GRASSROOTS

Newsletter of the GRASSLAND SOCIETY of SOUTHERN AFRICA

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Undergrazing causes overshadowing of pastures

Managing our shrinking heritage: Workshop in Midrand

Mike Peel takes GSSA into 2010

Environmental goods and services

Advancing rangeland ecology and pasture management in Africa

GRASSROOTS

Editor **JULIUS TJELELE**

Dear Readers

This is my first issue as the editor of Grassroots (Newsletter of the Grassland Society of Southern Africa). Alan Short has been the editor for the past five years. I would like to thank him for the trust he has in me and the support he is giving me. I am looking forward to the challenge and I will do my best to further build Grassroots from where Alan Short left off.

Most people do not know me. I am working for the Agricultural Research Council (Animal Production Institute) in Irene Pretoria. As a Researcher, I am working on management of bush encroachment and currently registered with the University of KwaZulu-Natal under the supervision of Professor David Ward.

I've always had a problem with young researchers, technicians or students who are afraid to grab opportunities to learn from the best or make mistakes. All the Professors, Doctors and Specialist Researchers in the Grassland Society started somewhere. To all the young researchers, technicians and students; grab this opportunity and share your results, problems from your projects and the future of your research with us.

The GRASSLAND SOCIETY of SOUTHERN AFRICA
P.O. Box 41 • Hilton • Pietermaritzburg • 3245 • South Africa
Tel: +27 (33) 390 3113 • Fax: +27 (0)86 622 75 76 • Cell: 083 256 7202
Email: admin@grassland.org.za • http://www.grassland.org.za
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News

Features

Regulars

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 jtjelele@arc.agric.za or admin@grassland.org.za or fax +27 (0)86 622 75 76

On the cover: Undergrazing causes overshadowing of pastures, Photo: Philip Botha

Biodiversity plan launched at Namakwa Expo

The first Namakwa Biodiversity Expo funded and hosted by Department of Environment and Nature Conservation (DENC) was held on the 10 and 11 July 2009 at the Goegap Nature Reserve just outside Springbok.

Among other dignitaries at the event were the Northern Cape Premier Hazel Jenkins, Director of Conservation for DENC Albert Mabunda, MEC of DENC Sylvia Lucas, MEC for Roads and Public Works David Rooi, HOD Patience Mokali and the Executive Mayor of the Namakwa District Hendrik Visser.

The Expo was held to launch the Critical Biodiversity Area (CBA) maps and Biodiversity profiles for the Namakwa District. The biodiversity products are the first steps towards the full implementation of the Namakwa Bioregional Plan (NAMBAF). The forum is in place to support the implementation of the Namakwa Bioregional plan and to guide environmental policy and legislation.

The expo was a collaborative event made possible by a range of conservation partners including Conservation International, South African National Biodiversity Institute (SANBI) and DENC.

The succulent karoo ecosystem program (SKEP), Programme Developer, Lububalo Ntsholo reported that event was a culmination of the work that SKEP has done over the past five years. He also said that "the launch of CBA maps together with the NAMBAF will go a long way in ensuring that the products that have been developed are put into practice"

For more information contact Lububalo Ntsholo at ntsholo@sanbi.org - SKEP newsletter

Sustainable Utilisation and Protection of Agricultural Resources Bill

The Department of Agriculture (DoA) started drafting the Sustainable Utilisation Resource Bill in 2002, now referred to as the Sustainable Utilisation and Protection of Agricultural Resources (SUPAR) Bill.

The draft Bill seeks to optimise productivity and sustainable utilisation of natural agricultural resources, provide for the control of weeds or invader plants and the subdivision and change of utilisation of agricultural land. The Bill will replace the Conservation of Agricultural Resources Act, No. 43 of 1993 and the subdivision of Agricultural Land Act, No. 70 of 1970.

The SUPAR Bill was stayed until the Constitutional Court ruled on the appeal case relating to the Subdivision of Agricultural Land Act, No 70 of 1970.

In September 2007 two farmers took the Registrar of deeds to Court arguing that they have the right to subdivide agricultural land to sell parts thereof as regulated under the Subdivision of Agricultural Land Act. The Supreme Court ruled in favour of the Minister to exercise power to demarcate certain land as agricultural land.

Latest Developments:
The Bill is under discussion within the Department. The State Law Advisors recommended further review of the Bill. The Bill's content remains unchanged.

For more information contact Mr Matai at 012 319 7394. (Participation junction newsletter)

Lowveld Co-ordinated Research Forum

NICOLA STEVENS
South African Environmental Observation Network

Lowveld Coordinated Research Forum

Dr Mike Peel of the Agricultural Research Council' s Animal Production Institute and the South African Environmental Observation Network (SAEON Ndlovu Node) have successfully organised the latest annual Lowveld Coordinated Research Forum (LOCORES).

LOCORES was held early this year at a bush camp within the Thornybush game reserve. Presentations revolved around the themes of conservation, management and research, with the aim of keeping people informed of new developments in research and management philosophies, as well as important conservation initiatives in the area.

LOCORES has been running since 1991. It was started by Dr Mike Peel as a means of promoting interaction between applied ecologists and natural resource managers. The LOCORES Forum has aided in facilitating a close link between management and research in the Lowveld's private protected areas, and hence was one of the factors behind the region being chosen for SAEON's first long-term environmental observation node – the SAEON Ndlovu Node.

Shortly after its establishment SAEON Ndlovu Node became actively involved with this successful forum to maximise its contact with the Lowveld research and conservation community. This year's Forum was attended by 60 people, comprised of land-owners, conservationists, interested members of the public and conservation managers.

Presentations were given by scientists, managers and conservationists all addressing ecological and practical issues that face the members of this forum in the lowveld.

Management

Robert Buitenwerf of SAEON discussed his findings from a long-term data set collected by Dr Peel and his team, looking at how grass species composition and productivity has changed over time in the private reserves in the area. He explained how these changes are related to management actions and the local environment.

Dr Peel explained and discussed the philosophy of holistic land management, which had been the subject of a large workshop in the Kruger National Park a few weeks prior to the LOCORES meeting.

Research

SAEON presented some of its research and monitoring initiatives in the area. SAEON registered student, Edward Kohi gave a presentation on the research he is conducting in the private reserves. He showed that elephant browsing causes a positive response in browsed trees. In the time following the browsing event, the browsed areas put out more leaves which stay greener for longer. However, these effects vary depending on which geology type the trees occur on.

Dr Wayne Twine of Wits Rural Facility updated the audience about the resource utilisation and HIV impact research being undertaken in the communal rangelands in the Acornhoek region. The research revealed how households impacted by AIDS-related and non-AIDS-related deaths utilise the natural resources in the area differently.

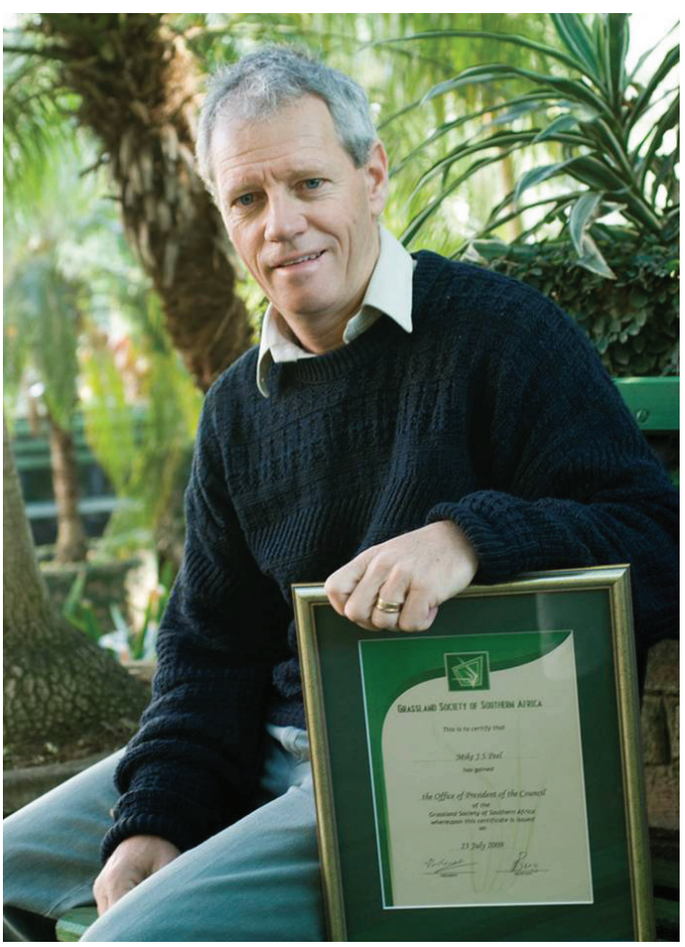
Conservation

Debbie Thompson, one of the founding members of the Kruger to Canyons Biosphere region (under which the most of the Hoedspruit and Phalaborwa regions fall), gave a talk on recent developments in the biosphere region and revealed some exciting sustainability and conservation initiatives currently in progress. One such project aims to provide incentives for fruit farmers in the region to convert to organic farming methods by setting up a contract with a German organic juice manufacturer.

Dr. Mike looks forward to the challenge of taking GSSA into 2010

Cailey Owen and Monika Ogden of Leopard Ecological Assessment presented the beginnings of a national leopard conservation initiative which promises to reveal considerable information about the status of the leopard in South Africa.

Dr Mike Peel, Professor Chalie Shackleton, Mr Kevan Zuncker and the late Dr. Joe Venter are the founders of LOCORES.



Dr. Mike Peel, ARC-Animal Production Institute (Rangeland Ecology) was elected as President of the Grassland Society of Southern Africa at the 44th Congress of the society held at the UNISA campus in Johannesburg in July 2009.

He looks forward to the challenge of taking this vibrant and diverse society which comprises both rangeland and pasture scientists into 2010.

Important topics discussed at Congress 44 included: the impact of climate change on the natural resources of southern Africa and the need for a complete re-analysis of the agricultural sector; concerns around the shortage of plant breeders in South Africa; the issue of future payment for ecosystem-services; food security; rangelands and mining; the use of pastures in animal production; the burgeoning wildlife industry; and the importance of the emerging farmer sector.

Dr. Peel believes that the interconnectedness of ecosystems and the fact that there is often a shortage of personnel in institutions necessitates a networking approach to rangeland and pasture research. He states that the Society is in a strong position to grow and in this regard the mentorship programme of the society should encourage working partnerships between young and establishedto ensure the future of the discipline in southern Africa.

Dr. Peel who is based in Nelspruit is programme manager of the Rangeland Ecology Programme and also heads up the Savanna Ecosystem Project which he initiated in 1989. The latter forms one of the longest running formal ecological monitoring programmes in southern Africa. (ARC intranet)

Marianhill Landfill Conservancy

The department of Water and Environmental Affairs estimates that S.A generates approximately 40 million tons of solid waste a year – 15 million tons of domestic waste and 25 million tons of industrial waste. Ninety five percent of waste is disposed in open trenches or sanitary landfills, of which there are about 1200 in South Africa.

The people and industry must begin to reduce wastes they send to landfills by re-using products or packaging that can have a secondary purpose. Marianhill Landfill Conservancy won an Impumelelo platinum Award in 2007.

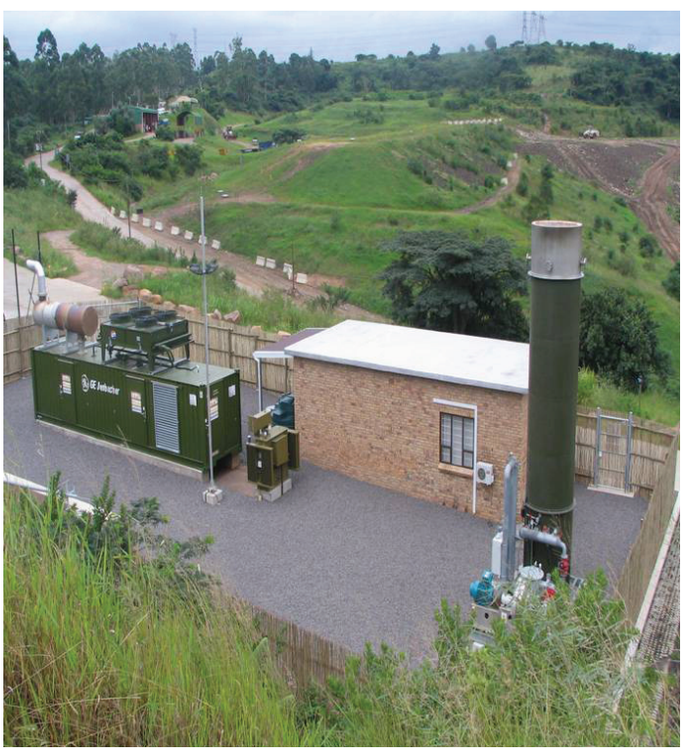
Throughout the world, the location of landfill sites has increasingly become the subject of considerable conflict and South Africa is no exception. Durban Solid Waste (DSW) was seeking for a new site for a landfill and proposed to locate it on a parcel of land from Marianhill Monastery. Marianhill currently receives 450 tonnes of municipal waste per day from Pinetown, Westville, Queensborough and Kloof areas. This represents about 15% of the municipality's total waste.

Wastes are stored in cells that are first prepared by removing the vegetation and soils from the area to be filled. The topsoil is kept on site and replaced after the cell is filled to capacity. Vegetation is placed in a large holding nursery called Plant Rescue Unit (PRUNIT).

This project has provided indigenous vegetation for rehabilitation of the peripheral buffer zone areas of Marianhill and an ongoing rehabilitation of Bisassar Road Landfill site.

Through consultation with the community, DSW applied for nature conservancy status from Ezemvelo-KZN Wildlife. To be recognised as a conservancy, a site must have a place in place a constitution, environmental management plan, site layout plan and environmental monitoring committee.

Marianhill was granted conservancy status in 2004. Today, a site is a home to 114 bird species and serves as a as an important natural corridor for species migration. It is also a rehabilitation area for the black-headed dwarf chameleon and University of Kwazulu Natal site for control of Alien species (Impumelelo case study).



Marianhill Landfill site

Environmental goods and services

Brian Read
Email: brianread@mweb.co.za

I recently had the privilege of attending the Buy Environmental Trade Show and Conference on behalf of Grassland Society of Southern Africa (GSSA). These brief notes are not an overview of the conference but rather a few key observations regarding those aspects of the conference which are likely to be of most interest to GSSA members.

Growth in green business
The conference emphasized the fact that there is now far greater awareness of the urgent need for business to deal effectively with environmental issues.

Internationally environmental goods and services are seen as being a very strong growth market even despite the current economic downturn. One speaker indicated an annual growth rate of between 20-30%.

The future of energy
A number of speakers addressed the subject of energy efficiency and alternative energy sources. The anticipated future growing need for biofuels was also emphasized.

Of particular interest to the agricultural industry was a comment by Dr Johan van Zyl (President and CEO of Toyota Motors SA) who mentioned that whereas strides are being made to improve efficiency with alternatives such as the hybrid car engines and alternative fuels we still need an alternative to diesel power in agriculture.

Mr. Andrew Guilder from Imbewu presented a talk dealing with carbon trading and offsets. I believe there could be opportunities for grassland solutions in this area. One of the speakers touched on the controversy which is rather topical namely the competition for the use of food crops as sources for the production of fuel.

I believe grassland scientists could be spearheading a search for alternative biological fuel sources and processes. We could be looking for perennial crops with low production cost which could be produced in areas where conditions not suitable for the production of food crops. In this way we could possibly find an alternative which does not compete with food crops and which makes use of low productivity land which would otherwise only be used for grazing.

Sustainability
Stephan Jacobs from the Natural Step, mentioned the concept of the "Ecological Footprint" which is a measure of the land space we need to support our lifestyle. We are currently overutilizing the world's available resources by some 25%. We are living on capital. One of the other speakers mentioned that we would need four planet earths to support the world's population (doubling every 40 years) in 100 years time. I think that figure quadruples if we take it to 200 years. This begs the question as to whether the sustainable development philosophy can ever be the full long term answer. Is it really the way to get us to the twenty second century and beyond? I personally believe that a sustainable life style where we live off the land like subsistence farmers and die young would have more hope of success. But I certainly do not see any takers for that suggestion. However, I believe we need to rethink what we are doing rather than wishfully hope that sustainable development is going to get us to the future.

Conclusion
If we consider the path we need to be on in order to reach the twenty second century and beyond then the following is probably likely:The human diet will include less in the way of animal products. All available arable land will be used to produce food for human consumption. Low potential lands currently considered unsuitable for crop production will become increasingly used for food cropping. Animal feeds and biofuels will be based on grassland species and byproducts from other industries. No longer will we feed grain to cattle.

It is the above path which should probably inform our research and development programmes.

Grassland Conservation in Midrand: Managing our shrinking heritage

ALAN SHORT
Agricultural Research Council, Animal Production Institute
Email: ShortA@arc.agric.za

The grassland biome covers about 30% of South Africa, and is economically one of the most important parts of the country Most of South Africa's water is generated in the grassland biome, yet it remains one of the least protected and probably most misunderstood biome in southern Africa.

Greater Johannesburg, the biggest urban area in the grassland biome, is developing rapidly, threatening to swallow up what few remnants of natural vegetation are left around the city. One area that is changing swiftly is Midrand, halfway between Johannesburg and Pretoria, where residential, commercial and industrial developments are rapidly gobbling up any available land. The Greater Kyalami Conservancy (GEKCO) is a small non-governmental organisation dedicated to trying to protect the portions of Kyalami that are still zoned as agricultural by lobbying policymakers and educating residents about the natural riches at their feet. The Grassland Society of Southern Africa (GSSA) and GEKCO combined forces to arrange a symposium on conserving grassland in Midrand, with the emphasis on practical suggestions for biodiversity management in a fragmented landscape.

Overview of the grassland biome and threats
Four speakers led the discussions with talks based on years of experience in their respective fields, with each subject being thoroughly debated by an audience consisting of people with a wide range of experience, from concerned housewives to retired engineers, to environmental consultants.

About forty people attended the talk, some from as far away as Ladysmith and Potchefstroom, and the majority from around Midrand.

Fire: the misunderstood element
Mike Panagos of Tshwane University of Technology started proceedings by giving an overview of the role and importance of fire in rangelands. Fire is seriously misunderstood by the general public and by policymakers, yet it remains one of the most crucial elements in rangeland ecology. Mike reminded the audience of the name given to southern Africa by early Portuguese explorers: "Terra dos fumos" – land of smoke. The South African grasslands are a fire-prone environment, adapted over millennia to frequent burns. Good reasons for burning are fairly well established by science – to remove moribund grass, to burn firebreaks, to control bush encroachment, to encourage animal movement. Other reasons for burning are questionable at best – to control ticks or to provide a "green bite" in winter.

The decision to burn should primarily be driven by the condition of the veld at the time, which includes considering the species composition and fuel load of the veld, as well as, of course, by the management objectives of the property. The practice of clearing firebreaks mechanically is widely practiced across South Africa, but is disastrous as it encourages soil erosion.

A great deal of the discussion centred around practical issues of burning in an area like Midrand which consists predominantly of small (1-2ha) plots surrounded by electric fences, and with a great deal of infrastructure per plot. Mowing was discussed as an alternative to burning, although several species do require fire to stimulate germination or growth. Mowing can replace burning to a certain extent, in removing the fuel load and keeping the structure of the grass sward short. Mowing in winter is far less destructive than mowing in summer, as most of the plants are dormant in winter.

Shallow wall with a palisade fence

Fences and Frogs

Vincent Carruthers, the renowned wildlife expert and author of numerous field guides to frogs and wildlife in general, followed with a wonderful and very practical talk on managing wildlife in a fragmented landscape. He started by differentiating between the "involved" school of wildlife management, which includes things such as putting out licks, feed or water for animals, and the "ecological" school of wildlife management, which focuses on managing the ecosystem and the surroundings and letting the animals look after themselves.

In the ecological school, habitats are conserved to provide foraging and breeding habitats and corridors for movement.

Vincent focussed on three broad Highveld habitat types: open grassland, wetlands and woodland, and for each habitat type gave the audience an idea of what species to expect and how to encourage wildlife in those habitats. For open grassland, structural diversity of the vegetation, in other words, a mixture of short and tall patches, can be very important for providing foraging areas and refuge areas for many species. Proper burning is crucial, which means burning at the right time of year, burning at the appropriate frequency and setting the right type of fire. Ring-burns, for example, though practically very useful for managers, are devastating for wildlife as a ring-burn leaves no escape route for small animals.

Lawns, insecticides, dogs, cats, floodlights and fences are disastrous for wildlife. The discussion centred on a number of practical suggestions for balancing security and ecology. Floodlights can be shaded appropriately so that they light up the area of concern and not half the neighbourhood. Insecticide use can be minimised or eliminated entirely. Dogs and cats are a more difficult subject, since most people love their pets, although as predators they can be fatal to many species.

Fences can be made more porous to animals by building shallow "subways" at regular intervals along the fence. Vincent proposed a design which, he said, allowed animals but not humans to crawl through the fence. A concrete trough with walls at both ends and spikes mounted on the walls is placed under the fence at intervals of about thirty metres. Animals as large as steenbok are able to crawl through the tunnel so made, but the hole is far too small even for a child to crawl through.

Ordinary palisade fencing is reasonably friendly to smaller animals, but solid walls and electric fences are impenetrable, as are designs involving a shallow wall (about 30 cm) with a palisade fence on top. Many small animals such as frogs simply cannot mount the shallow wall.

In woodlands, animals can be encouraged firstly by minimising disturbance. Trees should form coppices with many different species at different heights, not regular plantations. Old logs and litter on the ground will provide habitat for an enormous variety of smaller creatures. Vincent strongly opposed "gardening" in woodland patches, as the regular disturbance would destroy habitat for small creatures and discourage many others. The most important management input, however, is managing alien invasives.

In managing wetland areas for wildlife it is crucial to recognise the total wetland, which includes seeps, flood lines and the margin of the wetland. Wetlands are defined by soil characteristics, and a patch of land can be part of a wetland even if it is apparently dry on the surface. Compacted banks and eutrophication can greatly discourage wetland wildlife.

Finally, Vincent ended off with the advice to ensure a habitat for oneself. Create a quite, peaceful and comfortable corner where one can relax and enjoy the nature that one has worked so hard to protect.

Keystone of South Africa's water production systems

Wetlands and People

John Dini, head of the Working for Wetlands programme, introduced the audience to one of South Africa's major ecological/poverty relief programmes. Working for Wetlands is a job-creation project founded solidly on the principle that wetlands are a keystone of South Africa's water production systems, and therefore critically important to the economy of a semi-arid country (a fact often forgotten by South Africans, since most of the population lives in the higher-rainfall fraction of the country).

Wetlands are not easy to define or to measure, especially for a layman. Their definition rests not so much on water as on soil, or more accurately, on the interaction of water and soil. A wetland could, in fact, be invisible to the untrained eye while the soil a few inches below the observer's feet is seasonally or permanently saturated. However, the art of identifying wetlands does not require esoteric skills taught by secret societies exchanging coded handshakes – anyone can be taught to recognise the crucial signs that differentiate a wetland from the adjacent dryland, starting with the greyish colours of the soil.

Globally, half of historical wetlands are estimated to have been lost, while there is no estimate for South Africa. Working for Wetlands is in the process of compiling a national wetland database, which already consists of around 114 000 wetlands, covering 3.6% of the country's surface. Even this map, by John's own admission, is a long way from complete.

The major cause of wetland degradation is the perception, still widely prevalent, that wetlands are valueless wastelands that need to be "reclaimed" to be of use to society. Wetlands have been drained for agriculture or urban development, drowned under dams, eroded through poor road design or overgrazing, polluted by waste, or been afflicted by a hundred other curses of civilised society.

The result has been devastating for clean and reliable water production, flood control, and ecological functioning.

The Working for Wetlands programme was born out of the new recognition of the importance of wetlands to stable ecosystems and economic stability. Working for Wetlands spends R75 million annually repairing around 100 wetlands, creating 1 500 jobs a year.

A number of fundamentals for wetland management can be outlined, starting by maintaining the basic fabric of the wetland: water, soil and vegetation. In the case of water, minimise the impact of damming or draining, maintain diffuse flows across the surface of the wetland, and maintain the residence time of the water. The most important aspects of soil management can largely be summed up in two words: "curb erosion". As well as erosion, soil extraction or compaction can destroy wetland functioning. Native vegetation cover needs to be managed by careful use of grazing and fire and management of invasive plants.

Interestingly, the good news is that wetlands are surprisingly resilient and can be relatively easily restored to a functioning ecosystem, with some fairly minor engineering interventions and wise management thereafter.

Several pieces of legislation protect wetlands, including the Conservation of Agricultural Resources Act, the National Environmental Management Act and the National Water Act. Lawyers will say that ignorance of the law is not an excuse for breaking it, so anyone who has a property with wetlands on

it should familiarise themselves with the relevant portions of the law before considering any activity that might affect the wetland. Working for Wetland's website would be a useful place to start looking for information.

Comfort and Conscience

Charlotte Smit from a company called InSynch Sustainable Technologies presented a fascinating talk on sustainable building, using a combination of 21st Century and ancient technology. Existing houses can be retrofitted with technologies such as solar water heaters and "grey water" systems which reuse the waste water from baths, showers and sinks for purposes that require only grey water (such as watering the garden). But the core of her talk and the most interesting was the building technology. Houses can be built off materials which have a far lower cost to the environment than standard building materials such as brick and concrete. More to the point, these "green" houses need not look like shacks in a backpackers' commune on a Thai island. Architects can design stunningly modern homes built with materials such as straw or adobe. The technology exists to make these homes comfortable, safe and attractive. More importantly, the building technology is approved by the local council in Midrand and many other municipalities.

A green home does not simply refer to a straw house or the fitting of a solar water heater. InSynch calls a green home one that embraces smart design, technology, construction and maintenance elements to lessen the impact of the home on the environment and improve the health of the people who live inside it. One of the simplest and cheapest examples is simply the orientation and layout of the house – a house that absorbs the sun in winter and is shaded from it in summer will have far lower energy costs for heating and cooling than one in which orientation is poorly considered. Anyone who has sat in a freezing living room in winter and baked in the same room in summer will appreciate how a few simple design elements could have improved that room's comfort. A shaded patio with creeping plants to cool it in summer can make a pleasant place to relax on a hot summer's day without requiring an air-conditioner.

The essence of green building design is a holistic approach to the project, considering six design principles: Socio-economic (promoting social, economic and cultural upliftment), health, water efficiency, land (respectful of the local environment), and holism.

Green building is defined as a project with a low construction impact, resource efficient (considering the "cradle to grave" environmental cost of resources), long lasting, non toxic, practical and beautiful.

Charlotte described a range of actual designs that InSynch had worked on, including using grey water to create an artificial wetland to attract frogs and birds, or a swimming pool disguised as a wetland for the same reason (not using grey water!), as well as a number of houses built with materials such as rammed earth, adobe or straw bales. The possibilities are limited only by imagination.

The future

The symposium was a great success, due to the dedication of a passionate and knowledgeable group of speakers who gave up their Saturday morning to share their enthusiasm with others, and to an equally passionate group of delegates with a wide and fascinating range of skills and experiences to share. The remaining natural systems in the Midrand area are severely threatened by powerful forces of urban development, and the residents of the area and GEKCO will need a lot of help to fight off the waves of bulldozers waiting on the front line. The GSSA, with our network of real scientific expertise, can provide the contacts for much-needed back-up to small, local organisations like GEKCO.

Acknowledgments

Most of the hard work in arranging the symposium was done by Margie Donde of GEKCO, with the assistance of Shari De Nobrega and Alwina Brand. Beaulieu College kindly provided the venue for the symposium at no cost. We thank the four speakers for their dedication and all the delegates for their contribution to the lively discussions.

Nodulation and cross-effectiveness of clover rhizobia isolated from the soils of the Eastern Cape

ANDISWA FINCA(1), ANTHONY OKOH(2) AND JOHN HOWIESON(3)
1 Agricultural Research Council-Animal Production Institute, Grahamstown, South Africa
2 University of Fort Hare, Department of Biochemistry and Microbiology, Alice, South Africa
3 Murdoch University, Center for Rhizobium Studies, Murdoch, Western Australia
1 Email: fincaa@arc.agric.za

Introduction

Nitrogen (N) is the most abundant gas in the atmosphere (~80%) and the most difficult for plants to acquire. Only plants that form a symbiotic relationship with the nitrogen fixing bacteria can fix N (Lindemann and Glover, 2003). N-fixing bacteria (e.g. *Rhizobium* spp.) are associated with N-fixing plants (e.g. legumes). There is a degree of specificity between the legume and the bacteria. Specificity of *R. leguminosarum* biovar *trifolli,* is governed by Nod gene. The expression of nodulation genes in the bacteria is activated by signals from plant roots. The aim of this study was to determine nodulation efficiency of clover *Rhizobium* of White Clover (*Trifolium repens*), African Clover (*Trifolium africanum*) and Rose Clover (*Trifolium hirtum*) growing in the soils of the Eastern Cape and their cross nodulation ability.

Materials and methods

Trifolium repens, T.africanum and *T.hirtum* were planted in 10 cm pots containing soils from either one of the three rural villages (Roxeni, Lushington, Allan water) and two research centres (Mpofu Training Centre and Dohne Agricultural Research Station). The soils were either treated with *Rhizobium leguminosarum* strain Alosca C or untreated. After four weeks the clover plants were removed from soil, the tops were cut and dried at 60 °C for 24 hours, and their length was measured to determine if growth stimulation had occurred. The root nodule numbers were also observed to determine the degree of nodulation. This was followed by isolation of Rhizobium on Yeast Mannitol Agar (YMA) plates. The root nodules were excised from the clover root, sterilized in 70% ethanol and crushed in a drop of sterile water, then streaked on the YMA plates. After three purification cycles pure rhizobial colonies were used to prepare a rhizobial suspension. The suspension was then used to inoculate seedlings of the three clover *spp.* growing in Plant Growth Nutrient Agar Slants, to determine their cross nodulation efficiency. The effects of cross nodulation were determined by visual observation of the formation of root nodules.

Results

The growth profiles of the untreated and treated clovers are as shown in Figures 1-3.

Trifolium repens showed no growth difference in both the untreated and Alosca C treated soils of Dohne. Improvement in the growth of *T. repens* was observed following the addition of the Alosca C inoculant in the Lushington, Mpofu and Roxeni soil, while in untreated Allan water soils *T. repens* more growth was exhibited (Figure 1).

Trifolium hirtum showed no growth difference in both untreated and *Rhizobium leguminosarum* strain Alosca C treated soils of Lushington. Improvement in the growth of *T. hirtum* was observed following the addition of the inoculant (*Rhizobium leguminosarum* strain Alosca C) in Dohne, Mpofu and Roxeni soils, while in untreated Allan Water soils *T. hirtum* showed more growth (Figure 2).

Good growth was observed for *T. africanum* following the addition of the inoculant *Rhizobium leguminosarum* strain Alosca C in Dohne, Allan Water, Mpofu and Roxeni soils and in Lushington soils the growth in untreated soil was slightly high (Figure 3).

Discussion

In this study, nodulation was only observed in *T. africanum* and no cross nodulation was observed for all the clover plants. Since *T. africanum* is a South African clover and *T. repens* and *T. hirtum* are exotic species it is likely that they did not nodulate because the native soil microflora did not contain any rhizobia

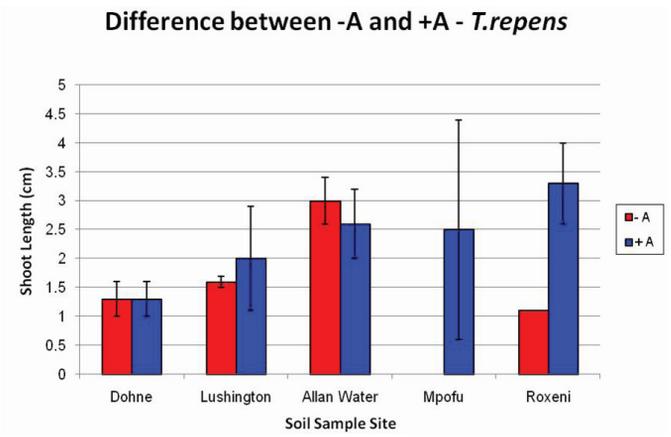


Figure 1. Difference of shoot length between *T. repens* with Alosca C and *T.repens* without Alosca C.

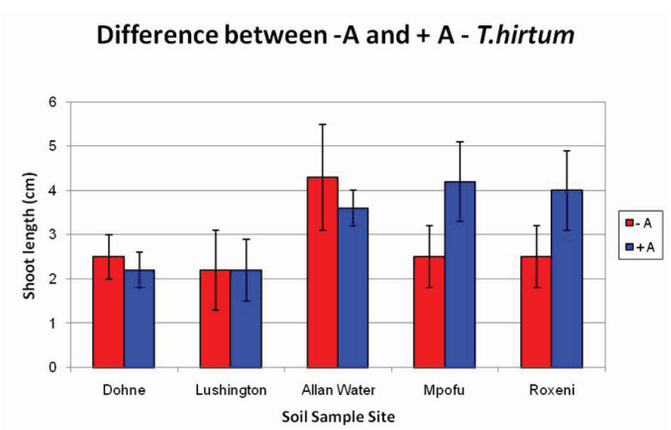


Figure 2. Difference of shoot length between *T. hirtum* with Alosca C and *T.hirtum* without Alosca C.

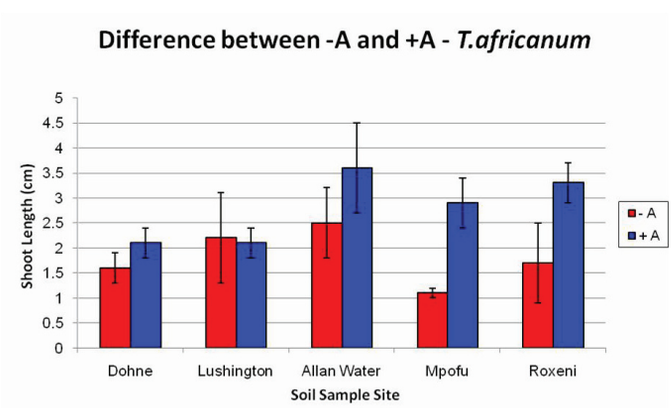


Figure 3. Difference of shoot length between *T.afrianum* with Alosca C and *T.africanum* without Alosca C.

specific for them. Soils free of the required rhizobia are usually encountered when a new crop is introduced where indigenous related legumes are absent (Catroux *et al*. 2001). Soil samples used in this study were collected from abandoned arable lands which have not been cultivated for five to ten years, during which the quality or nutrients in the soil might have reduced (Kennedy and Smith 1995; Ndiritu 1999).

Other unfavourable soil conditions that could have affected the presence of the desired *Rhizobia* include high temperature, dryness and salinity (Catroux *et al*., 2001). All three clover species used in this study failed to nodulate in soils treated with *Rhizobium leguminosarum* strain Alosca C inoculant and this could be probably because only four weeks was allowed for growth. The microorganisms in the inoculant needs time to adjust to the new environment (Pearce *et al*. 2008) and based on the observation made in (Fig. 1 –3) inoculation improved growth dramatically in Mpofu and Roxeni soils, but did not form nodulation. This could mean that infection was still at its initial phase when the plants were harvested. Cross nodulation failure by all the clover species could be attributed to the restricted host range of *T. repens* and *T. hirtum,* with respect to the strains used in this study (Lesueur *et al.*, 1996). However at this point it is not clear why the same strain isolated from *T. africanum* did not cross nodulation with it. The ineffectiveness of cross nodulation for these three clover species highlights the complex nature of cross-nodulation relationships between diverse *rhizobial* strains and legume hosts. The effectiveness of cross nodulation for these groups was going to serve as a guide to inoculant preparation (Turk and Keyser, 1992).

Conclusion

Based on the results obtained in this study it can be concluded that either the soil conditions were unfavorable for the clover species or the *Rhizobia* specific for them were absent in the soil microflora of the five sites. The ineffectiveness of cross nodulation for these three clover species highlights the complex nature of cross-nodulation relationships between diverse *rhizobial* strains and legume hosts. To correct this introduction of relevant inoculants and a soil analysis in abandoned land is recommended.

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Ineffective nodulation was observed for *T.africanum* grown in Dohne and Lushington soils whereas effective nodulation was observed for the same plant species grown in Allan water soils. No nodulation was observed for both *T.repens* and *T.hirtum* in the soils of all the five sites they were planted in (Table 1).

No nodulation was observed for all the three clover species in the soils of all the five sites they were planted in (Table 2).

Trifolium spp	Site				
	Dohne	Lushington	Allan Water	Mpofu	Roxeni
T. repens	X	X	X	X	X
T. africanum	I	I	E	X	X
T. hirtum	X	X	X	X	X

Table 1: Nodulation of three un-inoculated clover species grown in soil from five sites

Key: E – effective, I – ineffective and X – no nodulation

Trifolium spp	Site				
	Dohne	Lushington	Allan Water	Mpofu	Roxeni
T. repens	X	X	X	X	X
T. africanum	X	X	X	X	X
T. hirtum	X	X	X	X	X

Table 2: Nodulation of three inoculated clover species grown in soil from five sites

Key: X – no nodulation

Factors affecting the persistence of clovers in grass-clover pastures

PHILIP BOTHA
Western Cape Department of Agriculture,
Outeniqua Experimental Farm, George
Email: philipb@elsenburg.com

Grass-legume pastures are the basis of the dairy industry in the Southern Cape. The grasses used include annual and perennial ryegrass, tall fescue and cocksfoot. The legume component consists of red and white clovers. While pure grass pastures generally have higher dry matter production per hectare than pure clover pastures and provide for a more even fodder flow, clover pastures provide a higher quality fodder than grasses. With good management a high proportion of clover can be maintained in grass pasture without compromising the total dry matter production of the pasture. With grass-clover pastures not only its forage quality increased but, through their process of fixing atmospheric nitrogen and the recycling of fixed nitrogen, clovers reduce the requirement for inputs of inorganic nitrogen.

The production potential of a perennial grass-clover pasture depends mainly on the stability of the grass-clover ratio. For optimum quantity and quality of herbage a clover content of 30-50% is needed. As the contribution of clovers to total dry matter production of the pasture increases above 50%, so the dry matter production per hectare is significantly reduced. If, however, clover's contribution is below 30% then there will be a reduction in the nutritional value of the pasture. For example, cows grazing pastures which have a 25% or 50% clover component produce 22% and 33% more milk respectively than pastures which have a 0% clover component at the same dry matter availability per hectare.

Due to the different growth forms and growth requirements of perennial temperate grass and of clovers, and differences in palatability of the plants, most farmers find it extremely difficult to maintain a sufficient percentage of clover in their pastures. Grasses tend to be vigorous growers and, given the opportunity, will out-compete the clovers. The management of grass-clover pastures therefore puts greater emphasis onto ensuring that the requirements for optimal growth of clovers are maintained.

Factors influencing the persistence of clovers

Soil fertility

Optimum pasture production depends on correct management of soil fertility. The persistence of legumes in a grass-legume pasture depends largely on the physical and chemical status of the soil and moisture availability. Deeper, well drained soils, will normally be allocated for deep rooted legume plants e.g. lucerne while grass-clover pastures are well suited to shallow soils provided adequate moisture is available.

Annual soil sampling is necessary to monitor soil nutrient levels. Soil analysis will then indicate whether or not additional nutrients are necessary to raise soil nutrient status to the required levels, or simply to apply nutrients to ensure maintenance of current levels. Once the maintenance rates have been established, soil sampling can be undertaken every second year. The main advantage of soil analysis will be achieved by repeated testing over a number of years. A picture of trends in soil fertility status of the farm, on a camp basis, will then be build up. This can be used to monitor progress to achieve or maintain nutrient levels. This is an extremely important tool for the management of soil fertility in each pasture on the farm.

Grass-clover pastures are in the first place fertilized to raise soil fertility levels to the levels required for optimum growth and nitrogen fixing potential. Secondly to maintain the level of fertility by replacing nutrients lost through grazing and leaching.

Compared with grasses, white clover is a poor competitor for phosphorus (P), sulphur (S) and potassium (K). Competition with grasses also lowers clover's response to these nutrients (P, S and K). Inadequate levels of these nutrients will have a negative effect on clover yield and persistence.

The plant needs large amounts of macro nutrients compared to micro nutrients. The most important macro nutrients are nitrogen (N), phosphorus (P), potassium (K) and sulphur (S). The micro elements include all trace elements such as copper (Cu), molybdenum (Mo) and zinc (Zn). Recommended soil fertility levels for grass-clover pastures are P > 30 ppm, K 80-100 ppm, S >11 ppm, Cu >1.0 ppm, Zn >1.0 ppm and Mn 10-15 ppm for optimum production.

Soil pH is also important for clover growth and therefore, lime should be applied where the soil pH is below optimum levels (pH 5.5 [KCL]) for clovers. Liming also promotes nodulation, improves the use of P and increases molybdenum availability, which is essential for nitrogen fixation in clover.

Factors as soil fertility and the availability of water determine the composition of a pasture. Irrigation scheduling and grazing utilization determine the persistence of the pasture. Grass-clover pasture for dairy cows under full irrigation, where irrigation is scheduled with tensiometers installed at a depth of 150 mm, the pastures is grazed when 2500 kg DM/ha is available and pasture residual after grazing is 1300 kg DM/ha, the following pasture types are recommended:

Perennial ryegrass at 12 kg/ha.
Perennial white clover at 4 kg/ha.
Perennial red clover at 4 kg/ha.

If the pasture is utilized with dairy cows and followers which can include dry cows or low producing cows and only supplementary irrigation is available, grasses like tall fescue and Cocksfoot are included in the ryegrass-clover mixture. Tensiometers will still be used for scheduling but will be installed at a depth of 200 mm. The pasture will be grazed at 1900 to 2200 kg DM/ha and the stocking rate will be increased to allow for a pasture residual of 1000-1200 kg DM/ha after grazing.

The following pasture are recommended:
Perennial ryegrass at 4 kg/ha.
Tall fescue at 4 kg/ha.
Cocksfoot at 4 kg/ha.
White clover at 4 kg/ha.
Red clover at 4 kg/ha.

The same management factors do apply to kikuyu over-sown with a mixture of perennial ryegrass (8 kg/ha), perennial white clover (4 kg/ha) and perennial red clover (4 kg/ha). It is critical that the residual pasture after grazing must not be higher than 1200 kg DM/ha and the grazing rotation must not be shorter than 24 days during spring and between 28 to 30 days during summer and autumn.

Nitrogen.
Single applications of N during the autumn and early winter (25-50 kg N/ha), when the clover is dormant, will boost grass production at critical times without affecting clover N fixation or the clover composition. However, it is important to avoid heavy nitrogen application during the spring in order to ensure recovery of the clover stolon population after the winter.

Temperature.
Temperature has a significant effect on the growth and N-fixation of grass-clover pastures. The production of grass-clover pastures decrease at lower temperatures. Ryegrass has an optimum air temperature for growth of 18°C. White clover reaches a maximum growth rate at 25°C. For these reasons ryegrass-clover pasture tends to be ryegrass dominant during the winter and usually show an increase in white clover in spring and summer.

Ryegrass will react on N fertilization at temperatures as low as 5°C. White clover requires temperatures between 9°C and 27°C for growth and nitrogen fixation. This ability of ryegrass to react to nitrogen at low temperatures and the inactiveness of white clover at these temperatures, creates the opportunity for strategic nitrogen application. This will stimulate higher grass production during the winter without affecting the botanical composition or the N fixation of the clovers.

Soil moisture content.

Low soil moisture levels coinciding with high temperatures (>30°C) reduce clover growth. Maintaining soil moisture content is a critical management requirement for optimum production and botanical composition of grass-clover pasture. Clover growth is reduced as soils become dry and high temperatures prevail. Soil moisture management depends on rooting depth of the pasture species, the growth rate of the plants, soil type and the availability of water. A useful tool available to the farmer for scheduling irrigation is the tensiometer. This instrument, if placed at the correct depth and is correctly maintained, will provide a good indication of moisture availability to the plants. For example, on the Estcourt soil types of the George area a tensiometer depth of 150 mm and a maximum reading of -25 kilopascal (Kpa) are recommended for grass-clover pastures. The shallow rooted clovers need an irrigation system that can provide 10-15 mm of water on a frequent basis (2-3 times a week).

Cultivars and competition.

The choice of cultivars has an important influence in grass-legume mixtures in terms of their dry matter yield, botanical composition and animal production. Research has shown that the persistence of clovers was higher in mixtures with perennial ryegrasses than in mixtures with an additional component of tall fescue grass or in tall fescue grass-clover mixtures. Tall fescue-clover mixtures have a higher stocking rate than ryegrass-clover mixtures but also have a low average daily gain (ADG) resulting in a low animal production. For this reason the traditional grass-clover pasture mixtures, where the grass component consisted of perennial ryegrass and tall fescue (cv's Nui and Festal) were replaced by a mixture where the grass component consisted of only perennial ryegrasses (cv's Bronsyn, Ellett). This resulted in a more stable grass-clover ratio and higher animal production.

However, in some areas tall fescues are still grown as a part of the grass-clover mixtures. This is probably because farmers favour the higher late spring and summer production of tall fescue compared to perennial ryegrass. The tall fescue cultivars AU Triumph and Dovey are most popular because they germinate quickly and establish well. The grazing management of this mixture differs from the ryegrass-clover mixture in the sense that a higher stocking rate is required. The reason for this is that most of the tall fescue grasses become unpalatable if not grazed short in a short rotation system (24-28 days cycle). To achieve this, a pasture residual of 1000-1200 kg DM is required.

Cultivars and seeding rate

The choice of cultivars has an important influence on the dry matter production, botanical composition and animal production of grass-clover pasture. Clover is more persistent in perennial ryegrass pasture than in tall fescue pasture. In comparison with ryegrass-clover pasture, tall fescue-clover pasture has a higher carrying capacity but a lower animal production potential. Tall fescue is also not as palatable as perennial ryegrass. This causes the selective grazing of the ryegrasses and clovers in the mixture and leads to the shading of these plants by the tall fescue. In spite of this, farmers keep Tall fescue in their grass-clover pasture. The main reason for this is that tall fescue has a higher summer and autumn production than perennial ryegrass. The management of tall fescue pasture also differs from that of perennial ryegrass pasture. Tall fescue has a higher carrying capacity and therefore should be grazed with a shorter rotation.

Grazing management.
Pasture trials at Outeniqua Research Farm have shown that a hectare of grass-clover pasture can produce between 18 and 20 tonnes of dry matter (DM) a year. However, the dry matter intake was only between 11 and 14 tonnes of DM per year. On average 35% of this feed was going to waste. It has been estimated that on many farms 50% or more of potential feed is going to waste. Although the same trend was also found in Australia, they also found that there were farms where seventy and eighty percent of pasture which is grown is consumed.

Good management system is based on the optimum production (kg DM/ha/day) of high quality, palatable dry matter and the highest possible animal intake (kg DM/cow/day). To obtain these goals the pasture should be grazed at a point where the ryegrass tillers are mature (three leave stage). If the pasture is allowed to get older the third ryegrass leaf will die, resulting not only in pasture waste, but also in unpalatable roughage and in the shading of the growth points of the ryegrass and clover. This will prevent the development of new tillers and -stolons. Not only will the life of the pasture be shortened but the clover component will also decline.

Correct grazing intervals and grazing intensity are the only management practices that will ensure optimum utilization of grass-clover pasture. However, the intensity of grazing and grazing intervals should not be measured in time or in pasture height but by the availability and residual of pasture (kg DM/ha). Ryegrass-clover should be grazed at 2000-2400 kg DM/ha with a residual of 1100-1300 kg DM/ha. This will ensure an intensive grazed pasture with the shortest possible rotation. This system will also ensure that the grazing frequency will vary with the seasons and the intensity of grazing will stay the same. Grass-clover pastures managed this way have shown higher clover content during spring compared to pasture grazed at a low intensity with a long rotation (residual 2000-2400 kg DM/ha).

Pasture intake is reduced by the feeding of concentrates. In a study done at Outeniqua Research Farm Jersey cows grazed mainly on ryegrass-clover were fed 0, 2.4, 4.8, or 7.2 kg of concentrate per day over two lactations and produced 12.8, 15.2, 15.8 and 17 kg of fat corrected milk per day respectively. The feeding of each additional kg of concentrate resulted in production of 1.0, 0.71 and 0.58 kg fat corrected milk (FCM). The poor response to concentrate feeding can be attributed to substitution of pasture by concentrates. The substitution rate (SR) can be calculated as follows: SR = 0.093 X kg of concentrate fed per cow/day. Feeding of high levels of concentrates will result in reduced pasture intake, higher feed cost and under-utilization of pasture.

Pests.
Slugs, mole crickets, black maize beetles, aphids, cutworms, spittlebugs and army worms have been identified in established pastures. The negative effects of these pests have not been quantified. These pests may have a detrimental effect on the persistence of planted pastures.

Conclusions
A number of factors are important for clover growth and persistence in a mixed grass-clover pasture. It is important that they all need to be addressed in order to achieve increased clover content. The goal should be to increase clover content without reducing annual pasture dry matter yield. Higher clover content will improve milk yields for the same levels of dry matter available in the pasture. Unfortunately we are way behind the leading milk producing countries where it comes to the quantification of the factors that influence pastures persistence. The pasture production, the amount of pasture utilized by our animals and the actual cost in relation to our production cost will be the only guidelines that will tell us if we can produce our milk competitively on an international market.

Medium-term changes in grazing capacity of Rolfontein Nature Reserve

VHALINAVHO P. KHAVHAGALI
Department of Tourism, Environment and Conservation, Kimberly,
Email: Khavhagalivp@yahoo.com

Introduction

Vegetation monitoring is a series of observations over time, or repeated surveys of plant diversity using standardized methods (McDougald *et al.* 2003). It involves frequent testing of differences between baseline or initial surveys and follow-up surveys. Vegetation monitoring data must be collected at specific sites and at the specific times, to determine changes in species composition and veld condition over time. The primary objective of monitoring vegetation change is to gain an understanding of what is changing in the ecosystems and why (Roberts-Pichette 1995). Species composition and veld condition changes are monitored in relation to the baseline data, wildlife, rainfall and fire. Vegetation monitoring is used to assess the veld's potential condition as per habitat and soil unit characteristics. It is also used to develop methods necessary to promote effective management plans and to achieve conservation principles.

Grazing capacity is the average number of grazing animals that a particular area will sustain over time (Galt *et al.* 2000, Bothma 2002). Bothma (2002) defines stocking rate as the amount of land allocated to each animal for the grazable period of the year. A thorough understanding and assessment of changes in vegetation form the basis of reserve management decisions like game species composition and stocking rates. Vegetation management is specifically aimed towards improving the veld's condition through maintaining species diversity, improving species composition and maintaining abundance and resilience of species on Rolfontein Nature Reserve (Lloyd & Badenhorst 1995).

In 1995, a network of 29 monitoring sites were identified within the mountainous (koppies) and plains habitats, aimed to reflect veld condition changes, the impact of grazing, rainfall and fire in the two main habitat types. Emphasis was however, placed on the plains and plateau regions that were most degraded at that stage, namely Springbokvlakte (300 ha), Bloeigat (540 ha) and Bitterwater (360 ha) (Lloyd & Badenhorst 1995; Koen, Lloyd & Badenhorst 1997). The main purpose of the baseline data was to have a dataset according to which management actions can be assessed, and to enable analysis of vegetation-soil-game interactions (Lloyd & Badenhorst 1995). The bi-annual vegetation monitoring thus reflects the veld condition and grazing capacity change over the short- and long-term periods, for both dry and wet seasons (Hedges 2007).

The monitoring sites placements were aimed:

1. To establish whether the veld condition on the reserve / in regions is improving or not, through a) Detecting herbaceous component changes (species composition and cover), b) Evaluating veld condition change in relation to the baseline data, game, rainfall, fire and the veld's potential condition as per habitat and soil unit characteristics;

2. To guide effective game management with regard to stocking rates, game removals and game species composition,

The main purpose of this report was to assess if the goals of vegetation monitoring have been achieved over time, and to determine and establish long-term patterns and changes in the vegetation, on two habitat types namely the koppies and plains. Rolfontein Nature Reserve (RNR) represents a sweet-veld grass veld type, meaning that it is sensitive to overgrazing and drought (Van Oudtshoorn 1999).

Methods

Study sites

Rolfontein Nature Reserve was established in 1970. It is adjacent to Petrusville and Vanderkloof, on the southern bank of the Vanderkloof Dam, between 260 59' 00" S and 300 48' 20" S longitude, and 240 40'

20" E and 240 48' 20" E latitude (Lloyd & Badenhorst 1995). The reserve covers about 8 000 hectares (ha) (Birss 2000). The estimated habitat units consist of about two thirds (5 128 ha of the 7 693 ha) of mountainous (koppies) veld habitat, a third (2 565 ha of the 7 693 ha) of plains veld habitat and approximately 307 ha of dam's fluctuation zone habitat (Koen, Lloyd & Badenhorst 1997). RNR lies within a summer rainfall region with a mean annual rainfall of 355 mm, peaking in January, February and March. The RNR has two extreme temperature variations, with summer reaching a maximum daily temperature of 30,40C in January, and winter dropping down to –1,80C in July (Munro 1994).

The reserve is situated on the False Upper Karoo (Acocks 1988). Mucina & Rutherfords (2006) classified the vegetation as Northern Upper Karoo. The altitude varies from 1 000 – 1 500 m (Mucina & Rutherfords 2006). Common shrubs include *Pentzia incana, Salsola calluna, Eriocephalus ericoides, E. spinescens* and *Hermannia spp.,* while grasses, such as *Digitaria eriantha, Sporobolus fimbriatus, Aristida spp., Eragrostis spp.* and *Themeda triandra,* dominate the landscape after good summer rains. *Acacia mellifera, Rhigozum obovatum, R. trichotonum, Rhus burchelli / undulate, R. cilliata and Tarchonanthus camphoratus* are dominant tree species on koppies and slope areas.

Along the dry riverbeds, *Acacia* Karoo is a common element. Acocks considered the area the most degraded of all the vegetation types in South Africa due to potential threats such as desertification, alien species invasion and bush encroachment because of overgrazing, unpredictable rainfall events and drought periods (Bredenkamp *et al.* 1996).

Vegetation assessment surveys

Surveys were conducted bi-annually at the end of March/April (wet season, end of summer) and at the end of August/September (dry season, end of winter) at 29 permanently marked monitoring sites (Lloyd & Badenhorst 1995; Lloyd & Badenhorst 1997). Monitoring sites 1 - 9, 15 - 20, 23 - 24, and 26 - 29 were grouped as plains habitat, while monitoring sites 10 - 14, 21 – 22, and 25 were grouped as koppies habitat (Lloyd & Badenhorst 1997). The surveys were conducted by means of the "Strikes-and-Misses" line transect method (Lloyd & Badenhorst 1997) since 1995 (Lloyd & Badenhorst 1995) and specifically concentrates on the herbaceous, in particular grasses, rather than woody components. This method was preferred because most of the game species were grazers on the reserve (Lloyd & Badenhorst 1997), and the plains needed a more active annual management strategy to improve its condition. This method was more appropriate because it showed vulnerable soils prone to erosion (Lloyd & Badenhorst 1995).

Parallel line transects of 25 m in length (25 points per line), were spaced 3 m apart (25 m x 25 m plot size) to record 250 points, reflecting a minimum of a 100 "strikes" (Lloyd & Badenhorst 1997). If less than a 100 "strikes" were recorded from 250 points, the survey points were increased to 300. If more than one species was struck at a point, all were recorded, whether they were available for utilization or not. Thus, you could have more than one strike per survey point, e.g. where grasses grow underneath a shrub. The Grazing Index Values (GIV) was used to calculate the veld condition score (Lloyd & Badenhorst 1995; Lloyd & Badenhorst 1997). If a species does not have a constant GIV assigned to it, a value of 1 was assigned to that species. Plant species compositions were recorded for each monitoring site, together with the percentage canopy cover (Si) for each individual species at the site (Lloyd & Badenhorst 1995; Lloyd & Badenhorst 1997).

S_i = (Number of strikes of species i / Total number of points) x 100

The Veld Condition Score (VCS) was calculated accordingly by summing the Y values for each species (Lloyd & Badenhorst 1995; Lloyd & Badenhorst 1997).

$Y_i = S_i \times GIV_i$

A VCS of 650 was regarded the highest potential score for the vegetation types on the reserve (Nama Karoo), i.e. the highest potential veld condition score possible (Du Toit 2003). This was used due to the absence of benchmarks (Lloyd & Badenhorst 1995; Lloyd & Badenhorst 1997).

The game species composition of RNR was based on four major animal groups, namely non-selective grazers, selective grazers, mixed feeders and browsers. Animal numbers are expressed in large stock units (LSU) and recommendation of species composition ratio of 2:1:1:1 for non-selective grazers: selective grazers: mixed feeders: and browsers are used (Birss 2000). In 1997 (Koen, Lloyd & Badenhorst 1997), 1998, 1999 (Muller, Badenhorst, Birss & Koen 1999) and 2000 (Birss 2000) game numbers were reduced to alleviate the grazing pressure on the plains, allowing the veld to recover and improve its condition (Koen, Lloyd & Badenhorst 1997).

Basic statistical comparison tests were performed using MS Excel, comparing means. I analyzed the medium-term average grazing capacity and seasonal grazing capacity to determine trends and changes in the veld on two habitat types, 1995 vs. 2007. I compared veld condition scores using the seasonal datasets on two habitat types, 1995 vs. 2007. Dominant grass species were recorded in 1995 and 2004 (both reported in Powell 2005) and 2007, to determine if there were any changes in dominant grass species, 1995 vs. 2004 vs. 2007, I compared the dominant species and their percentage cover. All statistical analysis were performed using, and all factors were considered significant when $p<0.05$.

Results

The grazing capacity improved from 34.5 ha/LSU in 1995 to 18 ha/LSU by 2007. There have been lots of variation in veld condition and grazing capacity between 1995 and 2007, with the poorest being recorded in 1996, 1998 & 1999 at 38.8 ha/LSU, 36.5 ha/LSU and 39.93 ha/LSU respectively, and the best recorded between 2002 to 2007 (Fig. 1a). The long-term grazing capacity in March reflects an average of 22.71 ha/LSU in comparison to 26.37 ha/LSU in September. The grazing capacity of the veld has improved significantly for both wet and dry season, March (r^2=0.64) and September (r^2=0.60) (Fig. 1b).

Grazing capacity on plains has improved tremendously, (March data set), improving from 38.3 ha/LSU in 1995 to 16.3 ha/LSU in 2007. The September data set also revealed improvement, changing from 43.6 ha/LSU in 1995 to 25.1 ha/LSU in 2007. The average grazing capacity in the plains habitat was 40.9 ha/LSU in 1995 and has improved significantly to 20.7 ha/LSU by 2007. The data shows a difference of 6.9 ha/LSU on koppies, with an average of 10.6 ha/LSU in 2007 and 17.5 ha/LSU in 1995 (Fig. 2a). Grazing capacity in the koppies habitat improved (March data set) from 16.3 ha/LSU in 1995 to 9.4 ha/LSU in 2007.

The September data set, the grazing capacity improved from 18.7 ha/LSU in 1995 to 11.9 ha/LSU in 2007. The average grazing capacity on the plains was 17.5 ha/LSU in 1995 and has improved to 10.6 ha/LSU in 2007 (Fig. 2b). The veld condition scores showed significant changes in the March dataset, the VCS recorded in 2007 was double that recorded in 1995 on the plains. The March VCS on koppies habitat also improved (Fig. 3a). The VCS in September on the plains improved from 145 to 281, and 372 to 501.5 on koppies. Both these VCS influence the grazing capacity of these habitat types (Fig. 3b).

In 1995, ten dominant grasses were recorded according to their percentage cover. *Digitaria eriantha* had the lowest cover of 4%, followed by *Sporobolus fimbriatus* (5%) and *Eragrostis lehmanniana* and *Eragrostis obtusa* (6% both). In 2004, eleven dominant grass species were recorded these include *Aristida diffusa* having 4% cover. *Sporobolus fimbriatus* had the lowest percentage cover (2%), followed by *Digitaria eriantha* and *Eragrostis bicolor* (3%) and *Aristida adscensionis* (4%).

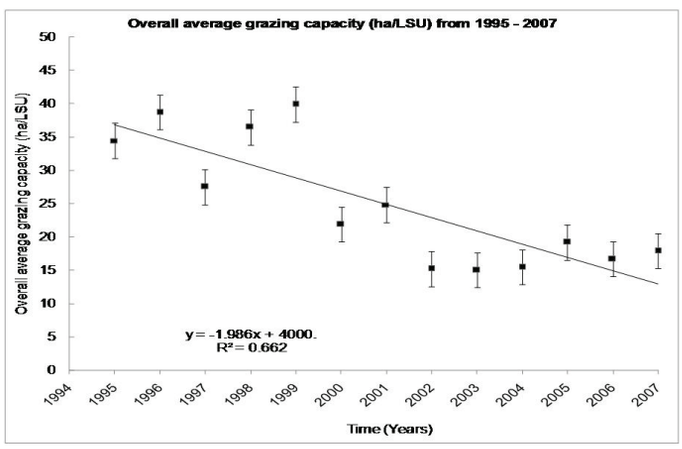
In 2007, twelve dominant grass species were recorded, adding up *Stipagrostis ciliata* with 2% cover. *Aristida congesta subsp. barbicollis, Aristida diffusa subsp. diffusa, Eragrostis curvula* and *Sporobolus fimbriatus* recorded only 3% cover each (Fig. 4). Two new grass species recorded in 2004 were not

recorded in 1995, are *Aristida diffusa subsp. diffusa* and *Eragrostis bicolor* (Powell 2005). However, *Enneapogon desvauxii* was reported in 1995 to have 19% cover was not encountered in 2004. Two more new grass species recorded in 2007 were not recorded in 1995 and 2004, are *Eragrostis curvula* and *Cynodon dactylon. Digitaria eriantha* and *Eragrostis bicolor* were not recorded in 2007. The grass absence in 2007 raises questions of local extinction vs. total extinction of which both terms are of concern in conservation biodiversity.

Discussion

The medium-term assessment shows that there was an improvement in grazing capacity and veld conditions from 1995 to 2007. Improvement in the grazing capacity and veld condition scores could be attributed primarily to active veld management practices in the reserve and other factors such as rainfall and reduced game numbers. The grazing capacity improved considerably since 1995, especially that of the plains habitat.

Most of the game species on RNR spent more time on the plains habitat, and this is the reason why the plains had low grazing capacity. The management's decision to reduce game numbers reduced the pressure from the veld and that played an influential factor by contributing to veld condition improvement. It is clear from the results that the veld



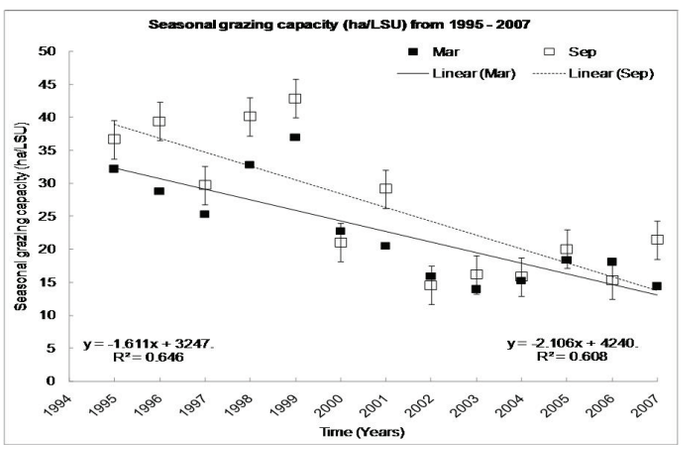


Figure 1. (a) Average grazing capacity since 1995 – 2007 and
(b) the seasonal grazing capacity since 1995 – 2007 of the Rolfontein Nature Reserve.

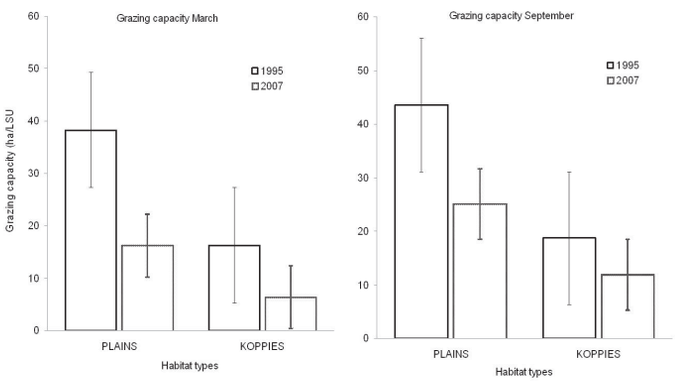


Figure 2. Comparison of seasonal grazing capacity, 1995 vs. 2007,
(a) March and
(b) September on two habitat types (plains and koppies) on RNR.

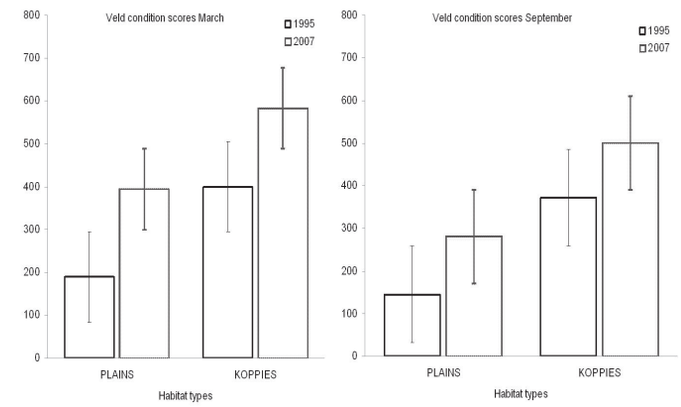


Figure 3. Comparison of seasonal veld condition scores, 1995 vs. 2007,
(a) March and
(b) September on two habitat types (plains and koppies) on RNR.

conditions grazing capacity will probably continue to improve, if active game management is maintained well to suit the needs of the reserve. The September monitoring shows that the veld was in poor condition because of low rainfall and long dry season spell from May to August. The April veld condition was good due to rains received during the growth season, which is from November-March.

These preliminary findings may be used as guidance in preparation for other ecological research projects focusing on species response to grazing and drought. Vegetation monitoring is an effective tool to monitor veld condition in rangelands. This report also encourage further analysis on how rainfall (seasonal) and game numbers (specific species) affect veld conditions in arid areas similar to RNR.

Powell (2005) argued that the veld condition and grazing capacity improvements are mainly due to the improved grass species cover and to a lesser extent species composition and species ratios. In addition, most of the species that increased in percentage cover have higher grazing index values (GIV), like *Themeda triandra* and *Eragrostis lehmanniana,* consequently improving grazing capacity of the veld. This concurs

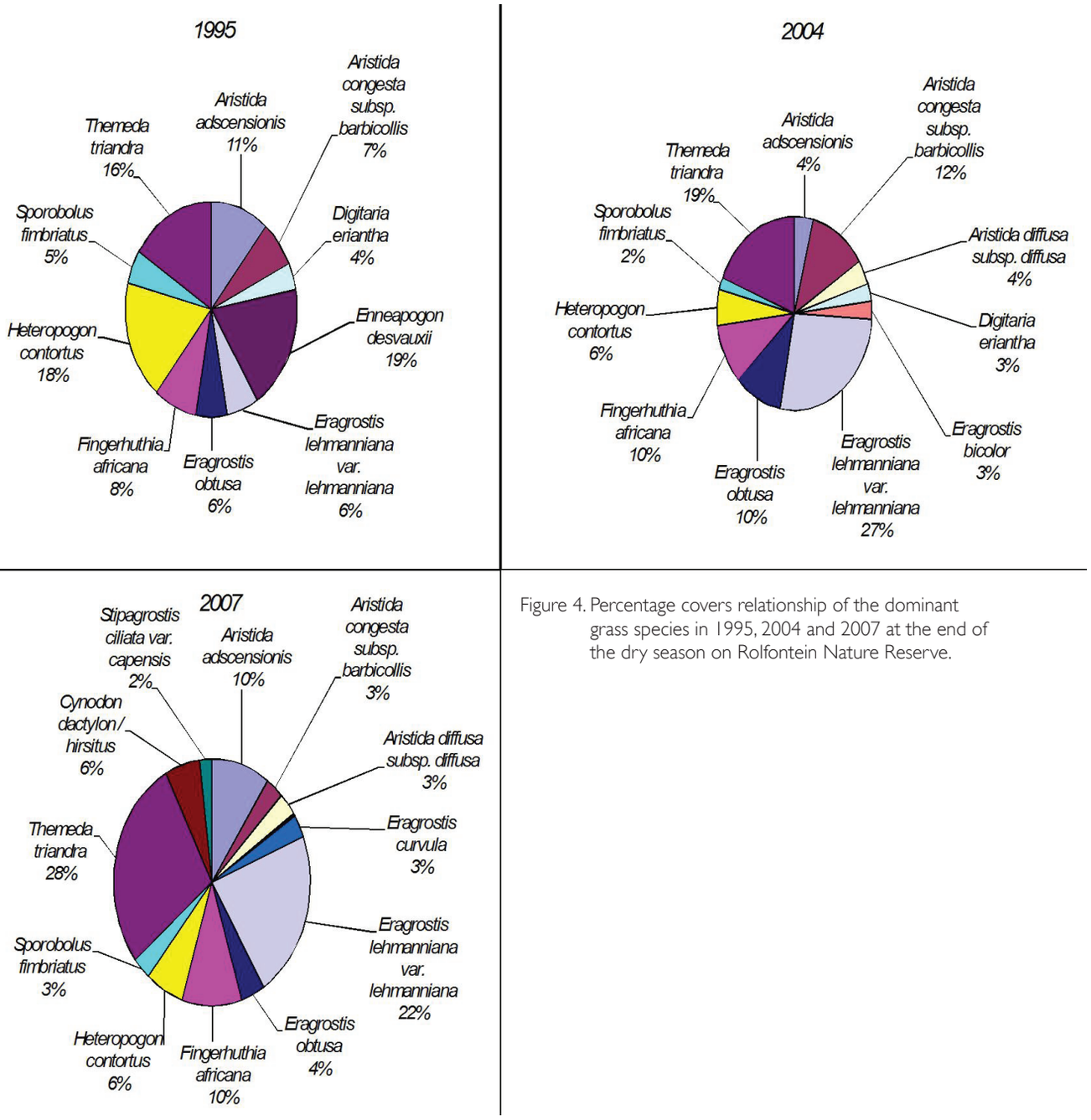


Figure 4. Percentage covers relationship of the dominant grass species in 1995, 2004 and 2007 at the end of the dry season on Rolfontein Nature Reserve.

with my results because *T. triandra* and *E. lehmanniana* had the highest percentage cover in 2007.

The plains habitat, on the other hand, reflects a different picture, as it consisted primarily of pioneer species like *Aristida adscensionis* and *Enneapogon desvauxi* in 1995. High moribund accumulation will suffocate and reduce chances of other grasses to establish, and result in high intense fires after lightning strikes, which is a serious biodiversity threat in this region (Khavhagali 2008).

Conclusively, the management objective of establishing the monitoring plots resulted in improved conditions on the veld. An increase of grass species on the plains will improve the veld. Constant reduction of game species should yield results that are more positive by reducing grazing pressures. However, koppies are not well utilized, therefore it will be important reduce grazers on the plains, considerably so, and bring game species that will utilize the koppies.

Acknowledgement
I acknowledge and remember the late Mr. Wellempie Nkuna (RNR Manager), who passed away during the preparations of this paper, and with whom I shared so many discussions around the RNR ecosystem dynamics. I also thank Sandra Hedges who provided the dataset and all the Field Rangers for the support in data collection and species identification.

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Knowledge fields development

The Knowledge Fields Development Directorate wishes to notify the research community of the following information with respect to development grant opportunities:

Part of the mandate of the Knowledge Fields Development Directorate (KFD) is to promote new knowledge and to push the boundaries of existing knowledge and associated research capacity by stimulating and developing the entire spectrum of knowledge fields.

In addition to the management of research programmes, KFD employs a range of tools to stimulate the development and advancement of knowledge fields.

These functions are driven by a dual approach, namely:

- A directed approach: development activities as identified and coordinated by the NRF;
- A non-directed, ad hoc approach: development activities as identified by the research community.

The KFD Directorate identifies a number of activities each year for implementation using both of these approaches.

Please be advised that the development grant strategy document, as well as the development grant application form for ad hoc grants may now be found on the NRF website (http://www.nrf.ac.za/). These grants are awarded throughout the year and as such, are NOT subject to specific submission deadlines.

The grant applications are subject to internal selection processes, and budget availability throughout the year.

Should you have any queries concerning the information on the website, please contact Candice Steele (Candice@nrf.ac.za) or Renee le Roux (Renee@nrf.ac.za).

Call for SABI 2010 funding

The National Research Foundation (NRF) on behalf of the Department of Science and Technology (DST) is offering SABI (South African Biosystematics Initiative) Postdoctoral Fellowships, SABI International Travel Student Awards and SABI Workshop/Training Courses.

SABI was developed to significantly enhance South Africa's capacity to undertake research in biosystematics, thereby establishing a skills base and information platform at the foundation of all scientific endeavour in the life sciences, such that the full potential of South Africa's unique biological resources can be realised and safeguarded for the future benefit of all. SABI is funded by DST and managed by the NRF.

This call for applications pertains to the Education and Training Thrust of SABI and is a direct response to SABI's purpose and vision because it will contribute to produce high-quality human resources, the generation of high-quality knowledge, and the development and transfer of this knowledge to ensure tangible benefits to society. The closing date for all applications is 15 October 2009. Please visit the NRF web site at http://www.nrf.ac.za to download the application forms.

Applications should be submitted to Ms. Pinky Matjeka: knowledge fields development grants at pinky@nrf.ac.za or faxed to 0866 477 279. Only signed applications will be accepted.

For more information or enquiry, please contact Mr Frank Mazibuko at fmazibuko@nrf.ac.za or 012 481 4017

Knowledge fields development

CALL FOR EXPRESSIONS OF INTEREST (2009)

The South African Department of Science and Technology (DST), having recently initiated bilateral Science and Technology relations with Namibia, are currently in the process of defining an operational and funding strategy in relation to these two countries. In order to gauge the state of existing collaboration between South African researchers and their Namibian counterparts, as well as to determine the possible uptake of funding to be made available for future collaboration in this regard, the Department of Science and Technology has requested the National Research Foundation (NRF) to issue the current Call for Expressions of Interest in joint research between the South African researcher community and their colleagues in their respective countries. As a result, we hereby invite all interested and qualifying parties to complete the short form accompanying this call and to remit it to the NRF by the date indicated below, taking note of the following points:

This is a Call for Expressions of Interest and no funding will be provided in response to expressions received. However, four expressions of interest will be selected and applicants requested to submit full proposals.

Envisioned collaboration between the two countries is required for response to this call,

Working researchers residing in South Africa and affiliated with a recognised higher education or any recognised research institution such as a university, university of technology or science council may apply. Responses must indicate at least one potential future collaborator in the respective country who is known to the respondent and with whom at least some prior contact has been established, though no input from said collaborator is required for the completion of the form.

The identified priority areas are:
- Biotechnology including Food Security
- Environmental & Climate Change with focus on trans-boundary resources (water and biodiversity) and invasive species
- Indigenous Knowledge System (IKS)

Should your project be selected for full proposal submission , please note the following:
- The project will be funded for two years:
- The funding will not exceed R200 000 per year per project ; and
- An amount of R100 000 will be contributed by South Africa and R100 000 by Namibia per year per project.

Responses from SA researchers should be submitted electronically to Ms Lee-Anne Seymour of the NRF International Research Grants section at the following e-mail address: seymour@nrf.ac.za and for Namibian researchers to Mr John Sifani of the Ministry of Education in Namibia at the following e-mail address: jsifani@mec.gov.na

Responses should be submitted by 31 October 2009. For further information, please contact:

In South Africa:
National Research Foundation
Ms. Lee-Anne Seymour
Tel: 012 481 4121 Fax: 0866 399 571
Email: Seymour@nrf.ac.za
NRF Website: www.nrf.ac.za

In Namibia:
Ministry of Education (Namibia)
Directorate Research Science & Technology
Private bag 13186
Windhoek
Namibia

Mr. John M Sifani
Email: jsifani@mec.gov.na
Tel: +264 61 270 6144 Fax: +264 61 270 6143

Upcoming events

Greengold Symposium
Date: 14 - 16 September 2009
Venue: Cape Town, South Africa
Contact: Jeannie nab Biljon
Tel: 014 536 3150
E mail: jeannievB@arc.agric.za

Cultivated Pasture Course
Date: 19 September 2009 (Afrikaans) 26 September 2009 (English)
Venue: Towoomba Research Station, Bela Bela (Warmbaths)
Contact: Frits van Oudtshoorn
Tel: 078 228 0008
E mail: frits@bushveldeco.co.za

Developing Animal Agriculture Interest group Symposium
Date: 28 September - 02 October 2009
Venue: Gauteng, South Africa
Contact: Heleen Els
Tel: 083 478 1940
E mail: heleen.Els@up.ac.za

African Crop Science Society Conference
Date: 28 September – 10 October 2009
Venue: Cape Town
Contact: Jeannie nab Biljon
Tel: 014 536 3150
Email: JeannieB@arc.agric.za

Grassland, Timber and Fire: A Symposium
Date: 14 - 15 October 2009
Venue: Bishopstowe, Pietermaritzburg
Contact: Freyni du Toit
Tel: 033 390 3113
Cell: +27 (0)83 256 7202
Fax: +27 (0)86 622 7576

International Development Conference
Date: 17 - 19 October 2009
Venue: UNISA, Florida Campus
Contact: M.S Robbertse
Tel: 011 471 2818
E mail: robbems@unisa.ac.za

4th International conference of SCU and ESES: Impact of climate change on natural resources
Date: 10 - 11 November 2009
Venue: Suez Canal University, Ismailia, Egypt
Contact: Hassan Mansour
E mail: hmansour@uga.edu
Website: www.eses.catrina.com

1st American Conference on "Precision dairy Management"
Date: 02 - 05 March 2010
Venue: Toronto (Canada)
E mail: info@precisiondairy2010.com

8th Annual Savanna Science Networking Meeting
Date: 7 - 12 March 2010
Deadline for abstract submissions: 6 November 2009
Venue: Skukuza
Contact Jackey Daecon
Cell. 082 447 1570
E mail: dot@mpu.co.za

New and resigned ~~members~~

New members

Adriaan Jonker:	University of Pretoria
Bernice Nel:	University of Pretoria
Leana Nel:	University of Pretoria
Ignatious Matimati:	SANBI
Collen Rabothata:	Mpumalanga Department of Agriculture
Oupa Keromecwe:	Mpumalanga Department of Agriculture
Luvuyo Khanyi:	BKB
Pieter Swanepoel:	Western Cape department of Agriculture
Nnzimeni Ndou:	Limpopo Department of Agriculture
Valentin Kindomihou:	Abomey Calavi University
Vanessa Weyer:	SRK Consulting

Resigned members
Anthony Sharp
Carol Green
Nick Zambatis

Council News

The council met on 20 July 2009 prior to the start of Congress 44 at University of South Africa Florida campus, Gauteng.

It has come to the attention of council members that attendance and congresses are important issues and should be further discussed. It was suggested that one of the council members should visit different Head of Departments to explain the importance of attending Congress and meetings. To enhance the attendance of congresses, President Dr. Mike Peel will write a formal letter to different HOD's for approval of GSSA members and/or council members to attend meetings or congresses. There were 200 delegates for this year's congress which were lower than the previous congresses. The reasons for this were ascribed to be due the major budget cuts from various Government Departments, and perhaps also reluctance to come to Johannesburg.

The preparations for Congress 45 are on track. It will take place from the 19-23 July 2010 in Kimberly. Most of the arrangements will be carried out by SANParks and Northern Cape department of Tourism, Environment and Conservation. The theme for the Congress will be "Challenging to integrate range and forage Sciences in arid and semi-arid landscapes".

The venue will be Tabernakel AGS Church and all sessions will be at this venue. The organizers will try to make a block booking for accommodation at the Horseshoe Motel. The provisional program is as follows:

Monday – Registration and Meet and greet (McGregor Museum)
Tuesday – Sessions and Dinner at Marrick Safari's
Wednesday – Free evening
Thursday – Sessions and gala dinner (Horseshoe Motel)

All pre and post Congress tours will be organised by the Northern Cape Tourism Authority.

At this stage the total cost to host Congress in Kimberly is R410 000 (R2 800/person excluding accommodation). The cost per person will decrease with an increase in delegate numbers.

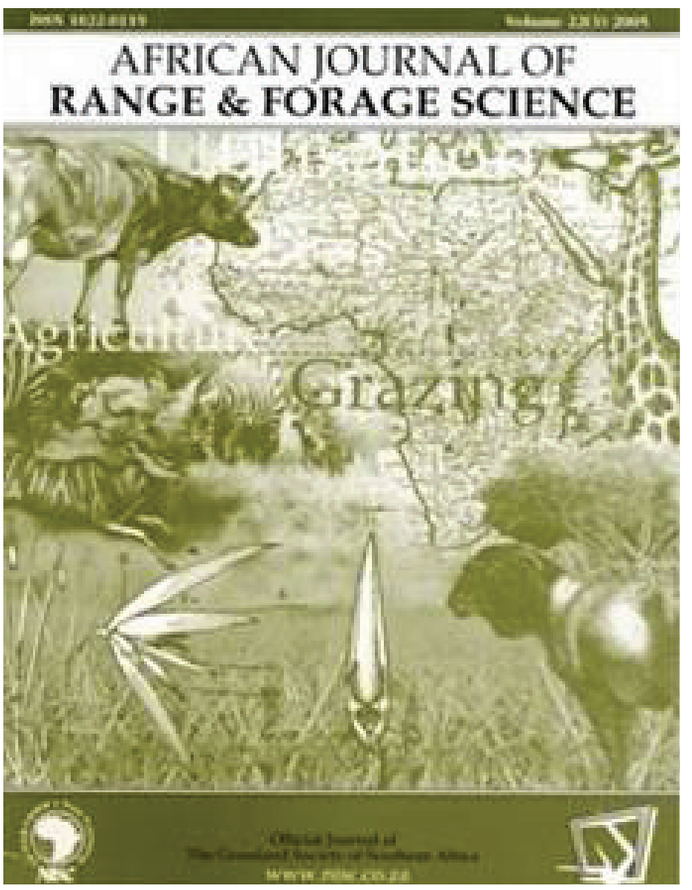
A proposal was presented at AGM to host Congress 46 (2011) in Middleburg at Grootfontein Agricultural Development Institute.

We welcome all the new Council members.

Benefits to GSSA Members

Three issues per year of the African Journal of Range and Forage Science, the Society's internationally recognised scientific publication.

There are no page charges for GSSA members publishing in the African Journal of Range and Forage Science in 2009



GRASSROOTS

Newsletter of the GRASSLAND SOCIETY of SOUTHERN AFRICA

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