Vegetation on the ultramafic soils of the Sekhukhuneland Centre of Endemism

by

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Submitted in partial fulfilment of the requirements of the degree

Philosophiae Doctor

in the Faculty of Natural and Agricultural Sciences

Department of Botany

University of Pretoria

Pretoria

promoters:

Prof. Dr A.E. van Wyk
Prof. Dr G.J. Bredenkamp

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"The primary tactic in conservation must be to locate the world's hot spots and to protect the entire environment they contain"

E.O. Wilson (1992)

"Ecology is the scientific study of the interactions that determine the distribution and abundance of organisms in nature"

C.J. Krebs (1978)

I live to honour God, and I present this thesis to Him, who thought it well to provide me with opportunities that I am certainly not worthy of.

ABSTRACT

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A floristic-ecological account of the vegetation of the Sekhukhuneland Centre of Plant Endemism (SCPE) is given. This is the first comprehensive botanical study undertaken in this floristically poorly known region. A brief review of the physical environment, namely topography, geology, soils and climate, as well as the vegetation and flora, is presented.

Data from 415 sample plots were subjected to phytosociological classification using TWINSPAN and refined with table-sorting procedures based on the Braun-Blanquet approach. The analysis revealed six major vegetation types consisting of 82 syntaxa, interpreted as *Fuirena pubescens–Schoenoplectus corymbosus* Wetland Vegetation, *Themeda triandra–Senecio microglossus* Cool Moist Grasslands, *Hippobromus pauciflorus–Rhoicissus tridentata* Rock Outcrop Vegetation, *Combretum hereroense–Grewia vernicosa* Open Mountain Bushveld, *Kirkia wilmsii–Terminalia prunioides* Closed Mountain Bushveld and *Acacia tortilis–Dichrostachys cinerea* Arid Northern Bushveld. Plant communities of each major vegetation type are described and diagnostic and rare/threatened species highlighted.

Thirteen rock types of the SCPE were analysed to evaluate the chemical relationships with serpentinite. Maize seedlings were grown in ultramafic soils of the SCPE and showed

symptoms of nickel and chromium toxicity. Plant material of indigenous species and soil samples were sampled along 13 points of a catena in the SCPE and analysed with recognised analytical methods to determine the levels of 33 elements. Nine SCPE endemics, three SCPE near-endemics, and eight common species were analysed. None of the plant taxa were hyperaccumulators of chromium or nickel, but seven species accumulated more than 1000 mg/kg of iron and aluminium. The accumulators were mostly common species and included one SCPE endemic form and one SCPE near-endemic. Three of the hyperaccumulators belong to the Asteraceae.

The threat status of 80 plant species of the SCPE was assessed using IUCN categories and 26 met these criteria. A first division of the SCPE into subcentres is presented to aid future conservation strategies. The SCPE endemic, near-endemic and disjunct plant taxa are listed, as well as those species shared with other centres or floristic regions. Major threats to the plant diversity of Sekhukhuneland are considered and a probable conservation solution presented. A checklist is given of the approximately 2000 plant taxa of the 4000 km^2 of the SCPE and arranged according to family, with genera and species listed alphabetically within the families. This analysis supports the recognition of the region as an important Centre of Plant Endemism and Diversity requiring conservation attention.

Keywords: biodiversity, Centre of Plant Endemism, chromium, conservation, endemism, grassland, heavy metals, hyperaccumulation, Mpumalanga, Northern Province, phytosociology, platinum, Red Data List, Rustenburg Layered Suite, savanna, Sekhukhuneland, TWINSPAN, ultramafic rocks.

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LIST OF ABBREVIATIONS

CBD = Convention on Biological Diversity

GIS = Geographical Information System

PRE = National Herbarium, Pretoria

PRECIS = Pretoria National Herbarium Computerised Information System

PRU = H.G.W.J. Schweickerdt Herbarium, University of Pretoria

QDG = Quarter Degree Grid

RLS = Rustenburg Layered Suite

SCPE = Sekhukhuneland Centre of Plant Endemism

SUMMARY

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The vegetation types of South Africa, and especially those associated with Centres of Endemism, are under increasing human pressure. Habitat loss as a result of open cast mining, mine dumps, population growth, overgrazing, trampling and alien species invasions, is the greatest threat to the Sekhukhuneland Centre of Plant Endemism (SCPE). A floristic-ecological account of the threatened vegetation of the SCPE is given. This is the first comprehensive botanical study undertaken in this floristically poorly known region situated west of the northeastern Drakensberg Escarpment, between 24°15' and 25°30'S latitude, 29°30' and 30°30'E longitude. A brief review of the physical environment, namely topography, geology, soils and climate, as well as the vegetation and flora, are given.

A detailed account is given of the vegetation types of the SCPE. Phytosociological data from 415 sample plots were subjected to phytosociological classification using TWINSPAN and refined with table-sorting procedures based on the Braun-Blanquet floristic-sociological approach. The vegetation classification revealed six major vegetation types consisting of 82 syntaxa, interpreted as *Fuirena pubescens–Schoenoplectus corymbosus* Wetland Vegetation, *Themeda triandra–Senecio microglossus* Cool Moist Grasslands, *Hippobromus pauciflorus–Rhoicissus tridentata* Rock Outcrop Vegetation, *Combretum hereroense–Grewia vernicosa* Open Mountain Bushveld, *Kirkia wilmsii–Terminalia prunioides* Closed

Mountain Bushveld and *Acacia tortilis–Dichrostachys cinerea* Arid Northern Bushveld. Plant communities of each major vegetation type are described and the diagnostic species highlighted, with the occurrence of rare and threatened plant species indicated.

Maize seedlings that were grown in ultramafic soils of the SCPE showed typical symptoms of nickel and chromium toxicity. To further investigate heavy metal accumulation, 20 indigenous plant species were sampled along 13 points of an ultramafic catena. Plant material and soil samples were analysed with recognised analytical methods to determine the concentrations of 33 elements. Thirteen rock types of the SCPE were analysed to highlight the chemical relationship between the rocks of the study area and serpentinite. Nine SCPE endemics, three SCPE near-endemics, and eight common species were analysed. None of the plant taxa were hyperaccumulators of chromium or nickel, but seven indigenous species accumulated more than 1000 mg/kg of iron and aluminium. The accumulators of high heavy metal concentrations were mostly common species. Accummulators included one SCPE endemic form and one SCPE near-endemic. Three of the hyperaccumulators belong to the Asteraceae.

Eighty plant species of the SCPE were assessed according to the IUCN categories of threat and 26 met the criteria. A first division of the SCPE into sub-centres is presented to aid future conservation actions. The endemic plant species are listed, as well as the near-endemic and disjunct taxa that are shared with other centres or floristic regions. A checklist is given of the approximately 2000 plant taxa that occur in the 4000 km^2 of the SCPE and are arranged by family, with the genera and species listed alphabetically within. Major threats to the plant diversity of Sekhukhuneland are considered and a probable conservation solution presented. The available data supports the recognition of the region as an important Centre of Plant Endemism and Diversity requiring conservation attention.

OPSOMMING

Plantegroei op die ultramafiese grond van die Sekhukhuneland Sentrum van Endemisme

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Die plantegroeitipes van Suid-Afrika, en veral die wat geassosieer is met Sentrums van Endemisme, is onder toenemende druk as gevolg van ontwikkeling. Habitat verlies as gevolg van oopgroef mynbou, mynhope, bevolkingsgroei, oorbeweiding, vertrapping en indringerplante, is die grootste bedreiging vir die Sekhukhuneland Sentrum van Plant Endemisme (SSPE). 'n Floristies-ekologiese ondersoek van the bedreigde plantegroei van die SSPE word aangebied. Dit is die eerste indiepte botaniese studie wat onderneem is in hierdie floristies onbekende gebied wat geleë is aan die westekant van die noordoostelike Drakensberg Eskarpement tussen 24°15' en 25°30'S breedtegraad, en 29°30' en 30°30'O lengtegraad. 'n Kort oorsig van die fisiese omgewing, naamlik die topografie, geologie, grond en klimaat, asook die plantegroei en flora, word aangebied.

'n Gedetaileerde ondersoek handelend oor die plantgemeenskappe van die SSPE word voorgelê. Fitososiologiese data wat in 415 plotte ingesamel was, was onderwerp aan fitososiologiese klassifikasie met behulp van TWINSPAN. Die resultate was verfyn met tabelsorterings tegnieke wat gebaseer is op die Braun-Blanquet floristies-sosiologiese benadering. Die plantegroei klassifikasie het ses hoof plantegroeitipes onderskei wat bestaan uit 82 syntaksa, geinterpreteer as die *Fuirena pubescens–Schoenoplectus corymbosus*

Vleiland Plantegroei, *Themeda triandra–Senecio microglossus* Koel Vogtige Grasveld, *Hippobromus pauciflorus–Rhoicissus tridentata* Rots Dagsoom Plantegroei, *Combretum hereroense–Grewia vernicosa* Oop Berg Bosveld, *Kirkia wilmsii–Terminalia prunioides* Geslote Berg Bosveld and *Acacia tortilis–Dichrostachys cinerea* Ariede Noordelike Bosveld. Plantgemeenskappe van elke hoof plantegroeitipe is beskryf en die diagnostiese spesies beklemtoon. Die teenwoordigheid van skaars en bedreigde spesies is aangedui.

Mielie saailinge is aangeplant in ultramafiese grond van die SSPE en het tipiese simptome van nikkel en kroom vergiftiging getoon. Om swaar metaal akkumulering verder te ondersoek, is 20 inheemse plantspesies versamel langs 13 punte van 'n ultramafiese katena. Plantmateriaal en grondmonsters was geanaliseer met erkende analitiese metodes om die konsentrasies van 33 elemente te bepaal. Dertien rots tipes van die SSPE was ook geanaliseer om the chemiese verband tussen die gesteentes van die studiegebied en serpentyn uit te wys. Plantmateriaal van nege SSPE endemiese, drie SSPE naby endemiese, en agt algemene spesies was geanaliseer. Nie een van die plant taksa was hiperakkumuleerders van kroom of nikkel nie, maar sewe inheemse spesies het meer as 1000 mg/kg van yster en aluminium geakkumuleer. Die akkumuleerders van hoë swaar metaal konsentrasies was meestal algemene spesies. Die akkumuleerders sluit een SSPE endemiese form en een SSPE naby endemiese spesie in. Drie van die hiperakkumuleerders is van die Asteraceae.

Tagtig plantspesies van die SSPE was geëvalueer op grond van die IUCN kategorieë van bedreiging en 26 spesies het hieraan voldoen. Vir die eerste keer is die SSPE opgedeel in subsentrums om toekomstige bewaringsaksies te ondersteun. Die endemiese plantspesies word gelys, asook die naby endemiese en disjunk taksa wat gedeel word met ander sentrums of floristiese gebiede. 'n Spesielys is opgestel van die ongeveer 2000 plant taksa wat in die 4000 km^2 van die SSPE voorkom. Die lys is alfabeties gerangskik volgens familie, met die genusse en spesies alfabeties gerangskik daarbinne. Aspekte wat die plant diversiteit van Sekhukhuneland bedreig is oorweeg en 'n moontlike oplossing vir bewaring word voorgestel. Die beskikbare data ondersteun die erkenning van die studiegebied as 'n Sentrum van Endemisme en Diversiteit wat dringend aandag benodig as 'n belangrike bewaringsgebied.

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CURRICULUM VITAE

Stefan John Siebert was born on 27 September 1974 in Empangeni, KwaZulu-Natal. He attended Mandini Primary School and later King Edward High School in Matatiele, KwaZulu-Natal, where he matriculated in 1992.

In 1993 he joined the South African Defence Force, where he became an officer and obtained the rank of second lieutenant at 4 Artillery Regiment in Potchefstroom.

In 1994 he enrolled at the University of Pretoria, and was awarded his B.Sc. degree in 1996, with Botany and Zoology as majors.

He registered for an Honours degree in Botany at the University of Pretoria in 1997 and specialised in taxonomy and ecology. He obtained this degree *cum laude* and recieved the H.G.W.J. Schweickerdt Medal for Botany at the Honours level.

In 1998 he registered for a Master of Science degree in Botany at the same university, specialising in the plant diversity of the ultramafic rocks of Sekhukhuneland. He completed his research dissertation that same year and was awarded the degree *cum laude*.

From 1999 to 2001 he pursued and completed a Doctor of Philosophy Degree with the title: *Vegetation on the ultramafic soils of the Sekhukhuneland Centre of Endemism*. His botanical work in the Sekhukhuneland Centre culminated in ten presentations in South Africa, one in the United States of America and one in Australia. Four articles have been submitted and accepted by scientific journals, and six articles are in preparation. Various articles have also been prepared and submitted to popular journals.

He is currently employed as the Regional Coordinator of the Southern African Botanical Diversity Network (SABONET) at the National Botanical Institute of South Africa (2001-2002).