grass roots

Newsletter of the Grassland Society of Southern Africa

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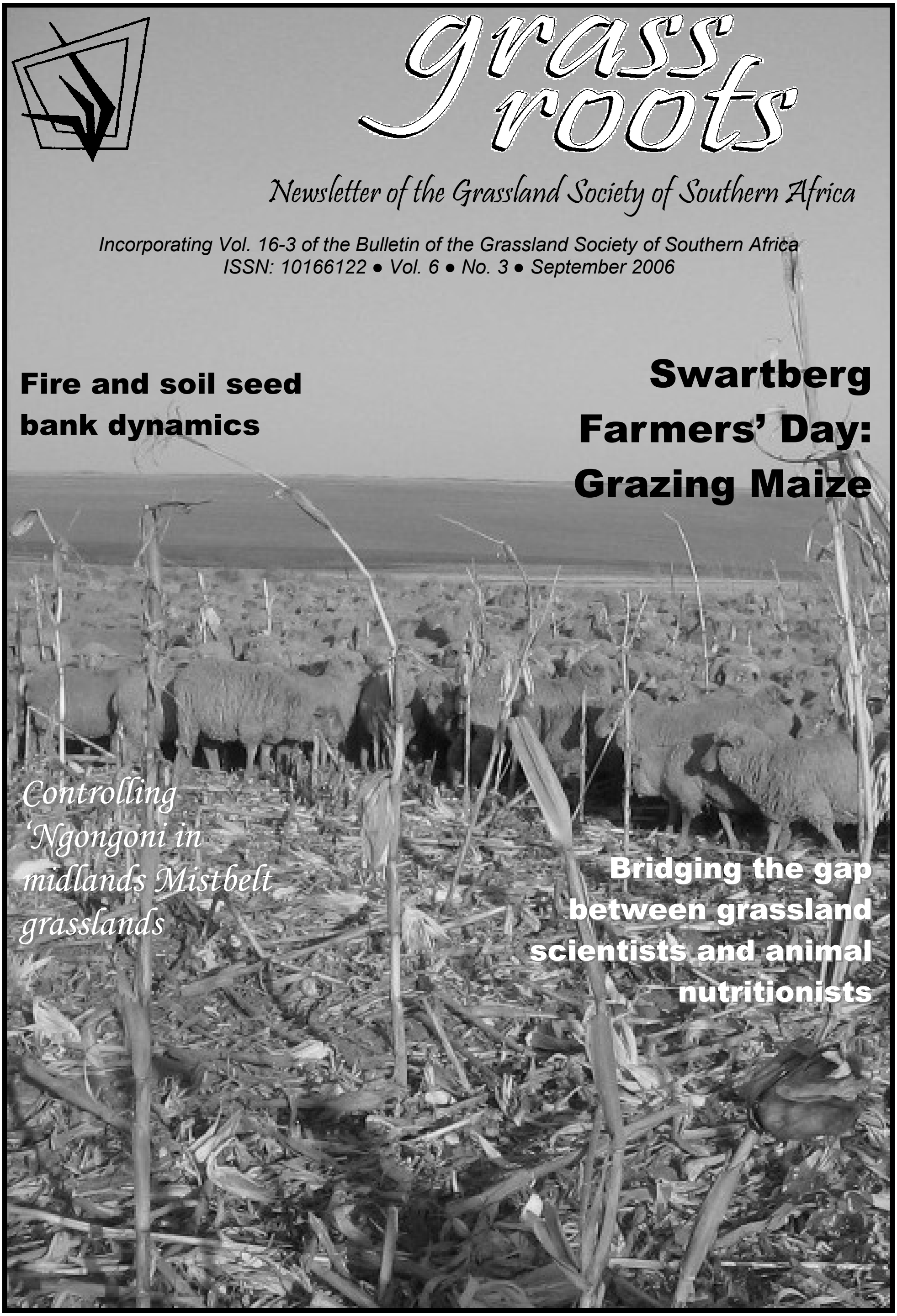

Fire and soil seed bank dynamics

Swartberg Farmers' Day: Grazing Maize

Controlling 'Ngongoni in midlands Mistbelt grasslands

Bridging the gap between grassland scientists and animal nutritionists

Editorial

Dear Members

Another Congress has come and gone, and it was an excellent event. Chris Dannhauser and his team from the Limpopo Province, and especially Freyni, deserve our congratulations for putting on a great Congress. From now on, the Administrator will be involved in all future Congresses, which ensures continuity and efficient management of the event.

One concern that was raised at this Congress was the decline in participation of pasture scientists, as opposed to rangeland scientists. Of course, the pasture science community in general has declined in numbers over the last decade or so, so it is not just something wrong with our Society. The organisers of next years' Congress, in Grahamstown, have been taking this issue quite seriously, and have been coming up with some innovative ideas to attract the pasture industry to the Congress. Hopefully, this time next year we'll have pasture professionals telling us what a great Congress it was. In the meantime, keep those articles coming and let's hear your views.

Alan

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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Contents

Features

Regulars

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Letters

An alien invasive grass, *Glyceria maxima* (see below), from Eurasia has been recently discovered in KZN, and it may be poised to become a considerable problem. Thanks to all those that have had input so far: Lyn Fish for the ID and Prof Gordon-Gray, Kevin Kirkman, Christina Currie, Craig Morris and Mark Graham for useful information.

1. It is known to be one of the most invasive grasses worldwide.

Some key characteristics of the plant are as follows.

2. It shows a preference for permanently flooded areas
3. It is able to rapidly spread vegetatively into these suitable areas, where it forms a dense stand with a root mat
4. It is able to out-compete indigenous sedges and grasses growing in these areas and greatly alters any aquatic environments into which it invades It seems to be a new arrival in KZN.

Milton (2004) does not list it as present in South Africa and it is missing from herbarium records. As far as I know it has been recorded in only 3 localities in South Africa, all in the Boston/ Bulwer/ Underberg area. The first is off the Mpendle Rd between Boston and Bulwer (where I found it when surveying a wetland for the Maloti-Drakensberg Trans-frontier project), the second is between Bulwer and Underberg and the third is just outside of Underberg.

I suspect that it could increase greatly in abundance in the general area as well a spreading in its range.

I think it is a priority to carry out the following:

1. Survey its distribution and extent, particularly in the Boston to Underberg area.
2. Research on its ecology and means of control
3. Develop a plan of action in collaboration with relevant stakeholders.

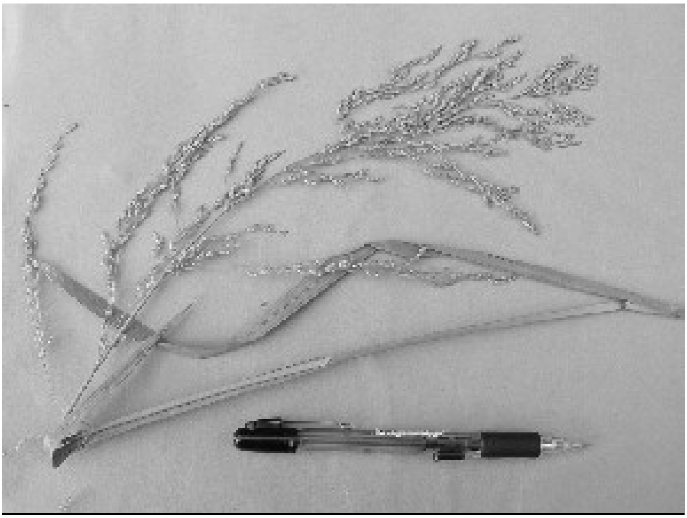
But where we take it from here I am not sure. Suggestions?

References

Milton S, 2004. Grasses as invasive alien plants in South Africa. South African Journal of Science 100: 69-75.

More info from: www.publish.csiro.au/paper/MF04043.htm

Donovan Kotze



News

Prof Hennie Snyman (left) and Ms Minette van der Lingen

Ms van der Lingen received the GSSA award for outstanding academic achievement, for the best B Sc. Agric final year student in Grassland Science with best continuous performance during all the years of study with an average of at least 70%. She is currently enrolled as a B Sc. Honours' student at the University of the Free State.

New course: How to Communicate Scientific Research

The International Food Policy Research Institute (IFPRI) Virtual Learning Room is now launching a global e-learning program designed to provide free e-learning opportunities for professionals around the world.

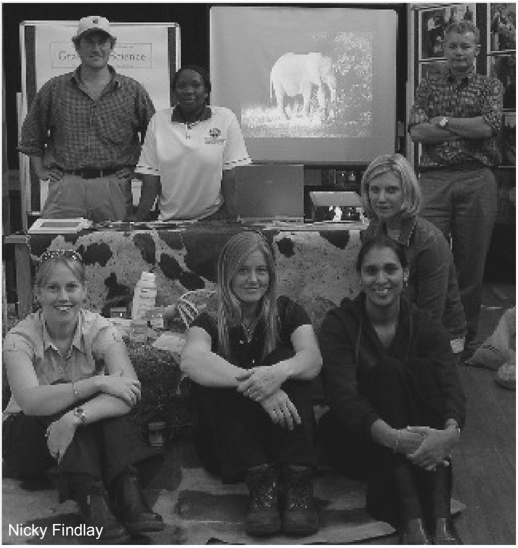
The course: How to Communicate Scientific Research (October 1, 2006 to January 31, 2007) is designed for professionals interested in improving their skills in scientific communication. It comprises 3 modules, as follows:

1) How to write good research reports
2) How to increase your chances of getting a research paper published
3) How to make good oral presentation

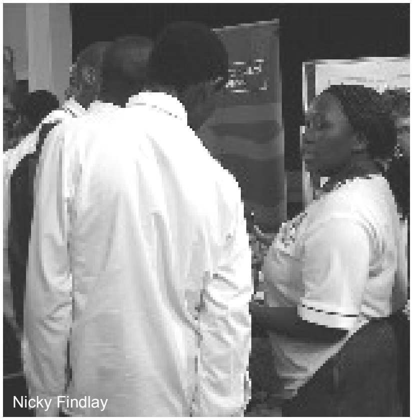
Before signing up for these courses, you need to be sure that you will have the time, energy and equipment available to take advantage of them. Each course will only be online for the given four month period, and you will be expected to complete each module within a month. Practice questions will be made available at the end of each month, and you need to be ready to take them, and review additional information at that time, to get the full benefit from the course.

In order to register, please go to the IFPRI Virtual Learning Room: http://learning.ifpri.org/

Vula careers expo at Hilton College



Left to right: standing: Alan Short, Doreen Ndlovu, Hannes de Villiers;
Sitting: Nicky Findlay, Marian Young, Bianca Theeruth, Martina Moore



The GSSA shared a stand with the South African Society of Animal Scientists at the Vula careers expo for children from previously disadvantaged schools, hosted annually by the Vula Outreach Programme. This programme is a social upliftment programme of Hilton College in the KZN Midlands. The focus of the day was on careers in the sciences, and there were many different industries competing for the learners' attention. The hall was packed with children, who left after the event with a clearer idea of the wide range of possibilities available for those with a dream and a scientific bent.

Competition—Slogan for GSSA

Calling all creative types—the GSSA is running a competition for members to come up with a byline/slogan for the GSSA to help us describe ourselves to the world (unfortunately "Just Do It" was already taken). Make it short, catchy and informative; let your imagination run wild, and we'll publish the best (and most original) in the *Grassroots*.

Upcoming events

From www.gssa.co.za

68th Conference of the New Zealand Grassland Association
Date: 14 - 16 November 2006
Venue: Otago University, Dunedin, New Zealand
Website: www.grassland.org.nz/authorguidelines.php

Society-in-Science - African Forum
Date: 5 - 7 December 2006
Venue: Nelson Mandela Metropolitan University, Port Elizabeth, South Africa
Contact: ascc@saasta.ac.za

21st Annual Conference of the Society for Conservation Biology
Date: 1 – 5 July 2007
Venue: Nelson Mandela Metropolitan University, Port Elizabeth
Website: www.conbio.org/2007

Global Spatial Data Infrastructure-9 Conference: Spatial Data - Tool for Reducing Poverty
Date: 6 - 10 November 2006
Venue: Santiago, Chile
Deadlines: Deadlines for submitting papers have expired
Contact: Harlan Onsrud, President GSDI Association: onsrud@gsdi.org
Website: www.ign.cl/gsdi9/

The sixth extinction - conserving zoological biodiversity: 33rd meeting of the Zoological Society of Southern Africa
Date: 8 - 11 July 2007
Venue: North-West University, Potchefstroom
Website: www.natural-events.com/ZSSA/

Grasslands Partner's Conference
Date: 22 - 24 November 2006
Venue: Biodiversity Centre, SANBI, Pretoria
Contact: Florence Nazare nazare@sanbi.org

Congress of African Scientists and Policymakers
Deadline for Registrations: 30 September 2006
Date: 27 - 29 October 2006
Venue: Alexandria, Eqypt
Contact: hambanim@africa-union.org

Deserts and desertification conference
Date: 30 October - 1 November 2006
Venue: Sebha, Libya
Contact: saharaconf@sebhau.edu.ly

The 5th KNP Science Networking Meeting
Deadline for registrations: 16 February 2007
Deadline for submission of abstracts: 2 March 2007
Date: 16 - 20 April 2007
Venue: Skukuza Goldfields Auditorium, Kruger National Park
Contact: Jackey Deacon dot@mpu.co.za

Council News

The Council met on 17 July 2006 at Congress 41 at Kelin Kariba near Bela-Bela. The Society AGM was also held at the Congress.

There is a need to inform the senior managers of government departments of GSSA events, as many of them are not aware of the GSSA and its objectives. Emails will be sent to senior managers as well as to our usual mailing list.

Chris Dannhauser has suggested that the proposed award for most improved farmer (see Council News, April 2006), be named in honour of Rob Drewes (of Venter-Drewes system fame), who did a lot of work among emerging farmers.

The GSSA is now VAT registered, which means that membership fees will have to increase by at least 14% to cover the VAT.

Pete Scogings, the Journal Editor, cited a survey that placed the Journal in the top twenty by impact in southern Africa (out of 255 journals), and the top 50 by citations.

The new President, Mark Hardy, has sought a legal opinion on the contract between the Society and NISC, the publishers of the Journal. Mark will maintain friendly relations with NISC, but will make clear the legal interpretation of the contract, which appears to state that the Society should retain its intellectual property rights over the Journal and its contents.

The GSSA awards for best student in a Range and Forage Related discipline were awarded to: Tim Kleu (Cedara Range Management); M van der Lingen (4th year, Univ. of the Free State); Clement Cupido (MSc. Univ. of Stellenbosh); Mike Peel (PhD, Univ. of KZN); Mahlodi Tau (MSc, UKZN); and D Kathawaroo (MSc, Wits)

The financial status of the Society was summed up by Justin du Toit. The Society needs to be extremely disciplined in order to survive the next few years. A large payment from the annual Congress will from now on be built into the Congress budget. Government departments will also be approached for substantial sponsorship, as it emerged that the Limpopo Department of Agriculture had been expecting a request for far more money than the Society asked of them for Congress 41.

New council member s were elected at the AGM. They are: Lorraine van den Berg (Secretary), Khanye Mbatha (Additional Member—Editorial Assistant); Jorrie Jordaan and Susi Vetter (Additional Members). Other posts that were filled with existing Council members are: President: Mark Hardy; Vice-President: Rina Grant; Treasurer: Justin du Toit; PRO: Luthando Dziba.

OBITUARY

J. Wendy Lloyd
1960 – 2005

Neil Fairall
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Wendy Lloyd, a member of the GSSA, passed away on the 3rd May 2005. She was born on the 25th August 1960 in Springs in the then Transvaal and matriculated from Sans Souci school in Cape Town.

She studied for a BSc. degree in geology and botany at the University of Cape Town, meaning to practice as a geologist, but was given the chance to do an MSc. in botany mapping the plant communities at the Vaalputs radioactive waste disposal site; this led her to a productive career as a botanist in the North and Northwestern Cape.

She started her career in the then Cape Department of Nature Conservation, stationed at the Jonkershoek research station near Stellenbosch, her brief being the Northern Cape. When the Northern Cape office was opened she transferred to Kimberley and stayed there as part of the new department, when the Northern Cape became a separate province. It was here that she spent her most productive time surveying and mapping the vegetation of the provincial nature reserves and laying the foundations for their management plans. While here she also started the work for her PhD. studying the problem of bush encroachment, which she correctly identified as mainly bush thickening.

Wendy joined the ARC Institute for Soil, Climate and Water in 1997 to continue working with remote sensing in which she became interested while mapping the Northern Cape vegetation. Here she led the team using this technique to map the invasive aliens for the Cape Action for People and the Environment (C.A.P.E.) project as well as other investigations into invasive trees, in spite of the cancer that eventually was to lead to her passing.

Wendy was always a team player both in the workplace and socially. She was fun loving and intensely loyal to her friends, but her most inspiring characteristic was her fighting spirit epitomized by her gaining her black belt in karate while already weakened by cancer. We can all learn from that.

Congress 41 report

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The Congress was attended by about 200 delegates from eleven countries, including several African Countries, the United States and Australia. The width of topics presented was enormous, and it was often difficult for delegates to choose between two equally relevant parallel sessions. The Congress was a mix of workshops, symposia and "ordinary" sessions, with many different institutions and fields of study represented.

Themes

The theme of the Congress was Range & Forage Science in a Developing Environment. The Mayor of Bela-Bela presented the opening address on behalf of the MEC for Agriculture in Limpopo province, Mrs DP Magadzi, who was unfortunately ill on the day. She spoke eloquently about the need for advancements in agricultural science and technology as a cornerstone of development in this country.

The first of three keynote addresses was presented by Prof. Sam Fuhlendorf, of Oklahoma State University. Prof. Fuhlendorf was one of two American researchers invited to the Congress to provide some insight into the recent paradigm shifts on fire and grazing management that have emerged from their long-term trials. Prof. Fuhlendorf has an impressive publication record (about 36 peer-reviewed papers and 20 book chapters), despite his relative youth. He presented a fascinating account of his work on heterogeneity in North American Tallgrass Prairies, and how this impacts on rangeland structure and functioning (positively) and animal production (no difference or better than traditional burning and grazing practices).

Some of the major sessions will be highlighted below.

Invasive Plant Management

The South African Weed Science Society and the GSSA held a joint symposium on "Invasive Plant Management" on the first day of the Congress. The second keynote address of the Congress was by Prof. Dave Richardson, on the invasion ecology of riparian vegetation. A number of very interesting papers were presented, on biocontrol and integrated weed control, as well as some papers on the ecology of plant invasions and the implications of this for control of invasions. A number of key concepts emerged from the symposium: (1) that no single control method is effective alone; (2) that a wider landscape approach needs to be used to manage plant invasions, and that single-species control measures are inadequate for managing plant invasions; (3) that plant invasions have major effects on the ecology of rangelands and riparian areas, switching the ecosystem from one state to another, and simply clearing the invasions will not automatically cause the system to switch back to its former state; and (4), that we need to understand more about the ecology of plant invasions in order to effectively prioritise control strategies and efforts.

Long-term research and monitoring

A symposium on long-term research and monitoring was arranged by Prof. Winston Trollope of Fort Hare University. This symposium generated a great deal of discussion, both during the session and around the dinner table afterwards. Several presenters gave summaries of a few of the "Ecological Gems" as Prof Trollope called them, of Southern Africa – long-term research trials that have contributed enormously to our understanding of key processes in veld ecology. These trials have formed the basis of many of our current veld management recommendations, and we are still gaining new insights from them. In many cases, the original questions have changed, and issues such as climate change, soil processes, and biodiversity, as well as other key ecological processes that affect production, are being investigated.

The third keynote address was by Ron Masters, Director of the Tall Timbers Research Programme in the USA. The Tall Timbers research programme is a private, non-profit long-term fire research programme that has generated enormous amounts of data, and fascinating insights into the role of fire in savannas and grasslands of the southern USA.

A number of questions were raised by the symposium (1) have long-term trials been useful; (2) should they continue; and (3) do we need new ones? The answer to all three questions was an overwhelming "yes", for a number of reasons:

Short-term changes may be misleading: many long-term trials have shown fluctuations in key responses within short time periods, but with a very clear long-term trend (e.g. increasing or decreasing abundance of a certain group of important species).

Key variables may respond in one direction for some time, and then suddenly change direction as the system reaches some threshold and changes. Such as response was shown in the plots protected from fire at Ukulinga. For the first twenty years, a key grass, *Tristachya leucothrix*, increased, only to suddenly begin decreasing and then almost disappear after fifty years. Had the trial been discontinued after twenty years, this response would never have been observed. Similarly, in the Towoomba long-term grazing trials at Bela-Bela, bush density was not even considered important enough to measure for the first thirty years, and then suddenly and dramatically increased after some forty or fifty years.

New questions are being asked that were not thought of at the time the trials were established. One of the most obvious examples is the effect of climate change on productivity and sustainability of rangeland systems.

But there were certain caveats.

Poorly designed trials should not be dragged on indefinitely; Ron Masters had two trials shut down because they were poorly conceived and designed.

Following on from the first point, new trials must be properly designed – far too many long-term trials have been poorly designed from a statistical perspective, making it very difficult to tease out the interacting effects of soil, grazing, fire and climate on the results.

New trials must address specific questions that have not been adequately addressed by past or existing trials. It is too easy to set up yet another "continuous vs. rotational grazing" trial, when there are many existing trials to address these issues.

Appropriate measurements must be taken on these trials – too many existing trials have had inadequate or inappropriate surveys and measurements taken to really address the key issues they are meant to address.

Long-term trials, in combination with specific, focused studies, provide valuable insights into the sustainable management of our natural resources.

South African Ecological Observation Network

Dave Balfour presented a talk on the South African Ecological Observation Network, SEAON, which was established as part of international efforts to coordinate ecological research and monitoring. The Kokstad Grazing trials have been registered on the SEAON database, which is still under construction (see Pauw and Peel (2003) and Mecenero (2005) for more background on SAEON). The SEAON initiative will consist of a series of nodes, based in each of the major biomes of South Africa. The Savanna node has been established in the lowveld, and many of the other nodes are well on their way to being established. The Grassland node will probably be established somewhere in KZN, although a hosting institution has not yet been confirmed.

Forage production and quality and animal production

A number of sessions addressed forage production and quality, both on veld and pastures. New results were presented from cultivar evaluation trials and from grazing on pasture trials. One thing that is of major concern is the shortage of new pasture research in the country. Cultivated pastures are a multimillion Rand industry and the backbone of a significant proportion of the livestock industry, and yet there is less and less investment from the various research institutions into cultivated pastures. The GSSA will be having discussions on how to get the industry more involved in the next Congress in Grahamstown, in order to try and address some of these concerns.

Erika van Zyl, Animal Scientist at Dundee Research station, presented the results of several years of research into grazing maize with sheep, including maize alone and maize in combination with other crops. The economics of grazing maize, rather than harvesting it and feeding, are quite profitable. A portion of the maize can be planted and grazed, if need be, while the rest is harvested and marketed as a cash crop. The most economical, and simplest system, was to graze maize alone (i.e. not in combination with other crops).

Erika presented two other papers on animal production from veld and pastures: an examination of early weaning of beef calves, and a study of the value of foggaged forage sorghum for young beef animals.

CB Katongole and co-workers from Uganda (presented by Elly Sabiiti) presented the results of their work on developing feeds for meat goats. Goat meat is commonly eaten in Central Africa, and many strategies for feeding goats have been developed. Amongst them was using the scraps from the market place as an inexpensive source of feed. The goats were being feedlotted on these marketplace scraps very cheaply and successfully.

Joseph Baloyi and colleagues worked on legume hays for improving animal production on veld, especially during critical times. They presented the results of work on cowpeas, fine stem stylo, and silverleaf desmodium supplemented to sheep fed veld hay. The dry matter intake of the sheep was highest when fed cowpeas.

National Range and Forage Working Group

The National Range and Forage Working Group was established at a workshop in Pietermaritzburg in November 2005 (Morris 2006). The Working Group is coordinated by the National Department of Agriculture, in collaboration with the various provincial Departments. The workshop at Congress was facilitated by Victor Musetha of the National Department of Agriculture. The aim of the workshop was to coordinate research efforts in the different biomes of South Africa, to improve veld and pasture management recommendations in the country. The agricultural research capacity in the country has deteriorated severely over the past decade, and the National Range and Forage Working Group is an attempt to address this issue through coordinating existing resources and efforts nationally. A committee was elected, consisting of a representative from each rangeland biome in South Africa (Grassland, Savanna, Karoo etc).

Rangeland Management, Communal Livestock Production and Rangeland Fire Ecology

Rangeland management under fire and grazing was very well attended, and the presentations raised a great deal of discussion from the audience. A number of papers examining the mechanisms of key ecological processes, and the implications of this for veld management, were presented by researchers from a wide range of southern African environments.

Erika van Zyl presented a fourth paper on communal rangelands, asking the question "Do planted pastures have a place in communal farming?". Research indicates that communal farmers already rely heavily on supplementary feeds during winter, but that the quality of the feeds varies enormously depending on the source. Successful pasture management programmes are constrained by lack of fencing and absence of fertiliser programmes in communal areas.

Cam MacDonald and co-workers presented a paper discussing fodder flows in communal livestock production systems. Small-scale farmers can benefit hugely by strategically supplementing their animals during critical periods. Strategic forage supply can enable communal farmers to gradually change from being "livestock keepers" to "livestock producers". "Livestock keepers" are owners of livestock that do not necessarily earn any income from their animals, while "livestock producers" are farming their animals – in other words, earning an income from the sale of animals and animal products. This can be achieved by involving the technical staff working in that area. Demonstrations of different technologies are very powerful educational tools, and inspire farmers to follow suit.

There were a number of papers discussing various issues around rangeland assessment and monitoring. Several papers looked at new, rapid or remote methods of rangeland assessment and carrying capacity estimation. Herman Fouché and WJ van den Berg presented a new application of the PUTU model of veld production, in a GIS environment, to enable predications of seasonal carrying capacities in arid and semi-arid areas. Theunis Morgenthal and TS Newby of the Institute for Soil, Climate and Water presented an update of the carrying capcacity map for South Africa (which was last updated in 1993) using course resolution, cheaply available satellite imagery and vegetation information. The resulting map was an update on the 1993 map, as well as filling in the blank spots left on the previous maps where the former homelands are located. The map appeared to somewhat overestimate carrying capacity in some cases, but it is a very useful first approximation and a potentially powerful planning tool for the future.

Rob Scott-Shaw, of Ezemvelo KZN Wildlife, has been working for several years on developing indices of grassland importance for conservation planning, using well-established ecological formulae as simple tools to rank patches of veld in terms of their ecological importance.

One very topical paper was presented by Lee Simons and Nicky Allsopp, on use of key resources by communal livestock farmers in the Richtersveld. In this area, animals are herded, and the herders utilise a number of different resources at different times of the day and in different seasons. This means that, although large areas of the veld have been severely degraded by decades of heavy grazing, there are still refugia such as steep koppies where the veld is in good condition. These koppies are less heavily grazed most of the time, but form important drought reserves. One interesting point is that the farmers' lands are not used by the animals until after harvesting, because the herders can keep the animals under control and away from the lands while the crop is growing.

The real stuff

The *faux pas* award was deservedly won by John Peel, who appeared to have not yet entirely entered the information age when he was distracted several times by the unmistakable sounds of a particularly excitable bushveld coming from his shirt pocket during someone's talk. The bushveld, was, of course, his new cellphone, which apparently had been programmed (probably by a five-year-old) not to be switched off in the middle of important speeches.

Every year, the Peter Edwards Award for conservation farming is awarded to a farmer in the province where the Congress is held. The farmers must have practiced outstanding conservation farming principles through sound veld and soil management, as well as sound general farm management. This year, the competition was tough, but in the end the private game farm Thaba Thola deservedly won the award. The Congress organizers put together a superb slideshow to illustrate the hard work that the owners and the manager, André Neethling, had put into the property over many years.

Conclusions

The above discussion represents


Anushka Barak

Above: John Peel gets closely acquainted with the *faux pas* award

only a small proportion of the papers presented at the Congress, as the amount and the depth of the material covered was enormous. ecology and pasture production. More importantly, the “after-hours” discussions are where many valuable ideas are thrown around in an informal setting, and where inspiration for new projects is born.

It is disturbing that so few extension officers attend Congresses such as the GSSA Annual Congress. The new technology and ideas that are presented and discussed there are valuable tools that the extension officers can take back to their clients. Extension officers are often working under extremely difficult conditions, with little contact with other experts in their fields, and the contacts that they make at such congresses are therefore invaluable to the development of their expertise, just as it is for researchers. Moreover, the extension officers have practical experience of the difficulties encountered in the field, and can make valuable contributions to the direction of future research.

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Are we feeding our animals properly?

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Long ago I read a science fiction story about a city in which two populations lived side by side, identified by the colour of their clothes, say the reds and the blues. Some ancient dispute had divided the people, and refusal to talk to each other had evolved into an innate inability to even see each other. They rubbed shoulders on the streets, but neither side knew of the other's existence. The climax came when a red-clothed cop, chasing a red-clothed robber, accidentally shot a blue clothed bystander whom his eyes were trained not to see. The blood on the pavement, the removal of the blue shirt to allow medics to attend the wound, made suddenly and starkly clear to each side that the other side existed. Then came the painful reconciliation.

I sometimes wonder if the same situation does not exist between grassland scientists and ruminant nutritionists. Neither side seems to want to work with the other to the benefit of stock and range husbandry. Every year the grassland scientists do their trials- three camp four camp, rest, burn, no burn, spring graze, short duration etc. Every year they faithfully apply the licks presumably recommended by the ruminant nutrition department- concoctions of urea, phosphates, salt and lime in winter, concoctions of phosphate, salt and lime in summer, seemingly scribbled out on the back of a cigarette pack. These ineffective supplements are fed at the absolute minimum level possible for the shortest possible time. Every year, stock production on these supplements remains at about half of what it could be, and at least six months of any year is wasted simply trying to keep grazing animals alive.

We seem to have forgotten that when the first trials on winter protein were done almost a century ago, the protein was fishmeal. Results were outstanding- higher calving percent, heavier weaners, higher reconception rates. Then urea came, as a cheap substitute for some of the protein. The watchword is some of the protein. Unfortunately for our long suffering livestock, urea usurped high-bypass natural protein and became practically the sole protein source. "Government licks," developed on research stations, and faithfully used by grasslands scientists, violate just about every principle of ruminant nutrition that can be violated. They are toxic cocktails in which 95% of the protein is urea-derived. Most commercial licks follow the same pattern, disguising the urea with molasses, or a smattering of maize. Feeding rates are designed to keep animals just on or above malnutrition levels. All over South Africa, these dangerous and inefficient supplements are fed too late and at too low a rate to have any real effect on the animals they are supposed to nourish.

High quality natural proteins have the potential to double performance on natural veld

There are huge opportunities for animal nutritionists to justify the diplomas on their walls by guiding grassland scientists in the correct formulation and use of supplements. High quality natural proteins, fed at the correct levels, and fed for longer than recommended by all the books, have the potential to double performance on natural veld, while also eliminating some of the negative effects of selective grazing. Urea has its place, but it is only a place. If you do not blend urea properly with high bypass natural protein, you may as well throw it onto the ground—most of it gets there anyway in the form of urine excreted by the animal.

Here are some rules of thumb that seem to have been forgotten in the race to make the cheapest, nastiest supplements available:

1. No more than 33% of the protein to come from urea or other NPN sources- therefore 67% of the protein must come from high bypass oilcakes or fishmeal - leave out carcass meal because of "mad cow" scares.
2. A true supplement is fed at a maximum of 5% to 10% of an animal's dry matter intake. At a DM intake of 3% of body weight, that would limit a 300 kg long weaner to a maximum of 450 to 900 grammes of supplement per day. Low levels of highly concentrated supplements ensure that the animal remains hungry—and the only thing then left to eat is grass, which it will consume and digest in surprising quantities.
3. Half the animal's protein requirement should be derived from the supplement in winter. If a 300 kg animal needs 700 grammes crude protein to keep a reasonable growth rate, this means 350 grammes must come from the supplement. This means that the supplement must be have 450 to 500 grammes of crude protein per

kilogram of supplement. At this concentration, this long weaner would need 700 grammes supplement to meet this requirement (and, by the way, if only 33% of the protein can come from urea, the supplement is limited to about 5% urea or 50 grammes urea per kilogram of lick).

Time of feeding

Everybody knows that South African rangeland, in most areas, is good for growth for about six weeks of the year, and good for little else for the rest of the year. That is because it is inherently low in protein. If this high quality, highly concentrated protein supplement is fed, at differing levels, for most of the year, it will transform performance on natural veld to the level of performance in irrigated fertilized pastures. And because an animal fed the correct levels of the right quality of protein will eat everything including old newspapers, this supplementation will absolutely transform grazing patterns.

Another opportunity that seems to have been ignored by grassland scientists and ruminant nutritionists: biotechnological products. There are natural products, not hormones or chemicals, which can totally transform ruminant function. Some examples are:

Ammonia-adsorbing feed supplements.

These products, initially derived from the yucca cactus, when mixed at low levels in animal feeds, have the ability to trap ammonia. Used with pigs and poultry, they reduce the amount of free, toxic ammonia in the animals' dung, to the extent that in some countries feed companies have to use them by law to protect farm workers' health.

However, the same additives in ruminant feeds have the ability to trap ammonia in the rumen—holding it for more effective digestion by rumen micro-flora. The result? Any urea used in the feed is utilized with far more efficiency and far less wastage, as is the highly soluble protein found inmost grasses.

Specialized living yeasts

These do not occur naturally in the rumen, but when introduced in a supplement, have the effect of stimulating rumen micro flora into feverish activity—digestion of roughage is increased, intake is increased, performance is increased.

Chelated trace minerals.

These are trace elements bonded to protein molecules: more easily digested and more efficiently utilized than inorganic trace minerals. Replacing 30% to 50% of the chemical trace elements with Chelated trace elements will improve animal performance.

It is duty of grassland scientists and animal nutritionists to break out of their separate glass cases they have been working in for the past century, and do some real, coura-


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geous experimentation that could revolutionize the ruminant industry in South Africa. The nutritionists must go back to the basics, get away from this low-grade, low performance cycle of a handful of urea and salt in winter and a thimbleful of phosphate and salt in summer, and formulate real supplements that will do some real work for the animals to which they are fed. The grasslands scientists must observe and take into their results, the huge effect that these highly sophisticated, high performance supplements will have on grazing intake, grazing patterns and performance, winter and summer. The supplements and the grazing trials have to be integrated: they cannot be regarded separately

And before everybody cries "but it is not natural!" remember that when the first caveman captured the first wild goat and domesticated it- life on the open range ceased to be natural - and by the way, what is natural about feeding chemical fertilizer to an animal and expecting it to perform?

Short-term influence of fire in a semi-arid grassland on (6): the soil seed bank

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Introduction

In semi-arid grassland areas of southern Africa fire is a natural phenomenon (Everson 1999) and may have a negative effect on grassland functioning by the reduction or elimination of aboveground biomass (Snyman 2003a, 2004a); the reduction of belowground physical, chemical and microbial mediated processes (Neary et al. 1999; Snyman 2003b), or altering the size and composition of the soil seed bank (Skoglund 1992). Soil seed banks are important components of vegetation dynamics affecting both ecosystem resistance and resilience (Pugnaire and Lazaro 2000). A phenomenon common to many grassland communities is the flush of germination that follows a burn (Whelan 1988; Tyler 1995). In recent years there has been an escalating interest in seed banks of grassland ecosystems. Factors affecting germination and early seedling growth are often the primary determinants of the distribution of adult plants (De Jong and Klinkhamer 1988; Mustart and Cowling 1993). Therefore, to understand the dynamics of communities, specifically in drier areas, knowledge of seedling responses to different environmental conditions is often of prime importance (De Villiers et al. 2001; Kinloch and Friedel 2005a,b). In this study the influence of a head versus a back fire on the soil seed bank of a grassland in a semi-arid climate is explored. The recruitment of grass species from the soil seed bank, after different fire treatments over two growing seasons in the greenhouse is reported.

Procedure

The study was conducted at Bloemfontein (28°50’S; 26°15’E, altitude 1350 m), situated in the semi-arid, summer rainfall region (mean annual rainfall 560 mm) of South Africa. Grassland in good ecological condition, typical of the dry Sandy Highveld Grassland in the Grassland Biome was selected for this study. The botanical composition and basal cover of the grassland in good condition was typical of that on commercial farms in the area. The soil is a fine sandy loam Rhodic Epigleyic Luvisol. Clay content increases with soil depth from 10% in the A-horizon (0 to 300 mm), to 24% in the B1-horizon (300 to 600 mm) and 42% in the B2-horizon (600 to 1200 mm).

The research was conducted on 18 plots of 10m x 10m each, with a buffer zone of 5m around every plot. This was a one-off burn. The three treatments included fire burning against the wind (back fire), with the wind (head fire) (Trollope 1978), and a control with no burning over the last 15 years. The design was fully randomised with three replications for each treatment. Six plots were burnt on 30 August 2000 and another six on 23 August 2001. The burnt plots were therefore burnt only once during the two-year trial period. The head and back fire treatments were applied on the same day to ensure that the two types of fires were comparable. The burn treatments were applied each year at the end of August after spring rainfall thoroughly wetted the soil causing the grass sward to become relatively green. Burning was carried out in the morning with a light wind blowing. To limit the fire to every burnt plot, the plants surrounding each plot were cut short and soaked before burning. The plots were excluded from any grazing over the two-year trial period. The estimation of fuel load and fuel-water content before the burning and fire behaviour was fully discussed in previous volumes of *Grassroots*.

Botanical composition before burning was determined with a bridge-point apparatus, where 500 points (nearest plant) were recorded per plot before the fire as well as four months after the fire.

The seed bank is defined as the seeds, at or beneath the soil surface, that are capable of germination. Within each treated plot, eight soil samples of 0.5m x 0.5m each, were randomly distributed and sampled to a depth of 50mm. Only the soil between the tufts was sampled, including those of the unburnt plots. Samples were collected into separate paper bags for immediate transport to the glasshouse for processing within 10 minutes of collection. In the glasshouse, soil samples were spread evenly to a depth of 50mm in plastic containers (0.5m x 0.5m) containing a 100mm deep layer of Hygrotech growth medium (Canadian peat, polystyrene vermiculite and mono-ammonium phosphate). As a control against contamination, eight additional plastic containers filled with autoclave-sterilized soil (90°C for 1 hour – repeated three times over a week) were included with each set of soil samples. Seedling plastic containers were placed at random in the glasshouse. Seedling plastic containers were hand-watered daily, after which the seedlings were counted daily over a two-month period. Any plants that could not be identified at the seedling stage were grown on until identification was possible. Seedlings that could not be identified after two months were individually potted and grown up until identification could be made. The soil medium ensured that the plants, which germinated, could reach a stage where they could be identified before dying down. The day/night temperatures in the glasshouse were kept between 25-30/15-18°C.

The seed bank was measured two weeks after the fire (middle September – before new seed set), end of December (after producing new seeds) and end of March (after sec-

Table 1 Frequency (%) of species, ecological status and veld condition score for the grassland before and four months after burning. Percentages within a row with different superscripts differ significantly (P≤ 0.01)

Ecological status	Species	Before fire	After fire
Decreaser	*Digitaria eriantha*	5.10	4.53
	Panicum stapfianum	0.20	0.02
	Sporobolus fimbriatus	3.16[a]	2.11[b]
	Themeda triandra	49.10[a]	34.54[b]
Decreaser total		**57.56**	**41.20**
Increaser II(a)	*Cymbopogon plurinodis*	4.14[a]	0.79[b]
	Digitaria argyrograpta	7.17[a]	14.12[b]
	Eragrostis chloromelas	10.16[a]	25.29[b]
	Eragrostis lehmanniana	2.92	3.15
	Eragrostis superba	1.11[a]	2.10[b]
	Heteropogon contortus	1.31[a]	3.04[b]
Increaser II(a) total		*26.81*	*48.49*
Increaser II(b)	*Eragrostis obtusa*	0.10[a]	0.02[b]
	Elionurus muticus	6.98[a]	1.94[b]
	Triraphis andropogonoides	0.02	0.02
Increaser II(b) total		*7.10*	*1.98*
Increaser II(c)	*Aristida congesta*	2.20	2.11
	Tragus koelerioides	2.33[a]	5.22[b]
Increaser II(c) total		*4.53*	*7.33*
Increaser II total		**34.44**	**57.80**
TOTAL		**100.00**	**100.00**
Veld condition score		**796.20**	**786.32**

ond seasonal seed produced), which were considered critical periods. This was conducted one and two years after burning. The study area is characterised by these two seed production peaks under normal rainfall conditions. The purpose of the different sampling dates was to collect soil seeds at different periods to allow dormancy breaking conditions to occur in the field and to sample transient (those seeds which germinate within a year of dispersal) and persistent (those seeds which remain viable in the soil until a second or later season of germination) components of the seed bank. Therefore an estimation of the between-year (persistent) and within-year (transient) seed bank was made.

Results

Botanical composition

The average species composition and grassland condition score of the experimental plots just before the fire and four months after the fire are presented in Table 1. The experimental plots were in good condition before the fire with a grassland condition count of only 13% lower than that of a benchmark site adjacent to the burnt plots (Snyman 2000). The benchmark site was especially dominated by *Themeda triandra*, which caused this difference in grassland condition to that of the experimental sites. The grassland condition score decreased by only 1.2% (P>0.05) due to the fire (Table 1).

The botanical composition did not differ much between head and back fires and is therefore presented as average in Table 1. Where the grassland was dominated by Decreaser species before the fire, the composition after the fire is dominated by a larger percentage of Increaser IIa species. The most conspicuous decrease in frequency due to the fire was the species *Themeda triandra* (30%); *Cymbopogon plurinodis* (81%); *Elionurus muticus* (72%) and *Digitaria eriantha* (11%). The species increasing with fire were *D. argyrograpta* (97%); *Eragrostis chloromelas* (149%) and *Tragus koelerioides* (124%). The fact that these species split up into many smaller tufts after the fire, could have caused an overestimation of its frequency.

Seed bank composition and size

During the soil collections at the end of December and March for the glasshouse germinations, all the grasses were dormant and most had already dropped seed. The September collection took place right after the fire and therefore no grasses had seeded yet, and scarcely had begun sprouting. Four days after starting the germination study in the greenhouse, the first grass seeds germinated. Especially *Eragrostis* species with small seeds germinated first in the soil of the unburnt grassland. After seven days most grass seeds had germinated and the soil of the burnt grassland showed the best germination of seeds. After two weeks no further germinations took place. Observations were still carried out for a further ten weeks to identify all species.

The head fire stimulated grass seedling density more ($P<0.01$) than the back fire for all months, except for September of the first season after burning (Table 2). Due to the higher intensity of the fire close to the soil surface, more seeds could possibly have been destroyed by the back fire. Generally, fire increased ($P>0.01$) seedling germination when compared to the lower number of plants/m^2 of the unburnt plots. Most germination took place at the end of the growing seasons, with the poorest germination during December (Table 2). The highest number of seedlings of 378 plants/m^2 was noted during the March germination of the first season with the head fire. Fire stimulated the grass seedling density more during the first season following the fire and was on average for both the head and back fires 50% more than during the second season following the burning. The total grass density for the first season after the fire was 485 and 142 plants/m^2 for burnt (average head and back fire) and unburnt grassland respectively, versus the 323 and 122 plants/m^2 for the second season. The grass seedling density of the unburnt plots did not differ much ($P>0.05$) over the two growing season and therefore are given as an average in Table 2.

The forb seedlings did not differ much ($P>0.05$) between the head and back fires during the first season after the fire (Table 3). The total forb seedlings germinating the first season after burning was 202.3 and 227.9 plants/m^2 respectively for burnt (average head and back fire) and unburnt grassland, compared to 259.4 and 209.9 plants/m^2 during the second season after burning. Interestingly, in both seasons, fire stimulated ($P<0.01$) seed germination during the first part of the season. In contrast, over the last half of both seasons, seedling germination was higher ($P<0.01$) on unburnt than burnt grassland. Most forb seedlings, regardless burning, germinated during December each season. Fire stimulated seedling germination of the forbs more over the second season after burning, than during the first season.

An average total for the first and second season following burning of 404 and 132 germinable grass seeds of eight and nine plant species for burnt (average for head and back fires) and unburnt grassland respectively were found in the soil cores collected. Three grass species (climax) were found in the seed bank of the unburnt grassland and not in that of burnt grassland, comparing to only two grass species (pioneer) only in the burnt and not in the unburnt grasslands seed bank. Species richness was therefore poorer with burning. All eleven plant species present in the seed bank were also present in the vegetation of the field. In contrast six species were present only in the vegetation in the field (Table 1)

Table 2: Density of grass seedlings/m for the burnt (first [1] and second [2] season after burning) and unburnt grassland estimated in September, December and March of the 2000/01 and 2001/02 growing seasons, which were germinating in the greenhouse. UB = unburnt, H = head fire and B = back fire. Numbers within a col-

Species	September				
	UB	H		B	
		1	2	1	2
Aristida congesta				2.0 ± 0.3	
Cymbopogon plurinodes	0.5 ±0.1				
Digitaria eriantha	0.9 ±0.1				
Eragrostis chloromelas	11.3 ±2.2	23.5 ±4.4	107.9 ±19.9	24.0 ±4.2	109.0 ±15.2
E. lehmanniana	1.9 ±0.3	10.8 ±2.0	6.1 ±0.8	13.5 ±3.1	2.0 ±0.1
E. superba	3.3 ±1.1	5.9 ±1.2	2.0 ±0.9	8.0 ±2.1	2.0 ±0.3
Elionurus muticus	5.7 ±1.4	4.9 ±0.9	4.0 ±0.9	5.5 ±1.4	5.7 ±0.9
Panicum stapfianum	1.9 ±0.9				
Sporobolus fimbriatus	1.9 ±0.2		2.1 ±0.3		2.0 ±0.1
Themeda triandra	24.7 ±5.4	31.2 ±3.6	9.9 ±2.1	36.0 ±1.4	11.5 ±1.3
Tragus koelerioides		2.0 ±0.3		1.9 ±0.3	
TOTAL	**52.1[a]**	**78.3[b]**	**132.0[c]**	**90.9[b]**	**132.2[c]**

umn with different superscripts for each month, differ significantly (P≤0.01). Data are means and standard error

December					March			
H		B		UB	H		B	
1	2	1	2		1	2	1	2
4.0 ±0.02		2.0 ±0.1			12.1 ±1.3		24.0 ±2.2	
				1.0 ±0.2				
42.0 ±6.5	5.0 ±2.2	13.8 ±1.1	4.0 ±0.3	38.3 ±4.6	313.7 ±30.1	136.0 ±19.4	266.0 ±29.2	122.1 ±12.4
6.0 ±2.1	1.1 ±0.2	4.0 ±0.3		1.0 ±0.1	6.1 ±0.3	10.1 ±4.6	7.9 ±0.9	12.0 ±1.3
5.0 ±1.4	2.3 ±0.9	2.0 ±0.1	2.0 ±0.1	5.0 ±0.2		2.2 ±0.9		8.0 ±1.3
16.0 ±2.4	2.0 ±0.9	8.1 ±1.0	2.0 ±0.9	3.0 ±1.0	40.1 ±1.0	33.9 ±8.4	19.9 ±3.3	8.0 ±0.9
				1.0 ±0.1				
	2.0 ±0.3	1.0 ±0.1	1.0 ±0.1	0.6 ±0.1		8.0 ±1.3		8.0 ±2.4
3.0 ±0.2	2.0 ±0.2		1.0 ±0.1	8.1 ±1.3		6.1 ±2.1		
					6.1 ±0.9		4.1 ±0.4	2.0 ±0.1
72.0^{c}	**14.4^{a}**	**28.9^{b}**	**10.0^{a}**	**58.0^{a}**	**378.1^{c}**	**196.3^{b}**	**315.9^{c}**	**160.1^{bd}**

Table 3 Density of forb (seedlings/m^2) for burnt (first and second season after burning) and unburnt grassland germinating in the glasshouse during September, December and March. Data are means and standard error. Numbers within a row with different superscripts differ significantly (P≤0.01)

	Unburnt	Burnt	
		Head fire	Back fire
First season (2000/01)			
September	42.2^{a}± 3.4	70.3^{c} ± 4.0	58.3^{b}± 3.8
p-Value = 0.214			
December	108.1^{a} ± 6.6	126.5^{b} ± 7.9	120.4^{b} ± 7.2
p-Value = 0.068			
March	77.6^{b} ± 4.2	17.3^{a} ± 1.1	11.8^{a} ± 1.0
p-Value =0.312			
Second season (2001/02)			
September	34.5^{a} ± 2.6	42.1^{b} ± 3.1	42.6^{b} ± 3.0
p-Value = 0.121			
December	108.2^{a} ± 6.8	165.3^{b} ± 12.9	154.5^{b} ± 6.4
p-Value = 0.086			
March	67.2^{b} ± 4.0	59.5^{a} ± 4.8	55.1^{a} ± 4.1
p-Value = 0.101			

but not germinating in the seed bank (Table 2).

Notable in Table 2 is that unburnt grassland is dominated by the species *Eragrostis chloromelas* and *Themeda triandra*. The pioneer grass species *Aristida congesta* and *Tragus koelerioides* occurred only in the burnt grassland during the first and second seasons following the fire. The species *Cymbopogon plurinodes*, *Panicum stapfianum* and *Digitaria eriantha* germinated only in the unburnt plots, *Elionurus muticus* increased to a great extent due to the fire, with *E. chloromelas* and *E. lehmanniana* showed the sharpest germination stimulation due to fire. Over the two seasons following the fire, 527% and 36% more seedlings/m^2 of *E. chloromelas* and *E. lehmanniana* respectively germinated in soil samples taken from burnt (average of head and back fire) than unburnt plots. Regardless of burning, *E. lehmanniana* and *T. triandra* germinated better at the start of the growing season. In contrast, with the exception of the second season after burning, the germination of *E. chloromelas* increased with the onset of the season, also regardless of burning. The first season following the fire, *T. triandra* showed a better germination than the second season after the fire. *Sporobolis fimbriatus* germinated only during the second season following the fire.

Panicum stapfianum was the only species in unburnt grassland occurring only in the seed bank and did not established in gaps as described by Snyman (2004b) in the same studies plots. In contrast, *Digitaria argyrograpta* and *Triraphus andropogonoides* only established in the gaps (Snyman 2004b) without being present in the seed bank.

The only forb actually occurring in the vegetation is *Geigeria aspera* that formed a small percentage (1.12%) of the botanical composition but did not germinate in the seed bank. No shrubs, namely *Lycium tenue* or *Walafrida saxatilis*, averaging 1.8% of the species composition of the vegetation in the field, germinated in the seed bank.

Discussion and conclusions

Fire may produce the post burn flush of seedlings in the seed bank by several direct and/or indirect means which include (1) direct heating of the soil and seed bank, which could affect seed germination (Ruyle et al. 1988; Zacharias et al. 1988; Zammit and Zedler 1988; Tyler 1995), change in soil structure (Adams 1996) and nutrient levels (Cavers 1995); and (2) temporary reduction in competition by removing aboveground vegetation (Tyler 1995; Edwards and Crawley 1999; Jutila and Grace 2002) thereby allowing seedlings greater access to light and water (Skoglund 1992; Snyman 2004b) and reducing allelopathic influences (Keeley et al. 1985). The relationship between fire intensity and patterns of seedling recruitment following a wildfire is still unclear (Tyler 1995).

Though grassland condition count (Table 2) did not decrease much due to fire, the short-term botanical composition varied significantly. This change could contribute to the slight seed bank decrease in species richness (Table 1) due to the fire. In contrast, the species richness of the head and back fires remained the same throughout, in spite of higher fire intensity of the back fire close to the soil. The soil seed bank results obtained in my study are of the few which could be linked to the short-term seedling recruitment and survival in the field. Although as much as 485 and 142 seedlings/m^2 for burnt and unburnt grassland respectively germinated the first season after the fire in the seed bank in my study, only 0.48 and 0.86 seedlings/m^2 survived on the same experimental plots and over the same season from burnt and unburnt grassland respectively in the field (Snyman 2004c). The burning of semi-arid grassland did therefore have an important impact on both the seasonal survival of seedlings in the field and the seed bank over the short-term.

Caution is necessary when comparing studies of soil seed banks because of differing methods, e.g.

with respect to sample size, depth, time and number of termination cycles (Snyman 2004b). The total average seasonal seedling densities (only grasses) from burnt and unburnt grassland in this study of 404 and 132 seedlings/m^2 respectively, were extremely low when compared to other foreign seed bank results. For example, average seed densities of 4000 seeds/m^2 (McIvor and Gardener 1994) in the drier central and north-east Queensland, 7639 seeds/m^2 in Central Queensland of Australia (Bahnisch et al. 1999), 800 seeds/m^2 of *Eragrostis lehmanniana* in southern Arizona (Ruyle et al. 1988) and 2252 to 4409 seeds/m^2 for a semi-arid grassland of the western Edwards Plateau, Texas (Kinucan and Smeins 1992) were recorded. Contrarily it compares well with South African seed bank studies of 172 seedlings/m^2 in a semi-arid *Themeda triandra* grassland (Snyman 2004b), 200 seeds/m^2 in the mesic Tall Grassveld of Kwazulu-Natal (Adams 1996) and up to 350 seeds/m^2 from *Themeda triandra* rangeland in the semi-arid Savanna (O'Connor 1997). Unfortunately, little information on the influence of fire on the seed bank of grassland is available in the literature, while the savanna areas and conditions dominated by shrubs were more concentrated upon. Perennial grasses, especially the larger-seeded species, do not, in general, form persistent seed banks even in the absence of seed predation because of poor seed survival. Researchers argued that species with large seed banks might be less likely to be seed limited (Crawley 1990) and therefore seeds from the seed bank fill all the establishment gaps that become available. However, some researchers suggest that this need not always be the case as the seed bank may be closed to recruitment and increases in seed production may well lead to increased seedling recruitment.

However, the influence of fire on the germination of grasses as a result of modifications to the environment and the effect of fire only on the seeds must be differentiated between. According to Zacharias *et al.* (1988) in some grass species effective burial would probably need to be achieved by some form of soil disturbance unless germination and establishment could take place before they are normally exposed to fire. In contrast, germination of *Heteropogon contortus* seed would seem to be well adapted to and indeed promoted by fire, whereas *T. triandra* responded negatively to fire (Zacharias *et al*. 1988). This response in *T. triandra* is in direct contrast to the findings in my study and to the generally held view that this species evolved under a consistent fire regime (O'Connor 1997). In summary, on the one hand *T. triandra* seedlings emerged most readily when the seed lay on the soil surface (O'Connor 1997), compared with the idea that, because of the sensitivity of this species' seeds to fire, it could be postulated that reproduction in

Themeda triandra is achieved primarily by vegetative reproduction (Zacharias et al. 1988). The evidence from studies in both semi-arid (Danckwerts 1984) and mesic (Everson 1985) environments support the last suggestion.

Only few forb seedlings were found in the seed bank in spring, but with the onset of the season they increased. The explanation for this could be that most of them flowered later over the season, where a lot of seeds distributed by wind into the rangeland. Luckily the competition of the grasses is too strong for germination and survival of these invaders in the field (Snyman 2003c).

A short-term warning trend is that the pioneer grass species *Aristida congesta* and *Tragus koelerioides* are the only two occurring in the seed bank (Table 4) in burnt and not in unburnt grassland. The second growing season following the fire, the impact of the fire on species richness and seed bank, was gradually lifted. The absence from the seed bank of several species dominating the vegetation has been reported for many grassland (Graham and Hatchings 1988; D'Angela et al. 1988; Milberg 1992). Soil seed bank is therefore an important component of vegetation dynamics affecting both ecosystem resistance and resilience (Pugnaire and Lazaro 2000).

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Height selective herbicide treatment of *Aristida junciformis* dominated grassland to facilitate veld restoration

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Introduction

Aristida junciformis, an unpalatable grass species that increases in abundance with severe selective grazing, has always been a natural feature of Midlands grasslands. Over time, driven mainly by mismanagement, the frequency of occurrence of *Aristida junciformis* increased to such an extent that it now constitutes a significant portion of the total species composition and has become a tangible threat to sustainable livestock production in these areas. Poor land husbandry in Midlands grasslands has resulted in the adjacent Dry Tall Grassveld (Camp 1999) being placed under increasing grazing pressure. The over-stocking of this Bioresource Group and the lack of adequate rest periods during the growing season has resulted in encroachment of *Aristida junciformis* into these areas.

Though it is perceived that a conventional management approach, which includes all the principles of sound veld management, will slow the trend of veld deterioration and bring about an improvement in veld condition, some rangeland managers consider this process to be too slow. Alternative radical veld improvement techniques that will lead to change in grass species composition are thus investigated.

One such a technique employs a vehicle drawn, height selective herbicide applicator, to apply non-selective herbicide to non-grazed grass plants. Since 2002 the managers on the farm Mount Ernestina have been engaged in an aggressive veld improvement program.

The efficacy of this technique, in relation to initial changes in veld condition, as well as baselines for future monitoring plots is presented.

Study Area

The farm Mount Ernestina is located

Figure 1: Application height and swathe width of herbicide applicator.

Figure 2: Drive train of herbicide applicator.

approximately 10km north of the town Greytown in the KwaZulu-Natal midlands between 30°27'43"E and 30° 30'20"E longitude and 29°00'19"S and 29° 01'54"S latitude. The altitude ranges between 1350 and 1550 meters above sea level. The farm falls mainly within the Moist Midlands Mistbelt (BRG 5), Dry Tall Grassveld (BRG 13) and Valley Bushveld Bioresource Groups as defined by the Natural Resources Section of the KwaZulu-Natal Department of Agriculture and Environmental Affairs (DAEA). This study looks at *Aristida junciformis* encroachment in Moist Midlands Mistbelt and Dry Tall Grassveld of the study area.

The study area receives a mean annual rainfall of between 729 and 887mm per annum with the greater majority of the rainfall occurring during the spring and summer months. The mean annual temperature is 16.1°C. Mean maximum temperatures could rise as high as 22.3°C, with a January mean of 25.3°C, while mean minimum temperatures can drop to 9.9°C with a July mean of 4.6°C. Heavy frosts occur annually and temperatures below 0°C are regularly recorded during winter months.

The study area in its entirety is underlain by the Vryheid Sediments consisting mainly of Middle Ecca shales and sandstone that was laid down in shallow water marshes or river mouths approximately 250 million years ago. The geology gives rise to shallow sandy loam soils that are generally well drained (South African Sugar Experiment Station, 1999).

Materials and Methods

Palatable grass species in camps dominated by *Aristida junciformis* were grazed short towards the end of the growing season. The under-utilized, unpalatable grass species were therefore distinctly taller than that of palatable grass species.

An All Terrain Vehicle (ATV) drawn herbicide applicator was used to wipe the top leaves and inflorescence of the taller mature unpalatable and ungrazed, grass species with non-selective herbicide. The applicator with a swath width of approximately 3m was set to a high of 300mm from ground level. A Glyphosate active ingredient with a concentration of 10%, were applied (Platt, pers. comm.).

Six sampling sites were set out over a three year period to monitor the impact of chemical control of *Aristida junciformis* on veld condition and grass species composition. Sites T1 and T2 were set out and monitored as a time series (surveyed in 2002 and again in 2005), sites T3 (untreated) and T4 (treated) as paired sites while P1 and P2 were baseline surveys (all surveyed in 2005) Table 1 summarises the sites and treatments. The location of the monitoring sites were subjectively chosen and based on suitable terrain (four-wheeler with spray rig can only be used in flat areas or areas with moderate slopes), known landmarks

Table 1: Summary of experimental design of transects and plots in *Aristida junciformis* dominated grassland treated with herbicide. See text for details

Sites	Experimental design	Layout	Initial treatment	Initial survey	Follow-up survey
T1 & T2	Paired t-test (2 reps) - before vs after treatment	Transect	2002	Feb 2002	May 2005
T3 & T4	Chi-squared—treated (T4) vs untreated (T3)	Transect	2003	Apr 2005	-
P1 & P2	N/A	Plot	-	Apr 2005	-

Table 2: Relative abundances (%) of species at the published benchmark and time series sites (before and after treatment with height-selective herbicide) and the significance tests of the differences (paired t-test).

		Bench mark	Untreated (T1 & T2 2002)	Treated (T1 & T2 2005)	P
Increaser 1	*Alloteropsis semialata*	0	2.5	2.5	1.000
	Cymbopogon excavatus	0	0	0	
	Digitaria tricholaenoides	0	1.5	1	0.500
	Setaria nigrirostris	0	1	0.5	0.500
	Trachypogon spicatus	0	6.5	10	0.090
	Tristachya leucothrix	11	2.5	3	0.795
Decreaser	*Brachiaria serrata*	1	0.5	0.5	1.000
	Diheteropogon amplectens	0	0.5	4	0.090
	Monocymbium ceresiiforme	0	0	0	
	Themeda triandra	67	6.5	5.5	0.844
	Panicum natalensis	0	0	0	
	Andropogon appendiculatus	0	2.5	2.5	1.000
Increaser 2a	*Eragrostis capensis*	2	2	1.5	0.874
	Harpochloa falx	0	1.5	1.5	1.000
	Heteropogon contortus	2	18.5	20.5	0.500
Increaser 2b	*Bothriochloa insculpta*	1	0	0	
	Digitaria monodactyla	1	0	0	
	Hyparrhenia hirta	2	4	5	0.500
	Eragrostis chloromelas	2	0	0	
	Eragrostis curvula	0	3.5	7.5	No result
	Eragrostis plana	0	0.5	0	0.500
	Eragrostis racemosa	2	0.5	2	0.205
	Sporobolus africanus	0	2	2	1.000
	Eragrostis superba	1	0	0	
Increaser 2c	*Cynodon dactylon*	0	0	0	
	Microchloa caffra	2	2	0.5	0.500
	Forbs	4	4	5.5	0.500
	Sedges	1	1.5	8.5	0.451
	Paspalum scrobiculatum	0	2	0.5	0.500
	Brachiaria eruciformis	0	0	0	
Increaser 3	***Aristida junciformis***	0	**33.5**	**14**	**0.049***
	Diheteropogon filifolius	0	0	0.5	0.500
	Elionurus muticus	1	0.5	1	0.500

* p<0.05

Table 3: Relative abundances (%) of species at paired sites (treated with height-selective herbicide and not treated) and the significance tests of the differences (chi-squared test).

		Untreated T3 2005	Treated T4 2005	P
Increaser 1	*Alloteropsis semialata*	0	0	
	Cymbopogon excavatus	0	0	
	Digitaria tricholaenoides	4	6	0.515
	Setaria nigrirostris	0	2	0.095
	Trachypogon spicatus	7	13	0.154
	Tristachya leucothrix	5	8	0.388
Decreaser	*Brachiaria serrata*	0	0	
	Diheteropogon amplectens	2	2	1.000
	Monocymbium ceresiiforme	3	5	0.468
	Themeda triandra	9	4	0.147
	Panicum natalensis	0	0	
	Andropogon appendiculatus	0	0	
Increaser 2a	*Eragrostis capensis*	0	0	
	Harpochloa falx	2	0	0.095
	Heteropogon contortus	23	27	0.513
Increaser 2b	*Bothriochloa insculpta*	0	0	
	Digitaria monodactyla	0	0	
	Hyparrhenia hirta	8	4	0.229
	Eragrostis chloromelas	0	0	
	Eragrostis curvula	4	3	0.700
	Eragrostis plana	0	0	
	Eragrostis racemosa	1	1	1.000
	Sporobolus africanus	1	1	1.000
	Eragrostis superba	0	0	
Increaser 2c	*Cynodon dactylon*	0	0	
	Microchloa caffra	0	0	
	Forbs	**2**	**9**	**0.024**
	Sedges	11	11	1.000
	Paspalum scrobiculatum	0	0	
	Brachiaria eruciformis	0	0	
Increaser 3	***Aristida junciformis***	**18**	**4**	**0.001**
	Diheteropogon filifolius	0	0	
	Elionurus muticus	0	0	

and areas with a high relative abundance of *Aristida junciformis*. The geographic locations of the sampling sites were recorded using a Trimble Global Positioning System (GPS) device.

The time series and paired sites were laid out as 100m transects while the remaining baselines sites (P1 and P2) were laid out as 2500m^2 plots. The frequency of herbaceous species was recorded at all sites using the descending point method.

Results and Discussion

A Detrended Correspondence Analysis performed on the data indicated a complete species turnover between the surveyed sites and that of the published benchmark (Species composition shown in Table 2 and 3).

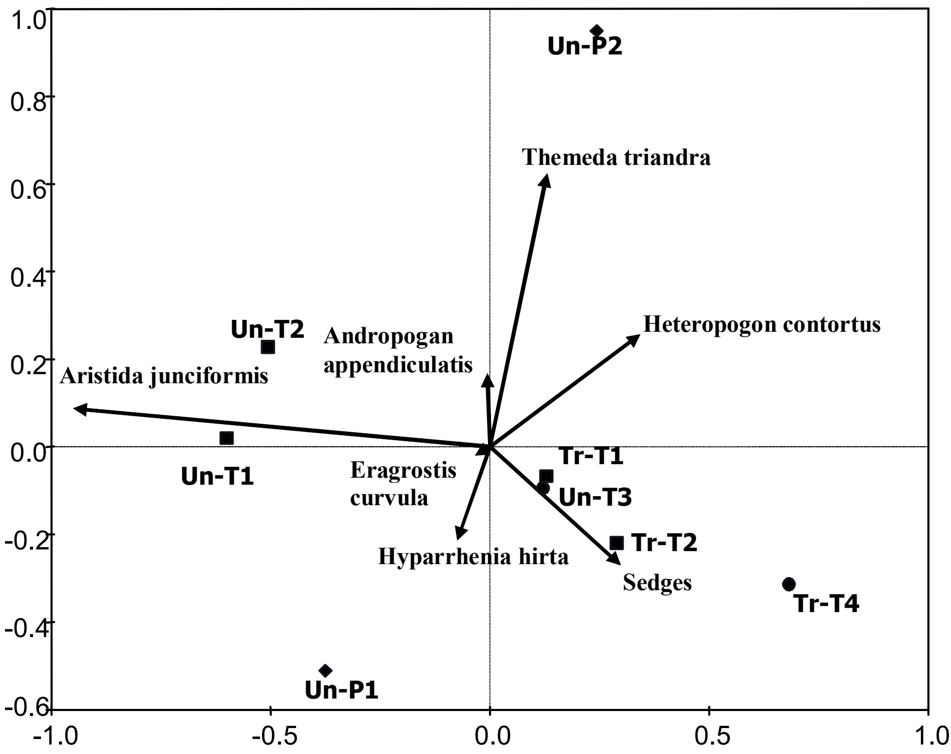

Figure 3: Principal component analysis of surveyed sites on the farm Mount Ernestina. Species with <50% of their variance accounted for in the biplot not shown. Key: Un - Untreated and Tr - Treated with height-selective herbicide to control *Aristida junciformis.* Squares: Time-series transects; Circles: paired transects; Diamonds: Untreated reference plots. Eigenvalues: Axis 1: 0.486; Axis 2: 0.271.

The benchmark was therefore excluded from further analysis.

A Principal Component Analysis performed on the remaining data show the untreated sites to be distributed to the right of Axis 2 while the treated sites are grouped to the left (Figure 3). Much of the variation along Axis 2 could be attributed to *Aristida junciformis* being dominant in the untreated sites while the species composition on the treated sites is heterogeneous. *Aristida junciformis* were therefore much more prevalent in the untreated sites compared to the sites treated with the height selective Glyphosate applicator.

The time series sites showed significant (P = 0.049) changes in the frequency of *Aristida junciformis* (Table 2). Pre-treatment sites had 33.5% Aristida but this was reduced to 14% post-treatment. No other grass species showed significant responses to the treatment. A general observation at these sites is that *Aristida junciformis* was also initially replaced by herbaceous forbs and these were again replaced by a variety of grass species in the following season. This shift in species composition over the medium term follows basic trends in rangeland succession. At one of the sites (T1) the species change was accelerated by the presence of a local disturbance in the form of a lick trough. This site was therefore subjected to more intense animal impact post treatment which resulted in the breaking up of the algal cap (present on all sites) that formed through raindrop action during the long periods of selective grazing. This gave seedlings the opportunity to establish in the disturbed soil, hence the visible increase in Eragrostis species.

Height selective herbicide treatment had a significant impact on the frequency of occurrence of *Aristida junciformis* in Mistbelt Grassland.

At the paired sites the frequency of *Aristida junciformis* decreased from 18% in the untreated site to 4% in the treated site (Table 3) which is significant (P = 0.001). Conversely forbs showed a significant (P = 0.024) increase from 2% in untreated site to 9% in the treated (Table 3). This increase could most probably be attributed to the re-colonization of forbs in the areas denuded of *Aristida junciformis*.

Conclusions

Height selective herbicide treatment had a significant impact on the frequency of occurrence of *Aristida junciformis* in Mistbelt Grassland. The rate of rehabilitation seem to be more affected by post–treatment grazing and animal impact which serves to break up the algal cap and surface crust which is restrictive to gaseous exchange and water infiltration.

Radical veld improvement through the application of herbicide to unpalatable species should be seen as a long term process in which quick visible results can be expected with regard to species composition, but relatively slow actual progress is made because of the natural successional sequence. The implementation of a rest directly following the treatment might improve the short term prognosis as it fuels the growth vigour of the palatable grass species

Future research should attempt to describe and quantify the impact of algal capping as a physical restriction to veld restoration.

Acknowledgements

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Swartberg Farmers' Day: Filling the fodder gap.

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Fodder flow, especially winter feeding, has always been the most important constraint for livestock producers in sourveld. To address some issues around ideas for winter feeding, Bom Louw of the National Wool Growers' Association (NWGA), together with the KwaZulu-Natal Department of Agriculture and Environmental Affairs, hosted a fodder flow day for sheep farmers at Swartberg in East Griqualand.

The event was attended by about 50 people, most of whom were local farmers, with several extension officers from the Department of Agriculture. Bom Louw set the scene by giving an overview of the critical periods in the typical production cycle of a sheep farmer. The productivity of the veld falls well below even maintenance requirements for an adult sheep in winter, and obviously cannot provide the nutrition required by a breeding ewe and her offspring.

Alan Short, of the Department of Agriculture, followed with a summary of the two long-term sheep grazing trials at Kokstad Research Station. These trials were established in the mid 1990s by Mark Hardy to examine the so-called "blaze and graze" system of veld management, and are designed as a follow-up to the trials established by Kevin Kirkman and Denis Barnes at Nooitgedacht in Mpumalanga. The grazing system is very simple: half of the veld is burned early in the season and grazed as soon as possible thereafter, continuously, by merino weaners. In the following season, the other half of the veld is burned and grazed. The veld is therefore rested for a full growing season every second year, and grazed heavily every second year.

One of the two trials, established in 1992, was established on relatively flat slopes (4-13%) with deep soils, while the other was established in 1995 on a steep slope (up to 20%) with shallow and heterogenous soil profiles. The differences in the response of the veld between the two sites were dramatic. The veld on the flatter site was far more stable, in terms of the change in composition over 12 years, than the veld on the steep site. In one of the camps stocked at a high stocking

Left: Mike Joyner explaining his grazing maize system

rate on the flatter site (1ha/AU over the long term), the proportion of *Themeda triandra* in the veld actually increased by nearly 25 percentage points. The changes in veld condition on the steep site were determined as much by the precise location of the camp (near the top or the bottom of the slope), as by the stocking rate. In general, there was a very strong interaction between edaphic factors and stocking rate in driving the amount and direction of change in species composition, which still needs to be thoroughly explored. Stocking rate alone did not determine the outcome of changes in veld condition. Primary productivity, on the other hand, was directly affected by stocking rate, with the vigour of the veld on the high stocking rates being much reduced compared to the vigour of the veld on the low stocking rates. There was a general decline in vigour over time, especially at the high stocking rate; at the end of the last rest year, production in the high stocking rate treatments had declined to less than half of the potential production of ungrazed veld.

Erika van Zyl, Animal Scientist at Dundee Research Station, summarised 10 years of research at Dundee on grazing maize, with and without companion crops. A range of companion crops was tested, either intercropped with maize, or side-by-side. The most important part of managing a grazing maize system

with companion crops is that the fodder should be carefully rationed, for example by using electric fencing to allocate a row or two of the companion crop per day. The economics of the various maize systems were dependant on the season, with rainfall have a significant effect on production. She pointed out that the simplest system, and one that was generally as productive as any other system, was grazing maize alone. In the highveld, maize is a useful dual-purpose crop, where it can be used for grazing livestock in a bad season and the surplus sold. In East Griqualand, maize is rarely planted as a cash crop, and therefore the opportunities for selling a surplus are more limited.

Anele Jikijela, Animal Science Technician at Kokstad Research Station, presented the results of a five-year lambing season trial. Traditionally, lambing occurs in Autumn and the lambs and ewes must be carried through the winter on pastures or green feed, a very expensive undertaking. The trial, established by Don Lyle in 1998, examined the potential of spring lambing, with the pregnant ewes being carried through the winter either on veld or tall fescue.

The sheep on veld were fed a production lick through the winter (Maxiwol at 300g/day, later increased to 400g/day). The fescure group was supplemented with a phosphate lick at 25 g/day. The weaning weights of the lambs from both groups are low at five months (about 20-22kg). However, the maiden ewes had grown satisfactorily by 18 months (44kg). Lambing percentages on veld were usually lower than fescue, but both groups were about 80% in most seasons. A financial analysis showed that overwintering on veld was generally substantially cheaper than overwintering on fescue.

Mike Joyner, a local farmer, then took the participants out to his farm, where he had established a grazing maize system. The sheep had been grazing for three weeks at the time of the visit, and the maize had been almost completely flattened. Mike had planted a dense population in order to force the maize to grow relatively slender stalks. He had also chosen a variety that is known for its ability to lodge easily (not usually considered a desirable attribute in maize). In his case, there was no option of using the maize for anything other than grazing, since it would have been exceptionally difficult to harvest the maize without most of the crop lodging and being left behind.

Kevin Kirkman, of the Grassland Science discipline at the University of KwaZulu-Natal, summed up the day by referring back to two previous farmers' days at Kokstad (reported in the Proceedings and the Bulletin of the GSSA, respectively). He pointed out that communication between the local farmers and the researchers needed to be re-established in order to guide the direction of future research, and to ensure that research results reached the audience for which they were intended.

The day ended with a braai at the Swartberg Farmers' Hall, where sum of the new connections made earlier in the day were strengthened over a frosty beer or two. One important by-product of the Farmers' Day was re-establishing the weakened connections between farmers, the Department of Agriculture, and organisations like the National Wool Growers' Association. Kevin had tried to encourage the locals to re-establish the joint farmer-department research committees of yore, although at the end of a long day, there was limited enthusiasm from the audience. However, with enthusiastic people like Bom Louw in the NWGA coordinating such efforts, the connections between organised agriculture, government departments and farmers should be strengthened in the near future.

Previous page: the audience listening to Mike Joyner.
Above: maize after three weeks of grazing (foreground) and protected by an exclosure (background)

Invitation to 42nd Annual Congress of the Grassland Society of Southern Africa

Twenty-first Century Challenges to Range and Forage Research

16 – 20 JULY 2007
Eden Grove, Rhodes University, Grahamstown

First Announcement and Call for Papers

The 42nd Annual Congress of the GSSA will be held at the Eden Grove complex at Rhodes University, Grahamstown. The Organising Committee would like to invite all those interested in participating in the Congress to submit the Registration Form giving titles for papers and posters. The main theme of the Congress is *Twenty-first Century Challenges to Range and Forage Research*.

Grahamstown is situated in an area of great biological diversity, where a range of biomes and land uses are found: from subtropical thicket to grasslands, savannas and the Karoo, and from dairy farming to communal rangelands and wildlife conservation. The Congress aims to reflect the great diversity of rangeland types, uses and challenges found around Grahamstown, and a range of post-Congress tours are planned to complement these themes:

1. Ecological research and management issues in game reserves and conservation
2. Pastures and dairy farming
3. Veld management and rehabilitation challenges and initiatives, and
4. Developments and initiatives in communal rangelands.

Currently, one symposium has been proposed, on linking plant-herbivore theory to management of rangelands. As the Congress is so close to a major dairy area, a day-long symposium centering on pastures and dairy farming is also planned. Several other special themes have been proposed, including a focus on Valley Bushveld and Thicket, the use of legumes in rehabilitating old lands, and managing rangelands for commercial wildlife operations. Please visit the website for regular updates!

If anyone has other pertinent issues which they would like to address via the media of symposia, workshops or short courses to be held in conjunction with the Congress, please contact the Organising Committee using the details below.

Susi Vetter	Freyni du Toit	Pieter Conradie
(046) 603 8595	(033) 390-3113	(043) 683 5410
(076) 103 3682	(083) 256-7202	(082) 857 5810
s.vetter@ru.ac.za	admin@gssa.co.za	pieter.conradie@agr.ecprov.gov.za

IMPORTANT DEADLINES:
All titles to be submitted by 9 February 2007
All abstracts to be submitted by 31 March 2007
Early bird PAYMENTS due by 30 April 2007

Please visit the website, www.gssa.co.za, for all further information, or contact the Organising Committee.

42ND ANNUAL GSSA CONGRESS
DELEGATES' REGISTRATION FORM

(Fax to + 27 (0)33 390 3113 or email to admin@gssa.co.za)

DELEGATE DETAILS					
Title:		Initials:		First Name:	
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E-mail:					
Special diet (if any):					

SCIENTIFIC PROGRAMME				
Do you intend presenting:	Platform? (tick)		Poster? (tick)	
Preliminary title:				

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REGISTRATION COSTS

CATEGORY					EARLY	NORMAL	TOTAL
Grassland Society of Southern Africa Member Delegate					R 1 750.00	R 2 100.00	
Non-Member Delegate					R 2 050.00	R 2 400.00	
Residence Accommodation (Mon Evening to Fri Morning)					R 500.00	R 600.00	
All Students including Residence Accommodation					R 2 250.00	N/A	
Day Delegate	TUES	WED	THURS	days X	R 650.00	R 800.00	
Accompanying Person					R 900.00	R 1 050.00	
Airport Shuttle: Port Elizabeth – Grahamstown Return					N/A	R 260.00	
Post-Congress Tour: please choose tour	1	2	3	4	N/A	R 120.00	
						TOTAL	

BANKING DETAILS: Nedbank Cheque Account 1343011299 Cascades Branch 134325

PLEASE NOTE:

1. **All costs include VAT.**
2. **Registration costs include all meals (except breakfasts and Wednesday evening).**
3. **Residence accommodation is in a single room with hand basin and a communal bathroom. Breakfast is included.**
4. **Accompanying persons will be catered for during lunches and evening events.**
5. **Early registrations should be PAID IN FULL by 30 April 2007. Thereafter, normal registration fees are payable.**
6. **The congress organisers reserve the right to charge a cancellation fee on all registrations cancelled after 6 July 2007.**

Congress 41 Pics

Clockwise from top left: Winner of the GSSA award for best presentation at the Eskom Science Expo, Emelia Swart; postgrad students at tea time; Prof Sam Fuhlendorf; the student volunteers who helped to make the Congress run smoothly; Prof Chris Dannhauser hands the Peter Edwards Award to André Neethling, manager of Thaba Thola Game farm. (Photos: Graham Peddie)