Plant species diversity in the Kaokoveld, Namibia

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Abstract

The Kaokoveld, situated in the north-western corner of Namibia and south-western Angola, is known for its floristic diversity and numerous endemic plants (Maggs, *et al*. 1994, Maggs 1998, Hilton-Taylor 1994) and has been recognised as a "hot spot" of global significance (Davis & Heywood 1994). Although diversity is the totality of genes, species and ecosystems occurring in a region, this paper concentrates on higher plant species diversity only. Studies carried out on ecosystems (plants in communities) are mentioned for background information.

An updated checklist of over 1064 vascular plants in 116 families, found in the Kaokoveld, south of the Kunene River, was evaluated and the results are presented. Twenty-four taxa are endemic to this area and about 100 taxa are Namibian endemics.

1 Botanical exploration and research

The first plant specimens from this area were probably collected by the Rev. Duparquet (Gunn & Codd 1981) along the Kunene River in about 1878. Since then, expeditions, e.g. the Bernard Carp in 1951, and numerous collectors have made valuable contributions to the flora of the Kaokoveld (Gunn & Codd 1981). The knowledge and interest of the local communities contributed greatly and one man in particular, Abner, after being an assistant to De Winter during a 1958 expedition, continued to collect specimens which are now housed in the National Herbarium of Namibia (WIND) and the National Herbarium, Pretoria (PRE).

The greatest contributions come from the collecting activities of Giess, Merxmüller, De Winter and Leistner after whom a number of Kaokoveld taxa are named, e.g. *Aloe dewinteri*, *Aristida dewinteri*, *Kirkia dewinteri*, *Commiphora giessii*, *Petalidium giessii*, *Heliotropium giessii*, *Stipagrostis giessii*, *Hibiscus merxmulleri*, *Euphorbia leistneri, Sesamothamnus leistneri* (ined.). Dr E. von Koenen (pers. comm.) whose plant collections are incorporated in WIND under the name of Giess, has also contributed to the flora and knowledge on plant uses. Much of this data is included in his book on useful and poisonous plants (von Koenen 1996) and another book on this area is in preparation. The collections of Owen-Smith (in WIND) with accompanying local names, provided the basis for an ethnobotanical study (Malan & Owen-Smith 1974).

Despite the Kaokoveld being a remote area, the intensity of plant collecting in the past was similar to other areas in Namibia or better, due to it being such a stimulating area. New plant records are being recorded by good collectors e.g. *Secamone punctulata* and *Ceraria carrissonana* were recently found by Bruyns and a new genus, *Baynesia* (Bruyns 2000), was described after a trip up the Baynes mountains. New taxa resulting from the work on the Pedaliaceae by Ihlenfeldt in Hamburg and the genera *Cordia* and *Ehretia* by Retief in Pretoria are expected.

Existing literature dealing with plants in the Kaokoveld contains information on plant utilisation (Bollig 1997, Bollig & Schulte 1999, Sander, Bollig & Schulte 1998), fairy rings (Eicher, *et al*. 1982, Moll 1994, Theron 1979, collecting trips (Giess 1968, Goyns 1971, Hall 1951), food preferences of animals (Viljoen 1989, Viljoen & Botma 1990) and miscellaneous information (Loxton, *et al.* 1974).

The National Herbarium of Namibia (WIND), founded in 1953, houses a collection of over 70 000 specimens and a reference library. Most of the holdings have been computerised onto a specimen database (SPMNDB) which also includes Namibian specimens in the National Herbarium, Pretoria (PRE). The holdings, database and literature references are used, not only as a resource and backup for plant determinations in the National Herbarium, but also as a source of baseline data for numerous projects. The results presented in this paper are based on this data as well as the author's flora database and field notes.

2 Physical Aspects

2.1 Location

The name Kaokoveld is derived from the Herero word "Kaoko", used to describe the mountainous region stretching from around the port of Namibe in south-west Angola to the vicinity of the Hoanib River in the south. Unlike the Kaokoland, an ethnic homeland with defined borders created in 1970, the Kaokoveld is a vague term that needs

definition when used. The portion of the Kaokoveld discussed in this paper lies within the Namibian political boundary. Such a definition is obviously artificial from a phytogeographic point of view, but due to the ongoing civil unrest in Angola, fieldwork in southern Angola is impossible and the presence of plants there could not be confirmed. The Namibian section falls within the Kunene Region. It covers the area between the Ugab and Kunene Rivers, namely the Ruacana, Opuwo, Sesfontein and Khorixas Constituencies of the Kunene Region. A thirty kilometer wide strip of Namib Desert along the coast is a proclaimed game reserve with restricted access.

2.2 Geography

As indicated by the paper on climate in this issue (Sander & Becker 2001), the Kaokoveld, although falling within the tropics, is an arid area. The distribution of the plants is therefore largely determined by the availability of water as well as the diverse geology and topography. The area varies in altitude from sea level to 1800 m in the northern Baynes and Otjihipa ranges. The perennial Kunene River cuts a deep gorge below the Ruacana Falls forming the political boundary with Angola, but it does not prevent numerous local taxa from occurring on both sides of the river.

3 Biological aspects

3.1 V egetation

Fourteen vegetation units i.e. those sharing important plant species and similar climatic, geological and soil requirements, were mapped by Viljoen (1980) during a six-year stay in the area while studying elephants. Additional information on vegetation types can be obtained in Malan & Owen-Smith (1974), Jacobsen & Moss (1987), Joubert (1971) for Otjovasandu area and Tarr & Tarr (1989) for the Ganias Flats as well as unpublished internal reports (De Sousa Correira 1976, Eloff, *et al.* 1977).

Two of the major vegetation zones recognised by Giess (1971) in his preliminary vegetation map of Namibia as occurring in this area are the Northern Namib Desert and the Mopane Savanna transition zone. Defining biomes as large land communities distinguished on the basis of dominant (plant) life forms and on climatic features, Irish (1994) categorised Namibia into biomes based on extensive fieldwork. Within the Kaokoveld, he defines the boundaries of Desert, Nama-Karoo and Savanna Biomes.

3.2 Floristic regions

Different attempts have been made to map or classify the vegetation of Africa (White 1965, 1983) or Namibia (Volk 1966) into floristic regions based on the geographical distributions of plants independently from their association with climate or geology. White (1983) proposed eighteen major floristic regions for Africa and in this very broad categorisation, the Kaokoveld lies in the Karoo-Namib floristic region. Looking at a more restricted area in southern Africa, Volk (1966) indicated a centre within his proposed Karoo-Namib region that extended from the Brandberg northwards to southern Angola (Kaokoveld centre) that was not only rich in species, but also localised taxa. Nordenstam (1974) listed taxa supporting this.

It was therefore no surprise that in 1994, the International Conservation Union (IUCN) identified the Kaokoveld as one of the centres of plant diversity and endemism for Africa (Davis & Heywood 1994). Hilton-Taylor (1994) provides further details on a datasheet (CPD site Af50) in the same publication.

Completed taxonomic studies, e.g. Hilliard (1994) for the Manuleae, allow mapping of the distributions of taxa which can be used to assess and evaluate areas of alliance of Namibian taxa and indicate floristic regions of importance. Although the full scale of phytogeographic relationships of all the taxa will never be complete, comprehensive studies have indicated that the flora of the Kaokoveld deserves it's special position, but is no longer considered to be so closely allied to that of the Brandberg flora. Provisional results from ongoing analysis of the distributions of other plant groups found on the Brandberg (Craven & Craven 2000) and elsewhere in Namibia by the author, indicate that it is more allied to the mountains and plateaux south of the Brandberg Mountain.

3.3 Checklist of plants occurring in the Kaokoveld

A preliminary checklist of plant species (Craven & Maggs 1993) was updated with voucher specimens, life forms, uses, local names & endemic status indicated (Craven 2001). The inventory of Craven (1999, 2000a, 2000b) which covers the entire flora of Namibia was followed, making consistency in recognition of components possible. In addition to herbarium specimens and extensive field work of the author over many years, literature sources (e.g. Jacobsen & Moss 1987, Viljoen 1980) and taxonomic papers mentioned in the checklist of Namibian plant species (Craven 1999, 2000a, 2000b) were used, especially the literature pertinent to the Kaokoveld flora such as Archer (1998), Bruyns (2000), Jacobson (1988, 1994), Leach (1976), Meyer (1973) and van der Walt (1973). The specimens were not examined or redetermined, with only problematic cases being checked where possible.

The total number of indigenous vascular plants recorded for the Kaokoveld is 1064 taxa and there are 51 naturalised species. A breakdown of the flora into families, genera, taxa and naturalised plants is given in Table 1 where the information is compared with that for the whole of Namibia following the Checklist of Namibian Plant species (Craven 1999).

Tab. 1: *Vascular plants recorded in the Kaokoveld compared to the rest of Namibia*
 # Taxa include species and infraspecific rank e.g. subspecies and varieties
Na Namibian data based on Craven *1999.*

	Families		Genera		Taxa #		Naturalised taxa	
	Kao	Na	Kao	Na	Kao	Na	Kao	Na
Pteridophytes	4	11	8	18	10	59		0
Gymnosperms	1	1	1	1	1	1		0
Monocotyledons	20	35	99	243	227	965	3	18
Dicotyledons	91	128	360 29*	751	809	2991	48	137
TOTAL	116	175	468	1011	1065	4016	51	156
% of Kao compared to Namibia	66%		46%		26%			

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The most common families and genera are as follows:

Family	No of Taxa in Kay	Most important genera, number of taxa in Kaokoveld in brackets
Poaceae	138	*Eragrostis* (19), *Stipagrostis* (14)
Fabaceae	126	*Indigofera* (23), *Acacia* (18)
Asteraceae	85	*Vernonia* (9), *Senecio* (6)
Acanthaceae	68	*Petalidium* (18), *Barleria* (13)
Euphorbiaceae	49	*Euphorbia* (25)
Burseraceae	19	*Commiphora* (19)
Malvaceae	31	*Hibiscus* (15)
Sterculiaceae	17	*Hermannia* (12)

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The Acanthaceae and Burseraceae are important families because of the number of taxa as well as for the numerous individuals, which make them prominent in this region. Sixty-eight of the 144 taxa of Acanthaceae found in Namibia occur in the Kaokoveld, with eighteen of the 26 *Petalidium* species present. The Commiphoras are even more impressive with nineteen out of 26 species in the Kaokoveld. The Amaranthaceae are also well represented with 26 taxa out of the 45 occurring in Namibia. This family is interesting as it includes two Namibian endemics, three species restricted to Namibia and Angola, and seven naturalised species. Of the 30 Pedaliaceae taxa occurring in Namibia over half are found in the Kaokoveld and the number may increase once the taxonomic revision is completed. There are also 30 taxa in the Capparaceae in Namibia and 20 occur in the Kaokoveld where they may be common, i.e. after rain, or prominent like the *Boscia* tree species. Forty-three Cucurbitaceae are recorded for Namibia with 24 in this area.

True succulent plants are limited in numbers and diversity, but occur in numerous families, e.g. Asphodelaceae, Dracaenaceae, Velloziaceae, Mesembryanthemaceae, Portulacaceae, Crassulaceae, Zygophyllaceae, Euphorbiaceae, Vitaceae, Passifloraceae, Apocynaceae and Asteraceae.

Numerous plants have been recorded only once e.g. Abner's collection of *Gloriosa superba.* Their presence in the region is not unfeasible, but many, like *Entandrophragma spicatum* have known uses which leads one to speculate about the possibility of them being brought in from neighbouring areas.

Hybrids or forms are not uncommon in certain taxa e.g. *Stipagrostis* and *Hermannia* while *Microchloa kunthii* intergrades with *M. caffra*. Plants previously recorded, but no longer thought to occur there after taxonomic revision, have been excluded from the list, e.g. *Trema orientalis. Stapelia remota* from the Baynes mountains collected in an extremely dry year is no longer considered to be a valid species (Bruyns pers. comm.).

Considering the size of the area and its extent from the arid coast line to the more mesic east, certain plants are found only in specific areas e.g. the Kunene river banks include water plants (*Danthoniopsis lignosa, Echinochloa pyramidalis*), while the Ruacana area has a number of plants not recorded further west e.g. *Ledermanniella warmingiana*, the Namibian endemic *Ornithoglossum calcicola*, *Tetradenia riparia*, *Wissadula rostrata.* The coastal region includes *Ectadium rotundifolium, Merremia multisecta, Hermannia gariepina* and grasses like *Chloris flabellata, Cladoraphis cyperoides* and *Sporobolus virginicus* which are not found further east. Taxa known from southern Angola may be restricted to the area just south of the border, or occur only in southern Kaokoveld (and further south in Namibia) showing an interesting disjunct pattern e.g. *Strophanthus amboensis* or

Leucophrys mesocoma which occurs in the Kaokoveld and then again in southern Namibia.

4 Endemism

Endemic taxa are those confined to a particular and usually restricted geographical area. The number documented for the Kaokoveld is impressive, but no attempt has been made to explain historic events that may have led to the high degree of endemism here. More basic floristic research needs to be completed first, especially as recent and ongoing diversification has been suggested in certain genera e.g. *Petalidium* (MEYER 1957). Twenty-three plants are found only in the Kaokoveld south of the Kunene and these include three taxa that are known from type collection only, namely *Aponogeton azureus*, *Monechma serotinum* and *Priva auricoccea*. The others with limited distributions are: *Aloe corallina, Aloe dewinteri, Baynesia lophophora*, *Euphorbia kaokoensis, Euphorbia leistneri, Euphorbia otjipembana, Euphorbia pergracilis, Helichrysum erubescens, Hibiscus merxmuelleri, Indigofera anabibensis, Kirkia dewinteri, Lavrania haagnerae, Petalidium ohopohense, P. subcrispum, Plectranthus unguentarius, Rhinacanthus kaokoensis, Ruellia bignoniiflora, Salsola hoanibica, Sesamothamnus leistneri* ined. and *Turnera oculata* var. *paucipilosa.* Significant areas for the localised endemics are the Otjihipa and Baynes Mountains and the Khuwarib Schlucht in the south. Nearly all growth forms are represented among the endemics, but the majority are dwarf shrubs.

Taxa endemic to the Kaokoveld both north and south of the Kunene include a number of *Petalidium* and *Commiphora* species, but the presence of all in the north have not yet been confirmed. Plants also found in southern Angola include *Oxygonum acetosella*, *Ceraria carrissonana*, *Lotononis tenuis, Indigofera cunenensis* (along the coast), *I. teixeirae, Turnera oculata* var. *oculata, Hoodia parviflora, Lantana dinteri, Sesamothamnus benguellensis, Rogeria petrophila* and *Phaulopsis semiconica, Petalidium cirrhiferum, P. crispum, P. halimoides, P. physaloides, P.welwitschii, Ruellia currorii* and *Barleria cyanea.* The widespread and variable *Rhigozum virgatum* has not yet been recorded from Angola, but is expected to occur there.

Plants endemic to the north-west i.e. confined to the Kunene and northern Erongo regions include six taxa all from different families, e.g. *Barleria meeuseana, Ceraria longipedunculata, Cleome laburnifolia, Commiphora crenato-serrata, Cyphostemma omburense,* and *Stipagrostis ramulosa.* One taxon, *Commiphora giessii,* is fairly common, occurring only in the southern Kaokoveld, while others like *Boerhavia deserticola* and *Acacia montis-usti* also occur further south into the Erongo region.

The list of plants limited to southern Angola, the Kaokoveld and other western parts of Namibia, and occasionally the Cape, is extensive. They include the famous *Welwitschia mirabilis*, *Acanthosicyos horridus*, *Cyphostemma currorii*, *Acacia robynsiana* and *Moringa ovalifolia*. Others include *Balanites welwitschii, Boscia microphylla, Cadaba schroeppelii* and a number of species from the Acanthaceae and Burseaceae families.

Nearly a hundred taxa that occur only within the political boundaries of Namibia have been recorded from the Kaokoveld. This means that about 20% of all taxa endemic to Namibia are found in this area.

5 Conservation

"Hotspots" (areas containing a high number of species with a high proportion of endemic species) like the Kaokoveld, are conservation priorities as they have high biodiversity values. Although the Kaokoveld's community-based conservation and tourism policies have contributed to the survival of its wildlife, much still needs to be done, especially with regard to plants. Uncontrolled tourist access and use of the area, especially by off-road vehicles, is having a detrimental effect and appropriate regulations need to be put in place. The numerous threats to the biodiversity may have resulted in the demise of some of the rarer plants already and potential loss for the local people who are already experiencing diversity loss due to increased pressure from the human and stock populations and regular droughts.

Forty-one plants are still listed on the outdated Nature Conservation Ordinance of 1975 and a further 37 are covered by Forestry Ordinance. Both ordinances have been under review since Namibia achieved independence over 10 years ago. Active law enforcement remains a problem as there is a shortage of staff at the Ministry of Environment and Tourism and the new legislation may be insufficient to protect vulnerable species. Plants that grow in the Kaokoveld and are listed on CITES (Convention on International Trade in Endangered Species of Fauna and Flora) Appendix II include *Welwitschia mirabilis*, nine *Aloe* species, *Ansellia africana*, an *Anacampseros* species, *Pachypodium lealii* and all succulent *Euphorbia* species. Five *Ceropegia* species were recently down-listed by CITES despite recommendations from Namibia that the genus remains listed.

Twenty taxa were listed as rare on the Red Data List of HILTON-TAYLOR (1996) using the old criteria of the IUCN. Another was evaluated as vulnerable and about 26 as insufficiently known. Later publications (HILTON-TAYLOR 2000, OLDFIELD, *et al.* 1998) using the 1994 IUCN categories, mention few Kaokoveld species. This will be rectified shortly as the threatened plants project of the NBRI is presently engaged in evaluating the status of all Namibian taxa according to the new IUCN system. The results will be published in conjunction with ten other Southern African countries under the auspices of the Southern African Botanical Diversity Network (SABONET). Three species have already been evaluated as Critically rare, six plants as Endangered and four are considered Vulnerable. All Namibian endemic, near-

endemic and potentially over-utilised species are under the spot-light.

The potential use of resources and the estimated costs and benefits associated with plant diversity conservation and sustainable use in the Kaokoveld need to be addressed. Hopefully this will be achieved in conjunction with other fields of expertise - environmental economists, anthropologists, etc.

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References

ARCHER, R.H. 1998. Euphorbia leistneri (Euphorbiaceae), a new species from the Kaokoveld (Namibia). South African Journal of Botany 64,4:258-260.

BOLLIG, M. (1997): Risk and risk minimisation among the Himba pastoralists in north-western Namibia. In: Göbel, B. & BOLLIG, M. (eds.) Risk and Risk Minimization in Pastoral Societies, Nomadic People 42:66-89.

BOLLIG, M. & SCHULTE, A. (1999): Environmental Change and pastoral perceptions: degradation and indigenous knowledge in two African Pastoral Communities. Human Ecology 72,3:493-514.

BRUYNS, P.V. (2000): Baynesia, a new genus of Stapeliad from the northwestern-most corner of Namibia (Apocynaceae). Novon 10:354-358.

CRAVEN, P. (ed.) (1999):. Checklist of Namibian Plant Species. Southern Africa Botanical Diversity Network Report No. 7 SABONET, Windhoek. 204 pp.

CRAVEN, P. (2000a): Additions and Corrections 1. Checklist of Namibian Plant Species, April 2000. SABONET News 5,1:21-23.

CRAVEN, P. (2000b): Additions and Corrections 2. Checklist of Namibian Plant Species, August 2000. SABONET News 5,2:102-103.

CRAVEN, P. & MAGGS, G.L. (1993): Checklist: Kaokoveld. National Botanical Research Institute, Windhoek. Unpublished.

CRAVEN, P. & CRAVEN, D. (2000): The flora of the Brandberg, Namibia. In Kirk-Sprigs, A.H. & Marais, E. Biodiversity of the Brandberg Massif, Namibia. Cimbebasia Memoir 9.

CRAVEN, P. (2001): Checklist: Kaokoveld. National Herbarium of Namibia, National Botanical Research Institute, Windhoek. Unpublished.

DAVIS, S.D. & HEYWOOD, V.H. (ed.). (1994): Centres of Plant Diversity: A Guide and Strategy for their Conservation. Oxford University Press, Oxford.

DE SOUSA CORREIRA, R.I. (1976): Main vegetation types of Kaokoland, North Damaraland and some transects of Owambo, Etosha and north west South West Africa (1st approximation). Unpublished Report: Department of Co-operation and Development.

EICKER, A., THERON, G.K. & GROBBELAAR, N. (1982): 'n Mikrobiologiese studie van 'kaal kolle' in die Giribesvlakte van Kaokoland, SWA/Namibie. South African Journal Botany 1:69-74.

ELOFF, F.C., BOTMA, J. DU P., THERON, G.K. & VAN RIET, W. (1977): Meesterplan vir die bewaring, bestuur en benutting van natuurreservate in Damaraland and Kaokoland. Unpublished report, part 1. University of Pretoria.

GIESS, W. (1968): A short report on the vegetation of the Namib coastal area from Swakopmund to Cape Frio. Dinteria 1:13-29.

GIESS, W. (1971): A preliminary vegetation map of South West Africa. Dinteria 4:5-114.

GOYNS, H.G. (1971): The Baynes Mountains: A reconnaissance. South African Journal of Science.

GUNN, M. & CODD, L.E. (1981): Botanical Exploration of Southern Africa. Balkema, Cape Town. 400 pp.

HALL, H. (1951): Plant collecting in the Kaokoveld. Journal of the Botanical Society of South Africa.

HILTON-TAYLOR, C. (1994): Karoo-Namib Region: Kaokoveld. In DAVIS, S.D. & Heywood, V.H. (eds). Centres of plant diversity: a guide and strategy for their conservation. Oxford University Press, Oxford. 201-203.

HILTON-TAYLOR, C. (1996): Red Data List of southern African plants. Strelitzia 4. 117 pp.

HILTON-TAYLOR, C. (Compiler) (2000): 2000 IUCN Red List of Threatened Species. IUCN, Gland, Switzerland and Cambridge, UK, 61pp. & CD.

IRISH, J. (1994): The biomes of Namibia, as determined by objective categorisation. Nationale Museum Bloemfontein. 10,13:550-585.

JACOBSEN, N.H.G. & MOSS, H. (1987): A contribution to the flora of the Northern Namib. Dinteria 19: 27-68.

JACOBSON, N.H.G. (1988): Euphorbias of the Skeleton Coast National Park: Namibia and Adjacent Areas. Euphorbia Journal 5.

JACOBSON, N.H.G. (1994): Kaokoveld Euphorbias. Euphorbia Journal 9:154-173.

JOUBERT, E. (1971): The physiographic, edaphic and vegetative characteristics found in the western Etosha National Park. Madoqua 1:55-32.

JÜRGENS, N & BURKE, A. (2000): The arid scenario: indelbergs in the Namib desert are rich oases in a poor matrix (Namibia & South Africa). In: Porembski, S & Barthlott, W. (eds) Ecological Studies 146: Inselbergs 10,3:237-257.

LEACH, L.C. (1976): Euphorbia (Tetracanthae) in Angola and northern Kaokoland. Dinteria 12:1-35.

LOXTON, R.F., HUNTING & ASSOCIATES. (1974): Report on a reconnaissance survey of the Natural Resources of Kaokoland. Unpublished Report: Department of Co-operation and Development.

MAGGS, G.L. (1998): Plant diversity in Namibia. In: Barnard, P (ed). Biological diversity in Namibia: a country study. Namibian National Biodiversity Task Force, Windhoek. pp 116-122.

MAGGS, G.L., KOLBERG, H.H. & HINES, C.J.H. (1994): Botanical diversity in Namibia - an overview. in B.J. Huntley (ed.) Botanical Diversity in Southern Africa. Strelitzia 1:93-104.

MALAN, J.S. & OWEN-SMITH, G.L. (1974): The Ethnobotany of Kaokoveld. Cimbebasia ser B(2):131-178.

MEYER, P.G. (1973): Neue und wenig bekannte Acanthaceen aus dem Kaokoveld (SWA). Mitteilungen aus der Botanischen Staatssammlung, München. 11:101-103.

MOLL, E.J. (1994): The origin and distribution of fairy rings in Namibia. In: Seyani, J.H. & Chikuni, A.C. Proc. X111 Plenary Meeting AETFAT, Malawi, 2:1203-1209.

NORDENSTAM B. (1974): The Flora of the Brandberg. Dinteria 11:3-67.

OLDFIELD, S., LUSTY, C. & MACKINVEN, A. (1998): The World List of Threatened Trees. World Conservation Press, Cambridge, UK. 650 pp.

SANDER, H. & BECKER, T. (2001): Klimatologie des Kaokolandes. This issue.

SANDER, H., BOLLIG, M. & SCHULTE, A. (1998): Himba Paradise Lost. Stability, Degradation and Pastoralist Management of the Omuhonga Basin (Namibia) Die Erde 129:301-315.

TARR, P.W. & TARR, J.G. (1989): Veld dynamics and utilization of vegetation by herbivores on the Ganias Flats, Skeleton Coast Park, South West Africa/ Namibia. Madoqua 16:15-22.

THERON, G.K. (1979): Die verskynsel van kaal kolle in Kaokoland, Suidwes-afrika. Journal South African Biological Society 20:43-53.

VAN DER WALT, J.J.A. (1973): A new species of Commiphora from the Kaokoveld (SWA). Dinteria 9:23-31.

VILJOEN, P.J. (1980): Veldtipes, verspreiding van die groter soogdiere en enkele aspekte van die ekologie van Kaokoland. Unpublished MSc thesis. University of Pretoria.

VILJOEN, P.J. (1989): Habitat selection and preferred food plants of a desert-dwelling elephant population in the northern Namib Desert, South West Africa/Namibia. African Journal of Ecology 27:227-240.

VILJOEN, P.J. & BOTHMA, J.D.P. (1990): The influence of desert-dwelling elephants on vegetation in the northern Namib Desert, South West Africa/Namibia. Journal Arid Environments 18:85-96.

VOLK, O.H. (1966): Die Florengebiete von Südwestafrika. Journal of the South West African Scientific Society 20: 25-58.

VON KOENEN, E. (1996): Heil-, Gift- und Essbare Pflanzen in Namibia. Klaus Hess Verlag, Gottingen.

WARDELL-JOHNSON, G., JANKOWITZ, W., RIMSTEIN, C & LOUTCHANSKA, E. 1997. Vegetation and flora in the area of a proposed hydropower project on the lower Cunene River on the border of Namibia and Angola. In: Burmeister & Partners. 1997. Draft feasibility study. http://burmeister.com.na/pub/epupa/draft_feasibility_study.html/.

WHITE, F. (1965): The savanna - woodlands of the Zambezian and Sudanian Domains. *Webbia* 19:651-681.

WHITE, F. (1983): *The vegetation of Africa.* UNESCO, Paris.

ACRONYMS

CITES - the Convention on International Trade in Endangered Species of Fauna and Flora

IUCN – International Conservation Union

RDL – Red Data List

SABONET – Southern African Botanical Diversity Network