DINTERIA No. 33: 3-11 Windhoek, Namibia – June 2013

Plant species of the Naute Game Park – an annotated inventory

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Abstract
This paper presents an inventory of plants of the Naute Game Park, based on field surveys and information from databases. The park extends over two quarter degree squares and 159 terrestrial plant species have to date been recorded. Deciduous dwarf shrubs comprise the majority of the flora. The rare, small tree Elephantorrhiza rangei *and populations of quiver tree (*Aloe dichotoma*), Nama corkwood (*Commiphora namaensis*), Nama resin-tree (*Ozoroa namaensis*) and black-winged twin-leaf (*Zygophyllum cretaceum*) are of conservation importance on the inselbergs. Also of conservation importance are the Namibian endemics* Euphorbia lignosa*,* Geigeria brachycephala*,* Indigofera pechuelii*,* Phyllanthus dinteri*,* Salsola arborea *and kinkelbos (*Tetragonia schenkii*) as well as unidentified dwarf stem-succulent Apocynaceae (*Stapeliod*) and* Hoodia *species. Invasive alien mesquite (*Prosopis*) trees may locally pose a threat to indigenous plants. More stringent track control in the recreational part of the park would limit the disturbance of natural habitat.*

Keywords: Conservation, Karas, Löwen River, natural resources, Naute dam, new discoveries

Introduction

The Naute Game Park adjoins the Naute Dam, some 50 km south-west of Keetmanshoop. The dam was built on the Löwen River and has been in operation since 1972 while the park was proclaimed in 1988. The area around the dam is open to the public for recreational purposes (angling, boating, camping), but the majority of the game park adjoining the recreation areas to the east and south is not accessible to the public. Here populations of gemsbok, springbok and smaller antelope such as steenbok and duiker roam the grassy plains. To date no inventory of plants has been compiled and this paper addresses this gap. This information can be used by conservation staff in this area to manage the plant resources.

Methods

Study area

The park initially covered 235 km^2 and is located in the Karas Region in southern Namibia. Recently the farm Ghoggab to the northeast has been added, increasing the total park area to 345 km^2. Four main landscape units can be distinguished: the Naute and Gawachab plains, the Löwen River and inselbergs (Figure 1).

The climate is arid with the mean annual rainfall ranging between 100 and 150 mm, increasing along a south-west to north-east gradient. Rains fall mainly in the summer months (January-April). Mean annual temperatures range between 18 and 22ºC increasing along a west-east gradient (Mendelsohn *et al.* 2002).

The majority of the park is level to gently southwest sloping plain, with a few isolated mountains (inselbergs) in the northwest section adding some relief (Figure 2). These inselbergs rise not much more than 100 m above the surrounding plains. The Löwen River

crosses the central area of the park, generally in a northeast to south-westerly direction. The river is ephemeral and usually flows during the rainy season for short periods, depending on rainfall in the upper catchment.

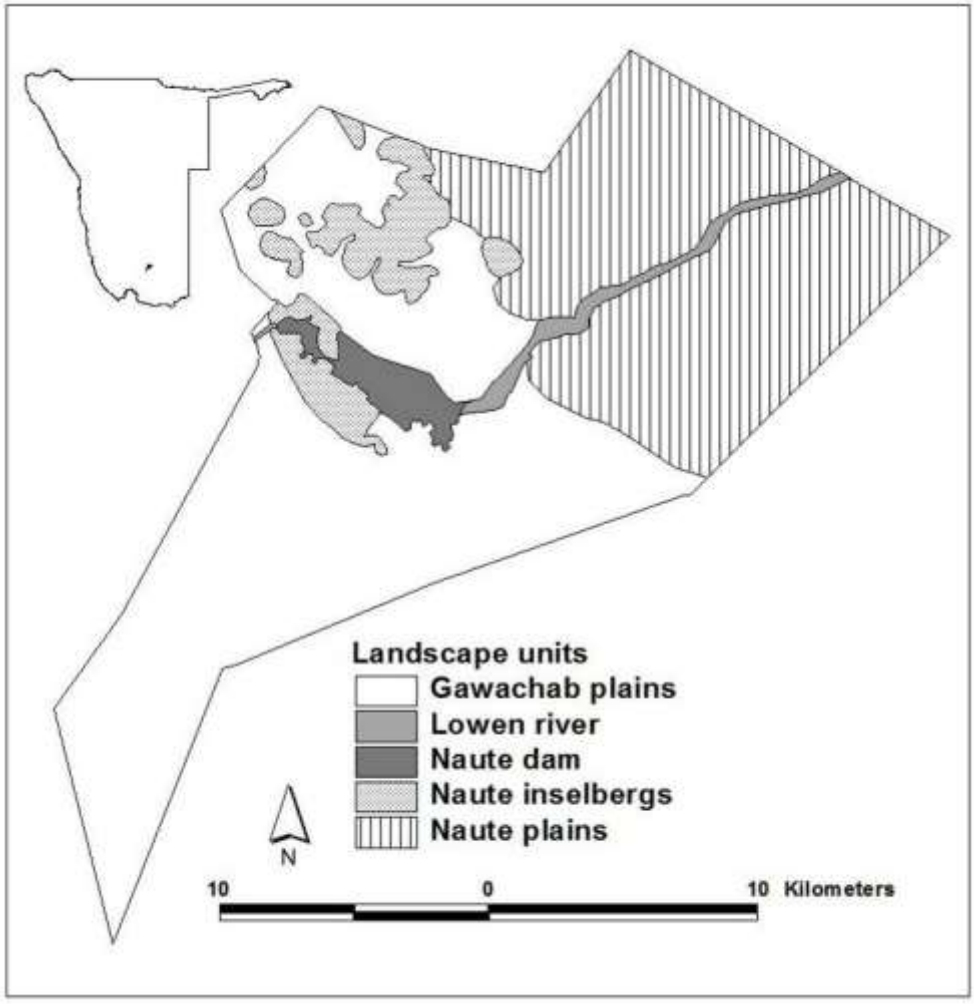

Figure 1. Landscape units and position of the Naute Game Park in Namibia (adapted from Burke 2013).

Karoo Group sedimentary rocks, largely shale and sandstone, underlie most of the park area, with the exception of a west-east running dolerite ridge (also of Karoo Group origin) providing the southern boundary of the dam. All these rocks are 300 to 180 million years of age (Swart 2008). Much younger Quaternary sand deposits cover some areas and form small patches of dunes between the inselbergs.

The vegetation is Karas dwarf shrubland (Burke *et al.* 2002), dissected by denser shrubland, and localised woodland along the Löwen River (Figure 3). The area falls within the Nama Karoo Biome (Rutherford 1997).

Figure 2. The Naute plains (view towards the Klein Karas Mountains to the southeast) are dissected by a dense network of shallow washes draining towards the Löwen River (recognised by a broad band of denser vegetation). The area to the left of the fence is the recent addition to the park.

Figure 3. Not only dwarf shrubs, but occasional trees, such as this fig (*Ficus cordata*) grow on the Naute inselbergs.

Compilation of the plant species list and plant attributes

The current list of terrestrial plant species was compiled following a field survey during April 2013; distribution records from the Specimens Database of Namibia's National Botanical Research Institute (NBRI) and the tree atlas (Curtis & Mannheimer 2005) (quarter degree squares 2618CC and 2617DD). This excludes species still awaiting identification by specialists. Voucher specimens from field surveys were lodged at the NBRI. The nomenclature follows Klaassen & Kwembeya (2013). Grazing and browse value of individual species was reviewed in published literature (van Breda & Barnard 1991; Esler *et al.* 2006).

The conservation status of plants was reviewed using Namibia's red-list (Loots 2005 and recent updates), Cites (Convention on International Trade of Endangered Species) status, as well as protection by national legislation (Nature Conservation Ordinance No. 4 of 1975 and No. 272 of 1977, Forest Ordinance No. 37 of 1952 and Forest Act No. 72 of 1968).

Results and Discussion

The current species list comprises 159 terrestrial plant species, including introduced, non-indigenous species (Appendix 1). Although the list is a good approximation, it is not complete. Aquatic plants are not represented and few semi-aquatic plants were collected so far. Also, no surveys were undertaken during an exceptionally good rainy season which is likely to add more plant species.

The majority of plants in the park are deciduous shrubs, followed by herbs, grasses and then evergreen shrubs (Table 1). Only ten geophytes have so far been recorded and this group is likely underrepresented. The low portion of leaf- and stem-succulent is expected, as the park is well beyond the boundaries of the Succulent Karoo Biome, where these growth forms are more prevalent.

Table 1. Growth forms and palatibility of plant species in the Naute Game Park.

Palatability	**Number of species**	**Examples**
High	15	*Berkheya spinosissima, Limeum aethiopicum, Polygala leptophylla, Montinia caryophyllacea, Salsola aphylla*
Low	21	*Aristida adscensionis, Cyperus marginatus, Enneapogon scaber, Kleinia longiflora, Rhigozum trichotomum, Tamarix usneoides, Tribulus terrestris*
Toxic	3	*Datura inoxia, Geigeria alata, Geigeria pectidea*
Growth forms		
Dwarf stem-succulents	3	*Euphorbia lignosa*
Evergreen shrubs	17	*Calicorema capitata,*
Grasses	21	*Aristida adscensionis, Stipagrostis uniplumis*
Geophytes	10	*Eriospermum rautanenii,*
Herbs	32	*Cleome suffruticosa, Tribulus cristatus*
Leaf-succulents	6	*Zygophyllum rigidum*
Shrubs	51	*Grewia tenax, Rhus burchellii*
Stem-succulents	4	*Aloe dichotoma*
Trees	15	*Acacia erioloba, A. karroo, A. mellifera, Boscia albitrunca*

Published information on grazing and browse value was retrievable for 39 species. Fifteen species are highly palatable which includes the trees *Acacia karroo* and *Pappea capensis*, the evergreen shrub *Cadaba aphylla*, and many shrubs (*Monechma incanum, M. spartioides, Nymania capensis*), and grasses (e.g. *Cenchrus ciliaris, Centropodia glauca, Phragmites australis* and *Stipagrostis ciliata*) – the remaining highly palatable species are listed in Table 1.

Two invasive alien plants were recorded, one of which (*Datura inoxia*) is toxic. Pods of the invasive mesquite tree (*Prosopis glandulosa*), although the tree is overall classified of low browse value, are believed to provide nutritious fodder for livestock. More intensive surveys may add more arid land invasive plants such as *Argemone ochroleuca*, other *Datura* species, *Nicotiana glauca* and *Ricinus communis*.

One *Oxalis* species is still awaiting identification by specialists and it may be a new species (Dreyer *pers.comm.*) (Figure 4). Another plant of interest is the tree *Elephantorrhiza rangei* which is only known from the Naute dam and immediate surroundings, thus one of the rarest plants in Namibia.

Figure 4. Possibly a new species, this white-flowered sorel plant (*Oxalis* sp.), grows amongst rocks on the Naute inselbergs.

Of conservation importance are populations of *Aloe dichotoma, Commiphora namaensis, Ozoroa namaensis* and *Zygophyllum cretaceum* on the inselbergs – the latter three are Gariep endemics – and the Namibian endemics *Euphorbia lignosa, Geigeria brachycephala, Indigofera pechuelii, Phyllanthus dinteri, Salsola arborea* and *Tetragonia schenkii*. Unidentified Stapeliod (dwarf stem-succulent Apocynaceae) and *Hoodia* species occurring in the park are protected species. These were unfortunately only present in vegetative state and could thus not be identified. *Geigeria brachycephala* is only known from five quarter degree squares and thus considered a restricted-range species which deserves attention. On the red data list are *Elephantorrhiza rangei*, classified as "endangered", *Ozoroa namaensis* as "rare" and *Zygophyllum cretaceum* as "near-threatened (Loots 2005).

Implications for research and management

1. The plant species list needs more additions, and plant collecting during a good season should be undertaken;
2. Mesquite (*Prosopis* sp.) invasions around the dam and habitations require some control. Although valuable shade trees in some places, these should be replaced with indigenous trees, and then eradicated. These measures are particularly important near the inselbergs and rocky outcrop areas where plants of conservation importance may be affected by the *Prosopis* trees' invasions;
3. The extremely rare *Elephantorrhiza rangei* deserves particular protection to avoid inadvertent damage;
4. A lot more habitat than necessary is disturbed in the recreational part of the park around the dam. Clear demarcation of tracks and picnic areas and enforcing track discipline would help to minimise these disturbances.

Acknowledgements: This work would not have been possible without the help of Ministry of Environment and Tourism and National Botanical Research Institute's staff. My hearty thanks go to many staff at these institutions who worked behind the scenes issuing permits, extracting data (thanks to the NBRI for the use of data from the Specimens Database) and processing and identifying specimens. Funding from Nam-place covered the fieldwork. Jonas Heita encouraged biodiversity zonation work in the Greater Fish River Landscape and Max Witbooi assisted in the field. Many thanks to all.

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Appendix 1. Plant species of the Naute Game Park and their growth forms.

Plant species	Growth form
Acacia erioloba E.Meyer	tree
Acacia karroo Hayne	tree
Acacia mellifera (Vahl) Benth. subsp. detinens (Burch.) Brenan	tree
Adenolobus garipensis (E.Mey.) Torre & Hillc.	shrub
Albuca sp.	geophyte
Aloe dichotoma Masson	stem-succulent
Aptosimum spinescens (Thunb.) Weber	shrub
Aristida adscensionis L.	grass
Asparagus denudatus (Kunth.) Baker	geophyte
Asparagus suaveolens Burch.	geophyte
Augea capensis Thunb.	leaf-succulent
Barleria papillosa T.Anderson	shrub
Barleria rigida Nees	shrub
Bergia anagalloides E.Mey. ex Fenzl	herb
Berkheya spinosissima (Thunb.) Willd. subsp. spinosissima	shrub
Blepharis grossa (Nees) T.Anderson	herb
Blepharis obmitrata C.B. Clarke	shrub
Boscia albitrunca (Burch.) Gilg & Gilg-Ben.	tree
Boscia foetida Schinz subsp. Foetida	evergreen
Cadaba aphylla (Thunb.) Wild	evergreen
Calicorema capitata (Moq.) Hook.f.	evergreen
Catophractes alexandri D.Don	shrub
Cenchrus ciliaris L.	grass
Centropodia glauca (Nees) Cope	grass
Chascanum garipense E.Mey.	shrub
Cleome angustifolia Forssk. subsp. diandra (Burch.) Kers	herb
Cleome suffruticosa Schinz	herb
Coccinea rehmannii Cogn.	geophyte
Commiphora namaensis Schinz	stem-succulent
Commiphora pyracanthoides Engl.	stem-succulent
Corbichonia rubriviolacea (Friedrich) Jeffrey	herb
Cryptolepis decidua (Planch. ex Hook.f. & Benth.) N.E. Br.	shrub
Cucumella cinerea (Cogn.) C.Jeffrey	geophyte
Cynodon dactylon (L.) Pers.	grass
Cyperus esculentus L. var. esculentus	grass
Cyperus longus L. var. longus	grass
Cyperus marginatus Thunb.	grass
Datura inoxia Mill.	herb
Dichanthium annulatum (Forsk.) Stapf var. papillosum (A. Rich) De Wet & Harlan	grass
Diclis petiolaris Benth.	herb
Dicoma capensis Less.	herb
Dipcadi cf. crispum Baker	geophyte
Dipcadi sp.	geophyte
Dyerophytum africanum (Lam.) Kuntze	shrub
Elephantorrhiza rangei Harms	tree
Enneapogon scaber Lehm.	grass
Eriospermum rautanenii Schinz	geophyte
Eriocephalus sp.	evergreen
Euclea pseudebenus E.Mey. ex A.DC.	tree
Euphorbia glanduligera Pax	herb
Euphorbia gregaria Marloth	stem-succulent
Euphorbia lignosa Marloth	dwarf stem-succulent
Ficus cordata Thunb. subsp. Cordata	tree

Forsskaolea candida L.f.	herb
Frankenia pulverulenta L.	shrub
Gaillonia crocyllis (Sond.) Thulin	shrub
Geigeria alata (DC) Benth.& Hook.f.ex Olivier & Hiern	herb
Geigeria brachycephala Muschl.	herb
Geigeria pectidea (D.C.) Harv.	herb
Gnaphalium confine Harv.	herb
Grewia tenax (Forssk.)Fiori	shrub
Gymnosporia senegalensis (Lam.) Loes.	evergreen
Heliotropium curassavicum L.	herb
Helichrysum zeyheri Less.	shrub
Hermannia affinis K. Schum.	shrub
Hermannia bicolor Engl. & Dinter	shrub
Hermannia fruticulosa K.Schum.	shrub
Hermannia gariepina Eckl.& Zeyh.	shrub
Hibiscus elliottiae Harv.	shrub
Hoodia sp.	dwarf stem-succulent
Indigastrum argyroides E. Mey	herb
Indigofera auricoma E.Mey.	herb
Indigofera pechuelii Kuntze	shrub
Jamesbrittenia canescens (Benth.) Hill. var. canescens	herb
Juncus rigidus Desf.	grass
Kissenia capensis Endl.	evergreen
Kleinia longiflora DC.	evergreen
Kohautia ramosissima Bremek.	shrub
Lebeckia dinteri Harms	shrub
Leucophrys mesocoma (Nees) Rendle	grass
Limeum aethiopicum Burm. subsp. namaense Friedrich var. namaense	evergreen
Limeum dinteri Schellenb.	shrub
Limosella africana Gluck var. africana	herb
Lycium amoenum Dammer	shrub
Lycium bosciifolium Schinz	shrub
Lycium villosum Schinz	shrub
Maerua schinzii Pax	tree
Microloma incanum Decne	evergreen
Monechma cleomoides (S. Moore) C.B.Clarke	shrub
Monechma genistifolium (Engl.) C.B.Clarke subsp. genistifolium	shrub
Monechma incanum (Nees) C.B.Clarke	shrub
Monechma mollissimum (Nees) P.G.Mey.	shrub
Monechma spartioides (T. Anders.) C.B.Clarke	shrub
Monsonia luederitziana Focke & Schinz	shrub
Monsonia senegalensis Guill. & Perr.	shrub
Montinia caryophyllacea Thunb.	shrub
Myxopappus acutilobus (DC.) Kaellersjoe	herb
Nolletia gariepina (DC.) Mattf.	shrub
Nymania capensis (Thunb.) Lindb.	shrub
Otoptera burchellii DC.	shrub
Oxalis sp. nov.	geophyte
Ozoroa namaensis (Schinz & Dinter) R.Fern.	tree
Panicum arbusculum Mez	grass
Pappea capensis Eckl. & Zeyh.	tree
Parkinsonia africana Sond.	tree
Pechuel-Loeschea leubnitziae (Kuntze) O.Hoffm.	evergreen
Pegolettia senegalensis Cass.	herb
Peliostomum leucorrhizum E. Mey. ex Benth. var. leucorrhizum	herb
Pentatrichia petrosa Klatt	shrub

Pergularia daemia (Forssk.) Chiov. var. leiocarpa (K.Schum.) H.Huber	evergreen
Petalidium setosum C.B.Clarke ex Schinz	shrub
Phaeoptilum spinosum Radlk.	evergreen
Phragmites australis (Cav.) Steud.	grass
Phyllanthus dinteri Pax	shrub
Phyllanthus pentandrus Schumach. & Thonn.	herb
Polygala leptophylla Burch.	shrub
Polygonum plebeium R.Br.	herb
Potamogeton pectinatus L.	herb
Prosopis glandulosa Torr. var. glandulosa	tree
Pteronia acuminata DC.	shrub
Pteronia sp.	shrub
Ptycholobium biflorum (E. Mey.) Brummit subsp. biflorum	shrub
Pulicaria scabra (Thunb.) Druce	herb
Rhigozum trichotomum Burch.	shrub
Rhus burchellii Sond.ex Engl.	evergreen
Rhus lancea L.f.	tree
Rogeria longiflora (Royen) Gay ex DC.	shrub
Salsola aphylla L.f.	evergreen
Salsola arborea C.A.Sm. ex Aellen	evergreen
Salsola sp.	evergreen
Salvia garipensis E.Mey.ex Benth.	shrub
Scirpoides dioecus (Kunth) J.Browning	grass
Senecio flavus (Decne) Sch.Bip.	herb
Sesamum sp.	herb
Setaria verticillata (L.) Beauv.	grass
Sisyndite spartea E.Meyer ex Sonder	evergreen
Solanum multiglandulosum Bitter	shrub
Stapelioid	dwarf stem-succulent
Stipagrostis ciliata (Desf.) De Winter var. capensis (Trin. & Rupr.) De Winter	grass
Stipagrostis hochstetteriana var. secalina (Hern.) De Winter	grass
Stipagrostis namaquensis (Nees) De Winter	grass
Stipagrostis uniplumis (Licht.) De Winter var. uniplumis	grass
Talinum caffrum (Thunb.) Eckl. & Zeyh.	geophyte
Tamarix usneoides E. Mey. ex Bunge	tree
Tapinanthus oleifolius (Wendl.) Danser	shrub
Tetragonia schenkii (Schinz) Engl.	leaf-succulent
Thamnosma africana Engl.	shrub
Tribulus cristatus Presl	herb
Tribulus terrestris L.	herb
Tricholaena capensis (Licht. ex Roem. & Schult.) Nees subsp. capensis	grass
Tripteris microcarpa Harv. subsp. microcarpa	herb
Triraphis ramosissima Hack.	grass
Verbesina encelioides (Cav.) Benth. & Hook. var. encelioides	herb
Wellstedia dinteri Pilg.	shrub
Ziziphus mucronata Willd. subsp. mucronata	tree
Zygophyllum cretaceum van Zyl	leaf-succulent
Zygophyllum decumbens Delile var. decumbens	leaf-succulent
Zygophyllum microcarpum Licht. ex Cham. & Schltr.	leaf-succulent
Zygophyllum rigidum Schinz	leaf-succulent