patches are part of a bigger system and that they should not be managed in isolation, from either the natural habitats in which they are nested, or from the matrix of transformed land surrounded them. There is a dearth of knowledge with regard to the life-histories of many renosterveld plants and their pollinators — and this applies particularly to the specialists and the endemics. Thus reserve design and management should be as inclusive as possible, as without conserving processes and inter-dependencies, we may merely be prolonging extinction debts (Tilman et al., 1994). Additional studies on the ecology of these plants and their respective pollinators should be a priority for future renosterveld research. Also, as the surveys carried out in this study were limited due to time constraints, a more detailed examination of alpha, beta and gamma diversity across the renosterveld in which the quartz–silcrete hillocks occur would be invaluable.

4.4. Protecting the last remnants of Overberg Renosterveld

Despite a heightened awareness about the levels of threat which renosterveld faces (e.g. von Hase et al., 2003), conservation efforts to conserve renosterveld across the Overberg landscape have been largely fruitless, with some rare exceptions. The ±30,000 ha that remains today represents less than 6% of the original extent of this vegetation type. Only four of these remnants are larger than 500 ha and 30 are larger than 100 ha. About 30% of these 'large' (i.e. >100 ha) fragments contain quartz patches. We reiterate that these quartz patches have been overlooked in the past and emphasize the need for further research and conservation attention in these habitats. These areas are relatively small in a global context, but comprise some of the richest plant diversity in the world, within the smallest, but richest plant kingdom, thus any successful attempts to secure these fragments for long-term conservation will certainly be of significant conservation and biodiversity value. By focusing on a small component of this rich ecosystem our study has highlighted the urgency for conservation organizations to urgently re-prioritize some of their efforts within the Fynbos biome.

We have presented data that shows that the quartz fields south of the Langeberg are not relicts of a fairly species-poor quartz field phytochorion as previously thought, but instead are a rich and distinct assemblage of species on an old landscape. The distinctive Overberg quartz–silcrete patches, just one of a number micro-vegetation types within ERS Renosterveld, are a challenge to broader landscape and vegetation mapping, particularly given their conservation importance. They do stand apart though in that they are easier to identify than the other micro-vegetation units and have a better potential to be managed and protected. Finally, this study has shown that there is still urgent work needed to fully document the plant diversity of the much-neglected renosterveld and that, given its threatened existence, it deserves a higher priority from conservation bodies and biodiversity NGOs.

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Appendix 1

Summary of Bray–Curtis Similarity Matrix generated for plant communities on quartz–silcrete outcrops on renosterveld in the Overberg, Western Cape. Key to farm names: AB = Aandblom, D = Dipka, GRS = Goereesoe, GK = Grootkloof, HWK = Haarwegskloof, K = Koppies, NKH = Niekerkshek, NKM = Napkysmond, NY = Nysty, OK = Oudekraal, PB = Potteberg, PK = Plaatjieskraal, UIT-Uitvlugt, UVS = Uitvlugt school, VST = Voorstekop, WGM = Welgemoed, and ZK = Zandkraal.

	GORS	NY1	NY2	PL1	PL2	HWK1	UVS	NKM1	WGM1	UIT1	UIT2	AB	K2	ODK1	ODK2	GK	D1	VST	ZK	K1	NKH	PB1	PB2	PB3	PB4
GORS																									
NY1	78																								
NY2	44	55																							
PL1	63	66	52																						
PL2	67	57	50	77																					
HWK1	61	60	49	73	70																				
UVS	51	50	52	49	42	59																			
NKM1	39	44	44	31	31	35	46																		
WGM1	61	54	50	60	55	58	45	37																	
UIT1	35	40	57	42	38	37	58	50	48																
UIT2	47	46	54	54	43	56	69	56	53	70															
AB	52	44	35	44	36	40	62	36	52	60	80														
K2	47	51	46	46	48	42	41	48	47	44	43	32													
ODK1	47	51	46	50	48	42	48	48	47	44	50	32	79												
ODK2	31	42	25	30	30	29	30	35	29	19	15	17	39	46											
GK	56	60	43	48	50	40	39	52	38	40	47	44	60	67	36										
D1	36	41	50	38	39	32	35	42	50	47	46	32	64	73	20	67									
VST	30	36	32	29	29	22	27	22	44	25	29	33	48	57	32	52	80								
ZK	39	38	26	27	31	35	39	73	37	40	40	36	48	40	26	44	32	22							
K1	52	63	61	40	36	40	39	55	52	40	48	36	72	72	44	52	63	56	46						
NKH	52	56	44	36	31	35	39	27	44	40	32	36	40	40	44	59	53	56	46	46					
PB1	55	59	48	51	44	48	64	50	55	46	52	42	44	59	24	41	57	40	42	50	33				
PB2	59	71	50	76	58	64	51	46	55	36	47	34	53	58	39	50	44	32	40	51	40	65			
PB3	54	58	41	55	44	57	63	50	61	46	52	36	52	65	35	55	56	42	50	50	50	73	78		
PB4	65	68	40	67	63	65	58	41	51	38	43	35	49	60	40	56	45	33	41	47	47	61	89	80	

References

Cowling, R.M., 1983. Diversity relations in Cape shrublands and other vegetation in the southeastern Cape, South Africa. Vegetatio 54, 103–127.
Cowling, R.M., Proches, S., Partridge, T.C., 2009. Explaining the uniqueness of the Cape flora: incorporating geomorphic evolution as a factor for explaining its diversification. Molecular Phylogenetics and Evolution 51, 64–74.
Dahlgren, R., 1988. *Aspalathus*. Flora of Southern Africa. 16, 1–430.
Goldblatt, P., Manning, J.C., 2000. Cape Plants. A conspectus of the Cape Flora of South Africa. National Botanical Institute of South Africa, Pretoria, South Africa, & MBG Press, Missouri Botanical Garden, Missouri, USA.
Kemper, J., Cowling, R.M., Richardson, D.M., 1998. Fragmentation in South African renosterveld shrublands: effects on plant community structure and conservation implications. Biological Conservation 90, 103–111.
McNeill, J., Turland, N.J., 2011. Major changes to the *Code of Nomenclature* — Melbourne, July 2011. Taxon 60, 1495–1497.
Muasya, A.M., Viljoen, J.-A., Stirton, C.H., Helme, N.A., 2012. Two new leafless species of *Ficinia* (Cypereae, Cyperaceae) from the Greater Cape Floristic Region of South Africa. South African Journal of Botany 96–101.
Mucina, L., Rutherford, M.C. (Eds.), 2006. The Vegetation of South Africa, Lesotho and Swaziland. : Strelitzia, 19. South African National Biodiversity Institute, Pretoria.
Orton, J., 1988. A late Pleistocene microlithic Later Stone Age assemblage from coastal Namaqualand, South Africa. Before Farming 2008 (1), 1–9.
Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A., Manyama, P.A. (Eds.), 2009. Red List of South African Plants 2009. Strelitzia, 25. South African National Biodiversity Institute, Pretoria.
Rebelo, A.G., 1995. Renosterveld: conservation and research. In: Low, A.B., Jones, F.E. (Eds.), The Sustainable Use and Management of Renosterveld Remnants in the Cape Floristic Region: Proceedings of a Symposium. FCC Report 1995/4. Flora Conservation Committee, Botanical Society of South Africa, Kirstenbosch, Cape Town, pp. 32–42.
SANBI, DEAT, 2009. Threatened Ecosystems in South Africa: Descriptions and Maps. DRAFT for comment South African National Biodiversity Institute, Pretoria.
Schmiedel, U., 2002. The Quartz Fields of Southern Africa: Flora, Phytogeography, Vegetation and Habitat Ecology. (PhD thesis) Cologne University, Germany.
Schmiedel, U., Jürgens, N., 1999. Community structure on unusual habitat islands: quartz-fields in the Succulent Karoo, South Africa. Plant Ecology 142, 57–69.
Schutte-Vlok, A.L., 2011. A new species of *Xiphotheca* from the Western Cape, South Africa. Bothalia 41 (2), 298–300.
Tilman, D., May, R.M., Lehman, C.L., Nowak, M.A., 1994. Habitat destruction and the extinction debt. Nature 371, 65–66.
Von Hase, A., Rouget, M., Maze, K., Helme, N., 2003. A fine-scale conservation plan for Cape Lowlands Renosterveld: technical report. Report CCU2/03. Botanical Society of South Africa, Kirstenbosch.