


New plant distribution records for southern Namibia

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Background: A biodiversity zonation in the Greater Fish River Canyon Landscape and delineation of environmentally sensitive areas along the Orange River was required for two conservation projects in the Ai-Ais-Richtersveld Transfrontier Park.

Objectives: This required filling gaps in plant distribution data.

Method: Field surveys of plants were undertaken during the period 2011–2013.

Results: These field surveys generated two cross-border range extensions, which represented new records for Namibia (*Ornithogalum decus-montium* G.Will. and *Salvia dentata* Aiton). Five recently described or still undescribed plant species were collected (*Chlorophytum boomense* Kativu, *Moraea thermarum* Goldbl. & Mann. and three *Oxalis* species) and several range extensions within Namibia were recorded (*Euclea asperrima* Holz., *Euryops lateriflorus* (L.f.) DC and *Othonna cyclophylla* Merxm.).

Conclusion: These findings highlighted the biodiversity importance of this area at the junction of three major biomes (Succulent Karoo, Desert and Nama Karoo) in the Gariiep Centre of Endemism. More stringent reviews of environmental impact assessments are required and associated environmental management guidelines need to be implemented to ensure these newly discovered and rare plants are adequately protected.

Introduction

The mountains to the west of the Fish River Canyon in southern Namibia are still a very poorly known part of southern Africa's Great Escarpment (Clark, Barker & Mucina 2011), and new species have been discovered here in the last decade (Swanepoel 2011; Van Jaarsveld et al. 2007). The area is positioned in the Gariiep Centre of Endemism (Van Wyk & Smith 2001), an arid area comprising sections of the Succulent Karoo, Desert and Nama Karoo biomes in southern Africa (Rutherford 1997). It includes the Huns and Namus mountains and falls within the Ai-Ais-Richtersveld Transfrontier Park, jointly managed by Namibia and South Africa. Recognising the lack of biodiversity information in this area, several initiatives supported plant surveys. A biodiversity zonation for (1) the Ai-Ais-Richtersveld Transfrontier Park and (2) the Greater Fish River Canyon Landscape (Burke 2011, 2013a) were supported by Support to Protected Area Network (SPAN) and Namplace, which are conservation projects at Namibia's Ministry of Environment and Tourism. (3) The Environment Investment Fund of Namibia supported the delineation of sensitive areas along the Orange River to guide small-scale mining operations (Burke 2013b). These surveys resulted in some novel findings, which are presented in this article.

Research method and design

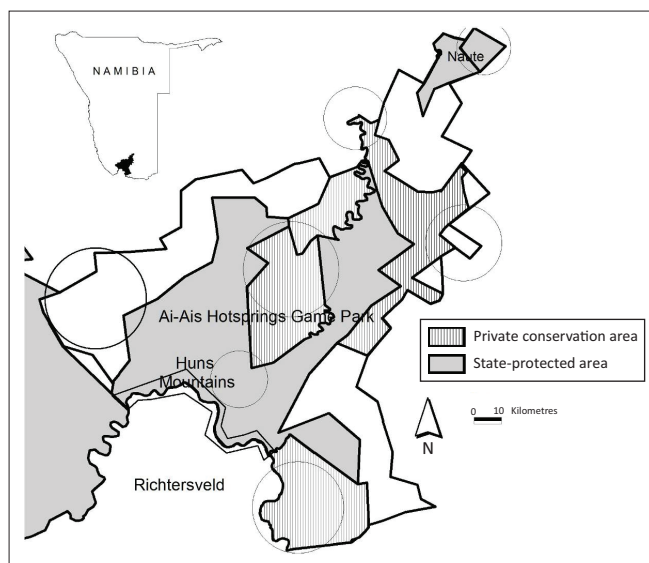
Study area

The study area in southern Namibia presents an approximate triangle around the Namus and Huns mountains and the southern reaches of the Fish River. It is bordered by a section of the lower Orange River in the south (Figure 1). This includes the state-protected Ai-Ais Hot Springs Game Park and adjacent private farmland. Termed the Greater Fish River Canyon Landscape (GFRCL), the area covers approximately 11 500 km² and falls floristically into the southern Namib and west Gariiep districts (Jürgens 1991) or Gariiep ecogeographic unit in the Extra Cape flora (Snijman 2013).

The climate is arid, with a mean annual rainfall between 50 mm and 150 mm, increasing along a south-west to north-east gradient. Summer and winter rains can occur. Mean annual temperatures range between 16 °C and 20 °C, increasing along a west-east gradient. The south-eastern corner of the study area borders one of the hottest areas in Namibia, where temperatures over 36 °C are

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Source: Author's own work

FIGURE 1: The Greater Fish River Canyon Landscape and its position in Namibia (circles and band along the Orange River indicate the target areas for plant surveys).

recorded during the hottest months (Mendelsohn et al. 2002). These broad bioclimatic gradients are modified locally by mountainous terrain. The higher reaches receive more rainfall and temperatures are lower. Occasional fog influences the western part of the study area. Rainfall during the field survey period at Keetmanshoop, some 30 km to the north of the northern boundary of the study area, was above average in 2011–2012 (July–June: 195 mm, average: 152 mm), but below average in 2012–2013 (July–June: 58 mm) (Meteorological Services of Namibia; www.meteona.com).

The topography is rugged and altitudes range from less than 100 m (amsl) at the deeply incised Orange River to 1654 m at the Namuskluft peak. The underlying geology is complex and ranges from the oldest rocks in Namibia to recent Quaternary sediments. In large parts of the study area some sedimentary rocks of the Nama Group (600 Ma–550 Ma) are exposed but there are also gneisses, granites and other metasedimentary rocks of the Namaqua Metamorphic Complex (1800 Ma–1000 Ma) and the Gariep Group (800 Ma–500 Ma), as well as sedimentary rocks and volcanic intrusions of the much younger Karoo Group (345 Ma–140 Ma) (Swart 2008). The Fish River and Orange River dissect these rock formations and created a heterogeneous landscape of plains, slopes, hills, inselbergs, plateaus, valleys, washes and rivers. The north eastern part of the GFRCL is largely plains with isolated mountains and hills, but the majority of the landscape to the south and west comprises rugged mountain terrain with deeply incised rivers. Soils are shallow and poorly developed regosols. Arenosols are present in rivers and washes.

The vegetation is dominated by succulent dwarf shrubs (mostly in the west) and dwarf shrubs. Grasses become more dominant towards the north and east, as in the Gariep Desert in the Richtersveld (Jürgens et al. 2006). Tall stem-succulents such as *Aloidendron dichotomum*, *A. pillansii* (formerly *Aloe*,

Grace et al. 2013) and *Pachypodium namaquanum*, and occasional trees (e.g. *Ozoroa concolor* and *O. dispar*) occur on mountain slopes in the west and more widespread, arid-adapted trees such as *Boscia albitrunca* and *Maerua schinzii* on slopes in the east. The permanently flowing Orange River locally supports riparian thicket with *Vachellia karroo* (formerly *Acacia*), *Maerua gilgii*, *Salix capensis*, *Searsia pendulina* and *Tamarix usneoides*. Perennial plant cover is generally low and hardly reaches 20% canopy cover, except locally in washes and along the Orange River, where plant cover can reach 100%. The flora of the Huns Mountains is suggested to be ancient, as indicated by the oldest *Indigofera* clades, evidenced by *I. nudicaulis* and *I. merxmülleri* in the study area (Schrire et al. 2009).

Field surveys and analysis

Field surveys were undertaken during the period 2011–2013, with three surveys in the winter season (September–October) and one in the summer season (April–May 2013). These specifically targeted under-collected areas within the study area, which were determined by plotting the collecting status of the national plant specimens database in Namibia and reviewing published sources (Irish 2008) (Figure 1). Plant collections focused on species that were unknown to us and on groups of plants that are difficult to identify or under revision. All specimens were lodged at the National Botanical Research Institute of Namibia (NBRI). Doubtful and potential new species were sent to relevant specialists: Prof. Shakkie Kativu (University of Zimbabwe) for *Chlorophytum*, Dr John Manning (Compton Herbarium) and Dr Peter Goldblatt (Missouri Botanical Garden) for *Moraea*, and Prof. Leanne Dreyer (University of Stellenbosch) for *Oxalis*.

Range extension was determined by reviewing information from the NBRI's specimens database, which was consolidated and cleaned, BRAHMS online (Craven & Kolberg 2017), published sources (Jürgens et al. 2010; Klaassen & Kwembeya 2013; Mannheimer & Curtis 2009; Merxmüller 1966; Snijman 2013; Swanepoel 2011) and SANBI's web-based threatened species programme (Raimondo et al. 2009).

Results

Cross-border range extensions

Surveys in border regions potentially generate new distribution records, and two new distribution records for Namibia in this study were *Ornithogalum decus-montium* G.Will. (Hyacinthaceae) (Figure 2a) and *Salvia dentata* Aiton (Lamiaceae) (Figure 2b). The geophyte *O. decus-montium* was described from the Richtersveld on arid mountain slopes approximately 20 km east of Sendelingsdrif near the Orange River at about 200 m altitude (Williamson 1998). We found it on slopes of the southern Huns Mountains on the Namibian side, approximately 25 km east of Sendelingsdrif, thus very close to the record in the Richtersveld (voucher: AB12027). The delicate geophyte is easily overlooked, appears for a short time after rains, and is only known from a few localities in Namibia and South Africa. More prominent, but nevertheless



Source: Photos taken by A. Burke

FIGURE 2: The delicate flowers of (a) *Ornithogalum decus-montium* are short-lived, while (b) *Salvia dentata*'s attractive purple flowers can hardly be missed.

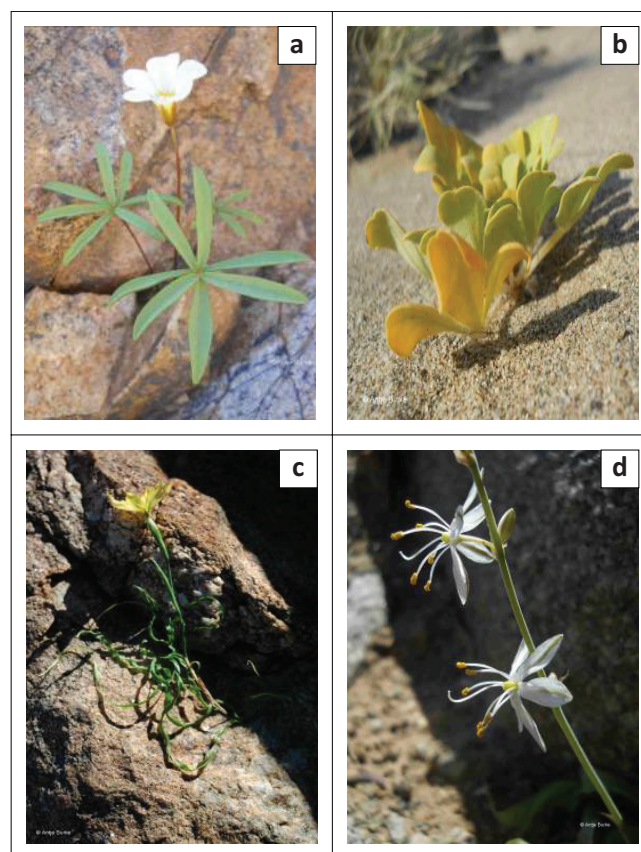
new to Namibia is the shrub *S. dentata* (voucher: AB13038). It is fairly widespread in the mountains of the Northern Cape (Snijman 2013) and grows on rocky hills, particularly granites, and in water courses from Namaqualand to Clanwilliam (Hedge 1974). In Namibia, it was found on a granite outcrop on the farm Zebrafontein, some 15 km north of Rosh Pinah. It is an attractive shrub when in flower, but easy to overlook during the dry season.

New plant species

Five new or recently described plant species were recorded during these surveys, one a completely new discovery, and the others either not previously recorded in Namibia or without adequate material for taxonomic description.

Oxalis canaliculata ined. (Oxalidaceae) (voucher: LN576) had been found on the Springbokvlakte in the Richtersveld before and is due to be described (Oberlander, Roets & Dreyer 2014). It is now also recorded on the Namibian side of the Orange River on mountain slopes very close to the river, some 10 km south of Aussenkehr (Figure 3a). The small, delicate plant with distinctive, linear leaves is short-lived and only appears after adequate rains. Its known distribution is limited to the Richtersveld and now one locality near Aussenkehr in Namibia. A second species, *Oxalis hunsbergensis* ined. (Oxalidaceae) (voucher: LN598), had been found at a few localities in the Huns Mountains previously (L. Dreyer, University of Stellenbosch, pers. comm., 2013). More localities were added during the recent surveys (Figure 3b). Possibly a third new species of *Oxalis* was recorded (voucher: AB13001). It had also been found previously (L. Dreyer, University of Stellenbosch, pers. comm., 2013). More localities were added during these surveys, one notably in the Naute Game Park, much further north than these *Oxalis* species had been recorded previously.

A small species of Iridaceae, growing beneath a granite rock overhang on slopes facing the Orange River, was identified as the new species, *Moraea thermarum* Goldblatt



Source: Photos taken by A. Burke

FIGURE 3: (a) The delicate *Oxalis canaliculata* ined. grows on rocky slopes along the Orange River and (b) *Oxalis hunsbergensis* ined. was found on sandy footslopes of a hill on the Gamkab plains, east of the Huns Mountains. (c) *Moraea thermarum* reaches about 10 cm height, with flowers of about 3 cm diameter and (d) *Chlorophytum boomense* is a slender, but relatively tall geophyte of about 30 cm height; both grow on slopes along the Orange River.

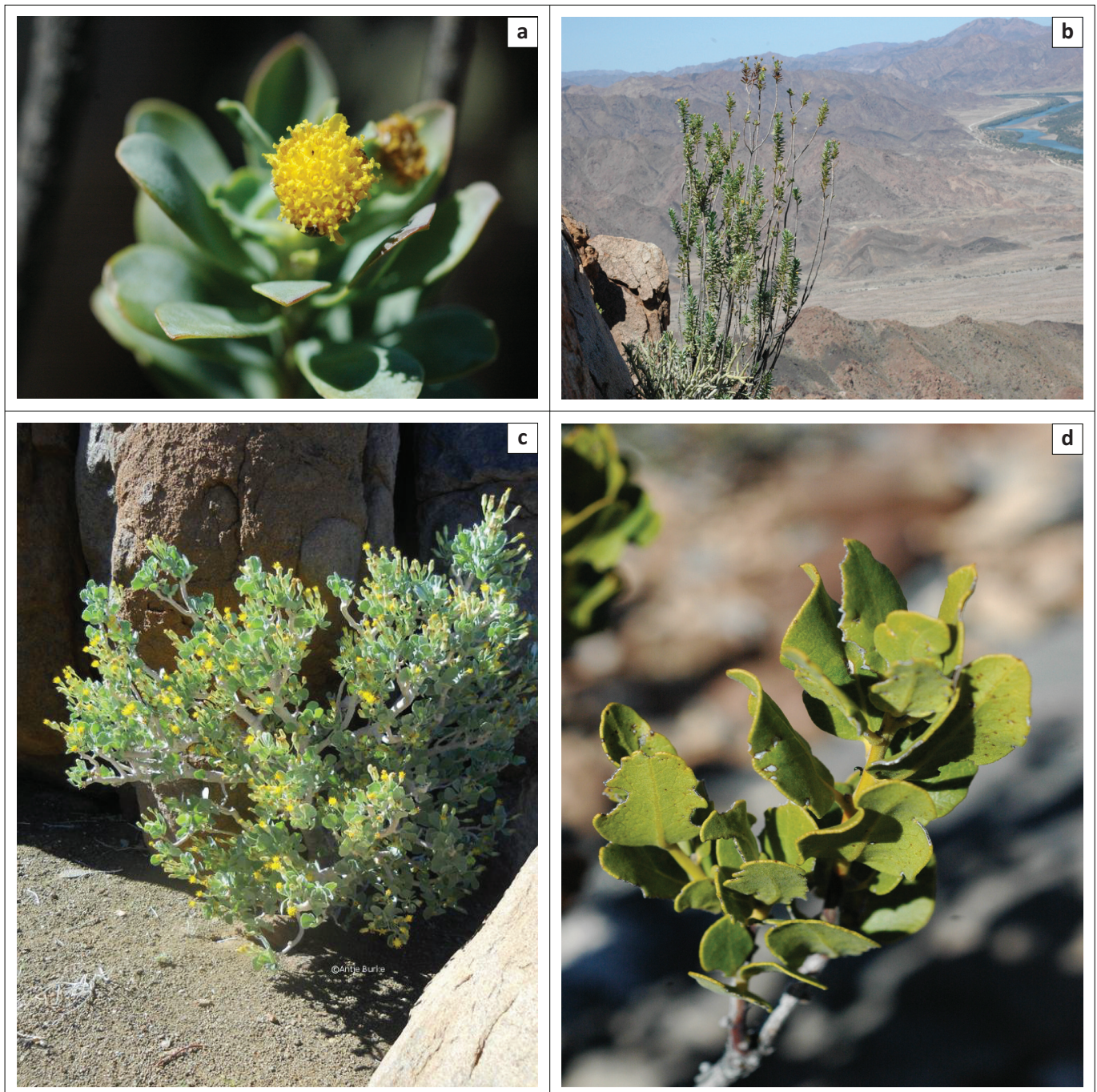
and Manning (2013) (voucher: AB12035). Vegetative material had been collected before in the Aurus Mountains in the Sperrgebiet to the west of the study area, but because of the lack of reproductive structures, the plant could not be described at the time. This new *Moraea* is a Namibian endemic and only known from these two localities (Figure 3c).

A geophyte that had never been collected before was also discovered during the field surveys growing on mountain slopes near the Orange River and has now been described as *Chlorophytum boomense* Kativu (Kativu & Bjora 2016) (Asparagaceae), named after the Boom River where it was found (vouchers: AB12032, LN380). Although locally common, it is only known from this one locality (Figure 3d).

Range extensions in Namibia

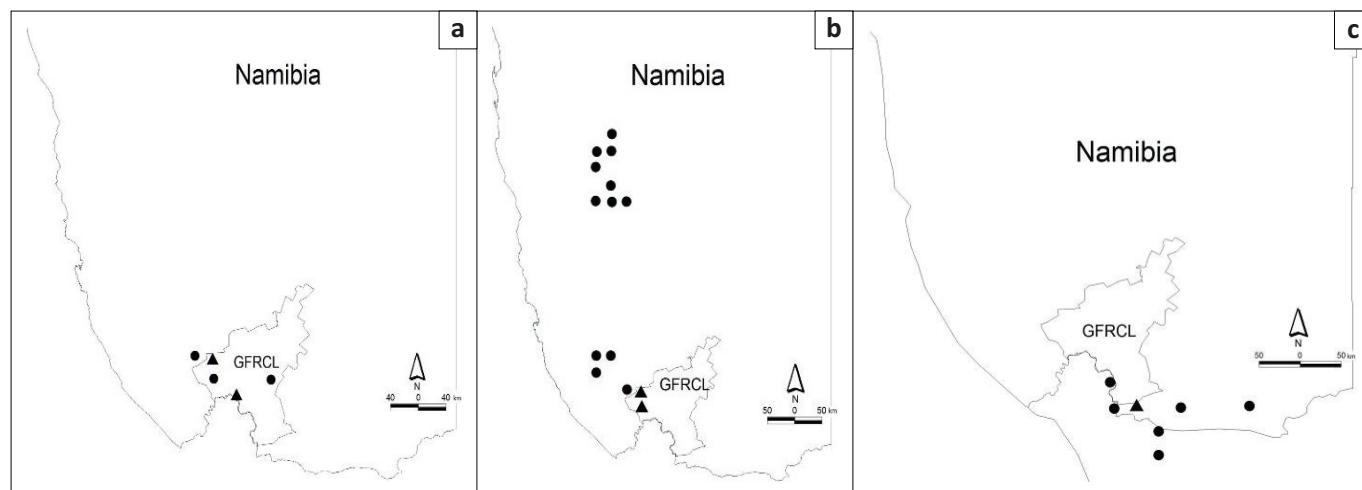
In addition to the cross-border range extensions, the study also generated some range extensions within Namibia. The

tall shrub *Euryops lateriflorus* (L.f.) DC (Asteraceae) is a rare plant in Namibia, although more widespread in South Africa (Foden & Potter 2005; Snijman 2013). The shrub grows on the higher slopes of the western Namus Mountains (Figure 4a and b). It was known from the Orange River Mountains and few localities in the south eastern Sperrgebiet, but this survey extended its range further north east and south than previously recorded in Namibia (Figure 5a). The tall shrub *Euclea asperrima* Holz. (Ebenaceae) (Figure 4d) is endemic to Namibia, but has a disjunct distribution with the largest population in the Naukluft and Zaris mountains in the central escarpment, a small population in the Tsaus Mountains and



Source: Photos taken by A. Burke

FIGURE 4: Species with range extensions as a result of field surveys in the Greater Fish River Canyon Landscape: (a) *Euryops lateriflorus* inflorescence and (b) in its natural habitat overlooking the Orange River. (c) *Othonna cyclophylla* and (d) *Euryops asperrima*.



Source: Author's own work

FIGURE 5: New distribution records (triangles) as a result of plant surveys in the Greater Fish River Canyon Landscape (GFRCL) in Namibia: (a) *Euryops lateriflorus*, (b) *Euclea asperrima* and (c) *Othonna cyclophylla* (previous records are indicated as dots).

associated hills in the Sperrgebiet, and a few populations in the western Huns Mountains (Mannheimer & Curtis 2009). The shrub is always associated with limestone, and the recent surveys resulted in a range extension to the east for the southern-most population (Figure 5b). The rare, stem-succulent shrublet *Othonna cyclophylla* Merxm. (Figure 4c) had only been recorded twice in Namibia previously (Craven & Kolberg 2017), but also grows in the south eastern Richtersveld, east of Vioolsdrif and in the Kamiesberge area (Snijman 2013). This study added an additional record on the north bank of the Orange River much further west than previously recorded in Namibia (Figure 5c).

Discussion and conclusions

The fact that new distribution records are generated and new plant species discovered when targeted field collecting is undertaken in the GFRCL emphasises the need for further inventory work. It is evident from the new discoveries that the ephemeral geophyte flora deserves attention, particularly the genus *Oxalis* (Oberlander et al. 2009), but there may even be surprises amongst the perennial flora (Swanepoel 2011; Van Jaarsveld et al. 2007). Oxalidaceae and Iridaceae are amongst the largest families in the Extra Cape flora (Snijman 2013), and it is therefore not surprising that four of the five new species belong to these two families. The exceptional rainy season of 2011 may have contributed to finding these new plant species and new records.

Although the largest part of this landscape is formally protected, it does not follow that there are no threats to the flora, of which 14% are Namibian endemics and nearly 30% threatened or rare species (of those that had been assessed so far) (Loots 2005, with updates). Where mining licences are issued, such as along the Orange River, some of the species are under threat. Mining takes precedence over all other land uses in Namibia in both protected areas and on private land (Legal Assistance Centre of Namibia 2009). Although environmental impact assessments (EIAs) are legally required for new developments, biodiversity assessments in the context of EIAs

have not yet reached a standard that guarantees adequate protection of vulnerable biodiversity (pers. obs.). More stringent reviews of biodiversity assessments are required, and compliance with environmental management guidelines needs to be checked, particularly in areas that are known to be of high biodiversity value. Ideally such areas should be excluded from mining and other developments altogether. Discussions about 'no-go' areas inside protected areas are under way between the ministries of Mines and Energy and Environment and Tourism, but agreements need to be finalised. Namibia still has a long way to go to achieve this.

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Competing interests

The author declares that she has no financial or personal relationship that may have inappropriately influenced her in writing this article.

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