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**Cover Illustration:** *Hermania stricta* (desert rose; Wüstenrose). Photograph by Peter Cunningham

## A plant checklist for the Bismarckberge in the central highlands of Namibia

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### Abstract

*A plant survey in the Bismarckberge, the eastern extension of the Auas Mountains near Windhoek, during the rainy season 2014 increased the species list for the quarter degree square 2217CB by 35%. Although this quarter degree square falls within an area generally considered well covered floristically, the enrichment of the species list shows that dedicated plant surveys are well worth the effort, even in well-collected areas. The plant species recorded in the Bismarckberge can be considered a subset of the flora of the Auas Mountains, as no species were restricted to the Bismarckberge only.*

**Keywords:** biogeography, central highlands, mountain flora, savanna

### Introduction

The Auas Mountain Range in the Khomashochland has been identified one of the most important areas for biodiversity in central Namibia (Irish 2002). Plant collecting on the main mountain range has been undertaken repeatedly and produced a fairly comprehensive plant inventory for the Auas Mountains (Burke & Wittneben 2008). However, the eastern-most extension of the range – the Bismarckberge, which is separated by about 10 km from the main mountain chain – had not been previously surveyed. The quarter degree square (QDS) in which the Bismarckberge are located, has been reasonably well collected. However, the data held at the Specimens Database of the National Botanical Research Institute (NBRI) are not sufficiently detailed to separate plants growing on these mountains from those on the plains, or on the eastern-most extension of the continuous Auas Mountain Range – Auasende – which is also positioned in this QDS. Therefore a plant survey of the Bismarckberge was warranted and a plant inventory of these mountains is presented here.

### Study area

The Bismarckberge in the Khomashochland in central Namibia form part of the Auas Mountain Range, although they are separated from the main mountain chain by approximately 10 km of *Acacia* dominated plains. These mountains fall into the quarter degree square 2217CB. The mountains are largely composed of Precambrian quartzites and other metasedimentary rock types of the Hakos and Rehoboth Groups (Miller 2002). The weather-resistant quartzites remained after the surrounding softer sediments were eroded over around 500 million years. The mountains ascend up to 400 m above the surrounding plains, with the highest peak at 2299 m amsl and cover about 15 km<sup>2</sup>.

The general climate is semi-arid and the mean annual rainfall ranges between 300 and 400 mm. Due to the high altitude, temperatures are moderate in summer (average maximum: 30-32°C), but cold in winter, with frost occurring on average 10-20 days per annum (Mendelsohn *et al.* 2002).

The Bismarckberge are located in highland savanna and the general vegetation is described as highland shrubland (Burke *et al.* in Mendelsohn *et al.* 2002). Shrubs are the most conspicuous components, but a low cover of trees and a high diversity of grasses and herbs add to the species spectrum (Figures 1 & 2).



**Figure 1.** African wild olive (*Olea africana*), next to Silke Rügheimer, grows in the upper reaches of the Bismarckberge. In the foreground, plenty of camphor bush (*Tarchonanthus camphoratus*), and generally a dense cover of shrubs is prevalent on the top of the mountain (©A. Burke).



**Figure 2.** The footslope and mid-section of the Bismarckberge are characterised by gentle slopes, with steep sections only in the upper reaches (©A. Burke).

## Methods

Plant surveys were undertaken during the period 11 February to 24 March 2014 during an above-average rainy season in Windhoek. Over 500 mm had been recorded in the Bismarckberge during the season from November to the last survey date at Hohe Warte (H. Köhler, pers. comm. 2014), the nearest rainfall station to the mountains and 447 mm were finally recorded in Windhoek during January-December 2014.

Plant collections focused on species not yet represented in the herbarium's collection, but the species list presented here also includes, for completeness, observational records of plants which have not been collected.

The following questions were addressed by this paper:

1. Is it still worth collecting in relatively well researched quarter degree squares – i.e. did the surveys add new species not recorded in QDS 2217CB before, in terms of (a) specimen collections and (b) observations?
2. Are there plants of particular interest in the Bismarckberge?

## Results and discussion

A total of 268 species were listed for the quarter degree square 2217CB prior to the survey conducted in 2014. Our survey added 94 new species, 35 of which were collected (Appendix 1; Table 1). This included common plants such as *Acacia erioloba*, *A. hebeclada*, *Cleome monophylla* and *Dichrostachys cinerea*, but also less common species such as *Euphorbia monteiri* and *E. spartaria*. These latter, rarer species are not necessarily restricted to high altitudes, but are less common in the highland savanna. The plant surveys in 2014 increased the species list for this quarter degree square by 35%. The 59 observed (only) species were not collected because insufficient material was available at the time of the survey, largely because reproductive structures (flowers or fruit) were missing. Plant surveys of areas believed to be well-collected are therefore still productive, particularly after a good rainy season.

**Table 1.** Number of plant species recorded prior and after the plant surveys at Bismarckberge in 2014.

<b>2217CB up to 2013</b>	<b>2217CB in 2014</b>	<b>New collected species</b>	<b>Additional observed species</b>
<b>268</b>	<b>362</b>	<b>35</b>	<b>59</b>

Overall, the plants found on Bismarckberge are typical species of the highland savanna around Windhoek, enriched by some plants of higher altitude, which are also found on the Auas Mountains. Examples of the latter are the grass *Brachiaria serrata*, the bulbs *Babiana longicollis* and *Hypoxis obtusa*, the tree *Osyris lanceolata* and the shrubs *Heteromorpha papillosa*, *Monsonia burkeana* and *Wahlenbergia denticulate* (Figures 3-5).



**Figure 3.** The iris-like bulb, *Hypoxis obtusa*, is rare in Namibia, but occurs throughout southern Africa (©A. Burke).



**Figure 4.** The attractive low shrub *Monsonia burkeana* is endemic to Namibia, and only found in higher altitudes (©A. Burke).



**Figure 5.** The striking iris *Ferraria glutinosa* was one of the few bulbs recorded during the plant survey in the Bismarckberge in 2014 (©A. Burke).

Based on current records, the Bismarckberge support 205 plant species, all of which also occur in the Auas Mountains (Burke & Wittneben 2008), and the Bismarckberge can thus be considered a less diverse outpost of mountain flora of the Auas Mountains. More plant species are recorded in the Auas Mountains, but they also cover a larger area than the Bismarckberge and reach a higher altitude.

Although many bulb species had already disappeared at the time of the survey, two attractive Iridaceae were found in flower – *Ferraria glutinosa* and *Moraea polystachya* – both savanna species that also occur in Botswana and South Africa.

Unavoidably the flora of the Bismarckberge also includes some introduced species that are now considered naturalised. The herbs *Achyranthes aspera*, *Bidens biternata*, *Chenopodium schraderianum*, *Pupalia lappacea* and *Schkuhria pinnata* are some such examples. Three of these have very effective means of seed dispersal by attaching to fur and clothes which could well explain their successful spread.

The majority (55 %) of the Bismarckberge flora consists of plants widespread in southern Africa, but there are also 19 plants endemic to Namibia. *Aptosimum arenarium*, *Anisopappus pinnatifidus*, *Eragrostis scopelophila*, *Euphorbia spartaria*, *Geigeria plumosa* and *Heteromorpha papillosa* are some examples. Of note are also some species typical of southern Namibia, usually found in the winter-rainfall influenced area, such *Diospyros ramulosa* and *Hermbstaedtia glauca*.

Although the species list presented here is reasonably comprehensive, our survey did not cover bulbs (Amaryllidaceae, Liliaceae *sens. lat.* and Iridaceae) well, because these were either past blooming or not yet in flower during the surveys. These are certainly underrepresented. Also not all aspects of the mountain, and particularly steep sections, were accessible, and there may well be additional species that have not yet been recorded here. The presented species list provides a plant inventory for land-owners and land users and can be used to guide further research, collecting and development planning.

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**Appendix 1.** Plant species of the Bismarckberge east of Windhoek (E = Namibian endemic, i = introduced, nE = near endemic).

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<i>Acacia erioloba</i> E.Meyer	
<i>Acacia hebeclada</i> DC subsp. <i>hebeclada</i>	
<i>Acacia hereroensis</i> Engl.	
<i>Acacia mellifera</i> (Vahl) Benth. subsp. <i>detinens</i> (Burch.) Brenan	
<i>Acacia reficiens</i> Wawra subsp. <i>reficiens</i>	
<i>Achyranthes aspera</i> L. var. <i>aspera</i>	
<i>Acrotome pallescens</i> Benth.	
<i>Aerva leucura</i> Moq.	
<i>Aizoon giessii</i> Friedr.	E
<i>Andropogon chinensis</i> (Nees) Merr.	
<i>Anisopappus pinnatifidus</i> (Klatt) O.Hoffm. ex Hutch.	nE
<i>Antheophora pubescens</i> Nees	
<i>Anthospermum rigidum</i> Eckl. & Zeyh. subsp. <i>pumilum</i> (Sond.) Puff	
<i>Aptosimum arenarium</i> Engl.	E
<i>Aptosimum lugardiae</i> (N.E.Br.) E.Phillips	
<i>Aristida adscensionis</i> L.	
<i>Asparagus cooperi</i> Baker	
<i>Asparagus larycinus</i> Burch.	
<i>Babiana longicollis</i> Dinter	E
<i>Bidens biternata</i> (Lour.) Merr. & Scherrf	i
<i>Blepharis leendertziae</i> Oberm.	
<i>Boophone disticha</i> (L.f.) Herb.	
<i>Boscia albitrunca</i> (Burch.) Gilg & Gilg-Ben.	
<i>Brachiaria nigropedata</i> (Munro ex Fical. & Hiern) Stapf	
<i>Brachiaria serrata</i> (Thunb.) Stapf	
<i>Bulbine capitata</i> Poelln.	
<i>Bulbostylis hispidula</i> (Vahl) R. Haines	
<i>Cenchrus ciliaris</i> L.	
<i>Chamaecrista biensis</i> (Steud.) Lock	
<i>Chascanum pinnatifidum</i> (L.f.) E.Mey.	
<i>Cheilanthes dinteri</i> Brause	

*Cheilanthes marlothii* (Hieron.)Schelpe  
*Chenopodium schraderianum* Roem.& Schult. i  
*Chloris virgata* Swartz  
*Cineraria canescens* J.J.Wendl ex Link var. *flabellifolia* Harv.  
*Cleome gynandra* L.  
*Cleome monophylla* L.  
*Cleome oxyphylla* Burch. var. *oxyphylla*  
*Cleome rubella* Burch.  
*Coccinea rehmannii* Cogn.  
*Coccinia sessilifolia* (Sonder) Cogn.  
*Combretum apiculatum* Sonder subsp. *apiculatum*  
*Commelina africana* var. *krebsiana* (Kunth) C.B. Clarke  
*Commelina benghalensis* L.  
*Commicarpus pentandrus* (Burch.) Heimerl  
*Commiphora pyracanthoides* Engl.  
*Convolvulus sagittatus* Thunb. var. *sagittatus*  
*Corallocarpus welwitschii* (Naud.) Hook.f.ex Welw.  
*Crassula tabularis* Dinter  
*Cucumis africanus* L.f.  
*Cucumis meeusei* C.Jeffrey  
*Cymbopogon caesius* (Hook.& Arn.) Stapf  
*Cyperus fulgens* C.B. Clarke  
*Cyphostemma congestum* (Baker) Desc. ex Wild & R.Drumm.  
*Cyphostemma hereroense* (Schinz) Decs.ex Wild. & Drumm.  
*Danthoniopsis ramosa* (Stapf) Clayton  
*Dichrostachys cinerea* subsp. *africana* Bren. & Brum. var. *africana*  
*Dicoma anomala* Sond. subsp. *anomala*  
*Digitaria eriantha* Steud.  
*Diospyros ramulosa* (E.Meyer ex A.DC.) De Winter  
*Dombeya rotundifolia* (Hoechst.) Planch.  
*Dyschoriste pseudirecta* Mildbr.  
*Echinochloa holubii* (Stapf) Stapf  
*Ehretia alba* Retief & A.E.van Wyk  
*Elephantorrhiza elephantina* (Burch.) Skeels  
*Elephantorrhiza suffruticosa* Schinz  
*Enneapogon cenchroides* (Roem.& Schult.) C.E.Hubb.  
*Enneapogon scoparius* Stapf  
*Eragrostis echinochloidea* Stapf  
*Eragrostis lehmanniana* Nees var. *lehmanniana*  
*Eragrostis nindensis* Fical.& Hiern  
*Eragrostis rigidior* Pilg.  
*Eragrostis scopelophila* Pilger E  
*Eragrostis superba* Peyr.  
*Eriocephalus dinteri* S.Moore E  
*Eriocephalus luederitzianus* O. Hoffm.  
*Euclea undulata* Thunb. var. *myrtina* (Burch.) Hiern  
*Euphorbia monteiri* Hook. f. subsp. *monteiri* nE  
*Euphorbia spartaria* N.E.Br. E  
*Evolvulus alsinoides* (L.) L. var. *linifolius* (L.) Baker  
*Felicia muricata* (Thunb.) Nees subsp. *muricata*  
*Ferraria glutinosa* (Bak.)Rendle  
*Fingerhuthia africana* Lehm.  
*Galenia africana* L.  
*Geigeria ornativa* O.Hoffm.

<i>Geigeria plumosa</i> Muschl.	E
<i>Gisekia africana</i> (Lour.) Kuntze var. <i>africana</i>	
<i>Gladiolus permeabilis</i> Delaroché subsp. <i>edulis</i> (Burch.ex Ker-Gawl.) Oberm.	
<i>Gomphocarpus fruticosus</i> (L.) Aiton f.	
<i>Grewia flava</i> DC.	
<i>Grewia flavescens</i> Juss. var. <i>flavescens</i>	
<i>Gymnosporia linearis</i> (L.f.) Loes. subsp. <i>lanceolata</i> E.Mey. ex. Sond. M.Jordaan	
<i>Helichrysum obtusum</i> (S. Moore) Moeser	
<i>Helichrysum tomentosulum</i> (Klatt) Merxm. subsp. <i>tomentosulum</i>	
<i>Heliophila minima</i> (Stephens) Marais	
<i>Heliotropium ciliatum</i> Kaplan	
<i>Hermannia comosa</i> Burch. Ex DC	
<i>Hermannia modesta</i> (Ehrenb.) Mast.	
<i>Hermannia tomentosa</i> (Turcz.) Schinz ex Engl.	
<i>Hermbstaedtia glauca</i> (J.C.Wendl.) Rchb. ex Steud.	
<i>Hermbstaedtia odorata</i> (Burch.) T.Cooke var. <i>odorata</i>	
<i>Heteromorpha papillosa</i> C.Towns	E
<i>Heteropogon contortus</i> (L.) Roem. & Schult.	
<i>Hibiscus fleckii</i> Guerke	E
<i>Hibiscus palmatus</i> Forsskal	
<i>Hibiscus pusillus</i> Thunb.	
<i>Hibiscus sulfuranthus</i> Ulbr.	E
<i>Hilliardiella oligocephala</i> (DC.) H.Rob.	
<i>Hirpicium gazanioides</i> (Harv.) Roessl.	
<i>Hoffmannseggia burchellii</i> (DC.) Benth. ex Oliv. subsp. <i>burchellii</i>	
<i>Hyparrhenia hirta</i> (L.) Stapf	
<i>Hypertelis salsoloides</i> (Burch.) Adamson var. <i>salsoloides</i>	
<i>Hypoestes forskalii</i> (Vahl) R.Br.	
<i>Hypoxis obtusa</i> Ker Gawl.	
<i>Indigofera alternans</i> DC.	
<i>Indigofera colutea</i> (Burm.f.) Merr. var. <i>colutea</i>	
<i>Indigofera damarana</i> Merxm. & A. Schreiber	
<i>Indigofera heterotricha</i> DC.	
<i>Indigofera vicioides</i> Jaub.& Spach var. <i>vicioides</i>	
<i>Ipomoea holubii</i> Baker	
<i>Ipomoea obscura</i> (L.) KerGawl. var. <i>obscura</i>	
<i>Ipomoea oenotheroides</i> (L.f.) Raf ex Hallier f.	
<i>Ipomoea sinensis</i> (Desr.) Choisy subsp. <i>sinensis</i>	
<i>Jamesbrittenia lyperoides</i> (Engl.) Hill.	E
<i>Kalanchoe brachyloba</i> Welw. ex Britten	
<i>Kyllinga alba</i> Nees	
<i>Kyllinga welwitschii</i> Ridley	
<i>Kyphocarpa angustifolia</i> (Moq.) Lopr.	
<i>Laggera decurrens</i> (Vahl) Hepper & J.R.I.Wood	
<i>Lantana dinteri</i> Moldenke	E
<i>Leonotis ocymifolia</i> (Burm.f.) Iwarsson var. <i>raineriana</i>	
<i>Limeum argute-carinatum</i> Warwa & Peyr. var. <i>argute-carinatum</i>	
<i>Limeum fenestratum</i> (Fenzl) Heim. var. <i>fenestratum</i>	
<i>Limeum sulcatum</i> (Klotzsch) Hutch. var. <i>sulcatum</i>	
<i>Lycium bosciifolium</i> Schinz	
<i>Lycium eenii</i> S.Moore	E
<i>Manuleopsis dinteri</i> Thell.	E
<i>Melhania damarana</i> Harv.	

*Melianthus comosus* Vahl  
*Melinis repens* (Willd.) Zizka subsp. *repens*  
*Mollugo cerviana* (L.) Ser. ex DC. var. *cerviana*  
*Monechma divaricatum* (Nees) C.B. Clarke  
*Monelytrum luederitzianum* Hack.  
*Monsonia angustifolia* E. Mey. ex A. Rich.  
*Monsonia burkeana* Planch. ex Harv.  
*Monsonia glauca* Knuth  
*Moraea polystachya* (Thunb.) Ker Gawl.  
*Nelsia quadrangula* (Engl.) Schinz  
*Nidorella resedifolia* DC. subsp. *resedifolia*  
*Ocimum americanum* L. var. *americanum*  
*Olea europaea* L. subsp. *africana* (Mill.) P.S. Green  
*Ornithoglossum vulgare* B. Nord.  
*Oropetium capense* Stapf  
*Osteospermum montanum* Klatt E  
*Osteospermum muricatum* E. Mey. Ex DC subsp. *muricatum*  
*Osyris lanceolata* Hochst. & Steud.  
*Otoptera burchellii* DC.  
*Oxalis depressa* Eckl. & Zeyh.  
*Oxalis purpurascens* Salter  
*Oxygonum alatum* Burch. var. *alatum*  
*Pavonia burchellii* (DC.) R.A. Dyer  
*Pegolettia retrofracta* (Thunb.) Kies  
*Pellaea calomelanos* (Sw.) Link var. *calomelanos* NE  
*Pennisetum foermeranum* Leeke  
*Pentarrhinum insipidum* E. Meyer  
*Peucedanum upingtoniae* (Schinz) Drude  
*Phyllanthus pentandrus* Schumach. & Thonn.  
*Plectranthus hereroensis* Engl.  
*Pogonarthria squarrosa* (Roem. & Schul.) Pilg.  
*Pollichia campestris* Aiton  
*Polydora poskeana* (Vatke & Hildebr.) H. Rob. sens lat  
*Polygala uncinata* E. Mey. ex Meisn.  
*Pseudogaltonia clavata* (Mast.) E. Phillips  
*Pupalia lappacea* (L.) A. Juss. var. *lappacea* i  
*Rhynchosia totta* (Thunb.) DC var. *totta*  
*Rumex sagittatus* Thunb.  
*Schkuhria pinnata* (Lam.) Kuntze ex Thell. i  
*Schmidtia pappophoroides* Steud.  
*Searsia lancea* (L.f.) F.A. Barkley  
*Searsia marlothii* (Engl.) Moffett  
*Searsia tenuinervis* (Engl.) Moffett  
*Selago alopecuroides* Rolfe  
*Sesamum capense* Burm.f.  
*Sida chrysantha* Ulbr.  
*Solanum delagoense* Dunal  
*Solanum incanum* L. i  
*Solanum multiglandulosum* Bitter  
*Sporobolus fimbriatus* (Trin.) Nees  
*Sutera patriotica* Hiern  
*Tagetes minuta* L. i  
*Talinum cafferum* (Thunb.) Eckl. & Zeyh.  
*Tarchonanthus camphoratus* L.

*Tephrosia rhodesica* Bak. fil. var. *rhodesica*  
*Tetragonia calycina* Fenzl  
*Themeda triandra* Forssk.  
*Thesium xerophyticum* A.W.Hill E  
*Tragus racemosus* (L.) All.  
*Tribulus terrestris* L.  
*Tribulus zeyheri* Sond. subsp. *zeyheri*  
*Tricholaena monachne* (Trin.) Stapf & C.E.Hubb.  
*Trochomeria macrocarpa* (Sonder) Hook.f. subsp. *vitifolia*  
*Urochloa brachyura* (Hack.) Stapf  
*Ursinia nana* DC. subsp. *nana*  
*Wahlenbergia denticulata* (Burch.) A. DC.  
*Ziziphus mucronata* Willd. subsp. *mucronata*

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