grass roots

Newsletter of the Grassland Society of Southern Africa

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Stall-feeding goats with market residues

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Editorial

Dear Members

Happy New Year, and I trust you had a reasonable break and a chance to recharge the batteries.

On January 22nd, the Cape Times broke the news of the discovery of Theo Manuel's murdered body in his home. His friends and colleagues were devastated at the news. Theo was not a member of the GSSA, but he was a dedicated conservationist and a member of the Fynbos Forum, and many of our members knew him well. Our sincere condolences to his family and friends.

I hope some of you (in the brief periods when you have electricity) have been able to visit the Society's new website. It's looking fantastic, and is packed full of useful and interesting features. Khanyi and Freyni have done a superb job of keeping the website relevant. One feature of the new website that I'd urge all of you to utilize is an electronic archive of member's publications—so if you have dissertations or useful reports of general interest, please send them through.

Alan Short

The Grassland Society of Southern Africa is dedicated to the advancement of the science and practice of range ecology and pasture management.

We welcome any contributions to the Grassroots*, in the form of news, informative articles, reports, short research notes, scientific papers and letters to the Editor. Email alan.short@dae.kzntl.gov.za or admin@gssa.co.za or fax 033-3559 605 or 033-390 3113*

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On the cover: Advanced degradation (p. 15). Photo: Brent Forbes

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News

Contribute to Valuable African Remote Sensing Market

The GSDI Association has joined forces with the U.S. Geological Survey (USGS) and Global Marketing Insights, Inc. to collect African Remote Sensing Research. Your industry knowledge and insight is needed to complete this valuable research.

Please take a few minutes to complete this survey by going to the URL link below and selecting the appropriate survey that best represents the area that you are employed in or affiliated with. www.empliant.com/USGS-remote-sensing-research

The U.S. Geological Survey (USGS) has awarded the 2008 USGS Remote Sensing survey and analysis of the AFRICAN Remote Sensing Market to Global Marketing Insights, Inc. as a follow on to last years study of Asia, North America and Europe (which was sponsored previously by U.S. National Oceanic and Atmospheric Administration (NOAA). This study which will survey the African Remote Sensing market will focus on remote sensing data type usage, application usage and data needs as well as include both a five-and ten-year analysis of the political, economic and technical trends impacting the African remote sensing market globally and will be completed by year-end 2008.

If you are interested in participating as an Alliance Team Member please contact Sherryloy at sherryloy @globalinsights.com.

This research will be free to everyone who participated in the survey at year end 2008 by logging onto http://www.globalinsights.com. To access both the 2005 U.S., Canada and Europe, and the 2006 final studies please go to www.globalinsights.com/splash.asp Thank you for assisting in the collection of this industry research!

Conservationist found murdered in Cape Town home

Award-winning conservationist Theo Manuel was found murdered in his home in Cape Town, the Cape Times reported on 22 January. Theo was a valued member of the Fynbos Forum. In 2006 he was awarded a Silver medal by the Cape Action for People and the Environment (CAPE) for his PhD work on the attitudes of the communities of Mitchell's Plain and Khayelitsha to the Wolfgat Nature Reserve. Theo had extensive conservation experience in several government departments, in addition to working as a maths and biology teacher in Mitchell's Plain. He had recently established a private environmental consultancy. Theo was much admired for overcoming major physical disabilities to reach his goals.

Grasslands Research Task Team meets for the first time

Mahlodi Tau
National Grasslands Biodiversity Programme
Email: tau@sanbi.org

The 1st Grasslands Research Task Team meeting of the National Grasslands Biodiversity Programme (*see article on page 8*) was held on the 31st January 2008 at SANBI offices – Pretoria. The Research Task Team members met to discuss processes to develop a research strategy and to identify research priorities in the grasslands biome.

SANBI has been tasked with developing a national biodiversity research strategy which is a priority under the National Biodiversity Framework (NBF). The NBF states that a national research strategy should articulate priorities by biome, guide allocation of research funding and should link with bioregional programme research strategies where these exist. The Grasslands research strategy will therefore link with the national biodiversity research strategy and should identify research priorities that need to be addressed to further conservation implementation in the grasslands biome. To achieve this, the research priorities and research areas in the strategy will be guided primarily by the National Biodiversity Strategy and Action Plan (NBSAP) and secondarily by the priorities of the National Biodiversity Framework.

The Task Team agreed to prepare a first draft of the grasslands research strategy that will be available for comment in June 2008. The strategy will be circulated to all programme stakeholders via e-mails, will also be accessed from the Grasslands Programme website, and will liaise with GSSA to publish draft in the *Grassroots* newsletter for further comments.

Three key research areas were identified for the grasslands biome research strategy:

- **Threats and drivers of change:** Research questions under this theme focus on the biodiversity impact by different land uses and climate change, the need to understand consequences of such threats and identify drivers of change for optimal biodiversity management. Other key questions include the effects of fragmentation, effects of restoration methodologies and to better understand land uses and their implications for biodiversity, such as under livestock grazing.
- **Ecological dynamics of grasslands:** Key research questions include the need to better understand the dynamics and diversity of grassland vegetation types and to identify impact of threats on species dynamics.
- **Quantify the value of grasslands:** Research questions include an economic assessment of different vegetation types within the grasslands biome, and quantifying ecosystem services of the grasslands in the light of major economic activities (e.g. mining, urban development, etc).

Bursaries

Savanna and grassland research opportunities

Post-graduate research opportunities are available in our Zululand Tree Project funded by the NRF and the Andrew Mellon Foundation. The main focus of our research is on what limits trees in grassy biomes. C4 grassy biomes occupy about a quarter of the world's vegetated land surface and are the most widespread ecosystems in Africa. They support a large proportion of the world's human population in the tropics, and are of central importance for conservation of Africa's surviving megafauna. There is also growing recognition that grassy biomes have large impacts on earth systems and that changes within them may have major feedbacks on global climate. Variation in woody cover is of central importance to utilisation, conservation, and vegetation/climate feedbacks. Tree cover varies greatly both spatially and temporally in C4 grassy ecosystems. The causes of this variability remain controversial and unresolved after nearly a century of debate. This means that we are still unable to make clear predictions on the future of grasslands and savannas in response to global change nor can we evaluate the potential for changing tree cover to contribute to global change.

We are exploring both top-down (fire, herbivory) and bottom-up (nutrients, climate, grass competition) limitations on tree cover using a variety of research approaches. We have used experiments to test competing ideas, modelling to help generalise the work, and remote sensing to extend the geographic domain of analysis. Though the field team is based in Hluhluwe–Imfolozi Park in KwaZulu-Natal, we also work in Kruger National Park and in private and public lands where appropriate for the problem. We have research links with groups elsewhere in Africa, Madagascar, Australia, North America and South America and have encouraged visits by our postgraduates to other regions to help broaden their experience. Within UCT, we work closely with Ed February, Lindsey Gillson and Jeremy Midgley with interests in ecophysiology and stable isotope ecology, palaeoecology and population biology respectively.

We have postgraduate bursaries available for 2008 within our ZLTP programme. If you are interested in postgraduate work with us, please contact William Bond and Mike Cramer in the Botany Department, UCT, for more information.

William.bond@uct.ac.za
Michael.cramer@uct.ac.za

Membership Changes

The GSSA saw a number of changes in membership in 2007, with several veterans retiring and a number of new people joining the Society. The Society membership continues to grow—there were 18 resignations and 24 applications for membership. In future, a regular column with the names and some background of new and retiring members will be published in each issue of the *Grassroots*.

Resignations:

Dr Pete Bartholomew
Mr Clement Cupido
Mr Russell Dalldorf
Mr Gideon de Klerk
Mr Gerhard de Kock
Mr Rick Dillon
Ms Sheila Househam
Mr Bryan Mappledoram
Mr Rob Markham
Dr Neil Miles
Mr Geoff Painter
Mr Mark Rynhoud
Mr Trevor Simpson
Mr Richard Smart
Dr Francois Smith
Mr Louis Steyn
Mr Graeme Tupper
Prof Dirk Wessels

New members

Ms Yvette Brits
Mr Charl du Plessis
Mr Patrick Duigan
Mr Brad Fike
Ms Lisa Hebbelmann
Mr Dylan Ludick
Ms Jennifer Manganye
Mr Jameson Masingi
Mr Chris Mbuti
Mr Ntuthuko Mkhize
Ms Mosima Molopa
Mr Musawenkosi Fano Msomi
Mr Messia Mtshali
Mr Petros Ngwenya
Ms Phuti Phukubye
Mr Patrick Ramaselele
Mr Sauli Ramatla
Mr Keith Ramsay
Mr Tshepo Sefara
Dr Adrian Shrade
Mr Trenly Spence
Mr Tian von Wielligh
Ms Julia Wakeling

Upcoming events

From www.grassland.org.za

Universities in southern Africa as catalysts for sustainable rural development

Date: 6 - 7 March 2008
Venue: Kopanong Conference Centre, Johannesburg
Contact: Ndinannyi Brutus Malada
E-mail: brutus@cepd.org.za
Website: www.cepd.org.za

3rd African Biofuels Conference

Date: 10 - 13 March 2008
Venue: Vodaworld, Midrand, South Africa
Contact: Craig Steward
Tel: 011-771 7114
E-mail: csteward@iir.co.za
Website: www.africanbiofuels.co.za/

Agriculture Development through Human Capacity Building
Date: 27 March - 14 April 2008
Venue: Galillee College, Israel
Contact: Mariel Ostrower
E-mail: mostrower@galilcol.ac.il

ISTA Seed Health Testing Workshop
Date: 7 - 11 April 2008
Venue: University of Pretoria, Pretoria, South Africa
Contact: Prof Theresa A.S. Aveling
Email: Terry.Aveling@up.ac.za
Website: www.seedtest.org

The 6th Seed Health Symposium: The International Seed Testing Association
Date: 14 - 18 April 2008
Venue: Berg en Dal Camp, Kruger National Park, South Africa
Contact: Prof Theresa A.S. Aveling
Email: Terry.Aveling@up.ac.za
Website: www.up.ac.za/conferences/ielc/

Royal Society of South Africa Centenary Congress
Date: 17 – 18 April 2008
Venue: Breakwater Lodge, Cape Town, South Africa
Contact: Dr Margaret Avery
E-mail: mavery@iziko.org.za

Portuguese Pasture and Forages Society—XXIX spring meeting of SPPF
Theme: Pastures and biodiversity: **New Opportunities for Forage Production**
Date: 7 -9 May 2008
*Deadline for abstracts:*15 November 2007
*Deadline for texts:*15 February 2008
Venue: Centro Cultural de Samora Correia, Companhia das Lezírias, Portugal
*Contact:*Jerónimo Pinto
Email: sppf29primavera@gmail.com

Organisation and Management in the Seed Sector Training Programme
Date: 23 June - 4 July 2008
Venue: Berlin, Germany
Contact: Dr. Walter Haege
Email: walter.haege@gmx.net

43rd Annual Congress of the GSSA
Date: 21-25 July 2008
Venue: Aventura Badplaas, Mpumalanga, South Africa
Tel: +27 (0)33 390 3113
Contact: Freyni du Toit
Email: admin@gssa.co.za
Website: www.grassland.org.za/annual-congress/2008

Joint Forum- AZEF and FF
Date: 3-7 August 2008
Venue: Oudtshoorn, South Africa
Further information will be made available soon

New World: Future World
The 10th World Conference on Animal Production;
Date: 23-28 November 2008
Venue: Cape Town International Convention Centre, South Africa
Tel: +27 12 420 3276 or +27 12 420 3290
Contact: Darlynne Louw
Email: wcap@up.ac.za

Council News

The Council met on 24 January in Johannesburg for their first meeting of 2008.

The theme for Congress 43 – New approaches to range and pasture science – has already sparked interesting discussions, and various relevant symposia and special sessions covering various topics are being planned. A number of these symposia and special sessions are specifically aimed to attract practitioners and farmers in the area. Delegates can also look forward to exciting post congress tours, such as a visit to the long term burning trials in the Kruger National Park. Remember to visit the website for updates and further information.

Council would like to thank everybody who sent suggestions and comments regarding the new website. At this moment the website is very user friendly and interactive, but we would like to ask members to continue sending updates to Freyni du Toit or Khanyi Mbatha. We would also like to receive interesting photos, reports and dissertations to feature on the website.

Very exciting news is that NISC, the publisher of the Journal, has started testing the online article submission and tracking system on the African Journal of Range and Forage Science – so now is the time to submit all those finished manuscripts you have lying around in your office!

An improved Trust funding application form has been developed and will be in use very shortly. This will make the application for Trust funds as well as the dispersal thereof a lot easier.

Council is currently looking into ways to improve the linkage between the rangeland and pasture industries and welcomes any suggestions or comments in this regard.

The first ever Annual Report of the GSSA has been completed and is currently available on the website.

A full review of the GSSA Strategic Plan will take place at the end of March. Please feel free to contact Council if there is anything that you would like to include in the review.

Report on the Grassland Research Meeting held on the 22nd November 2007 at SANBI – Pretoria.

Mahlodi Tau
SA National Biodiversity Institute
National Grasslands Biodiversity Programme
Email: tau@sanbi.org

Introduction

As the Grassland Programme embarks on the implementation of a 5 year mainstreaming strategy in early 2008, a concern was raised regarding lack of research agenda in the Programme. The Programme comprises of four production sectors (i.e. urban, agriculture, forestry and coal mining) and Task Team for each sector to oversee and coordinate its strategic plans. This report outlines some of the discussions and recommendations agreed from the meeting on research needs of the Programme and the Grassland Biome. Among some of the reasons for a discussion on constituting the Research Task Team were concerns regarding lack of structured research body of the Programme and fragmented research collaborations from institutions working in the Biome. The Programme Task Teams recommended a more structured research agenda and strategy to address research opportunities from the four production sectors.

A synopsis of research priorities in the grassland biome

Prior to the meeting a questionnaire was distributed from the Grassland Coordinating Unit to relevant scientists working in the biome to give preliminary suggestions on research gaps and priorities in the biome. Over 20 scientists from different disciplines identified a wide range of key areas for research considerations and were categorized into key research disciplines, namely, Hydrology, Ecology, Environmental Law, Climatology, Agriculture and Social studies. Some of the key research themes within the six disciplines mentioned above were: climate change which poses a serious thereat to the biome and its likely impact on the grassland ecosystem, production, livelihood and national policies should be understood; the threats posed by Land use activities such as biofuels needs to be understood, ecological functioning of the biome which answers questions of biodiversity restoration, functionality of ecosystem services, and ecological monitoring; grassland economics to research the value of ecosystem services, quantifying value of land use compatibility etc; social studies to investigate the ecological state of communal lands, understand livelihoods from grasslands etc; aquatic ecosystems - the most threatened habitat in the biome requires major research attention; environmental law to address efficiency of law reform. Different scientist gave different views from their field of expertise. For instance, Prof Tim O'Connor approached the task from a threats – change – response perspective and identified the following research priorities: climate change and CO_2 fertilisation, land transformation, nutrient loading, disturbance regimes, alien invasive organisms, pollution and pests. It was emphasized in each of the themes, monitoring should be viewed as an integral component of an integrated research programme.

Recommendations from the Grassland Research Meeting

The meeting was well attended by over 20 scientists representing conservation bodies, academic institutions, research councils, independent consultants and government departments. Participants of the meeting discussed research gaps and priorities in the grasslands biome, the need for a research strategy for the grasslands biome and programme, and looked into options to constitute a grasslands research task team.

Participants agreed that a Grasslands research strategy and priorities document should be developed which will have the following objectives:

- To fill the gaps in current key biodiversity research knowledge in a coordinated manner;
- To facilitate research collaboration across the biome and across disciplines;
- To bridge the gap between research and conservation implementation (i.e. what the conservation agencies, GCU etc are doing) in order to improve the management and mitigation of impacts on grassland biodiversity and to contribute towards the GP vision of "the biodiversity and associated ecosystem services of the grasslands biome are sustained and secured for the benefit of current and future generations";
- To create an approach which will enable funding to be sourced for grasslands research;
- To monitor impacts and inform implementation

Participants also agreed that a Grasslands Research Task Team should be established to develop a research strategy and coordinate research priorities of the Programme and across the grassland biome. The meeting identified three possible institutions that could take responsibility for leading the task team - SANBI: Grassland Programme, SAEON or SANBI: Conservation Science (Research). The GSSA was also mentioned but removed because it is an association. The recommendation is that SANBI lead – be it via the Grassland Programme or the Research Unit. SANBI will discuss this matter internally and decide whether it should be the Grassland Programme or the Research Unit.

The meeting agreed that the following people would constitute the research task team:

Prof Tim O'Connor—SAEON
Dr Rob Scott-Shaw—KZN-Wildlife
Mr Mahlodi Tau—Grasslands Programme
Dr Mark Robertson—University of Pretoria
Mr Mervyn Lotter—MTPA (Mpumalanga Parks and Tourism Agency)
Mr Graham von Maltitz—CSIR
Prof George Bredenkamp—University of Pretoria
A representative from SANBI Conservation Sciences.

The Research Task Team will initiate the process of addressing research across the biome and across the four sectors of the programme. A broad group of stakeholders - including universities, research councils, conservation agencies, provincial research wings of department of Agriculture, research agencies associated with production sectors and Working for Water - will be consulted in this process. Key discussions of the upcoming meeting will focus on:

- opening up approaches to developing research strategies/priorities;
- ways of linking up database to research gaps;
- discussions on funding opportunities.

The 1st meeting of the Research Task Team is scheduled for the 31st January 2008 at SANBI – Pretoria.

SAAB-SASSB Joint Conference 2008

Glynis Cron
University of the Witwatersrand: Animal, Plant and Environmental Sciences
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A joint conference of the South African Association of Botanists (SAAB) and the Southern African Society for Systematic Biology (SASSB) was held from 14 to 18 January at the Drakensville Mountain Resort in the northern Drakensberg. It was hosted by the School of Animal, Plant and Environmental Sciences of the University of the Witwatersrand, and attended by about 275 delegates, many of whom were members of both societies.

Fifteen international and local guest speakers provided stimulus to the numerous symposia within the conference, including topics ranging from biogeography to plant physiology; phytochemistry to landscape functioning and restoration. Tony Cunningham of People and Plants International opened the SAAB conference with a talk on the status of ethnobotanical work in Africa, identifying strengths and gaps in the research currently being done by African researchers, and advising on what the needs are for future research. Amongst these needs Tony listed research into (i) adaptation to climate change, (ii) the impact of urban growth in Africa on rural supplies, (iii) the anticipated impact of Asian “take-aways”, and (iv) the importance of building confidence and capability amongst students and researchers in ethnobotany. Neil Crouch of SANBI introduced the afternoon symposium on Biodiversity and Conservation with a special focus on Threatened Species. Neil spoke on South Africa’s bioprospecting legislation and emphasised how important it was for local researchers to be involved in the review process during the drafting stages of legislation - to ensure that it does not hinder genuine research, while protecting the country’s flora and fauna and indigenous knowledge.

Conservation in Madagascar

The SASSB conference officially opened on the Tuesday with Steven Goodman speaking on conservation priorities in Madagascar. Steve is a recipient of many international grants and fellowships (including WWF) and has lived and worked in Madagascar for the last 20 years, although he still maintains links with the Field Museum of Natural History in Chicago, USA. He describes himself as a true naturalist and has been instrumental in exploring, discovering and documenting the diversity (mainly land vertebrates) of Madagascar through his own field work and collaborative efforts in training Malagasy scientists. The importance of understanding the geological and climatic histories of Madagascar and particularly of its river catchments in determining areas of endemism were outlined as key to identification and prioritization of 'new' areas for conservation.

We were fortunate to have a symposium put together by council members of the International Association of Plant Taxonomists (IAPT) who were currently in South Africa for their annual general meeting. We were graced by the likes of Tod Stuessy, Warren Wagner, Robert Gradstein, Nick Turland, Santiago Castroviejo, Jun Wen and Josef Greimler who put together an interesting afternoon of talks on their particular interests - both current and past. This included information about the Flora of China project, the unusual idea of the role of Hawaii as a source area (vs. sink) for migration and subsequent speciation, as well as various phylogenetic studies of families of plants such as the Asteraceae, Vitaceae, Gentianaceae and even some liverworts in the form of the Porellaceae. An interactive panel discussion on research priorities for systematics following the presentations highlighted the importance of systematics work to biodiversity conservation.

Responding to global change

A highlight of the conference was a plenary lecture by Christian Körner of the Institute of Botany, University of Basel, Switzerland, who spoke on '*Global change affects ecosystems through biodiversity responses'*. The take home message from Christian's extremely stimulating talk was that different plant species have differential responses to global change and that research should be designed to take this into account, as well as to accommodate the numerous variables (e.g. hydrology, mineral elements, biotic interactions) that can have secondary effects on their responses.

Leading into the Ecology Symposium, Brian van Wilgen of the CSIR, Natural Resources and the Environment, based in Stellenbosch stimulated considerable discussion with his controversial talk entitled "*Fire management in South Africa's Conservation areas: why bother?*" Brian discussed the different fire management practices in the fynbos and savanna biomes in terms of frequency and seasonality of burning and the potential long term effects of these strategies, as well as the effects of unplanned fires due to human ignitions and lightning.

Landscape Dynamics

Another symposium of potential interest to the members of the Grasslands Society was that entitled 'Vegetation and Landscape Change' with Lindsey Gillson of UCT (previously from Oxford) heading it up with a plenary lecture entitled '*Resilience, thresholds and dynamic landscapes'*. Lindsey is using fossil pollen data to study transitions between grassland, savanna and forest phases at various sites in the Kruger

National Park and interpreting the dominant driving processes or limiting factors and the interaction between these forces/factors. This work is important for our understanding of what drives change in landscapes over long periods of time, and how and why stable ecosystems cross thresholds rapidly resulting in new 'stable' phases.

In the symposium on Landscape Functionality and Restoration, David Tongway of the CSIRO, Australia spoke on the importance of 'soil health' in maintaining ecosystem functioning. David has developed a methodology that enables practitioners to rapidly assess soil health in its landscape and land-use contexts. His approach, called 'landscape function analysis' (LFA), uses a number of rapidly assessed indicators to evaluate the problems in a wide range of degraded lands. David used the opportunity to entice the delegates to attend his two-day workshop directly after the conference to learn more about his approach. Isabel Weiersby of the University of the Witwatersrand then gave an overview of her research and experience in the use of plants, algae and micro-organisms in rehabilitation of mines. It is encouraging to see that 'phyto-technological' solutions to serious problems created by mining are being developed and put into practice.

"Fire management in South Africa's Conservation areas: why bother?"

Patterns and Processes in the Cape Floral Kingdom

The last day and a half of the conference was dedicated to the Cape Biota Symposium, organised by Tony Verboom and Leanne Dreyer of Cape Town and Stellenbosch universities respectively. A series of presentations focussed on understanding the patterns and processes resulting in the tremendous diversity of the Cape Floral Kingdom. Topics ranged from the geological history of Africa (Tim Partridge), the roles of geomorphic evolution (Richard Cowling), pollinators (Richard Waterman), the evolution of rivers (Ernst Swartz) and even fungal radiation (Francois Roets) in the Cape Floristic Region. Timo van der Niet and Steve Johnson came to the interesting (and controversial) conclusion that patterns of plant ecological speciation in the Cape are not markedly different from those in the rest of southern Africa. Steve Hopper of the Royal Botanic Gardens, Kew, gave an extremely fascinating talk related to OCBIL theory (old, climatically-buffered, infertile landscapes), in which he compared rates of speciation in lineages of the Haemodoraceae occurring in the Greater Cape and Southwest Australian Floristic Regions. The roles of reduced dispersability resulting in local endemics, the selection for heterozygosity in small populations (the 'James effect') and the role of chromosomal variation (e.g. polyploidy) were all discussed.

In addition to the LFA Workshop (funded by the NRF's Technology and Human Resources for Industry Programme—THRIP), there was a South African Biosystematics Initiative (SABI)-funded workshop on Reticulation in Phylogenies facilitated by Lucinda McDade, director of research at the Rancho Santa Ana Botanic Garden, California, USA. Lucinda is renowned for her work on hybrids and some stimulating discussion was held on the definition/ identification and detection of different kinds of hybrids, the types of characters one might use in order to study hybrids and strategies for dealing with hybridization in phylogenetic studies. A number of software programmes were explored for their potential to identify hybrids and hybridization using molecular and/or morphological data.

A poster session comprising ca. 50 posters was held on the Wednesday evening amidst a great mountain storm. This ensured a captive viewing audience, although it made communication difficult under a tin roof!

Wrapping up

The conference dinner on the Thursday evening was extremely festive and everyone had a good time. The SAAB Silver Medal for Botany was awarded this year to Jill Farrant who currently holds a research chair in plant physiology and molecular biol-

Jill Farrant, winner of Silver Medal for Botany

ogy at UCT. Jill is a leading researcher in the field of plant responses to water deficit stress (i.e. drought/desiccation tolerance). The SAAB Bronze Medal was awarded to Dr Bridget Crampton whose PhD work represents the first in depth molecular biological study of pearl millet and has relevance both in the South African context and in the broader agricultural and botanical arenas.

The foothills of the Drakensberg created a marvellous setting for the conference and truly facilitated valuable interaction amongst the scientific community attending it, as well as providing opportunity for socializing and even a brief excursion into the 'berg. The conference was deemed a great success and it was very encouraging to see the quality and quantity of student presentations. Thanks to all involved - organ-

The Influence of Physical Landscape and Soil Properties on the Threshold of Rangeland Degradation

A.O Fatunbi and S. Dube*

University of Fort Hare, Faculty of Science and Agriculture, Livestock and Pasture Science Department

*Email: SDube@ufh.ac.za

Introduction

Land degradation is a major ecological problem across the globe. It is more prominent in the drier lands as the semi arid, and arid part of the world. In South Africa, land degradation is also a widespread environmental problem (Hoffman and Todd, 2000), especially around the former homelands. The concept of land degradation has been defined differently by authors (Thomas and Middleton, 1994), but all definitions encompass a reduction of the current or the future capacity of the land to produce; or a reduction in its potentials for environmental sustainability.

In rangelands, overgrazing is often considered as the major cause of land degradation. It is reported to result in extensive decrease in the population of palatable species, and encroachment of undesirable forbs and shrubs (Snyman, 2004). It further leads to decline in soil quality variables such as aggregate stability, water infiltration rate, soil organic matter content and microbial activity (Russel *et al*., 2001; Snyman and Du Preez, 2005; Du Preez and Snyman, 2003). In a game reserve, where human activities are limited, land degradation could be due to a number of other natural factors. Such factors include excessive proliferation of game animals leading to overgrazing of the natural vegetation, soil innate properties and climatic variables.

Land degradation is observed to be associated with several components of the ecological system; these components interrelate in a specific way with one another. Thus, a disruption in the state and function of any of the components will create an imbalance that could result in land degradation. Destroyed vegetation and degraded water resources could endanger biodiversity; degrade the soil, induce climate change and disturb hydrologic cycles. Therefore, a sustainable remedy to land degradation must restore the balance in the components which sustains the function of the system. This is only possible with a proper understanding of the relationship between the components and how they affect land degradation episodes.

The South African landscape is made up of abundant highlands intermingled with valleys and plains. This influenced settlement patterns and land use; more importantly, the use of slope lands and valleys for crop and animal production. This feature is common across the country especially in the former homelands where land ownership is a challenge. The practice of communal rangeland that is currently being used for livestock production in these areas gives little or no room for management practices that could sustain productivity at optimal level. Hence, land degradation is a common feature that requires both scientific and policy intervention.

This article reports the influence of landscape soil properties on the initiation of land degradation episodes. It is a segment of a long term study that is being conducted to understand the interrelationship of several known ecological variables that could induce land degradation. This will inform the development of appropriate remediation action at different spatial and temporal scale.

Materials and Methods

Study Site

The study was conducted at the Tsolwana game reserve in Eastern Cape of South Africa. The reserve covers an area of 8500ha, with an altitude of 1350m at lowland and 1800m at the mountainous area. Annual average rainfall ranged from 500mm-800m. The soils of Tsolwana were formed from sandstone and shale which has led to the development of less fertile soils. The geology was part of the Tarkastad sub-group which comprises of the arenaceous Katberg formation which is about 1000m thick. The formation overlays an agillaceous Burghersdorp formation with some intruding Karoo dolerite dykes.

Data Collection

Twenty three land degradation sites were selected for evaluation across the 8,500 ha game reserve. A land degradation index (LDI) was generated for each site using a multidimensional analysis technique based on six indicator variables (Table 1). The amount of soil loss due to different erosion type was measured while the severity of soil erosion and degree of landscape slope were scored on a scale of 1- 5 across the sites. Representative soil samples were collected from each site and analyzed for the pH, EC, total Ca, Mg, K and Na; particle size fractions, aggregate stability and soil organic C.

Data analysis: Variables measured as scores were log-transformed as necessary and were subsequently subjected to summary statistics using SAS (1999). Correlation and regression analysis were conducted to establish the amount and direction of the relationship between land degradation index and other measured variables. Index of degradation was determined using the multidimensional analysis technique reported by Shama *et al*. (2005). The index was further categorized into four degradation classes 1= Non degraded; 2= moderately degraded; 3= Poorly degraded; 4 = Extremely degraded.

Result and Discussion

The LDI multiple regression model was significant (P>0.001) with a R^2 =0.997. The relative contribution of each variable to the model was in the order of Erosion severity > Presence of gully > Sand deposition on roads >

Table 1. Land degradation index and degradation class derived from weighted parameter values of six indices for land degradation

Site	Soil looseness (4)*	Sand deposition (4)	Animal tracks (3)	Erosion severity (5)	Degree of landscape slope (4)	Presence of gully (5)	Degradation Index	Degradation Class†
1	2.4	1.6	1.2	5	1.6	5	**16.8**	**4**
2	1.6	3.2	1.8	4	1.6	5	**17.2**	**4**
3	1.6	3.2	1.8	2	0.8	1	**10.4**	**2**
4	1.6	3.2	0.6	5	1.6	2	**14**	**3**
5	2.4	3.2	3	4	2.4	4	**19**	**4**
6	0.8	2.4	3	4	1.6	3	**14.8**	**3**
7	4	3.2	1.2	5	0.8	4	**18.2**	**4**
8	3.2	3.2	1.8	5	3.2	5	**21.4**	**4**
9	4	3.2	1.8	3	2.4	2	**16.4**	**4**
10	3.2	2.4	1.2	2	1.6	3	**13.4**	**3**
11	2.4	3.2	2.4	4	0.8	1	**13.8**	**3**
12	3.2	3.2	2.4	5	1.6	3	**18.4**	**4**
13	3.2	3.2	1.8	4	1.6	3	**16.8**	**4**
14	2.4	3.2	2.4	4	1.6	3	**16.6**	**4**
15	1.6	0.8	2.4	1	1.6	1	**8.4**	**2**
16	3.2	3.2	2.4	5	3.2	5	**22**	**4**
17	4	4	2.4	5	4	5	**24.4**	**4**
18	4	4	1.8	5	3.2	3	**21**	**4**
19	2.4	2.4	1.2	2	1.6	2	**11.6**	**3**
20	3.2	3.2	1.8	4	2.4	5	**19.6**	**4**
21	0.8	0.8	0.6	1	0.8	1	**5**	**1**
22	0.8	0.8	0.6	1	0.8	1	**5**	**1**
23	1.6	1.6	0.6	2	1.6	1	**8.4**	**2**
CV	**42.3**	**35.3**	**42.6**	**41.3**	**48.0**	**52.5**	**34.4**	**31.0**

*Value in parenthesis is the value for weight of importance for the specific variable
†1= Non degraded; 2= Moderately degraded; 3 = Poorly degraded; 4= Extremely degraded

Table 2. Result of multiple regression between the land degradation index and the six indices of degradation showing the coefficient of relative contribution

Variable	Regression Coefficient	F value	Coefficient of relative contribution
Soil looseness	0.741	27.76	0.12
Sand deposition	0.805	44.55	0.19
Animal tracks	0.614	8.54	0.04
Erosion severity	1.051	76.69	0.32
Degree of landscape slope	0.728	26.75	0.11
Presence of gully	1.034	52.04	0.22
Intercept	-0.059		
R^2 = 0.997	**CV = 2.08**	**P> 0.001**	

Soil looseness > degree of slope > presence of animal track (table 3). The observed high contribution of erosion severity (32%) to the model confirms the role of soil erosion in land degradation (Valentin *et al*, 2005). Soil erosion is often preceded by a number of other occurrences, such as removal of vegetation cover, destruction of soil aggregates, soil sealing, impact of climatic variables etc. Uncontrolled soil erosion over time could result in gully formation; this is often seen as a point of no return in land degradation episodes. The observed least contribution by animal tracks to the LDI model (4%) suggests that the presence of animal tracks may have an indirect contribution to land degradation.

Soil acidification was not a problem at the Tsolwana game reserve. The soil pH of the sampled degraded land ranged from 5.5 – 6.5. The soil pH tended to increase with increasing land degradation but the difference between categories was not substantial (Table 3). The EC ranged from 51.0 – 185.3, (CV = 55%) with the highest value on non degraded soil. The organic C content of soils around the sampled sites ranged from 4.0 g/Kg- 32.7 g/Kg. The organic C content was higher at the non degraded soils compared with the extremely degraded portion.

The observed relationship between land degradation index and other soil erosion variables as shown in Table 4, showed that erosion is the main contributing factor to the observed land degradation at Tsolwana game reserve. The observed positive correlation between the degree of landscape slope and erosion severity implied that soil erosion is more se-

Plate 1. Effect of chemical degradation (Calcification and sodification) on land degradation at Tsolwana game reserve

vere on steeper slope side than on plain landscape or long slope. This could be due to more rapid soil particles movement down the slope. The observed positive relationship between the silt content of the soils and size of gully indicated the contribution of silt particles to disintegration of soil aggregates and subsequent erosion. The measured disaggregation potentials of the soil showed a negative correlation between sand content and mechanical disaggregation. This suggest that the aggregates of soils with high sand content will be more stable under torrential rainfall and animal tracks which are the major source of mechanical disaggregation observed

Table 3. Effects of soil chemical properties on land degradation at Tsolwana game reserve

State of degradation	pH	EC	Org C	K	Na	Mg	Ca
		μS cm^{-1}	g kg^{-1}		mg kg^{-1}		
Non degraded	5.8	98.3	13.8	2683.1	1885.2	407.5	2842.3
Moderately degraded	6.1	80.5	13.3	4639.2	1702.4	600.2	2645.4
Poorly degraded	6.1	79.5	13.1	6125.7	1959.2	463.7	3368.5
Extremely degraded	6.2	70.8	10.6	4246.3	2160.8	468.9	3618.1
SED (0.05)	0.1	7.3	1.3	816.8	109.5	47.1	260.8

Table 4. Correlation coefficient (*r*) showing the relationship of indices of soil erosion on land degradation index and other soil erosion variables

Variables	Correlation coefficient (*r*)
LDI x Total soil loss	0.579 ***
LDI x Pedestals soil loss	0.502**
LDI x Soil erosion severity	0.886***
LDI x Degree of landscape slope	0.749**
Degree of landscape slope x Erosion severity	0.504***
Size of gully x Silt content of soil	0.520**
SAS (Mechanical disaggregation) x Sand content of soil	-0.425***

Note: *** = Significant at P>0.01; ** = Significant at P>0.05; LDI = Land degradation Index; SAS= Soil aggregate stability

at the reserve.

Conclusion

Results from this study showed that the innate soil properties and landscape contributed significantly to the observable land degradation. Hence, efforts to remediate degraded lands need to incorporate the best practice for the management of landscape and soil properties along with other factors.

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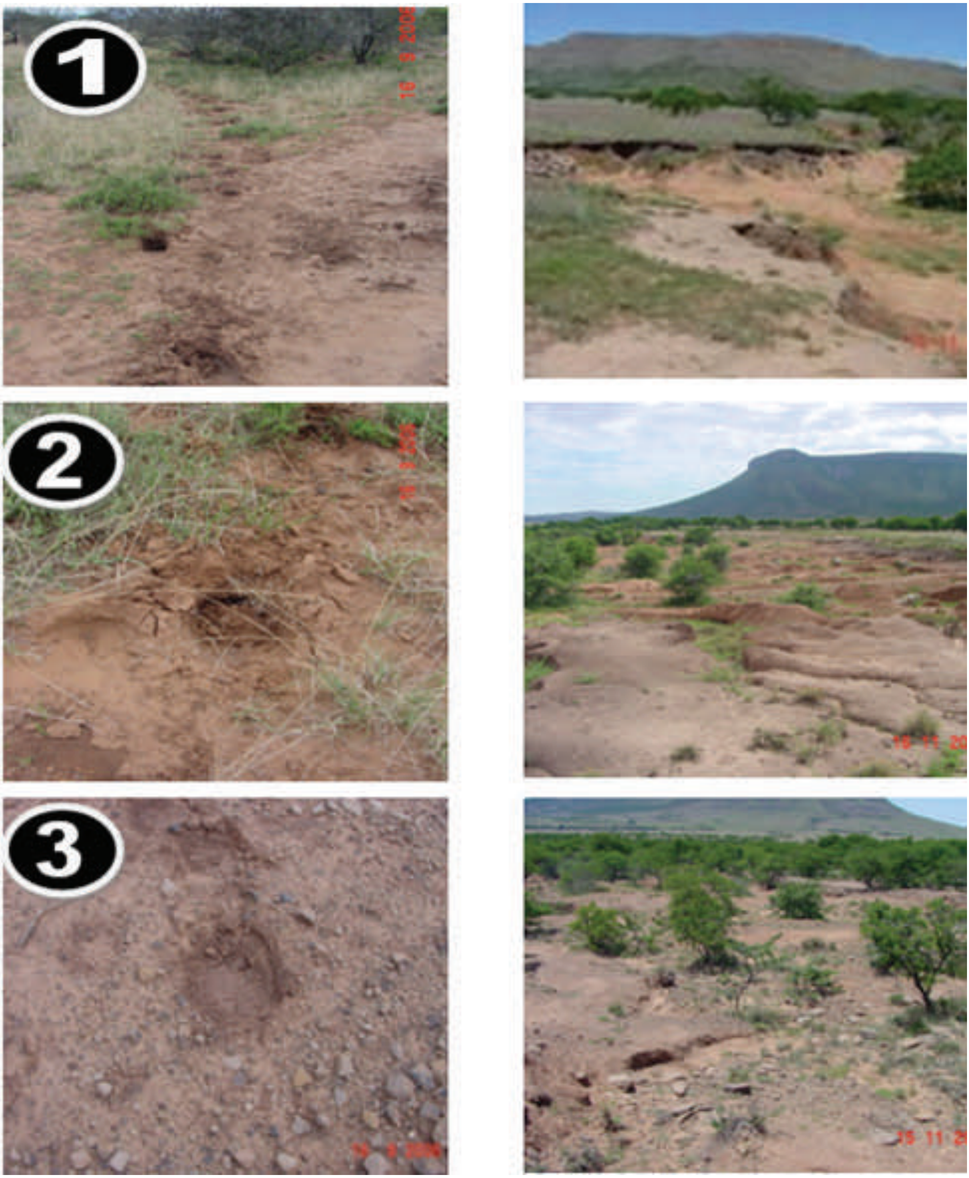

Plate 2. Stages in erosion development by mechanical aggregate destabilization by animal tracks on non-vegetated land

Influence of degradation on the short-term nutritive value of a semi-arid grassland

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Introduction

Since rainfall is the limited environmental factor determining grassland production in the arid and semi-arid areas (approximately 65% of South Africa's grasslands) (Snyman 1998), sustainable utilization of the grassland ecosystem must emphasize the capturing and efficient use of water. In these drier areas, grassland is frequently subjected to seasonal droughts that may lead to instability in farming systems and necessitates a high standard of risk management (Oosthuizen *et al*. 2006). Although the livestock farmer cannot control the rainfall on his farm, he can directly and/or indirectly influence its effectiveness, since grassland condition is influenced by management practices. Selecting the correct stocking rate is the most important of all grazing management decisions and is based on sustainable use of vegetation, livestock and wildlife production, and economic return (Van der Westhuizen *et al*. 2005). It is therefore important to apply stocking rates based on estimated grazing capacity, which will allow for the sustainable utilization of the grassland ecosystem as stocking rate is the most important factor influencing: rangeland condition, available grazing material, sensitivity to drought periods, animal performance and gross income (Snyman 1998). In calculating water-use efficiency or water utilization, most researchers (Le Houérou 1984) only express it in terms of the quantity of dry matter produced per unit water consumed, while its calculation in terms of crude protein produced per unit of water consumed, receives little attention at present. The latter calculation can make a large contribution to the estimation of short-term nutritive value of grassland, given the quantity of rainfall received or water consumed. The ability of grassland to efficiently utilize limited soil water in a semi-arid climate, was therefore investigated along a degradation gradient.

Procedure

The research was conducted in Bloemfontein (28°50'S; 26°15'E, altitude 1 350 m), which is situated in the semi-arid summer rainfall (annual average 560 mm) region of South Africa. The data were collected from a typical Dry Sandy Highveld grassland. The soil is a fine, sandy, loam soil of the Bloemdal Form (Soil Classification Working Group 1991). The percentages of clay increased down the profile from 10% in the A-horizon (0–300mm depth), to 24% in the B1-horizon (300–600mm) and 42% in the B2-horizon (600–1 200mm depth).

The experimental layout was a fully randomized design consisting of three treatments with three replications. Rangeland in three different compositional classes (good, moderate and poor) were studied from 2000/01 to 2003/04 seasons. The research was conducted on nine plots of 10 x 10m2 each, which were randomly set out on the same soil form. All plots were excluded from livestock grazing during the four-year trial period. Grassland condition was determined according to the method of Foran *et al*. (1978). Soil-water utilization (SWU) is defined as the quality (crude protein) of dry matter (DM) produced per unit of water evapotranspired. Herbage production, that was determined for each grassland condition class by clipping plants to a height of 30mm in eight randomly selected quadrats of 1m2 for each treatment, was used to determine N-content (Technicon 1977) following Kjeldahl digestion of the plant material in concentrated sulphuric acid. Crude protein calculated from N-content of the whole aboveground organs (leaves, stems and seeds), was determined in the middle and end of each month. Evapotranspiration was determined by quantifying the soil-water balance equation (Snyman 1998). The soil-water content was monitored with the aid of a neutron hydroprobe, at 200mm depth intervals every fourth day.

Results and Discussion

The average rangeland condition scores (expressed as a percentage of that in a benchmark site) were 88.14, 61.71 and 31.06% respectively for veld in good, moderate and poor condition, with a basal cover of 8.85; 6.01 and 3.20% respectively.

The highest CP occurred in mid-September, where it formed an average (± s.e.) of 126.6 ± 31.2g/kg and 128.1 ± 33.6g/kg of the DM for grassland in good and moderate condition respectively (Figure 1). Grassland in poor condition had the highest ($P \leq 0.01$) monthly CP during the growing season except for the beginning of the growing season (September and the beginning of October). The lower crude protein found in plant material as grassland condition improves is possibly caused by its mobilization (growth

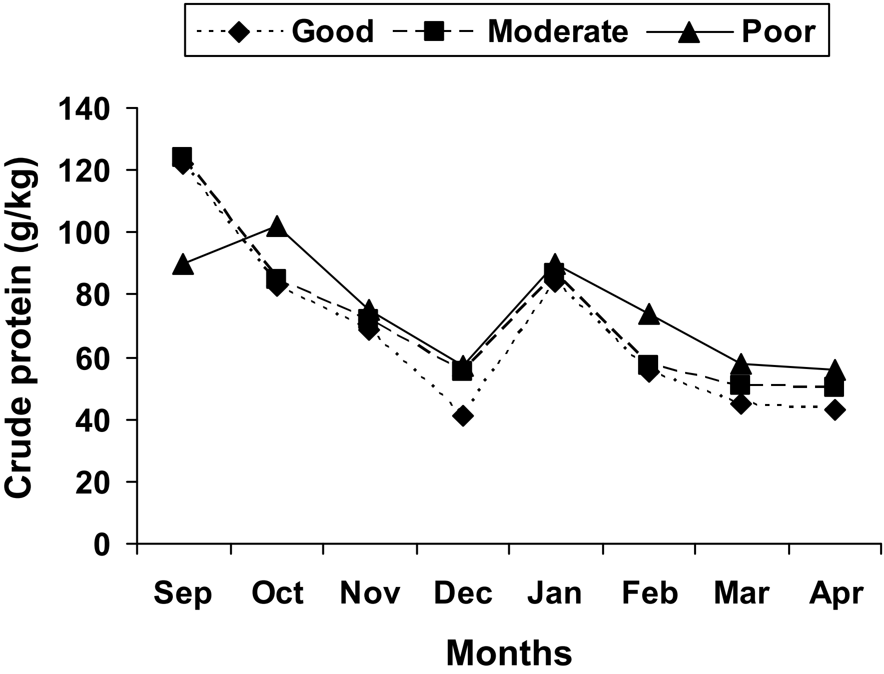

Figure 1 Average crude protein (g/kg) for different veld conditions as measured during the middle and end of each month for the 2000/01 to 2003/04 growing seasons. LSD0.01 = 0.42.

reserves) for high DM production per unit area delivered.

The gradual decrease in CP occurring after the spring and reaching a low at the end of December can be ascribed to most of the plants being in full seed at that stage and gradually becoming dormant (Figure 1). The CP (± s.e.) of grassland in good condition was as low as 40.1 ± 6.1g/kg at the end of December, almost similar to that reached in middle April, when the first frost occurred. Most of the growing seasons were characterized by a mid-summer drought (middle December to middle January) that could also contribute to a decrease in CP. The study area is normally characterized by a second growth cycle, which usually starts during the middle of January, resulting in a second peak in CP at the end of January. During most seasons, about the middle of February, the grasses start becoming reproductive again, with a rapid decrease in CP as the season progresses and the plants become dormant. Remarkably, similar seasonal varia-

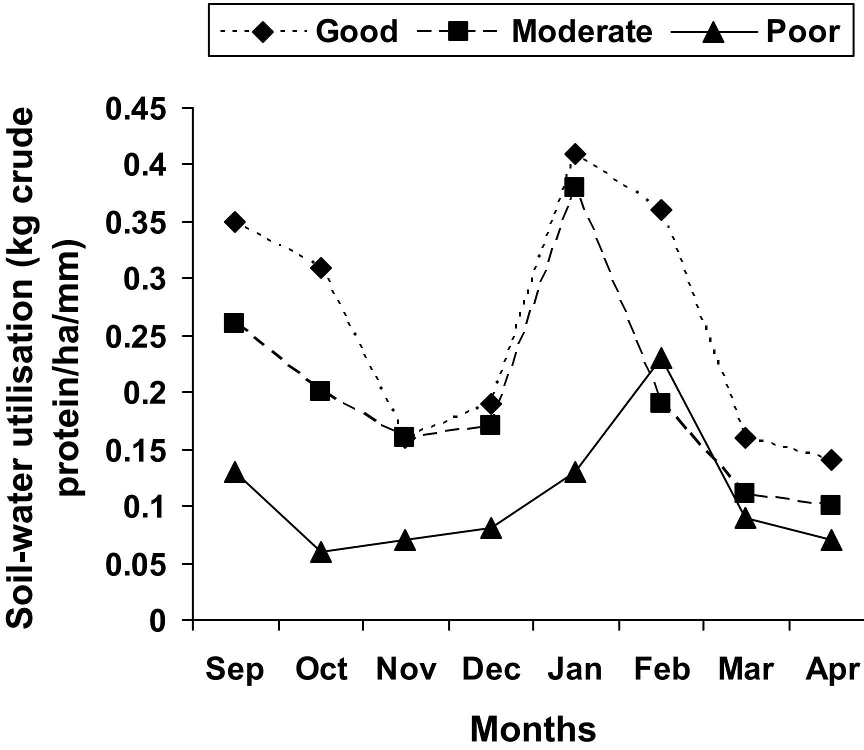

Figure 2 Monthly average soil-water utilization (kg CP/ha/mm) for the different veld conditions for the 2000/01 and 2003/04 growing seasons. LSD0.01 = 0.06.

tion and trends in CP of the diet selected by oesophagally fistulated sheep on the same veld type is well documented (De Waal 1990).

Grassland in good condition produced on average (± s.e.) 1 899 ± 214kg DM/ha/season, moderate condition 1 007 ± 196kg DM/ha/season and veld in poor condition 369 ± 102kg DM/ha/season, which differed ($P \leq 0.01$) from each other . These results validate/confirm the rangeland condition scoring system used to classify the veld as good, moderate and poor. The seasonal CP (expressed in kg/ha) of 141 ± 31, 97 ± 21 and 32 ± 11kg CP/ha for grassland in good, moderate and poor condition respectively, also differed ($P \leq 0.01$) between the different grassland condition classes as expected. Though grassland in poor condition had for most of the year a higher ($P \leq 0.01$) monthly seasonal CP (g/kg) than grassland in good condition, the CP expressed in kg per ha was much lower ($P \leq 0.01$) due to lower

($P \leq 0.01$) aboveground DM production accompanying veld degradation.

On average (± s.e.) over the four growing seasons, veld in good, moderate and poor condition produced 0.32 ± 0.09, 0.25 ± 0.06 and 0.09 ± 0.02kg CP/ha respectively for each mm water used. Regardless of the quantity of rainfall occurring over the growing season, grassland in poor condition had a notably lower ($P \leq 0.01$) production in CP per area. The better the grassland condition, the more effective the reaction obtained in terms of CP production per hectare (Figure 2). The monthly and seasonal SWU decreased ($P \leq 0.01$) with veld degradation. It was only for the months November to January that the SWU for veld in good and moderate condition differed not much ($P > 0.05$). Only for February the SWU for veld in poor condition was higher ($P \leq 0.01$) than that of veld in moderate condition. The highest seasonal SWU (± s.e.) occurred during the 2000/01 seasons, during which rangeland in good, moderate and poor condition produced 0.38 ± 0.03; 0.27 ± 0.02; 0.10 ± 0.01kg CP/ha/mm respectively. Veld in good and moderate condition used water the most efficient during January, while the most efficient water use for veld in poor condition occurred in February. In the same semi-arid grassland, Snyman (1999, 2005) also recorded the highest water use during the last half of the growing season.

The low SWU during November/December and March/April occurred within the reproductive phase of most grass species within a specific veld condition. Most grasses underwent another active growth cycle after the reproductive phase at the end of December, which can be observed in Figure 2 in the SWU increase, due to an increase in crude protein. This increase is in agreement with findings of most researchers (Snyman 1999, 2000, Van der Westhuizen *et al*. 2005) that grasslands in these drier areas produce their total seasonal dry matter over only four to five months of the year. Therefore, these productions must be distributed to the non-productive months for constant fodder flow planning and ensure sustainable grassland management.

Conclusions

It is clear that grassland in good condition does not only deliver a higher DM production than degraded veld, but also has significantly higher total CP content and better soil-water utilization than grassland in poor condition. Soil-water utilization (expressed in kg CP for each mm of evapotranspiration) is a convenient and suitable tool to evaluate the productivity of a grassland ecosystem. Fodder flow planning and veld risk management for livestock production are more complicated in grassland in poor condition due to lower production and soil-water utilization efficiency. The efficiency and risk with which rainfall is converted into plant production by fodder plants and eventually gross farming income, forms the basis of sustainability of extensive ruminant production on a grassland ecosystem.

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Alternative feed base with stall-feeding: the key to reducing grazing/browsing pressure from natural grasslands in Uganda

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Natural grasslands support about 90% of Uganda's livestock population. In this system, goat and sheep herds are always integrated with cattle herds, hence, grassland areas in Uganda have been more accurately labelled the "cattle corridor" (Kisamba-Mugerwa, 2001). However, at present the cattle corridor is under heavy grazing and browsing pressure. Besides, the inherent communal land-tenure system hampers efforts to improve its proper management. The rapidly increasing human population has also caused an increased need for food crops, which has led to a drastic reduction in available grazing areas within the corridor. With tree felling the entire corridor has subsequently been marginalized. As a result fodder needs now exceed the sustainable yield of the cattle corridor. The rainfall pattern has also made its productivity very seasonal.

Goats have become an important asset and source of income in the cattle corridor, because they have the ability to survive in environments with sparse vegetation, hence both high and low income households can afford to keep goats. Their role has been

Figure 1: Goats feeding on market *Solanum aethiopicum* wastes

amplified by the rising interest and demand for goat meat in the urban areas. The consumption for goat meat has been reported to be growing at a rate of 3.2% annually compared to the 1.7% for beef (FAO, 2005). However, goats have been blamed for contributing substantially to the grassland degradation. They eat almost anything left in an already degraded environment. They will browse shrubs and trees, graze forbs and grass, and eat fallen fruits, bark and other dead plant material. They also have the ability to graze in areas inaccessible to other large herbivores such as in trees or in dense thickets or slopes. These inherent abilities in turn make goats a major cause of degradation.

To deal with this problem of grassland degradation, which subsequently causes fodder shortage, there is a need to improve the feed base through better utilization of any available feed resources, preferably in a cut-and-carry (stall-feeding) system. In Uganda there is an increased use of non-conventional feed resources under stall-feeding, particularly in urban and peri-urban production systems where fodder cultivation is almost impossible.

For instance the marketing of many crops in Uganda is done in their raw form, with the traders providing the link between the rural producers and the urban consumer markets. This practice has been reported to be a key source of crop waste in urban markets. It is estimated that more than 18,000 MT (Ekere, unpublished data) of crop wastes are generated within the markets of Kampala per year and are of potential feed to goats (Figures 1

Figure 2: Goats feeding on market sweet potato vine wastes

Table 1: Nutritive value of selected market crop wastes in Kampala, Uganda

Market Wastes	DM (%)	CP (%DM)	NDF (%DM)	Effective DM Degradability (%DM)
Sweet potato (*Ipomoea batatas*) vines	19.7	11.2	40.9	69.4
Solanum aethiopicum (leafy vegetable)	12.1	11.4	54.8	55.7
Banana (*Musa acuminata*) leaves	21.6	10.9	61.3	43.1
Banana pseudo-stem sheaths	9.7	3.4	65.9	47.3
Banana peels	18.6	6.0	31.7	57.7

and 2).

Due to financial hardships, these wastes are left uncollected in the markets causing serious environmental and social problems. The potential of their use as feed for goats has been investigated at Makerere University, Kampala, and basing on their chemical composition and dry matter degradability (Table 1) the studies have shown that a number of them are potential feedstuffs for goats particularly where feed resources are scarce, in a cut-and–carry system. However, to be used successfully they should be collected from the markets early enough before they are contaminated with other undesirable wastes as a consequence of the practice of indiscriminate dumping.

In conclusion, by using such wastes the problems of waste disposal within the urban markets may be reduced as well as easing the grazing pressure on the already degraded grasslands.

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Adjust concentrate feeding to pasture quality!

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Effective pasture utilization and optimal pasture digestion should be aimed for on dairy farms. The fibre (NDF) content of ryegrass pasture may vary from 40% in June to 55% in November and that of kikuyu may be as high as 65% in March. Pasture with a higher fibre content takes longer to digest and pass through the digestive tract than pasture with a lower fibre content. This results in a lower pasture intake. Rumen micro-organisms digest fibre in the rumen of the cow. Optimal fibre digestion takes place when the rumen pH is higher than 6. If the rumen pH is below 5.8 the rate of fibre digestion will be reduced. When the pH gets below 5, many of the fibre digesting bacteria will die and fibre digestion comes to a standstill. Cows stop eating and experience acidosis. Research done at Outeniqua Experimental farm has shown that the rumen pH of Jersey cows fed only 4kg of concentrate was below 5.8 from 18:00 to 24:00 when cows grazed high quality ryegrass. When cows grazed kikuyu during March, the rumen pH remained above 6.2 when 4kg of concentrate was fed. When the fibre content of pasture is high, more rumination takes place and the cow's digestive system can tolerate higher levels of concentrate feeding. Under these conditions the rumen of the cow is more buffered and higher levels of concentrate feeding could be considered. Research has shown the poorest milk response to concentrate feeding when cows graze high quality pasture and pasture allocation is high.


Photo: Nicky Findlay

With the increase in concentrate cost, farmers should ensure a good return on concentrate feeding. Concentrate feeding to Jersey cows grazing high quality ryegrass should not exceed 6kg/cow/day and 4kg/cow/day may be more cost effective. Feeding 6kg concentrate to Jersey cows grazing kikuyu during summer and autumn will not result in sub-optimal rumen pH levels. The effect of concentrate feeding on milk production, depends on pasture quality, pasture allocation, level of concentrate feeding, quality and composition of the concentrate, stage of lactation and the genetic potential of the cow. Farmers should determine the response on concentrate feeding by monitoring milk production when changing concentrate feeding. Pasture quality and availability should be considered when deciding on the level of concentrate feeding.

Does the soil seed bank of veld dominated by *Pteronia paniculata* change as a result of brush-cutting?

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Introduction

Pteronia paniculata is an indigenous, unpalatable dwarf shrub that increases in veld that was subjected to poor grazing and cultivation practices over the long-term. In the Central Mountain Renosterveld of the Little Karoo it forms in some places monospecific-stands. The objective of this paper is to show whether brush-cutting of *P. paniculata* has an effect on the soil seed bank. Brush-cutting was done in an attempt to inhibit the growth *P. paniculata* enough to enhance the plant species composition, grazing potential and biodiversity of the area.

Study area

The study was done on the farm Kleinvlakte, 33°50'S 20°40'E, which forms part of the Koktyls Private Nature Reserve in the district of Barrydale, Western Cape

The area falls within the Central Mountain Renosterveld as classified by Low and Rebelo (1996) and Soutkloof Randteveld as classified recently by Vlok *et al*. (2005). The dominant plant species are *Pteronia paniculata* and *Pteronia sordida*.

The average annual rainfall of the area is 274.6 mm. Soils are mainly sandy loam in texture and have a pH of 5.5.

Methods

Brush-cutting was done in 2001. There were two treatments, namely 5 cm-cut and 20 cm-cut and a control, with two replications of each. Soils samples of 15 x 23 cm of the top 2 cm were taken at 5 randomly located places within each replication of each treatment in October of each year from 2001 to 2005. The soil was placed in seed trays in a nursery at the Worcester Veld Reserve where it was watered every day and all emerging seedlings were counted and identified on a weekly basis, whereafter the seedlings were carefully removed.

Table 1: Density of species (seeds.m^{-2}), grouped according to family, present in the different treatments in the seed bank at Koktyls in 2001 and 2005 (*Continued on next page*)

Species	Treatments					
	2001			2005		
	Control	5 cm cut	20 cm cut	Control	5 cm cut	20 cm cut
Asteraceae						
Pseudognaphalium luteo-album	223.19	269.57	492.75	92.75	142.03	124.64
Conyza canadensis	211.59	249.28	156.52	0.00	17.39	8.70
Sonchus oleraceus	40.58	52.17	37.68	40.58	11.59	14.49
Lactuca serriola	34.78	11.59	11.60	246.38	269.57	272.46
Galinsoga parvifolia	179.71	179.71	165.22	2.90	5.80	2.90
Cichorium intybus	5.80	11.59	14.49	2.90	0.00	5.80
Cyperaceae						
Bulbostylis hispudila	11.59	2.90	2.90	0.00	5.80	0.00
Solanaceae						
Sutera sp	0.00	17.39	0.00	2.90	0.00	0.00
Oxalidaceae						
Oxalis corniculata	34.78	28.99	31.88	0.00	0.00	0.00
Fabaceae						
Indigofera heterophylla	0.00	0.00	0.00	2.90	0.00	2.90

Results

Twenty species from 9 families were present in the seed bank of the different treatments over 5 years. These were mainly annual and bi-annual species with a low grazing value. Most plants were forbs, of which Asteraceae was the dominant family with *Pseudognaphalium luteo-album* the most common species in 2001, contributing up to 44% of all the seed found, and *Lactuca serriola* the most common species overall in 2005 ($p<0.0001$; $F=115.89$), contributing more than 53% of all seed found (Table 1).

The density of most families, including Asteraceae and Poaceae, decreased over time in the different treatments, while that of Mesembryanthemaceae and Fabaceae, consisting of *Indigofera heterophylla*, increased from 2001 to 2005 (Table 1).

The density of the seeds of the different species show no significant differences between the treatments

Table 1 (*continued*)

Species	Treatments					
	2001			2005		
	Control	5 cm cut	20 cm cut	Control	5 cm cut	20 cm cut
Polygonaceae						
Platago lanceolata	5.80	20.29	17.39	2.90	2.90	2.90
Poaceae						
Echinochloa colona	23.19	28.99	89.86	0.00	5.80	0.00
Lolium temulentum	11.59	49.28	89.86	0.00	0.00	0.00
Phalaris minor	0.00	0.00	0.00	2.90	0.00	0.00
Crassulaceae						
Crassula sp	0.00	0.00	0.00	2.90	5.80	0.00
Mesembryanthemaceae						
Ruschia sp	0.00	0.00	0.00	2.90	0.00	2.90
Ruschia indurata	0.00	0.00	0.00	0.00	0.00	0.00
Drosanthemum sp	0.00	0.00	0.00	0.00	0.00	2.90
Mesemb sp 4	0.00	0.00	0.00	14.49	0.00	0.00
Mesemb sp 5	0.00	0.00	0.00	0.00	0.00	0.00
Mesemb sp 6	5.80	5.80	2.90	0.00	0.00	0.00
Unknown						
Sp 1	0.00	5.80	0.00	11.59	17.39	66.67
Sp 2	0.00	0.00	0.00	0.00	0.00	2.90

(p=0.1067; F=8.38).

Discussion and conclusions

The species present in the seed bank were not present in the aboveground vegetation, as was also found in work done by Wellstein, Otte and Waldhardt (2007) in mesic grasslands, and were mainly small seed, pioneer species as were found in the present study.

The absence of palatable species in the seed bank can possibly be ascribed to the fact that the seeds of these species are not normally long-lived and therefore do not survive in the seed bank, as well as that they are not present in the aboveground vegetation. In the same instance is the seed of *P. paniculata* also not long-lived and

Seed trays at the nursery at Worcester Veld Reserve.

does not survive for more than a season in the soil seed bank. However, the plants are present in large numbers, produce large quantities of seed and there is reduced competition from desirable species, making their chances of establishment and survival better (Milton 1994).

Although there are differences in the density of the different species in each treatment, there are no differences between the treatments, and therefore it can be concluded that brush-cutting did not have an effect on the seed bank.

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The fodder bank system: its current place in veld management

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The purpose of this paper in the Grassroots is to stimulate views and to receive comments on the principles and practises of the Fodderbank Grazing Management System. The system was introduced to Limpopo Province farmers in 1997, favourably received and up till now, implemented by certain individuals. It is a grazing management system that includes basic grazing management principles, suited for application in communal areas. However, it has never been published for inputs/ criticism from other pastoralists. It would be appreciated if viewpoints on this veld management system could to be directed to the authors.

Introduction

South African veld is severely degraded. It is estimated that only 30% of the sweetveld remains in good condition, while the Karoo continues to expand. It is estimated that 60% of South African veld is in a bad, 30% in an intermediate and 10% in a good condition. According to Tainton (1981) the reasons are mainly overgrazing and selective utilisation of grass species. Since 1966, as a countermeasure, rotational grazing, mostly multi-camp systems with short rotational grazing periods, were recommended (O'Reagain and Turner 1992). Experience, however, showed that these systems were poorly adopted by farmers, and that the end product was usually fast rotational systems without specific management objectives. After thorough evaluation researchers also came to the conclusion that the basis of these recommendations proved to be scientifically inaccurate (O'Reagain and Turner 1992). Since then, more information gained led to alterations which improved these systems dramatically.

Current grazing management systems, shortcomings and alterations

Since 1966, different veld management systems were developed with rotational grazing as a basis. The reason was to eliminate selective grazing (Booysen *et al.* 1975). Grazers always select palatable grass species first. After grazing palatable species, less palatable species are selected. By applying rotational grazing, frequency and intensity of utilisation are influenced by manipulating the period of absence and period of stay. Selective grazing can thus be controlled to enable management towards better veld condition, animal production and increased carrying capacity.

The following four veld management systems were recommended, as currently used in practise:

High production grazing (HPG)

The accent here is light utilisation of veld. The aim is to utilise only palatable species, which are lightly defoliated. Production of palatable species is thereby stimulated, while unpalatable species become moribund due to accumulated material. To apply HPG, a minimum of four camps (preferably eight) per herd is needed. In comparison to other grazing systems, both the period of stay and the period of absence (rotation cycle) is relatively short. Better animal production and veld condition is obtained, since only highly nutritious and palatable grasses are lightly utilised (Booysen 1966, 1969).

Controlled selective grazing (CSG)

The objective here is to ensure moderate utilisation of palatable species, while unpalatable species are not utilised at all. Palatable species are stimulated, while unpalatable species become moribund and die. In practise, CSG and HPG do not differ much. By just “creaming” the veld both production per animal and production per hectare are increased and veld condition is improved. This rotational grazing system is characterised by eight or more camps per herd, short periods of stay and long periods of absence (Pienaar 1968, Low 1975).

High utilisation grazing (HUG) / Non-selective grazing

The accent here is the total utilisation of available grazing. A camp is grazed until all grasses, including least palatable species, are fully utilised. Animals are forced to utilise species that they would otherwise ignore. By utilising all species, palatable species are not dominated and/or replaced by other species. Better animal production (production per hectare) is obtained, and veld condition is maintained (Booysen 1969).

Short rotational grazing (SRG)

With this, an attempt is made to ensure that palatable species are utilised only once during the grazing period. The so-called “second bite” which damages the grass tuft, is hereby prevented. For this, a multi-camp system (eight camps or more per herd) and a high grazing pressure is needed. Livestock remain in the camp for a short period, and are removed before grazed tufts are re-utilised. The period of stay is relatively short, and the period of absence relatively long. Grasses remain in a constantly stimulated condition, and it has been suggested that the carrying capacity of veld can be doubled if more camps (up to as many as 37) per herd are included in the system (Savory 1978).

Rotational grazing was thus seen as the starting point of all grazing management systems, since it provided a countermeasure for the selective grazing behaviour of livestock. By controlling selection, animal production, carrying capacity and veld condition could be controlled (this was the viewpoint until recently). However, these grazing systems required large capital inputs in terms of fencing and water supply. In the past, it was accepted that this was part of the package.

In direct opposition to some long-held beliefs, continuous grazing cannot be considered better than rotational grazing, or *vice versa*.

Scientific research

Management systems

In direct opposition to some long-held beliefs, continuous grazing cannot be considered better than rotational grazing, or *vice versa*. This is suggested by the following, based on various long-term grazing management trials throughout southern Africa:

1. Selective grazing cannot be "bettered" by adding more camps to a rotational system (Gammon and Roberts 1978);
2. Livestock follow the same selection patterns under both rotational and continuous grazing (Gammon and Roberts 1978);
3. Animal production is equal or higher under continuous grazing in comparison to rotational grazing (Hart *et al*. 1988);
4. If compared, veld condition does not differ under continuous grazing in comparison to rotational grazing (Barnes and Denny 1991);
5. Veld deteriorated under both continuous and rotational grazing where a proper rest period was absent (Jordaan *et al*. 2003);
6. Applying rotational grazing does not increase carrying capacity (Barnes and Denny 1991);
7. The stocking rate (LSU/ha/year) (O'Reagain and Turner 1992) and adequate rest (Jordaan 2004) are the two most important factors that have an influence on animal production, irrespective of the grazing system followed.

Grazing

When CSG was initially developed and implemented, the following principles were proposed:

1. Moderate defoliation stimulates

grass regrowth (Low 1975).
2. Unpalatable grass species become moribund and die if not defoliated (Edwards 1981).

Lush regrowth after utilisation, combined with the dead appearance of unpalatable, unutilised tufts often give the impression that this is true. However, Kirkman and Moore (1995), found that utilisation, light or severe, had an adverse effect on the vitality of tufts during the following season: the heavier the utilisation, the bigger the effect.

Thus, good veld management starts with the grazing process (that is, the actual requirements of the animal and physiological response of the plant), and not with the grazing procedure (number of camps or rotation system). The negative effect of grazing must first be looked at in total. Thereafter, attention can be given to aspects such as grazing management systems and the number of required camps in terms of practical herd management.

Principles of veld management

Rest

Adequate rest can be defined as a prolonged period of absence of livestock, long enough for the veld to overcome the effect of previous grazing treatments in terms of both grass production and seed production (vitality).

Research indicated that the period of absence is usually too short to give adequate rest (Barnes and Dempsey 1992). In order to be seen as “vitality rest”, a period of absence of more that eight weeks (CSG) is needed to overcome the effects of grazing. At present, little is available to indicate what the length of an effective rest period should be. Preliminary results indicate that a full growing season is needed for grasses to recover after defoliation (Barnes 1989, Robinson 1998, Jordaan 2004). It is also clear that grazed veld which receives no rest, progressively deteriorates over time. In practise, rest must be applied regularly to all camps and must be seen as an integral part of veld management.

Stocking rate

It is generally believed that by applying high stocking rates, carrying capacity is increased due to a higher grass production as a result of the continued stimulation of grass species. This belief is totally unfounded. Research by O’Reagain and Turner (1992) indicated that the carrying capacity of veld could be increased by rotational grazing. This lasted for the first season of grazing only. Thereafter, grass vitality and veld condition decreased over time.

Carrying capacity can not be changed by changing the grazing procedure. Carrying capacity is determined by the available material. This, in turn, depends on climatic conditions (mainly rainfall), veld type and veld condition. The carrying capacity of each farm is unique and varies between years.

The importance of using the correct stocking rate must be emphasised. Overstocking is the single most important factor that leads to veld deterioration. It is not feasible to overstock veld and to amend by incorporating long rest periods. Veld recovers partially, but not enough to maintain its previous condition (O'Reagain and Turner 1992).

Since grass production varies from year to year, stocking rates must also be adjusted annually. The norms as set by the Department of Agriculture, Land and Environment are only to serve as a guide. The annual adjustments must be made by the farmer himself.

Separation of veld types

This was one of the practises that was not questioned by more recent research. The influence of grazing on unseperated veld types was recorded by various researchers in the past, and it is clear that, for optimal utilisation, separation of veld types in order to prevent area-selective grazing is of the utmost importance (Kirkman and Moore 1995).

The fodder bank system

Currently, various veld management systems are used in the Limpopo Province. They are largely based on the concept of CSG. This is however a complex and capital intensive grazing management system, which is difficult to apply. Therefore, in practice, farmers have simplified it to rapid rotational grazing. This and the dubious scientific basis of CSG stimulated the development of the fodderbank system.

Requirements for a veld management system

When deciding on a successful grazing management system, the following basic aspects must be attended to. These were the aspects that were used as a basis when the fodder bank system was developed:

- Management must be simple.
- The system must be economical (low infrastructure requirements).
- Systematic rest periods of sufficient length must be incorporated.
- The farmer must be able to do his own fodder flow planning on an annual basis.
- The system must provide a mechanism to adjust stocking rate according to veld productivity on a yearly basis.
- Veld types must be separated to allow separate utilisation of different plant communities.

Applying the fodderbank system

Planning the system

The planning phase of the system is the most important part.

As in the case of most of the other grazing management systems, veld types must be separated. Thereafter, the production potential and the area of each plant community are determined, relative to one another. The farm is now divided into three groups, each similar in production potential and carrying capacity (all camps are thus divided into one of three camp groups. All three camp groups have the same total carrying capacity/ potential).

Accordingly, the calendar year is divided into three equal periods with one period covering the peak growing season. The peak growing season corresponds with the peak rainfall period, and will be as follows in the Limpopo Province: 1 December - 31 March (growing season), 1 April - 31 July (dormant season), 1 August - 31 November (Dormant/ start of growing season)

Implementing the system

The best time to start is at the beginning of the growing season. Thus, on 1 December, all livestock are moved to one third of the farm's veld where they will remain for a full four months. The stocking rate must be within the total carrying capacity of the farm.

Table 1: Sequence of rotation for the three camp groups (A, B and C) over four years.

Year	Camp group	1 Dec - 31 March (Growing season)	1 April - 31 July (End of growing season to dormant period)	1 Aug. - 30 Nov. (Dormant period to beginning of growing season)
1	A	**GRAZE**	**REST**	**REST**
	B	**REST**	**GRAZE**	**REST**
	C	**REST**	**REST**	**GRAZE**
2	A	**REST**	**REST**	**GRAZE**
	B	**GRAZE**	**REST**	**REST**
	C	**REST**	**GRAZE**	**REST**
3	A	**REST**	**GRAZE**	**REST**
	B	**REST**	**REST**	**GRAZE**
	C	**GRAZE**	**REST**	**REST**
4	A	**GRAZE**	**REST**	**REST**
	B	**REST**	**GRAZE**	**REST**
	C	**REST**	**REST**	**GRAZE**

Managing the system

Each camp group (third of the veld) is grazed for four months (a third of the year), continuously, by the total number of cattle that the farm can carry. In this way, the entire farm is grazed annually, but only one third is grazed during the active growing season. During the following year a different third of the veld will be grazed during the growing season (Table 1).

From Table 1, the following emerges:

• Each camp group is grazed during the growing season, once every three years.

• Each camp group rests for two consecutive years during the growing season. This means that two thirds of the veld rests receives an annual rest during the growing season.

Grazing during the growing season is based on an indicator camp system. The camp with the highest potential is utilised first. After utilisation of all palatable species, the animals are moved to the next camp within the camp group. Camp are repeatedly re-utilised upon recovery, irrespective of the fact that they have already been previously grazed. Thus: where more than one camp is available, rotational grazing is applied within the camp group for the full four months. If only one camp is available, the camp is continuously grazed for four months.

During the following two-thirds of the year, the next two camp groups are similarly grazed. In this case, they are grazed during the dormant season, a grazing treatment which is considered to do the least damage to the grass plant (Low 1975). However, during the dormant season, the whole farm can be grazed (including the camp groups that were grazed during the growing season) if required by circumstances (hail, termites, fire, etc.). The main objective is to ensure that only one third is utilised and two thirds rested during the growing season.

Comparison of the fodder bank system to the requirements for an ideal veld management system

Day to day management is simple. After the initial planning, relatively little time and management inputs are needed for successful management.

• Fencing cost - a minimum of three camps per herd is required (there are normally at least three herds on a farm).

• Rest - the system incorporates ample rest. Two thirds of the veld rests each year during the growing season.

• Fodder flow - by grazing a third of the veld during each third of the year, provision is made for an annual fodder flow.

• Adjusting the stocking rate - annual veld productivity of a farm is a function of the annual rainfall and the plant communities of the veld. Therefore, current carrying capacity of the veld can be determined at the end of each growing season and he stocking rate adjusted accordingly. If the camp group is, for example, fully utilised by February (75% of the growing period), it is clear that the farm is 25% overstocked. Fodder shortages will then occur during both the other two grazing periods as well.

Plant communities are utilised separately.

Conclusions

What is very clear is that veld condition and animal performance is determined by three crucial factors, namely the separation of plant communities, the maintenance of a realistic stocking rate and rest during the growing season. Complying with these factors will ensure that veld condition and animal production is maintained, irrespective of the grazing management system that is used.

The fodderbank grazing system satisfies all the requirements for sound veld management in the Northern Bushveld.

The fodderbank grazing system satisfies all the requirements for sound veld management in the Northern Bushveld. It provides a framework through which the basic principles of veld management can be applied, and might prove to be valuable in the rural areas, where grazing management is problematic.

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Congress 43 Update

43rd Annual GSSA Congress: Implementing New Approaches to Range and Pasture Management

21 - 25 July 2008, Badplaas, Mpumalanga

Visit www.grassland.org.za for more details, or contact the Administrator

Have you registered for the 43rd Congress of the GSSA yet?

The main theme of the Congress is Implementing New Approaches to Range and Pasture Management although a wide range of themes will be covered during the Congress.

Several symposia, workshops and session themes are already taking shape, as listed below. To submit titles and abstracts for inclusion in the Congress, please register.

If you have other ideas for symposia, workshops, tours or short courses to be held in conjunction with the Congress, please submit them before the end of February.

Deadlines

- Early Bird Payments: 30 April
- Submission of Titles: 29 February
- Submission of Abstracts: 16 May

Speakers, Symposia, Workshops and Sessions

Dr Richard Stirzaker will be presenting the keynote address on Tuesday morning. Dr Stirzaker, of CSIRO in Australia, is a leading researcher working on the relationships between plant water use, soil health, crop yields and salinity.

The symposia, special sessions and workshops will include:
• Savannas: How has our knowledge grown since the biome projects? • Linking Planted Pastures with Natural Rangelands: Knowledge gained in the past 25 years; • GIS Course - a hands on workshop; • Farmer Development: New Approaches to Rangeland and Pasture Management.

Post-Congress tours

Several exciting post-congress tours have been arranged, including one short one on Friday morning for those who cannot stay over on Friday night. Accommodation can be arranged in Badplaas for Friday evening.

Mpumalanga Game Parks and Farming

The Kruger National Park: Science and Tourism All in One
Including a visit to scientific services, the rhino bomas and exclosures, long term burning trials plus some game viewing.

Mpumalanga: an agriculturally diverse region
Visits near Badplaas focusing on changes in vegetation and farming practises including citrus and forestry.

Books

Adaptive Livestock Management in Semi-Arid Rangelands: A Modelling Approach

Sikhalazo Dube

Droughts are an integral part of semi-arid environments with far reaching consequences. Management decisions in these environments should be evaluated against a scenario of uncertainty in climate and prices. There is a need for forecasting environmental and economic risks associated with different management options. Development of simple yet effective models to assist in development of effective management strategies is vital. This study evaluates the effects of stocking rate for fixed and flexible strategies on range condition, ranch income and expenses for cow-calf enterprises. The analysis should assist livestock managers produce sustainably in semi-arid environments. Use of principles in the study can alleviate some of the drought induced livestock mortalities through forward-looking forage planning.

The book is addressed to livestock producers, ecologists, drought management strategists and climatologists. It is also a good guide for researchers in the field of ecological modelling, particularly those looking and developing more robust and user-friendly models.

The author

Sikhalazo Dube is a rangeland ecologist based at the University of Fort Hare in the Eastern Cape, where he is head of the Department of Livestock and Pasture Science

He has worked in Zimbabwe and Namibia, and is currently leading a project on the management of communal lands in the Eastern Cape.

Details

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