grass roots

Newsletter of the Grassland Society of Southern Africa

Incorporating the Bulletin of the Grassland Society of Southern Africa
ISSN: 10166122 • Vol. 8 • No. 3 • September 2008

Savory—the debate continues

- Rainfall and Kruger's buffalo population
- Allan Savory's visit to Zimbabwe

Planting dates of sorghum cultivars

Predator control in communal systems

Impact Factor for African Journal of Range and Forage Science!

Advancing rangeland ecology and pasture management in Africa

Editorial

Dear Readers

After more than three decades, the debate about Allan Savory's theories on rangeland management is still as heated as ever. Like him or loath him, it is doubtful that any other individual has had as much of an impact on range science as Allan Savory.

Mr. Savory recently visited Zimbabwe, and invited a number of interested people to join him. Richard Fynn gives a fascinating account of the discussions and observations that were inspired by the trip (p. 25). A new generation of practitioners were able to meet the man himself, rather than one of his adherents, and it appears that the debate on Savory's theories has just become a little more exciting. Richard also presents some data on buffalo numbers and rainfall in Kruger, which support Allan Savory's hypotheses (p. 38). Mr Savory has asked for the opportunity to respond to some of Richard's comments, and I hope that the wider *Grassroots* readership will be able to read his thoughts in the near future.

The 43rd Annual Congress was the most successful ever, with over 280 delegates, and the number of new members show that the Society's growth is strong. What is more important is that new concepts were explored and debated and young practitioners exposed to the wealth of experience within the Society's membership.

Alan Short

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

We welcome any contributions to the Grassroots*, in the form of news, informative articles, reports, short research notes, scientific papers and letters to the Editor. Email shorta@arc.agric.za or admin@grassland.org.za or fax +27 (0)86 622 75 76*

GSSA Council

President:
Pieter Conradie
pw_conradie@yahoo.com

Immediate Past President:
Rina Grant
rina@sanparks.org

Vice-President:
Mike Peel
MikeP@arc.agric.za

Honorary Secretary:
Loraine van den Berg
LoraineVDB@nda.agric.za

Honorary Treasurer:
Justin du Toit
dutoitJCO@ukzn.ac.za

Scientific Editor:
Peter Scogings
pscoging@pan.uzulu.ac.za

Publications Editor:
Alan Short
ShortA@arc.agric.za

Public Relations Officer:
Sikhalazo Dube
Sdube@ufh.ac.za

Chairperson of Trust:
Klaus Kellner
klaus.kellner@nwu.ac.za

PAC Chairperson:
Leslie Brown
lrbrown@unisa.ac.za

Additional Member: Publications Assistant
Erika van Zyl
VanZylE@dunrs.kzntl.gov.za

Additional Member: Acting Scientific Editor
Susi Vetter
S.Vetter@ru.ac.za

Additional Member:
Wayne Truter
wayne.truter@up.ac.za

Additional Member:
Anuschka Barac
abarac@nwpg.gov.za

Additional Member: Pastures
Philip Botha
philipb@elsenburg.com

Honorary Member:
Max du Toit

Administrator:
Freyni du Toit
admin@grassland.org.za

Layout and design:
Alan Short

Printed by:
CPW
49 Langalibalele St
Pietermaritzburg
cpwart@telkomsa.net

Contents

Features

Regulars

On the cover:

Cattle and goats grazing at Dimbangombe, Zimbabwe, where Allan Savory discussed his ideas with a group of grassland scientists (p. 25) Photograph: Richard Fynn

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

News

Justin Bower receives GSSA award for academic excellence

The GSSA awarded Justin Bower of Tshwane University of Technology the award for academic excellence in May 2008.

The title of his thesis is "Feeding patch selection of African Buffalo (*Syncerus caffer caffer*) in the Satara region of the Kruger National Park, South Africa." for which he was awarded a Masters degree in Technology (Nature Conservation) *cum laude* by the Tshwane University of Technology in 2007.

Above: Justin Bower (centre) with Prof. Brian Reilly (left) and Mike Panagos of the GSSA (right)

Email your submissions to the African Journal of Range and Forage Science to journal@ grassland.org.za

Upload your publications to the website

The website has a new facility for members of the GSSA and the broader range and forage science community: members can now share their publications on the website, or provide links to their publications on other academic websites.

Send in your thesis, reports, journal articles or abstracts, or any other relevant outputs that you would like to have available to the wider world.

Several members have already done so. Note that the Society cannot assume responsibility for dealing with copyright issues; it is up to members to determine whether their publications can be made freely available on the website.

No page charges for Journal

NISC, the publishers of the Journal, have agreed to waive page charges for GSSA members submitting papers for Vol. 29 (2009), says Mike Schramm, Publishing Editor. This is to help increase submission rates, and page charges will be reviewed next year.

News

Expertise database now operational

One of the GSSA's strengths is the diverse range of skills within the Society's membership. The GSSA has now developed an expertise database to identify the members with particular skills.

The Professional Members' database will be open to the general public, while only GSSA members will be able to search the database for other members. The security on the database will be strict.

Members who have not filled in their details on the expertise database, please contact the Administrator or Catherine Lund (cat@grassland.org.za).

Youngest Congress delegate arrives

Freyni and Justin du Toit celebrated the birth of their first child, Max, in May 2008. Max attended the Congress with parents at the age of 9 weeks, making him officially the youngest Congress delegate ever.

Our warmest congratulations to Justin and Freyni from all the members of the GSSA.

African Journal of Range and Forage Science now has ISI rating

The African Journal of Range and Forage Science has now officially been included on the Thomson ISI list. This means that the Journal will receive an ISI rating in 2010 which will be published in 2011. However, as it is now included on the lists that Thomson publishes, including Science Citation Index Expanded and Journal Citation Reports—Science Edition, the Journal is regarded as an ISI journal and will have an impact factor.

ISI-rated journals are more visible, and receive higher weighting from funding agencies and universities.

Council member assaulted

Wayne Truter, a long-standing GSSA member and new Council member, was assaulted at his home while hosting a party, during a robbery last month. He was severely injured and is recovering. Our thoughts are with Wayne and his family as they deal with their traumatic experience.

Grassland Science

The Japanese Society for Grassland Science is keen to establish closer links with the GSSA. They will be publishing a similar advertorial in their journal for the African Journal of Range and Forage Science.

Grassland Science is the official English language journal of the Japanese Society of Grassland Science. It publishes original research papers, review articles and short reports in all aspects of grassland science, with an aim of presenting and sharing knowledge, ideas and philosophies on better management and use of grasslands, forage crops and turf plants for both agricultural and non-agricultural purposes across the world.

Edited by: Masahiko Hirata
Print ISSN: 1744-6961
Online ISSN: 1744-697X
Frequency: Quarterly
Current Volume: 54 / 2008

Highlight Articles:

The grassland farming system and sustainable agricultural development in China

Grassland degradation in China: Methods of monitoring, management and restoration

Ecological importance of *Neotyphodium* spp. grass endophytes in agroecosystems

Genetics and molecular breeding in *Lolium*/*Festuca* grass species complex

Factors associated with species richness in a remnant calcareous grassland

For more information, please visit: www.blackwellpublishing.com/GRS

Letters

Dear Editor

Re: your interesting comments in *Grassroots* concerning the 'failure to translate scientific info into layman's terms in popular media (*Grassroots*, May 2008, p. 11).

I've been writing for Farmer's Weekly for many years and have hardly ever experienced problems getting info from researchers and then rewriting/summarising their articles for the magazine. But I only scratch the surface - most of the info that could be of value to land users never reaches them by way of the printed word. Which is a great pity because, as a farmer, I've come to realise that scientists are 'right' most of the time. The only problem is that they're five to 10 years (sometimes even more) ahead of the average farmer in their thinking.

I do believe, however, that some researchers resent 'giving away' info for free. They argue that American publications pay researchers very well for their work. I don't know if there is a solution to this complaint in the limited local market. Unless, perhaps, if the researchers can switch their writing style from journal to popular. But even then there would be no guarantee that they will be published.

On a lighter note - Although I usually get their cooperation, a standard comment from researchers seems to be: 'I'm snowed under right now.' Or, 'things are a bit hectic.' I always smile at that because any multitasker is always 'snowed' under, and that includes farmer/journalists like me!

Regards

Roelof Bezuidenhout

New Members

- Mr Justin Bowers: Ecoleges - Environmental and Planning Law Consultants
- Mr P Meulenbeld: Anglo Operations Limited
- Dr Hugh Pringle: Bush Heritage Australia
- Ms Vuyi Matokazi: SANParks: Kruger National Park
- Mr Anthony Maluka: Department of Agriculture
- Dr Richard Kinking: SiVEST
- Mr Riaan Robbeson: Bathusi Environmental Consulting cc
- Mr Ramagwale Mampholo: Department of Agriculture
- Ms Kirsten Oliver: Endangered Wildlife Trust
- Mr Kedibone Mashaku: Limpopo Department of Agriculture
- Mr Garreth Champion: University of KwaZulu-Natal
- Mr Andries Wessels: Agricol (Pty) Ltd
- Mr Anthony Borrel: Big Game Parks of Swaziland
- Ms Mankhane Bontsi: Free State Department of Agriculture
- Mr Talifhani Mukwevho: Limpopo Department of Agriculture
- Mr Mashudu Radamba: Limpopo Department of Agriculture
- Ms Mpho Nemakhavahni: Limpopo Department of Agriculture
- Mr Alson Mutswari: Limpopo Department of Agriculture
- Mr Hasani Sambo: Limpopo Department of Agriculture
- Mr Matodzi Sitholimela: Limpopo Department of Agriculture
- Mr L Mulaudzi: Limpopo Department of Agriculture
- Ms L Mulaudzi: Limpopo Department of Agriculture
- Mr Mafunise Mabusha: Limpopo Department of Agriculture
- Mr Mutshinya Budeli: Limpopo Department of Agriculture
- Mr Anthony Sharp: Limpopo Department of Agriculture
- Mr Stephen Castle: Stanford Valley Farm
- Eric Mpikeleli: Eastern Cape Department of Agriculture Mr Pieter Wagner: Limpopo Department of Agriculture
- Mr Vhalinavho Khavhagali: Northern Cape Department TEC
- Mrs Erna van Schoor: Limpopo Department of Agriculture
- Mr Douglas McCulloch: Land Resources International
- Mr Matsobane Ngoasheng: University of Limpopo
- Ms Helen King: University of KwaZulu-Natal
- Ms Budu Manaka: SANBI
- Mr Thabo Motsoane: Department of Range Resources Management
- Mr Shaun MacGregor: Ecoleges - Environmental and Planning Law Consultants

Bursaries

MSc., PhD. Or Post-Grad in Molecular biology, Ethnobotany, Algal biotechnology and Plant physiology University of KwaZulu-Natal, Research Centre for Plant Growth and Development

Based in Pietermaritzburg, the "City of Choice", the Research Centre for Plant Growth and Development (RCPGD) is committed to excellence in research, training and skills development of postgraduate students. Our main areas of focus include plant physiology, molecular biology and ethnobotany. We believe strongly in collaborative research, and have partnerships with several research groups throughout the world. Our research group is similarly diverse with international students enjoying and flourishing in the dynamic and well-equipped working environment of the RCPGD at the University of KwaZulu-Natal.

Applications can be made to Professor J. Van Staden for bursaries (MSc, PhD or Post-doctoral) in the following areas:

- Plant physiology – seed biology, hormone physiology, eco-physiology
- Molecular biology
- Ethnobotany
- Algal biotechnology

Applications must include a short CV, two letters of reference and a letter of motivation for the position with potential project/areas of interest. Please submit applications via e-mail to rcpgd@ukzn.ac.za

Postgraduate training fellowships for women scientists from sub-Saharan Africa and least developed countries (LDCs)

The Fellowships are offered to women scientists to pursue postgraduate research in the following fields of basic sciences: biology, chemistry, mathematics and physics.

This fellowship programme is for female students from Sub-Saharan Africa or Least Developed Countries (LDCs) who wish to pursue postgraduate training leading to a doctorate degree at a centre of excellence in the South outside their own country.

Only women scientists from Sub-Saharan Africa and/or one of the Least Developed Countries can apply. Host institutions must be located in a developing country. Submissions by email or fax cannot be accepted.

The general purpose of the scheme is to contribute to the emergence of a new generation of women leaders in science and technology, and to promote their effective participation in the scientific and technological development of their countries.

For more information, visit the GSSA website

Contact Details

Ms. Leena Mungapen
TWOWS Secretariat , c/o
TWAS, ICTP Campus
Strada Costiera 11, 34014
Trieste, Italy
Tel: +39 040 2240-321
Fax: +39 040 2240-689
E-mail: info@twows.org

Upcoming events

From www.grassland.org.za

SAWMA Conference 2008
Date: 16 - 18 September 2008
Venue: Mpekweni Beach Resort, Eastern Cape
Contact: Elma Marais
Tel: 021 554 1297
Email: elma@mweb.co.za
Website: www.sawma.co.za

SASAS and Developing Areas Interest Group: Understanding Communal Livestock Production
Date: 30 September - 2 October 2008
Venue: Drakensville ATKV Resort
Approx. cost: R1000, incl. meals and accom.
Tel: 033 3559258
Contact: Michelle Shearing
Email: shearingm@dae.kzntl.gov.za

GSSA Research Skills Workshop
Date: 12-13 November 2008
Venue: Lythwood Lodge, KZN Midlands
Contact: Freyni du Toit
Tel: 033-390 3113
Email: admin@grassland.org.za
Website: www.grassland.org.za

Kimberley Diversity Research Symposium
Date: 23 November 2008
Venue: Rooifontein Eco-Centre Kimberley
Tel: 053 807 4800
Contact: Vhalinavho Khavhagali
Email: vkhavhagali@half.ncape.gov.za

New World: Future World
The 10th World Conference on Animal Production;
Date: 23-28 November 2008
Venue: Cape Town International Convention Centre, South Africa
Tel: +27 12 420 3276 or +27 12 420 3290
Contact: Deidre
Email: deidre@iafrica.com
Website: www.wcap2008.co.za

Africa Climate Change Conference
Date: 12 -16 January 2009
Venue: University of Cape Town
Tel: 033 3559258
Contact: Ms Pavs Pillay OR
Email: *humboldt@africaclimatescience.org*

First International Workshop on Summer Dormancy in Grasses: Coping with increasing aridity and heat under climate change
Date: 36 – 8 April 2009
Venue: Ardmore Oklahoma USA
Website: http://www.nobleorg?ForageImprovement/Summer dormancy/index.html

African Crop Science Society Conference
Date: 28 September – 10 October 2009
Venue: Cape Town
Email: JeannieB@arc.agric.za

Council News

The Council met on 21 July 2008 prior to the start of Congress 43 at Badplaas Forever Resorts, Mpumalanga.

The venue for Congress was very good and it was pleasing to see the large number of delegates attending the Congress, as well as the AGM. A number of very interesting symposia and sessions were organized for Congress, attracting practitioners and researchers from all over South Africa. Council would like to urge members to become more involved in nominating people for the Peter Edwards Award in 2009.

A strategic planning session was conducted for the Journal to clarify issues surrounding the operation of the Journal, low submission rates and other matters. During this session the aim and scope of the Journal was reformulated to be in line with the GSSA vision and mission. It was also decided to introduce a mentorship program with regards to writing papers for the Journal. This will all be carried out under the auspices of an appointed "Chief Executive Editor".

Members are reminded that current and back issues of the Journal can be accessed on the internet. Formal instructions on how to do this are available on the GSSA website. Please submit any news or upcoming events so that it can be published on the website and in the *Grassroots*.

Trust funds are available for dispersal throughout the year and application forms can be obtained from Freyni du Toit. Please make use of this opportunity!

The proposed theme for Congress 44 is: *Meeting rangelands, pasture and wildlife challenges in a changing landscape*. Members are requested to make inputs and suggestions regarding Congress 44, which will be held in Gauteng next year.

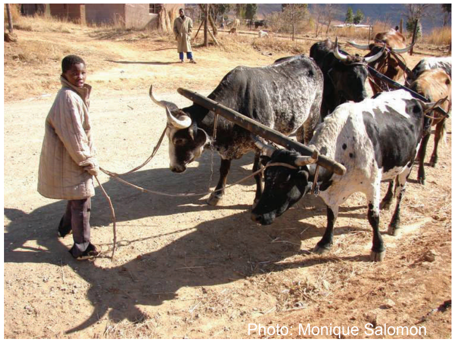
We welcomed several new Council members: Mike Peel as Vice President; Sikhalazo Dube as PRO; Anuschka Barac, Erika van Zyl and Wayne Truter as Additional Members. We thank departing members Mark Hardy, Khanyi Mbatha, Luthando Dziba and Jorrie Jordaan for all their contributions over the years, and hope they enjoy their rest!

Challenges and contestations in communal grazing

Monique Salomon
Centre for Environment, Agriculture and Development, University of KwaZulu-Natal
Email: salomon@ukzn.ac.za

A recent seminar was held at the University of KwaZulu-Natal (UKZN) in Pietermaritzburg on 8 May 2008 focusing on challenges faced by scientists and practitioners in livestock grazing in communal areas. The seminar was part of an annual meeting of a research project "Keeping cattle in a changing rural landscape" funded by the South African-Netherlands Programme for Alternatives in Development (SANPAD). The research project involves three post-graduate students from UKZN, their supervisors and collaborators from South Africa and the Netherlands, South African Environmental Observation Network (SAEON), Khanya African Institute for Community Driven Development, Wageningen University and Research (WUR), and the International Institute for Geo-Information Science and Earth Observation (ITC).

Over twenty staff from the University, Provincial Department of Agriculture, Agricultural Research Council and local NGOs attended the seminar and engaged with the many issues raised by the presenters. In his opening address, Prof. Deogratius Jaganyi, Deputy Dean of the Faculty of Science and Agriculture at UKZN, highlighted the importance of academic excellence and scholarship that contribute to challenges in Africa.



Dr Nicky Allsopp from SAEON challenged the audience by arguing that livestock management interventions will continue to fail if they remain underpinned by 'modernization' and 'degradation' narratives. Dr Claudius van de Vijver from WUR in the Netherlands, suggested that increased frequency and intensity of burning regimes in Africa have exacerbated bush encroachment. Adjusting fire management practices and using grazers such as goats in the agro-ecosystem, can improve the situation.

The potential of farming systems methodology and participatory Geographical Information Systems (PGIS) were highlighted by two speakers. According to Prof. Akke van der Zijpp from WUR, placing livestock management practices within a broader farming systems framework will facilitate better understanding of why people keep livestock, how it contributes to their livelihood and what strategies to improve are likely to succeed. Dr Michael McCall from ITC in the Netherlands illustrated how high-tech applications using Global Positioning Systems (GPS), remote sensing and modelling are increasingly being used in urban and rural development contexts to engage project beneficiaries as equal partners in development interventions. Spatial mapping of natural resources, spiritual sites, cultural heritage and land use change can assist in community-based natural and cultural resources management, and defend indigenous peoples' property rights. Using GPS to track livestock movement, water points and forage distribution across rangelands are helpful in understanding livestock management practices and develop recommendations to improve.

Monique Salomon, Mphumzeni Chonco and Victor Bangamwabo presented the framework and interim results of a participatory research initiative in the uKhahlamba-Drakensberg focusing on how livestock management practices, and particularly cattle keeping, has changed since 1850, how the landscape has changed, and whether there is a causal link between livestock keeping practices and land degradation.

Participants agreed that sharing experiences and reflecting on successes and failures will strengthen research and development efforts in communal grazing.

Photo: Monique Salomon

Predator – human conflict as influenced by livestock depredation

Nathan Thavarajah
NThavarajah@bicton.ac.uk

Large African land carnivores, some of which are close to the borderline of extinction, may be viewed upon by many as figures of natural beauty. However, for those who are forced to live along side large carnivores, and for those who rely on livestock farming as their livelihood, large carnivores may be seen as nothing more than a nuisance.

The aim of this paper is to investigate the role that humans play in influencing conflict, and to determine whether livestock depredation is a contemporary leading factor as to why conflict exists. Using two methods of primary research, questionnaires and interviews, data were collected from a variety of locations including; Kenya, Tanzania, Uganda, Zambia, Botswana, Zimbabwe and South Africa. Respondents were asked to express their views and disclose information concerning the fundamental reasons why conflict exists, the effect that conflict has on both humans and large carnivores, and how conflict can be alleviated.

Lion believed to be a man eater, killed in Tanzania in 2004.

Before we go any further we have to ask the question: Is there actually a problem, or has the topic been blown out of proportion? According to the data collected the answer is certainly yes, conflict between humans and carnivores is a big problem for both parties. A hundred percent of respondents expressed that they had experienced an incident where a predator had been caught or accused of killing livestock, indicating that there is definitely a problem concerning livestock predation. In addition, the results also indicated that a substantial number of large carnivores are killed in some areas in response to livestock depredation.

There is no doubt that some

wildlife species do genuinely threaten human lives and livelihoods (Woodroffe et al, 2007). For example in Tanzania, as well as being renowned as livestock killers, lions *Panthera leo* are also regarded as man eaters, with more than 563 people killed and 308 injured within the period of 1990 – 2004 (Packer et al, 2005).

Lions as well as other predators like leopards *Panthera pardus*, spotted hyena *Crocuta crocuta*, and African wild dogs *Lycaon pictus* are widely perceived as being persistent killers of livestock. Adding fuel to their negative perception, these predators are particularly likely to kill multiple animals on each attack, thus causing great economic loss (Schiess-Meier et al. 2007; Butler 2000, Woodroffe et al. 2007).

Interest is focused on both sides of the problem. From a human perspective negative perceptions towards carnivores are there because of the economic cost of having predators on their land. Livestock production in Africa ranges from large scale ranching operations to small scale subsistence livestock ownership, typical of the majority of rural Africa, many of these people face formidable economic pressure (Hemson 2003).

The difference between large scale and small scale operations can be big. A study area in central Kenya revealed that commercial ranchers own an average of 1,536 head of cattle; whereas community members own an average of 8 head of cattle (Romanach et al. 2007). As negative attitudes towards predators are often related to economic loss (Lindsey et al. 2005), stock lost to predation, even when very few, can be significant to small scale producers (Swarner 2004, Butler 2000). The outcome of a study in Zimbabwe (Butler 2000) showed that the average loss per livestock owning household to predation was $13 per year, this was 12% of each household's net annual income, in this type of case, lethal control may seem like an effective and convenient way of dealing with problem (Swarner 2004).

However, in contrast of these negative perceptions it is worth remembering that carnivores are built to kill and eat other animals, and livestock are built to be eaten (Fascione et al. 2004). It is widely agreed that carnivores are forced into conflict with humans. If natural prey is available, predators take wild species in preference to domestic stock. Yet if natural prey densities are low, predators will increasingly prey on livestock as an alternative food source (Schiess-Meier et al. 2007). Livestock depredation is often most serious when wild prey has been reduced by agricultural development or widespread bush meat poaching (African Lion Working Group 2006).

Trends indicate that human expansion, encroachment, and human caused fragmentation is the main outstanding cause of livestock depredation and thus human – predator conflict. Like the rest of the world, Africa's human population is growing. In Kenya, human population growth is 3.8% per year (Romanach et al. 2007), Tanzania's human population has risen from 23.1 mil-

Lion Guardians in the Amboseli-Tsavo ecosystem, Kenya.

lion in 1988 to 34.6 million in 2002 (Packer et al. 2005), and over the past 100 years Botswana's human population has grown from 120,000 to 1.7 million (Schiess-Meier et al. 2007). Accompanying the human population growth has been the expansion of agricultural land and increased livestock numbers, resulting in increasing isolation of conservation areas and decreasing wildlife (Hackel 1999).

In Africa, more than 50% of the increased agricultural production since 1961 has resulted from cultivating new areas. Between 1981 and 1993 Africa as a whole saw a 5.8% increase in cropland and approximately 12% increase in livestock numbers (Hackel 1999). In Botswana over the past 50 years, the cattle population has grown from 400,000 to 3 million. With this more land has consequently been transformed into livestock grazing areas. Livestock are persistently encroaching on the edges of protected areas, and sometimes several kilometres inside reserves (Schiess-Meier et al. 2007). Human alteration of carnivore habitat has without a doubt led to escalated conflicts (Treves and Karanth 2003). The difficulty is that these areas are often prime habitat, and livestock farmers are heavily reliant on the resources within these areas (Hazzah 2006).

With alteration of wildlife habitat often comes extirpation of wildlife species, and lethal control in order to establish human interests has had a significant effect on some species population numbers. For instance, the current population collapse of African wild dogs can be attributed to lethal control (Swarner 2004). African wild dog population numbers are currently at approximately 5,750 individuals (Lindsey et al. 2005). The same can be said for the current population collapse of cheetah *Acinonyx jubatus*, whose species population has fallen from an estimated 30,000 in 1975, to fewer than 15,000 in the 1990s. The largest remaining cheetah population is in Namibia with approximately 2,500 animals (Marker et al. 2003), in the Serengeti National Park, Tanzania, the cheetah population numbers are dangerously low, approximately 200 – 250 animals (Kelly 2001).

Conflict with pastoral farmers over livestock depredation has been, and still is a key factor of large carnivore population decline (Hazzah 2006; Romanach et al. 2007). The decline of population sizes and distribution of large carnivores in Africa because of retributive killings has resulted in some species being increasingly limited to protected areas. In addition, there are limited protected areas in Africa which still support significant populations of large carnivores (Romanach et al. 2007; Schiess-Meier et al. 2007). The persecution of animals that are considered pests has driven several species to extinction, and has contributed to the endangerment of many others (Woodroffe et al. 2007). Therefore, for large carnivore species, their continued existence relies on mitigating livestock depredation and thus lethal control (Swarner 2004).

However, with such an expansive human population growth occurring, what can be done to alleviate the hardship caused by depredation, and in turn prevent lethal control from taking place?

Data indicate that although physical barriers are essential for keeping people and wildlife apart, they are not completely effective. The problems found with the use of physical barriers are not only the great cost in erecting and maintaining them (Muruthi 2005; Marker et al. 2003; Woodroffe et al. 2007), but given time even the most extensive barriers will not impede predators for long (Treves and Karanth 2003). Warthogs dig holes under fences allowing access for predators (du Plessis and Smit 2002; Marker et al. 2003), and where some fences might be effective against a lion or a cheetah, they may not be effective against leopards that could easily jump over them (du Plessis and Smit 2002). Therefore a successful management plan for a predator species is reliant on effective livestock husbandry and education, as well as financial incentives for those people who are affected by the conflict.

It is a reality that throughout many parts of Africa, as is the case with many parts of the world, traditional livestock husbandry practices have typically been abandoned (Woodroffe et al. 2007). In Botswana, livestock husbandry systems allow herds to roam free with little direct supervision (Hemson 2003; Frank et al. 2006). In a slightly different context, pastoralists in east Africa during the dry season are sometimes forced into travelling long distances in search of water and fodder. As temporary bomas have to be used in these circumstances, they usually lack in strength (Hazzah 2006). Although these examples may seem different in extremity, they both have similar consequences. Wildlife species generally attack livestock that are poorly defended; therefore wildlife damage is closely correlated to the effectiveness of the defences (Muruthi 2005). There is growing confidence that livestock depredation can be most effectively limited by improving static defences (Hemson 2003; Lindsey et al. 2005) such as reinforced stock enclosures, guard dogs and increased vigilance of human guards, especially during certain periods (Hemson 2003). It is accurate to say that those with good livestock husbandry systems rarely lose stock, and therefore rarely kill predators (Frank et al. 2006).

The only realistic way that attitudes can be changed is through financial incentives

As persistently expressed throughout the data collected, the only realistic way that attitudes can be changed in order to prevent conflict is through financial incentive. If people see economic benefits from carnivores then it would be a step towards mitigating or reducing the killing of carnivores (Hazzah 2006). Compensation schemes can be effective, but in essence may only increase tolerance without preventing the problem from occurring, (Hemson 2003). So it may be more effective to allow communities and individuals that are affected by wildlife to become active participants in, and enjoy tangible benefits from wildlife management (Muruthi 2005), thus bringing them closer to their national heritage. When people become involved in enjoying tangible benefits from wildlife in their areas, it is often achieved through community based conservation (CBC) strategies. CBC programs allow people living near protected areas to participate in land use policy and management decisions, they give people proprietorship over wildlife resources, and people receive economic gain from wildlife conservation (Hackel 1999).

There are circumstances where effective conservation considerations require the removal of chronic problem animals (African Lion Working Group 2006) and suggestions indicate that selected removal of stock killing predators, may help to avoid the spread of such behaviour throughout populations (Woodroffe and Frank 2005). However, many individual carnivores pose no threat to domestic animals or humans despite having access to them for years, and lethal control methods often do not selectively target the individuals that cause economic losses (Treves and Karanth 2003). In lethal control it would be desirable to focus on those individuals actually causing the problems, but in reality the problem animal is not identified, and so any individual is killed to satisfy the demand for action and revenge (Muruthi 2005).

In conclusion, where livestock farming constitutes a major part of local livelihoods, high levels of conflict can occur between livestock owners and carnivores due to predation. Rural people will therefore sometimes understandably kill predators to defend their interests. In concurrence, it is fair to say that human – predator conflict in east and southern Africa, is principally linked to livestock depredations.

Although the rising human population numbers and the transformation of wildlife habitats contribute as a major factor of predator – human conflict, evidence points towards discontinued husbandry practices as another cause. Physical barriers like fences are important but not 100% effective in preventing predation, so in order to prevent conflict, good husbandry practices need to be established or re-established in conjunction with physical barriers, especially in areas where conflict is high. In addition, income factors are of foremost significance in shaping the perceptions of carnivores by livestock farming communities. Negative perceptions are usually unabated because of the economic cost of having predators on their land. It is an inevitable certainty that in order to achieve co – existence, financial benefits derived from wildlife will need to be shared between communities that are affected by wildlife – human conflict.

This research creates a profound reflection covering the effect that a growing human population has on the natural world. Predators are forced into conflict with humans for a number of reasons relating to human population growth, unless these factors can be compromised, the future looks considerably bleak for large land predators in Africa.

References

African Lion Working Group. 2006. Problem Lion Control Fact Sheet Forth Draft [online] South Africa: African Lion Working Group. Available from: http://www.african-lion.org/pac_fact_sheet.pdf [Accessed 25/4/08].

Butler J. 2000. The economic costs of wildlife predation on livestock in Gokwe communal land, Zimbabwe. African Journal of Ecology, 38: 23 – 30.

Du Plessis H and Smit G. 2002. The Development and Final Testing of an Electrified Leopard Proof Game Fence on the Farm Masequa, Unpublished technical report, Dept. of Animal, Wildlife and Grassland Sciences. University of the Free State. South Africa. 34 pp.

Fascione N, Delach A, Smith M (eds). 2004. People and Predators: From Conflict to Coexistence. USA: Island Press.

Hackel J. 1999. Community conservation and the future of Africa's wildlife. Conservation Biology. 13 (4): 726 – 734.

Hazzah LN. 2006. Living Among Lions (*Panthera leo*): Coexistence or Killing? Community Attitudes

Towards Conservation Initiatives and the Motivations Behind Lion Killing in Kenyan Maasailand. MSc. Thesis, University of Wisconsin – Madison.

Hemson G. 2003. The Ecology and Conservation of Lions: Human – Wildlife Conflict in semi – arid Botswana. PhD. Thesis. University of Oxford.

Kelly M. 2001. Lineage loss in Serengeti cheetah: Consequences of high repro7duction variance and heritability of fitness on effective population size. Conservation Biology. 15 (1), pp 137-147.

Frank L, Hemson G, Kushnir H and Packer C. 2006. Lions, Conflict and Conservation in Eastern and Southern Africa. The Eastern and Southern African Lion Conservation Workshop, 11 – 13 January 2006 Johannesburg South Africa.

Lindsey P, du Toit J and Mills M. 2005. Attitudes of ranchers towards African wild dogs Lycaon pictus: Conservation implications on private land. Biological Conservation, 125: 113 – 121.

Marker L, Mills M and Macdonald D. 2003. Factors influencing perceptions of conflict and tolerance toward cheetahs on Namibian farmlands. Conservation Biology. 17 (5): 1290 – 1298.

Muruthi P. 2005. Human Wildlife Conflict: Lessons Learned From AWF`s African Heartlands. Kenya: African Wildlife Foundation.

Packer C, Ikanda D, Kissui B and Kushnir H. 2005. Lion attacks on humans in Tanzania. Nature, 436: 927 – 928.

Romanach S, Lindsey P and Woodroffe R. 2007. Determinants of attitudes towards predators in central Kenya and suggestions for increasing tolerance in livestock dominated landscapes. Oryx, 41 (2): 185 – 195.

Schiess-Meier M, Ramsauer S, Gabanapelo T and Konig B. 2007. Livestock predation – insights from problem animal control registers in Botswana. Journal of Wildlife Management, 71 (4):1267 – 1274.

Swarner M. 2004. Human – carnivore conflict over livestock: the African wild dog in central Botswana. Breslaver Graduate Symposium on Natural Resource Issues in Africa, March 5th 2004, UC Berkeley. California: University of California: pp. 1 – 8.

Treves A and Karanth K. 2003. Human – carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology, 17 (6):1491 – 1499.

Woodroffe R and Frank LG. 2005. Lethal control of African lions (*Panthera leo*): local and regional population impacts. Animal Conservation, 8: 91 – 98.

Woodroffe R, Frank LG, Lindsey P, ole Ranah S and Romanach S. 2007. Livestock husbandry as a tool for carnivore conservation in Africa's community rangelands: a case – control study. Biodiversity and Conservation, 16:1245 – 1260.

The effect of planting date on the dry matter production of annual forage sorghum hybrids and hybrid millet cultivars.

J. Voigt, P.R. Botha[1] and H.S. Gerber
Department of Agriculture Western Cape, Outeniqua Experimental Farm
[1]Email: philipb@elsenburg.com

Introduction

The use of forage sorghum hybrids (*Sorghum bicolor* (L.) Moench x *Sorghum sudanense*) (Viaene and Abawi 1998) and hybrid millets (*Pennisetum glaucum*) as summer and autumn pasture have became very popular during recent years. This is because forage sorghums hybrids and hybrid millets have low water requirement, high dry matter (DM) productions and rapid growth over a short season (Renato et al. 2001; Butler et al. 2003). Unfortunately no information is available on when to establish these pastures and if some cultivars can be planted earlier than others. It is important during establishment to choose the most effective planting date to ensure optimal growth. The wrong planting date could lead to insufficient germination and uneven growth.

The aim of the study was to determine the effect of planting dates of different cultivars on the DM production of forage sorghum hybrids (*Sorghum bicolor* (L.) Moench x *Sorghum sudanense*) and hybrid millets (*Pennisetum glaucum*).

Table 1: The types of forage sorghum hybrids and hybrid millets and cultivars evaluated.

Type of sorghum	Cultivar
<u>**Conventional:**</u>	
Late	**Jumbo**
	Pac 8288
Early	**Greengrazer**
	Super King
BMR	**Revolution BMR**
	Kow Kandy BMR
Sweet	**Hunnigreen**
	Betta Grazer
Hybrid millet (Pennisetum)	**Hy Pearl Millet**
	Nutrifeed

Material and methods

An experiment using four different planting dates was conducted at Outeniqua Experimental farm with forage sorghum hybrids and hybrid millet cultivars. The farm is situated near George in the Western Cape (altitude of 210 m, 33º 58' 38" S and 22º 25' 16" E,) (Botha, 2003) with an annual rainfall of 730 mm (Anonymous 1990).

Ten cultivars were selected according to previous sorghum trail results (Gerber et al. 2006). The cultivars were planted at four different planting dates. The planting dates were 22 September 2006, 20 October 2006, 21 November 2006 and 20 December 2006. Table 1 indicates the different types of forage sorghums hybrids and hybrid millet cultivars that were selected.

The cultivars were planted on an Estcourt type of soil. Sixteen paddocks sized 138 m² each was each divided into 10 blocks. The size of these blocks was 11.5 m².Soils were sprayed with glyphosate (2 L/ha) 2 weeks before planting. Soils were tilled with a disc harrow (1.5m) followed by a kongskilde. Seeds were broadcasted on plots and then rolled with a land roller (2.33m width, 30 rollers, Cambridge type). The seeding rate of forage sorghums hybrids and hybrid millets were 30kg/ha and 15kg/ha respectively. Irrigation was scheduled according to a tensiometer reading. Irrigation commenced at a tensiometer reading of –25 Kpa and terminated at –10 Kpa (Botha 2003). Fertilizer was applied to raise the soil potassium (K) level to 80mg/kg, phosphorous (P) to 35mg/kg and pH (KCl) level to 5.5. Nitrogen (N) and K was applied before planting at a rate of 50kg LAN/ha and 150kg KCl/ha respectively. Four weeks after emergence a top dressing of 200kg/ha of 4:3:4 (33) was applied and after each cutting 200kg/ha LAN. and 90kg/ha KCl were given.

Plants were harvested when 60% of plots reached a height of 1 meter. It was cut down with an Agria 5400 cutter (1.27m width) to a height of 100 mm. Sorghums were separated from weeds to determine plot weight. Samples of approximately 300g were taken from each plot to be weight and dried for 72 hours at 60º C, this was used to determine DM production (kg DM/ha), growth rate (kg DM/ha/day) and DM content (%).

The experimental design was a split-plot with 4 main plot treatments (planting dates) and 10 split plot treatments (cultivars). To select the treatments, which performed the best, a monthly average was calculated for each variable. An appropriate analysis of variance was conducted. Student 's LSD (least significant difference) at a 5% significance level was used to compare the treatment means (Ott 1998) The assumption of normality of the residuals was tested by a Shapiro Wilk test before the analysis of variance could be called reliable and valid. The "LSTATS" module of SAS program version 8.2 was used to analyze the data (SAS 1999).

Result and Discussion

Table 2 indicates the total DM pro-

Table 2: The DM production (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted during September 2006

Cultivar	Cutting date					**Total DM production**
	11 Dec	8 Jan	6 Feb	12 Mar	25 Apr	
Betta Grazer	440^{a}	1615^{a}	1854^{a}	1054^{ab}	1446^{a}	**6409^{a}**
Hy Pearl Millet*	67^{e}	453^{cd}	940^{cd}	608^{cd}	644^{cd}	**2712^{cd}**
Nutrifeed*	117^{cde}	803^{bc}	1681^{ab}	1168^{a}	1373^{a}	**5142^{ab}**
Pac 8288	265^{bc}	1204^{b}	1767^{a}	1171^{a}	1175^{ab}	**5582^{ab}**
Greengrazer	281^{b}	1143^{b}	1609^{ab}	837^{abc}	973^{bc}	**4843^{ab}**
Super King	228^{bcd}	1007^{b}	1155^{bc}	790^{bc}	896^{bc}	**4076^{bc}**
Revolution BMR	46^{e}	382^{d}	322^{e}	180^{e}	151^{e}	**1080^{e}**
Kow Kandy	12^{e}	226^{d}	74^{e}	23^{e}	35^{e}	**369^{e}**
Hunnigreen	78^{e}	502^{cd}	371de	134^{e}	162^{e}	**1247de**
Jumbo	83de	531^{cd}	580^{cde}	351de	327de	**1872de**
LSD (0.05)	**148.2**	**402.5**	**586.9**	**345.8**	**347.5**	**1618.5**

Figures with letters in common do not differ significantly (P>0.05)
*Hybrid millet

Table 3: The DM production (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted during October 2006

Cultivar	Cutting date					**Total DM production**
	19 Dec	18 Jan	16 Feb	27 Mar	14 May	
Betta Grazer	711^{a}	1357^{a}	1330^{a}	2128^{a}	604^{b}	**6131^{a}**
Hy Pearl Millet*	206^{d}	725^{d}	667de	1145^{c}	401^{bcd}	**3145de**
Nutrifeed*	379^{cd}	995^{c}	1243^{ab}	1909^{ab}	1279^{a}	**5805^{a}**
Pac 8288	694^{a}	1257^{ab}	1498^{a}	2044^{a}	559^{bc}	**6052^{a}**
Greengrazer	462^{bc}	1037^{bc}	919^{bcd}	1525^{bc}	404^{bcd}	**4346^{bc}**
Super King	631^{ab}	1031^{bc}	1124^{abc}	1796^{ab}	544^{bc}	**5125^{ab}**
Revolution BMR	303^{cd}	747^{d}	480^{ef}	636^{d}	194de	**2359^{e}**
Kow Kandy	198^{d}	400^{e}	114^{f}	135^{e}	42^{e}	**888^{f}**
Hunnigreen	250^{cd}	575de	523^{e}	546^{d}	195de	**2090^{e}**
Jumbo	446^{bc}	1031^{bc}	758^{cde}	1133^{c}	343^{cd}	**3710^{cd}**
LSD (0.05)	**226.8**	**243.1**	**380.1**	**401.8**	**256.6**	**1109**

Figures with letters in common do not differ significantly (P>0.05)
*Hybrid millet

Table 4: The DM production (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted during November 2006

Cultivar	Cutting date					**Total DM production**
	1st cutting 11 Jan	2nd cutting 8 Feb	3rd cutting 15 Mar	4th cutting 4 May	5th cutting	
Betta Grazer	1314[abc]	775[b]	1032[a]	1172[bc]	-	**4293[bc]**
Hy Pearl Millet*	1456[ab]	1543[a]	751[bc]	1095[bc]	-	**4845[b]**
Nutrifeed*	1597[a]	1712[a]	795[ab]	1809[a]	-	**5913[a]**
Pac 8288	930[cd]	831[b]	1009[ab]	1264[b]	-	**4034[bc]**
Greengrazer	1031[bcd]	653[bc]	484[d]	654[de]	-	**2822[d]**
Super King	958[cd]	770[b]	779[abc]	1031[bcd]	-	**3538[cd]**
Revolution BMR	357[e]	374[c]	217[e]	326[ef]	-	**1274[e]**
Kow Kandy	257[e]	398[c]	50[e]	74[f]	-	**780[e]**
Hunnigreen	264[e]	385[c]	194[e]	400[ef]	-	**1244[e]**
Jumbo	647[de]	621[bc]	528[cd]	804[cd]	-	**2599[d]**
LSD (0.05)	**459.0**	**371.1**	**259.8**	**383.9**		**1055.2**

Figures with letters in common do not differ significantly (P>0.05)
*Hybrid millet

Table 5: The DM production (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted during December 2006

Cultivar	Cutting date					**Total DM production**
	1st cutting 1 Feb	2nd cutting 28 Feb	3rd cutting 17 Apr	4th cutting	5th cutting	
Betta Grazer	1397[a]	924[b]	1536[ab]	-	-	**3856[abc]**
Hy Pearl Millet*	1051[ab]	1579[a]	1583[a]	-	-	**4213[ab]**
Nutrifeed*	1188[ab]	1686[a]	1700[a]	-	-	**4574[a]**
Pac 8288	954[b]	957[b]	1325[ab]	-	-	**3236[bc]**
Greengrazer	1219[ab]	818[b]	804[cd]	-	-	**2841[c]**
Super King	961[b]	875[b]	1050[bc]	-	-	**2886[c]**
Revolution BMR	229[c]	290[c]	284[e]	-	-	**802[d]**
Kow Kandy	160[c]	148[c]	71[e]	-	-	**379[d]**
Hunnigreen	296[c]	319[c]	199[e]	-	-	**814[d]**
Jumbo	273[c]	394[c]	376[de]	-	-	**1044[d]**
LSD (0.05)	**412.0**	**367.7**	**494.8**			**1067.8**

Figures with letters in common do not differ significantly (P>0.05)
*Hybrid millet

duction (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted during September 2006.

Betta Grazer produced the highest amount of DM during the first two cuttings. During the third and fourth cutting Betta grazer, Nutrifeed, Pac 8288 and Greengrazer produced similar amounts of DM. This resulted in Betta Grazer, Nutrifeed, Pac 8288 and Greengrazer to produce the highest total amount of DM per hectare (kg/ha).

Table 3 shows the total DM production (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted during October 2006.

Betta Grazer, Nutrifeed, Pac 8288 and Super King had high DM productions throughout the majority of the first four cuttings. Nutrifeed produced the highest amount of DM during the fifth cutting. This resulted in Betta Grazer, Nutrifeed and Pac 8288 to produce a higher amount of DM/ha than most of the cultivars and only Super King could produce a similar amount of total DM/ha.

Table 4 indicates the total DM production (kg DM/ha) of frequently

Table 6: The total DM production (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted on 4 different planting dates.

Cultivars	22 September	20 October	21 November	20 December
Betta Grazer	6409[xx]	6131[x]	4293	3856
Hy Pearl Millet*	2712	3145	4845	4213
Nutrifeed*	5142	5805[x]	5913[x]	4574
Pac 8288	5582[x]	6052[x]	4034	3236
Greengrazer	4843	4346	2822	2841
Super King	4076	5125	3538	2886
Revolution BMR	1080	2359	1274	802
Kow Kandy	369	888	780	379
Hunnigreen	1247	2090	1244	814
Jumbo	1872	3710	2599	1044
[1]LSD (0.05)	1618.5	1109.0	1055.2	1067.8
[2]LSD (0.05)	1193.0			

[1]LSD within planting date
[2]LSD over planting dates
[xx]Highest value (P<0.05) LSD = 1193.0
[x]Differ not from highest value (P>0.05) LSD = 1193.0
Hybrid millet*

cut forage sorghum hybrids and hybrid millet cultivars planted during November 2006.

During the first cutting Nutrifeed had a higher DM production than most of the cultivars and only Betta Grazer and Hy Peal Millet had a similar DM production. The fact that Nutrifeed had a higher DM production during each cutting than most of the other cultivars and only similar to that of Betta Grazer during the third cutting, resulted in Nutrifeed to produce the highest total amount of DM per hectare.

Table 5 shows the total DM production (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted during December 2006.

Hy Pearl Millet and Nutrifeed produced similar amounts of DM during each of the three cuttings followed the December planting date. The similarity of DM produced by Betta Grazer compared to that of Hy Pearl Millet and Nutrifeed during the first and third cut resulted in these three cultivars to produce a higher total amount of DM per hectare than most of the cultivars.

Table 6 shows the total DM production (kg DM/ha) of frequently cut forage sorghum hybrids and hybrid millet cultivars planted on 4 different planting dates.

Insert Table 6

Betta Grazer planted during September produced a higher amount of total DM than most of the other cultivars. Only Pac 8288 planted during September or October, Nutrifeed planted during October or November and Betta Grazer planted during October could produce a similar amount of DM than Betta Grazer planted during September.

Conclusion

Cultivar had a significant influence on DM production. Betta Grazer, Nutrifeed, Pac 8288, Greengrazer, Hy Pearl Millet and Super King were the most prominent cultivars and produced a higher total DM production than most of the other cultivars if compared to planting date and the frequency of cutting. Betta Grazer, Nutrifeed and Pac 8288 are recommended for the September and October planting date, Nutrifeed for the November planting date and Nutrifeed, Hy Pearl Millet and Betta Grazer for the December planting date.

Acknowledgement

We would like to thank the Plant Production team at Outeniqua Experimental farm, as well as Mardè Booyse and Dalena Robertson for their help and support.

References

Anonymous 1990. Beskrywing van boerderygebiede. Suidkussubstreek Landbou-ontwikkelingsprogram, Elsenburg Landbou-ontwikkelingsinstituut vir die winterreëngebied, 4. 126-127

Bates G. 1995 Summer Annual Grasses. The University of Tennessee, Agricultural Extension Service. http://www.utextension.utk.edu/

publications/spfiles/SP434A.pdf

Botha P.R. 2003. Studiegebied en eksperimentele prosedure. Die produksiepotensiaal van oorgesaaide kikoejoeweiding in die gematigde kusgebied van die Suid-Kaap. 3. 72.

Butler T., Bean B., 2003. Forage Sorghum Production Guide, http://foragesoftexas.tamu.edu/pdf/FORAGESorghum.pdf

Gerber H.S., Botha P.R., Meeske R. 2006. Die produksie en kwaliteit van Voersorghum- en Bastervoermannakultivars as wei- en Kuilvoergewasse. Information day Outeniqua Experiment Farm, The production potential of Crops for Milk and Beef Production 2006. P17-23

Ott, R.L. (1998) An Introduction to Statistical methods and data analysis. Belmont, California:Duxbury Press: pp 807-837 (pp 1-1051)

Peterson P. R. 1998. Plant combinations for Extended Dairy Pasture Production. Feed and Nutritional Management Cow College. January 7-8. http://www.dasc.vt.edu/extension/nutritioncc/peterson98.pdf#search=%22Plant%20Combinations%20for%20Extended%20Dairy%20Pasture%20Production%22

Renato S. F., Sollenberger L.E., Staples C.R. 2001. Yield, Yield Distribution, and Nutritive Value of Intensively Managed Warm-Season Annual Grasses, Agronomy Journal 93: 1257-1262 January 2001 http://agron.scijournals.org/cgi/content/full/agrojnl;93/6/1257?maxto-show=&HITS=10&hits=10&RESULTFORMAT=&searchid=1&FIRSTINDEX=0&minscore=5000&resourcetype=HWCIT

SAS Institute, Inc. (1999), SAS/STAT User's Guide, Version 8, 1st printing, Volume 2. SAS Institute Inc, SAS Campus Drive, Cary, North Carolina 27513.

Shapiro, S. S. and Wilk, M. B. (1965) ; An Analysis of Variance Test for Normality (complete samples)., Biometrika, 52, 591-611.

Viaene NM and Abawi GS 1998. Management of *Meloidogyne hapla* on Lettuce in Organic soil with Sudangrass as a Cover Crop. Plant Disease 82:945-952. P 94

Savory insights – is rangeland science due for a paradigm shift?

Richard Fynn
University of KwaZulu-Natal
fynn@ukzn.ac.za

Introduction

Following a visit by Allan Savory to Kruger National Park, Harry Biggs got together a diverse group of ecologists to visit Allan at the learning site ranch Dimbangombe near Victoria Falls in Zimbabwe which is owned and managed by the Africa Centre for Holistic Management. The group consisting of Harry Biggs, Rina Grant, Vuyi Matokazi, Cathy Greaver, Tony Swemmer, Mike Peel, Luthando Dziba, Kevin Kirkman, Kate Matchett, Norman Owen-Smith, Wayne Twine and Richard Fynn arrived at Dimbangombe on Monday afternoon the 12th of May 2008. The afternoon was spent chatting with Allan and planning how to best utilize our time there over the week. Our aim was to spend time with Allan and see for ourselves what Holistic Management (HM) was about and how it influenced the grasslands, woodlands and wetlands of Dimbangombe. The claims arising from HM have been severely criticized by rangeland scientists so we thought it would be good check it out.

Savory's planned grazing, which is an integral part of HM, use high cattle densities to have a large impact on a grassland by breaking soil crusts with hoof action, crushing down moribund grass tufts thereby removing aerial litter and depositing it on the soil surface, improving light availability to the growing points of grasses and forbs and depositing large amounts of dung and urine. The breaking of the soil surface combined with the laying of litter, dung and urine together with adequate compaction he claims allows seedling establishment in bare spaces leading to greater perennial plant cover. Importantly, a thick litter layer is able to develop on the soil surface because of animal trampling and the exclusion of fire. Closer plant spacing and increased plant density combined with the litter layer in bare spaces in the absence of fire results in much more effective rainfall owing to the litter layer reducing evaporation from the soil surface and the combined effects of high plant density and the litter layer preventing rain water running off into streams, which represent a loss to the system. Moreover, less leaf area and smaller root systems (Coughenour *et al*. 1985; Edroma 1985; Danckwerts and Nel 1989) on grazed vs. ungrazed plants is likely to result in less evapotranspiration in

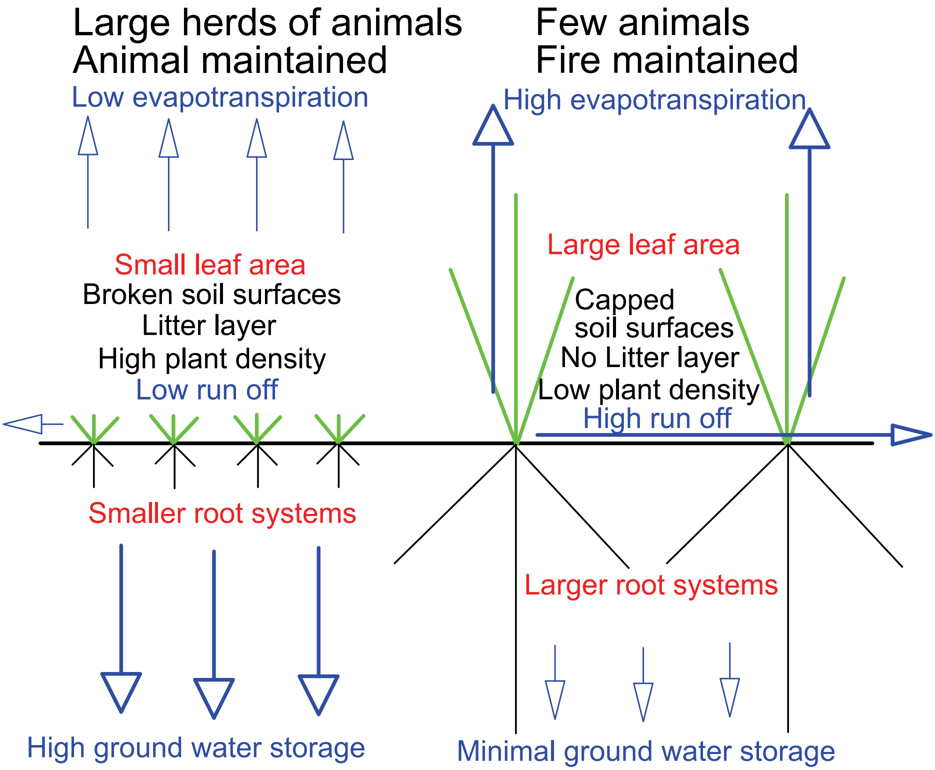


Figure 1. Conceptual model showing how greater plant density, healthy litter layers, broken soil surface and reduced evapotranspiration of grazed down plants under high density grazing may improve hydrological cycles. The effect of grazing on root systems was derived from studies by Coughenour et al. (1985), Eroma (1985) and Danckwerts and Nel (1989). The effect of grazing on evapotranspiration and soil moisture was derived from McNaughton (1985).

heavily grazed systems. The combination of the above factors is likely to result in much better soil moisture and better hydrology, wetlands and rivers under HM (Figure 1).

We spent as much time as possible in the field on Tuesday and Wednesday looking at a whole range of sites and the effects of HM on the grasslands and wetlands of the area. We saw how a tightly bunched herd of cattle can reduce a tall grassland to a few standing stems leaving a thick litter layer on the soil surface. We saw how stockading the animals overnight for a week on large bare and degraded areas results in impressive rehabilitation of the site. It appears that the large urine and dung inputs on the degraded soil and the seed inputs with the dung result in a good grass layer developing where it would have been impossible to do so without intervention. This technique definitely has great potential for restoration of degraded and eroded areas. We watched a large herd of cattle and goats out in the veld with their full-time herders. It was interesting to see that cattle and goats can be used together as a single herd very effectively. We saw the effects of this management on wetlands where water was seeping through wonderful sponges and previously dry rivers now ran clear and pure. We also got to look at degraded rangelands in adjacent communal areas. Overall the trip was well worthwhile and insightful and it was great to finally meet the man we had heard so much about.

Savory's background and insights

Insight into ecological systems is best derived from spending lots of time on the ground observing phenomena across environmental gradients and changing conditions while distilling one's observations with deep thinking and reading. Insight cannot be obtained by observing phenomena under static conditions and at single points on environmental gradients because patterns and trends do not emerge. This unfortunately has been the case for most of rangeland science; experiments are conducted at a single location (at too small a scale), with a single land-use and are guided by and interpreted under a specific paradigm.

Savory was fortunate to spend many years in Africa on the ground observing veld condition in many different locations, landuse types and environmental conditions. He started off with a degree in Botany and Zoology at the University of Natal and at the age of 20 obtained a job with the Northern Rhodesian game department in the Luangwa valley and subsequently in the Southern Rhodesian Game department. It was here that he observed wildlife management before fences and the removal of people from the land. The Luangwa at that time had massive herds of game with herds of buffalo in excess of 4000 animals. He saw how the land began to change once people were removed from wildlife areas destined for future national parks and the animals became more sedentary and altered their behaviour. Overgrazing took place and the reedbeds and grasslands degraded. Culling did nothing to reverse the situation. Savory observed that hunting by people and predators are important for keeping the game moving and maintaining tightly bunched herds that have a high impact on the veld. He also noticed that animal behaviour in small herds is not the same as in large herds, nor do they have the same effect on the veld. Animals in small herds have more freedom to move around obstacles and graze selectively whereas animals in very large herds tend to graze less selectively and smash down everything in their path: bushes, tree seedlings and large grass tufts. This is especially so when they are being harassed by predators where the main defence of many herbivores is to bunch into tight herds.

Later, while working as a Tsetse fly control officer in Zimbabwe, he noticed that shooting out all the game in a region did not improve the veld but worsened it. During the Zimbabwe bush war he led a tracking unit following up on insurgents. Tracking forces one to observe and examine the soil and veld with acute intensity and detail. This enabled him to observe conditions in the veld under diverse landuse types such as wildlife, commercial ranching and communal landuse and confirmed his earlier observations that resting of veld and partial rest under light stocking rates and diffuse herds of animals results in wide plant spacing, bare patches and moribund grass tufts. At this point it is pertinent to note that few, if any, rangeland ecologists ever get exposed to what Savory experienced, especially the effects of massive herds of game on rangelands and the consequences of their removal. It is unlikely, therefore, that conventional rangeland ecologists will ever get insight into the relationship between veld condition and large herd dynamics. Savory's observations showed that the best veld occurs where massive herds of game have a localized heavy impact, scuffing the soil surface, crushing down shrubs, tree seedlings and old unpalatable grass tufts and depositing a litter layer on the soil surface. This is in direct contrast to the currant range management paradigm which predicts that veld condition will be best under conditions that minimize the intensity of trampling and grazing impacts. Under the rotational grazing management paradigm managers seek to allow animals to graze down certain key grasses only lightly before moving them. In the last decade rotational grazing has come under increasing criticism and it is clear that it has failed to produce results (Briske *et al*. 2008).

Savory was not the only one to notice that high impact grazing resulted in much better basal cover and veld condition. Clive Buntting in KwaZulu-Natal uses high densities of cattle to graze the veld to lawns. Clive has realized independently of Savory that the best veld occurs under high impact grazing for a season or two followed by at least a season's rest. Surely this simulates what occurred under natural conditions where large herds of game grazed down one region and then moved on to the next region. Sam Fuhlendorf uses the focal grazing system with Bison in prairie grasslands where Bison heavily graze focal burnt patches for a season but leave those to focus on new burnt patches in the following season. In contrast, areas grazed diffusely by Bison where a much larger area is burnt have much higher invasions of alien plants because the Bison are free to select more palatable native species (Fuhlendorf *et al*. 2006). The problem with any system that allows diffuse herds of animals and light grazing intensity is that the animals have minimal impact on tree recruitment and graze only the palatable grasses which allows bush encroachment and gives the unpalatable grasses an unfair advantage over the palatable grasses. Take the Transkei grazing lawns as an example: grazing is extremely heavy but non-selective and has resulted in almost complete dominance by a species considered to be intolerant of heavy grazing, *Themeda triandra* (pers. obs.). Moreover, basal cover is excellent, far better that any commercial ranchers achieve; except perhaps those who use high density grazing like Clive Buntting.

This brings us to the question of

our obsession with species composition as an index of veld condition. If veld has over 50 % *T. triandra* it is considered to be in good condition by most ranchers and rangeland scientists yet it may have poor basal cover, capped soils between the tufts and no surface litter. Another grassland with no *T. triandra* and dominated by *Hyparrhenia hirta* but with excellent basal cover would be considered to be in much poorer condition. The latter grassland is much better from an ecosystem function perspective and *H. hirta* is a good grazing species when grazed short.

Is fire necessary and does it maintain healthy grasslands?

Savory's opinion is that grasslands have changed from animal-maintained to fire-maintained grasslands. Herbivory can be more effective than fire in preventing bush encroachment. Fire only reduced bush density on the Kruger burning plots in areas where there were higher concentrations of herbivores (Mills and Fey 2005). *En masse* recruitment of trees was shown to be clearly correlated with *en masse* die-offs of herbivores during the rinderpest and more recent anthrax outbreaks (Prins and van der Jeugd 1993). Browsers in the Serengeti were shown to be just as effective as fire in preventing tree recruitment to upper layers (Belsky 1984). Winston Trollop's burning experiments at Alice in the Eastern Cape show the same trends; goats and fire resulted in much more open grassland than fire alone (pers. obs.). The Serengeti is a classic example of an animal-maintained grassland with very few trees. In the low-rainfall short-grass plains herbivores consume almost all the biomass (McNaughton 1985) severely constraining the influence of fire. Here is the paradox: Minimal fire, yet wide open grasslands. Although shallow soils play a part, the effects of trampling, browsing and grazing by massive herds of animals undoubtedly also prevent tree recruitment in these grasslands. Clearly fire is not needed to maintain open grasslands. On the contrary, animals can do a much better job provided that the herds are big enough and concentrated enough to have a large localized effect.

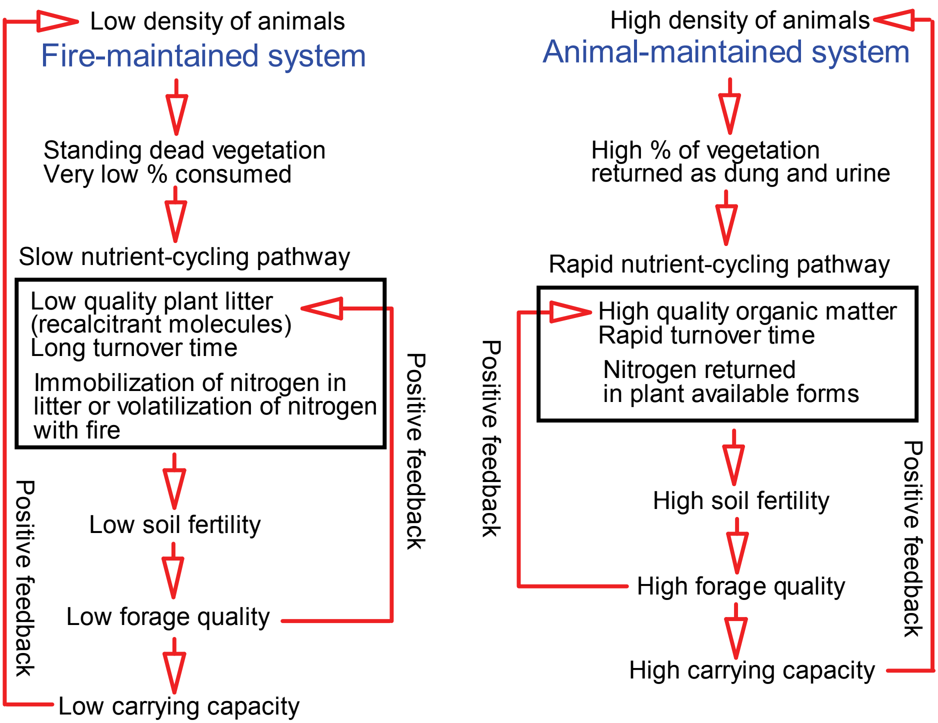
Savory is strongly against the use of fire and where you can use animals to prevent the build up of moribund grass tufts and prevent bush encroachment then I would agree with him because not only do large herds of animals do a better job than fire in preventing bush encroachment but also because of the negative effect of fire on a range of ecosystem properties. Fire dries out the soil by removing surface litter which greatly increases evaporation from the soil surface (Redman 1978; Snyman 2002; Fynn *et al*. in prep). Apart from drying the soil through surface litter removal perhaps the greatest effect that removal of surface litter has is to expose the soil surface to raindrop impact resulting in soil capping and reduced infiltration. This combined with no surface litter to slow overland flow of rainwater results in much greater losses of rainwater into streams rather than being stored as ground water and in the soil itself. Fire, therefore, results in much less effective rainfall and a drying out of the system, degraded wetlands, reduced stream flows and greater drought effects. The healthy wetlands, sponges and clear flowing streams on Dimbangombe, where fire has been replaced by increased animals resulting in a surface litter built up, were testimony to the negative effects of fire on the hydrology of a region. Independent evidence for this comes from the long-term fire experiment plots at Nwanetsi and Marheya near Satara in the Kruger National Park. *Panicum maximum* is a resource-loving species (Fynn and O'Connor 2005) and especially favours moist sites (Fynn *et al*. in prep). In the plots with regular fire it occurs only under trees where fertility and moisture are higher but in the unburnt plots it has become a dominant in the open sites between trees, clearly indicating that soil resources are much better where fire is excluded.

It is not just soil moisture that is affected by fire. Long-term fire reduces total soil nitrogen and rates of nitrogen mineralization (White and Grossman 1972; Ojima *et al*. 1994; Fynn *et al*. 2003; O'Connor *et al*. 2004). In addition, fire reduces grassland productivity (Tainton *et al*. 1978; Snyman 2004). Fire may improve productivity in high rainfall regions because it removes dead material and improves light availability but has the opposite effect in dry seasons because of its negative effects on soil moisture (Knapp *et al*. 1998). Thus, the more arid the environment or the poorer the soils the more negative the effect that fire has on grassland productivity. The combined negative effects of fire on soil moisture and nutrient availability results in an increase in abundance of earlier succession grasses such as *Eragrostis racemosa* (O'Connor *et al*. 2004) because it is a good competitor under low soil resources (Fynn *et al*. in prep). Thus, taken as a whole, fire reduces soil quality and nutrient and moisture availability, reduces stream flows and exacerbates drought effects. Regularly burnt habitats become less productive and more xeric. By contrast, grazing without fire results in greater rates of nitrogen mineralization and increased soil moisture levels (McNaughton 1985). The effect of grazing on soil moisture resulted in grassland productivity being poorly correlated with rainfall and strongly correlated with grazing intensity (McNaughton 1985).

The drying up of many streams around southern Africa is a consequence of the reduction in effective rainfall as a result of bad land management. The Kruger National Park is no exception. On the surface the veld looks good with a high dominance of perennials such as *T. triandra*. Closer inspection, however, reveals large bare spaces between tufts and capped soils and little or no surface litter, hence *P. maximum* can only survive under trees. The concern is that long-term frequent fires in Kruger will result in continuing drying out of the system, loss of top soil, and increases in the undesirable fire-driven species *Bothriochloa radicans*, as we see under annual burning in the burning plots. Not only is *B. radicans* unpalatable but when it dominates it forms monospecific stands with massive (50 cm +) bare spaces between tufts. Plant diversity in these stands is appalling. If this species becomes the major dominant in the future, Kruger will be as good as dead. This is a question that South African National Parks (SANParks) needs to take really seriously: what is fire really doing to Kruger's ecosystem functioning, productivity and sustainability? Could we see, or have we already seen, a state change to a much less productive system incapable of supporting the large herds of game it was once proclaimed to conserve?

Kruger has extremely low animal biomass per hectare relative to many other national parks in Africa. I believe this is due to several factors: 1) Animals can no longer migrate across to the much more productive grasslands at the base of the escarpment where rainfall is very high and deep productive soils exist. Most of these sites are under orchards or human settlement now (Barberton, Nelspruit, Hazyview, Graskop, Bushbuck ridge, Tzaneen and Thoyandou regions) but would have once been a dependable source of forage

Figure 2. Effects of herbivores on nutrient cycling pathways, forage quality and carrying capacity (Derived from McNaughton 1985 and 1988)



in winter and especially during droughts – key resource areas; 2) Losses of big herds of game (take the wildebeest as a recent example) have resulted in Kruger becoming a fire-maintained system rather than a grazing-maintained system. The catastrophic declines in rare antelope species such as sable, roan, eland and reedbuck could possibly have been caused by a general drying of the habitat, loss of wetland function, changes in plant composition and increased drought effects. Buffalo numbers crash with every major drought prompting Kruger to stop culling them (See Kruger population dynamics graph on page 11). It is likely that drought will continue to constrain their numbers. These crashes would not be as severe if the high rainfall western key-resource areas were still available to grazers and if Kruger's grasslands had a more effective water cycle through being maintained by grazers rather than fire (see McNaughton 1985). Moreover, the lack of heavy grazing results in most plant material being left to decay as standing dead litter which becomes low quality and nutrients are, therefore, cycled through slow-cycling pathways rather than being converted to dung and urine and cycled through rapid cycling pathways (See McNaughton 1988). This results in several feedbacks on plant quality and nutrient availability, rates of nutrient cycling and carrying capacity (Figure 2).

A large watershed-scale experiment is urgently needed to test how grazing-maintained rather than fire-maintained systems affect stream flow, wetland function, habitat productivity and bush density. If results show that grazing-maintained systems are far better than fire-maintained systems then game ranchers could replace fire management of their bush/grasslands with cattle management as Savory has successfully done. Game and cattle go very well together and it is time to get away from this spurious mindset of separating game and cattle. It is clear from writings by the early African explorers that most areas of Africa prior to European settlement had a mix of game and cattle (Isaacs 1836; Livingstone 1865). Even in the Tsetsi fly dominated areas herders knew where they could move their cattle without them being bitten (Livingstone 1865). Ted Reilly in Swaziland runs a fantastic Nguni herd with his game. His Ngunis are hardened to Africa's diseases and natural selection is allowed to run its course with no dipping or veterinary intervention

The effects of grazing and fire along ecological gradients

Savory says that the effect of resting veld will differ on a gradient of soil and atmospheric moisture distribution throughout the year or what he calls a "brittleness scale". Brittle environments have periods of severe soil and atmospheric moisture deficit in various seasons whereas non-brittle environments have no soil or atmospheric moisture deficit over the year, with most systems lying somewhere in between. The development of this brittleness scale actually makes good ecological sense because the scale reflects a gradient of litter (dead plant material) accumulation. In environments with periods of moisture stress of sufficient duration plants senesce *en masse* during the dry period resulting in formation of a large amount of standing litter. By contrast, plants growing in environments with little or no soil moisture stress at any point in the year have no reason to senesce as a whole plant but individual leaves will senesce when they get old. So in these environments there is not the *en masse* death of plants that occurs at the end of the wet season in more brittle environments. Thus, non-brittle environments supposedly do not experience the problem of moribund grass tufts and masses of light inhibiting litter experienced in brittle environments and, therefore, resting non-brittle environments is less damaging. I question whether there is much use in this brittleness scale for rangeland ecologists because there are very few rangelands on earth where there is not a dry period and *en masse* senescence of plants (even in the tropics). Perhaps in a tropical rainforest there is no distinct period of senescence and litter accumulation but of what relevance is that to rangeland ecologists? Moreover, even if a grassland did not have a period of senescence and litter accumulation because there was no period of moisture limitation, it would accumulate a lot of litter because, having no moisture stress, it would be very productive, and is well recognized that litter production is directly related to productivity. If these productive grasslands were not grazed they would end up with a few shade-tolerant dominant plants and very low diversity (Proulx and Mazumder 1998; Osem *et al*. 2002: Bakker *et al*. 2006). Thus, the brittleness scale fails in its predictions; resting of non-brittle grasslands will almost certainly result in loss of species diversity, as they are productive owing to favourable conditions for growth throughout the year.

I feel that a far more useful and tangible scale for land managers would be a productivity scale determined by rainfall, landscape position and soil depth. It is clear that deep moist soils near rivers will be much more productive and produce much more litter than shallow-dry upland soils (Osem *et al*. 2002). In addition, fertile clay soils will produce more than leached sandy soils (Deshmukh 1984). Also, the higher the rainfall of a region, the higher the productivity of that region (Deshmukh 1984). Rainfall, soil type and depth and landscape position are parameters that are easy to determine and, therefore, it would be easy for a manager to work out a grazing plan for a farm based on the particular combination of these parameters in the various parts of the farm. The manager can get tangible, objective answers using these parameters, whereas it appears to me that there is no clear way of determining the brittleness of a region. Even in the tropics rangelands have dry seasons so, in effect, all rangelands are going to be classified as brittle to some extent. Also, the whole farm is classified as brittle or not brittle so it cannot be applied to developing a grazing plan for the different areas of the farm. What is the use then of the brittleness scale for rangeland managers?

Finally, ecological research has shown that the effect of grazing on diversity varies predictably along productivity gradients. Resting dry unproductive grassland resulted in increased diversity with the reverse being true in moist productive grassland (Proulx and Mazumder 1998; Osem *et al*. 2002: Bakker *et al*. 2006). Burgess (2001) reports on several examples of where planned grazing has failed to improve the land and they are all from the unproductive arid American west, as I would have predicted from simple ecological knowledge. Even on Savory's own ranch Dimbangombe, there was no evidence that planned grazing had resulted in any improvement of the land on dry rocky uplands relative to adjacent communal lands on the same soil types; both were dominated by annuals. Where we did see the positive effects of planned grazing was on better, more productive soils. Again this result was easy to predict because the extremely unproductive grasslands on the shallow dry rocky upland soils at Dimbangombe do not produce enough litter to result in moribund grassland or severe light limitation so grazing has no benefit in this regard. In contrast, the more productive grasslands on the better soils closer to river lines needed grazing or fire to remove the light-inhibiting litter and, therefore, responded nicely to planned grazing. It is clear, therefore, that dry grasslands (unproductive owing to poor soils or low rainfall) need less grazing to maintain health than moist productive grasslands. This is the sort of information that managers for need for planning not this vague, intangible notion of brittleness, which is almost impossible to quantify and does not appear to vary sufficiently in rangelands to be of much use for management.

Conclusion

In conclusion, our trip to Allan Savory's ranch was extremely worthwhile and insightful and everyone was impressed with what they saw, and was determined to return. I feel that Savory's experience on the ground in such a wide variety of unique landuse impacts, changing animal numbers and environments combined with some clear thinking allowed him to gain several insights into African rangeland ecology that could bring important breakthroughs in rangeland management. His ideas have met with much scorn and resistance but that happened to all who challenged incorrect paradigms (e.g. Galileo). I fully support his thinking that the current paradigm of resting veld to restore it and minimizing grazing and hoof impact in rangeland management is false, at least for moderate to high productivity grasslands. Moreover, I believe that the role of fire in rangeland management needs to be re-evaluated. The evidence is clear; fire reduces soil quality and grassland productivity and interferes with hydrological cycles. Herbivores used in the correct way can prevent bush encroachment without the negative effects of fire on ecosystem properties. Rotational grazing has been buried (Briske *et al*. 2008) so now is the time to take some of Savory's ideas and to put them to test. It would be useful to look at the mechanisms through which Savory's grazing methods affect grasslands. Do animal-maintained grasslands with no fire have higher plant density, broken soil surfaces, increased surface litter, higher seed germination, reduced surface runoff of water, greater infiltration, higher soil moisture, higher recharging of ground water and better wetlands and stream flow relative to fire-maintained grasslands with little grazing? Also, are root systems of grasses bigger or smaller in animal-maintained grasslands with no fire relative to fire-maintained grasslands with little grazing? Research on the effects of clipping grasses on their root systems suggests that animal-maintained grasslands will have smaller root systems than fire-maintained grasslands (Coughenour *et al*. 1985; Eroma 1985; Danckwerts and Nel 1989). This is not necessarily a bad thing because grazed-down grasses with low leaf area and smaller root systems are likely to draw out much less soil moisture than grasses with lots of leaf area and big deep root systems. I believe that the hydrology of animal-maintained grasslands may be better than fire-maintained grasslands not only because of higher plant density, more surface litter and broken soil surfaces but also because of lower evapotranspiration by the grasses owing to their lower leaf area and smaller root systems. These are the things that rangeland ecologists need to start to examine.

References

Bakker E, Ritchie ME, Olff H, Milchunas D and Knops JMH 2006. Herbivore impact on grassland plant diversity depends on habitat productivity and herbivore size. Ecology Letters 9:780-788.

Belsky, AJ 1984. Role of small browsing mammals in preventing woodland regeneration in the Serengeti National Park. African Journal of Ecology 22:271-279.

Briske DD, Derner JD, Brown JR, Fuhlendorf SD, Teague WR, Havstad KM, Gillen RL, Ash AJ and Willms WD 2008. Rotational grazing on rangelands: Reconciliation of perception and experimental evidence. Rangeland Ecology and Management 61:3-17.

Burgess J 2001. Holistic Resource Management (HM): Panacea or Snake Oil? http://www.jdburgessonline.com/grazing/HM.html

Coughenour MB, McNaughton SJ and Wallace LL 1985. Response of an African graminoid (*Themeda triandra* Forsk.) to frequent defoliation, nitrogen, and water: a limit of adaptation to herbivory. Oecologia 68:105-110.

Danckwerts JE and Nel LO 1989. The effect of frequency of defoliation on *Themeda triandra* in the False Thornveld of the Eastern Cape. Journal of the Grassland Society of Southern Africa 6:32-36.

Deshmukh IK 1984. A common relationship between precipitation and grassland peak biomass for east and southern Africa. African Journal of Ecology 22:181-186.

Edroma EL 1985. Effects of clipping on *Themeda triandra* Forsk and Brachiaria platynota (K. Schum.) Robyns in Queen Elizabeth National Park, Uganda. African Journal of Ecology 23:45-51.

Fuhlendorf SD, Harrell WC, Engle DM, Hamilton RG, Davis CA and Leslie DM 2006. Should heterogeneity be the basis for conservation? Grassland bird response to fire and grazing. Ecological Applications 16:1706-1716.

Fynn RWS, Haynes RJ and O'Connor TG 2003. Burning causes long-term changes in soil organic matter content of a South African grassland. Soil Biology and Biochemistry 35: 677-687.

Fynn RWS and O'Connor TG 2005. Determinants of community organization of a South African mesic grassland. Journal of Vegetation Science 16: 93-102.

Fynn RWS, Kirkman KP, Morris CD, Ward D, Platt MJ and Ghebrehiwot H. Plant strategies and dominance on productivity and disturbance gradients in South African mesic grasslands. In prep

Isaacs N 1836. Travels and adventures in Eastern Africa. C. Struik (Pty.) Ltd. Cape Town.

Knapp AK, Briggs JM, Blair JM and Turner CL 1998. Patterns and controls of above-ground nett primary production in tallgrass prairie. In: Knapp, A.K., Briggs, J.M., Hartnett, D.C. and Collins, S.C. (eds) *Grassland dynamics: long-term ecological research in tallgrass prairie*, Oxford University Press, Oxford. pp. 193-221.

Livingstone D 1865. A popular account of Dr. Livingstone's expedition to the Zambesi and its tributaries. The Echo Library 2006.

McNaughton SJ 1985. Ecology of a grazing ecosystem: the Serengeti. Ecological Monographs 55: 259-294.

McNaughton SJ 1988. Large mammals and process dynamics in African ecosystems. Bioscience 38: 794-800

Mills AJ and Fey MV 2005. Interactive response of herbivores, soils and vegetation to annual burning in a South African savanna. Austral Ecology 30:435-444

Osem Y, Perevolotsky A and Kigel J 2002. Grazing effect on diversity of annual plant communities in a semi-arid rangeland: interactions with small-scale spatial and temporal variation in primary productivity. Journal of Ecology 90: 936-946.

O'Connor TG, Uys RG and Mills AJ 2004. Ecological effects of firebreaks in the montane grasslands of the southern Drakensberg, South Africa. African Journal of Range and Forage Science 21: 1-9.

Ojima D, Schimel DS, Parton WJ and Owensby CE 1994. Long and short-term effects of fire on N cycling in tallgrass prairie. Biogeochemistry 24: 67-84.

Prins H and van der Jeugd 1993. Herbivore population crashes

Allan Savory (left, in bare feet) elaborating on his observations on grazing effects on rangelands

and woodland structure in East Africa. Journal of Ecology 81:305-314.

Proulx M and Mazumder A. 1998. Reversal of grazing impact on plant species richness in nutrient-poor vs. nutrient-rich ecosystems. Ecology 79: 2581-2592.

Redman RE 1978. Plant and soil water potentials following fire in a northern mixed grassland. Journal of Range Management 31: 443-445.

Snyman HA 2002. Fire and the dynamics of a semi-arid grassland: influence on soil characteristics. African Journal of Range and Forage Science 19: 137-145.

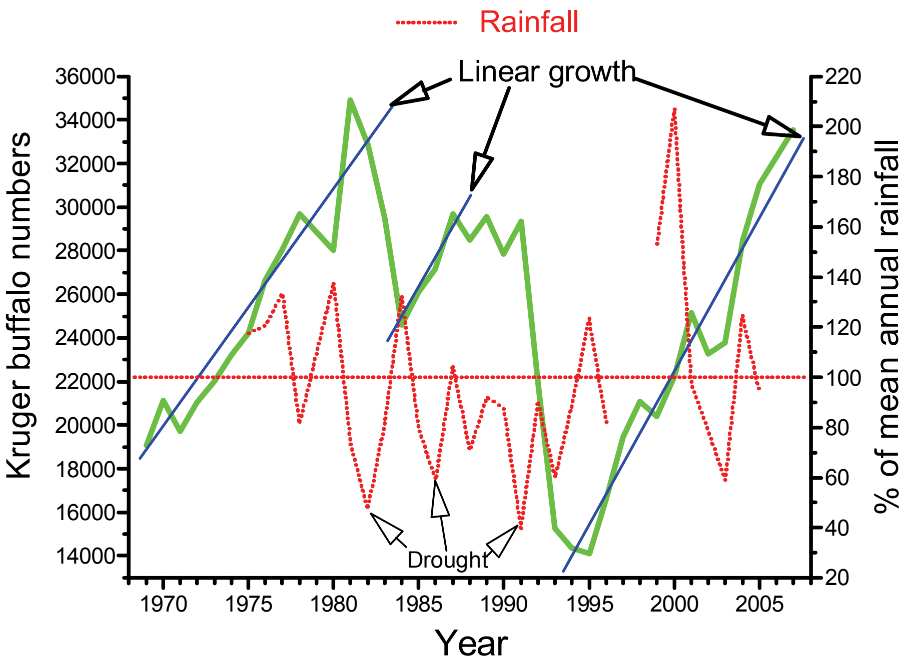
Snyman HA 2004. Estimating the short-term impact of fire on rangeland productivity in a semi-arid climate of South Africa. Journal of Arid Environments 59: 685-697.

Tainton NM, Booysen P de V, Bransby DI and Nash RC 1978. Long-term effects of burning and mowing on tall grassveld in Natal: dry matter production. Proceedings of the Grassland Society of Southern Africa 13: 41-44.

White RE and Grossman D 1972. The effect of prolonged seasonal burning on soil fertility under Trachypogon-other-species grasslands at Frankenwald. South African Journal of Science 68: 234-239.

Drought effects on buffalo numbers in Kruger

Richard Fynn
University of KwaZulu-Natal

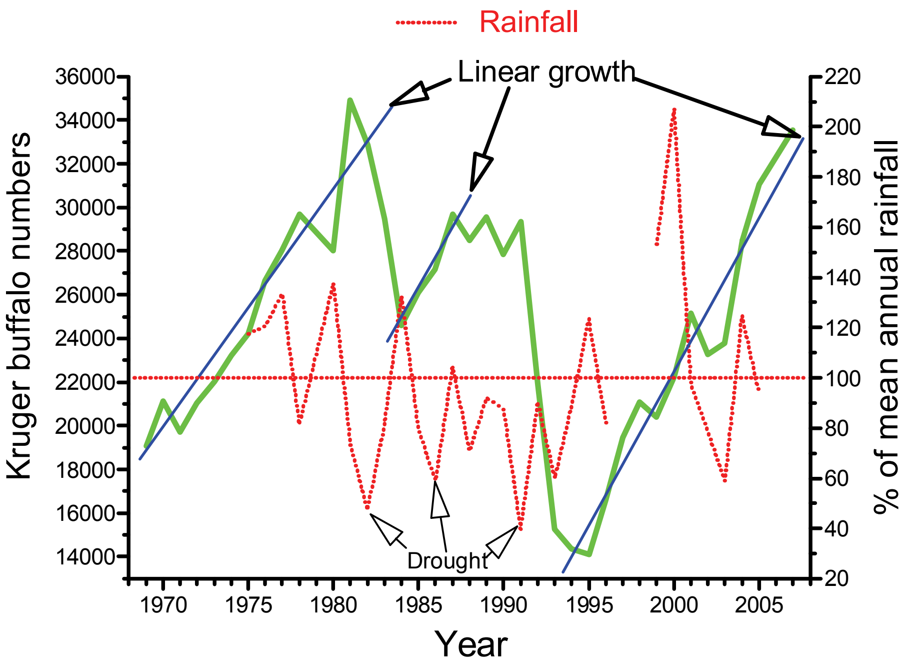


Drought effects on buffalo numbers in the Kruger National Park. Strong evidence for the non-equilibrium dynamics as argued by Ellis & Swift (1988. Journal of Range Management, 41:450-459). An equilibrium system will exhibit density dependent feedbacks on population growth resulting in an asymptotic growth curve. Non-equilibrium systems are controlled by external abiotic drivers such as rainfall rather than internal biotic feedbacks and consequently population growth has no evidence of density dependence (linear growth curves). This is exactly what is observed in the Kruger buffalo population and is caused by the fact that buffalo no longer have access to the high rainfall savannas at the base of the escarpment (regional key resource areas) which would provide more dependable forage during drought and buffer its effects on population numbers. Consequently, animal numbers never rise to levels that affect grass biomass during normal years, as seen in Kruger.

Acknowledgements: Rina Grant and Kruger National Park for buffalo data

Drought effects on buffalo numbers in Kruger

Richard Fynn
University of KwaZulu-Natal



Drought effects on buffalo numbers in the Kruger National Park. Strong evidence for the non-equilibrium dynamics as argued by Ellis & Swift (1988. Journal of Range Management, 41:450-459). An equilibrium system will exhibit density dependent feedbacks on population growth resulting in an asymptotic growth curve. Non-equilibrium systems are controlled by external abiotic drivers such as rainfall rather than internal biotic feedbacks and consequently population growth has no evidence of density dependence (linear growth curves). This is exactly what is observed in the Kruger buffalo population and is caused by the fact that buffalo no longer have access to the high rainfall savannas at the base of the escarpment (regional key resource areas) which would provide more dependable forage during drought and buffer its effects on population numbers. Consequently, animal numbers never rise to levels that affect grass biomass during normal years, as seen in Kruger.

Acknowledgements: Rina Grant and Kruger National Park for buffalo data

Congress 43

Badplaas, Mpumalanga

21-25 July 2008

Rina Grant[1] and Mike Peel.
SANParks and ARC—Range and Forage Unit
[1] RinaG@sanparks.org

Badplaas has a very scenic setting in the Highveld of Mpumalanga, overlooking a game reserve with a wide variety of animals such as white rhino, zebra and kudu. The natural hot water spring that flows into two large swimming pools, has long been known for its natural curing properties. This presented a very soothing and relaxing atmosphere after the many interesting sessions and added vigour to the start of day.

This congress specifically aimed at highlighting the important links between planted pastures and natural rangeland as there has been a concern that the planted pasture section of the GSSA has not received the attention it deserves.

The meeting was opened by Dr Hector Magome, the managing executive: conservation services of SANParks. The presence of the executive of SANParks at the congress emphasised the importance of science in conservation, as well as the need to share conservation issues with rangeland and pasture scientists. Dr. Magome emphasised the importance of allowing scientists to think freely about approaches to solving emerging problems when the system is under threat, rather than restricting the possible approaches.

The keynote address by Dr Richard Stirzacker from CSIRO in Australia discussed "What can agriculture learn from the study of natural ecosystems?" He emphasised the role that planted pastures played in food provision and population growth and how improved technology made this possible to produce sufficient food in the limited area available for crop production between the extremes of hot and cold zones, and extremely wet and dry zones.

However, there are now huge challenges to food production in the form of increased production costs and environmental changes and degradation. The richer insights rendered from knowledge of the functioning of ecological systems may help to overcome some of these problems. An important point to consider is that even though optimal efficiency which was always strived for is still a worthy goal, it should not be the ultimate goal any more. The emphasis should now change towards encouraging diversity to enhance resilience or be prepared to pay the cost of not having a resilient system which might still be small at this stage, but will become huge as resilience of the system decreases in the face of increasing disastrous events.

The following plenary session aimed at linking planted pastures to natural rangelands with the emphasis on the knowledge gained over the past 25 years. The first talk by Amie Aucamp emphasized the role of planted pastures in livestock production and the risks of degradation due to overstocking. Norman Rethman followed on by discussing how planted pastures can be integrated into livestock production systems taking the conservation of natural resources into account, making sure that resources are used sustainably.

A special session also addressed the question of "How our knowledge has grown since the Biome projects and the 'Responses of Savannas to Stress and Disturbance: a proposal for a collaborative programme of research'. The objective of this exercise was: 'To develop a predictive understanding of the ways in which savannas respond to natural and man-made stresses and disturbances'. The session concluded that while previously investigated issues were largely still relevant additional factors such as the effects of climate change had emerged as major drivers. Methods of measurement were discussed and the importance of new technologies such as remote sensing as an adjunct to field monitoring was highlighted. The session hopefully contributed to the matrix of what is useful to measure and what new ideas need to be added in order to better understand and predict ecosystem function and trends.

The lack of capacity in grassland sciences is a huge concern that was discussed at both these sessions and a workshop held on teaching rangeland and pasture science will hopefully address some of these issues. A further workshop on Farmer Development: New Approaches to Rangeland and Pasture Management further addressed the lack of capacity at ground level.

These sessions set the scene for the rest of the congress. The savanna and rangeland theme was addressed by eighteen papers on the understanding of Savanna Ecology. These included papers on nutrient and energy flow, degradation and ecosystem resilience. The five papers in the Adaptive Management session focussed on discussing progress with the implementation of adaptive management in practise. A special session with four papers on Integrating Land and Water Systems as a Resource Management Imperative discussed how to link the river and terrestrial systems in the production landscape. A session on Rangeland Fodder Production and Quality addressed questions on how utilization affects forage quality and

production and how forage quality in turn effects herbivory. How to monitor all these interactions has long been a contentious issue and was addressed by six papers in the session on Rangeland Assessment and Monitoring.

The recovery of degraded areas is another issue that has received a lot of attention in management and research. Approaches to rehabilitation of degraded areas as well as the control of invasive aliens and bush encroached areas was discussed in 23 papers.

One of the most difficult aspects in range and intensive livestock production systems is to ensure fodder flow. Approaches to this problem was addressed in 28 papers presented in various sessions and was aimed specifically to help the farming community. These papers covered topics such s the role of nitrogen fertilizer in the production of planted pastures, to different approaches in determining production.

Biodiversity has become a very important goal in most conservation areas, but has also gained importance in rangeland systems. A session with 9 papers discussed biodiversity initiatives in a wide range of fields from crane conservation to conservation of grasslands.

A field new field in grassland science is remote sensing. This special session with six papers discussed how this tool could be used for monitoring the effect of factors such as fire, nutrient and soil distribution and rainfall on rangeland production.

Every day was concluded by a social get together around the warm fires, which were often concluded by a warm dip in the pools nearby. The social vibe of the society is still strong and many important insights and co-operations were gained in this less formal arena.

At the final dinner, several awards were handed out for excellence in science. Alan Manson, Debbie Jewitt and Alan Short received the award for best paper in the African Journal of Range and Forage Science for *Effects of season and frequency of burning on soils and landscape functioning in a moist montane grassland.* Vol. 24(1): 9-18.

Best Poster was won by Bethwell Moyo of University of Fort Hare for Moyo B, Dube S Lesoli MS and Masika PJ: *Temporal and spatial variation in activity patterns of cattle grazing in the communal areas of the Eastern Cape, South Africa*.

The best presentation by a

young scientist was handed to Meghan Ellis, University of KwaZulu-Natal for Ellis M, Kirkman KP and Morris CD: *Seedling growth and competition in five South African grasses: the nitrogen effect.*

Finally, best presentation was handed to Jabulani Mashiya, Tshwane of University of Technology for *Additional skills and training for pasture scientists needs attention for the future survival of rangelands in South Africa.*

Each congress award is judged by a panel of four judges per session, according to a strict set of criteria, and the winners can be proud of being the top-scorers in their categories.

The most coveted award of the week, the Faux Pas award, was more tightly contested than most years, but eventually the five other candidates had to concede defeat to Alan Short who (*Editor's note: censored to maintain the good name of the Society*).

I am sure every delegate is already looking forward to the meeting next year in Gauteng and those who missed out this year should seriously consider joining in the fun in 2009.

The Peter Edwards Award for Conservation Farmer of the Year: Mpumalanga, 2008

Mike Peel.
ARC—Range and Forage Unit
mikeP@arc.agric.za

The annual GSSA congress incorporates the Peter Edwards Award which is presented in recognition of the sound application and practice of the principles of range and forage science and conservation. The aim of the Award is to recognise top land-users in different areas of southern Africa and thereby encourage the wise use of natural resources. There were three final nominees accepted for this years award, the Associated Private Nature Reserves (APNR) adjacent to the Kruger National Park, Kopje Alleen (in the Badplaas area) and Karan's Camp (in the Timbavati Private Nature Reserve). The award recognizes land users who strive to attain the vision of the Society which is to advance rangeland ecology and pasture management in Africa.

Associated Private Nature Reserves

The APNR is some 171 637 ha in extent and forms part of the greater 2.3 million hectare Kruger National Park protected area. It is comprised of the Timbavati, Umbabat, Timbavati and Balule Private Nature Reserves. The APNR was originally formed with the main objective of conserving a tract of pristine country and its natural biodiversity, the area having been set aside for the enjoyment and benefit of its owners. With time, the objective has evolved to include the development of a high quality wildlife tourism product that generates better revenue than the limited agricultural options offered by this harsh environment. It has also become apparent that such land use generates more business and employment opportunities for local communities than that possible through livestock farming. This is vital in today's prevailing socio-economic conditions. The APNR aims to provide for ecologically and aesthetically sustainable (non-consumptive and consumptive) use of the area for its owners, based on wildlife focussed recreation, tourism and hunting, encouraging the participation of local communities and without compromising the ecological and aesthetic objectives, the economic viability and investment value of the properties.

All of the reserves making up the APNR have been a part of the Agricultural Research Council's comprehensive ecological programme since its inception in 1989/90. This includes extensive veld monitoring and animal count data. Further, in terms of new legislation, the ARC has together with the APNR submitted the first management plan for a Private Nature Reserve.

Kopje Alleen

Kopje Alleen is run by Brenda and Avena Jacklin and focuses mainly on organic crop production, compost production out of water-guzzling and alien invasive wattle trees which are removed from the environment and chipped. The compost produced from the trees is an effective substrate for their vegetable production business, and they also sell surplus compost locally. They are hoping to expand their compost-production programme. Production of compost from alien trees is a novel, effective and economical way of clearing aliens without leaving piles of woody debris behind. They have a strong outreach programme with talks on waste minimisation, climate change, indigenous birds and plants. The Jacklins make donations of indigenous plants to local schools and are

Thinned bush at Klaserie, APNR

Heaps of compost made from chipped alien plants at Kopje Alleen
Overleaf: River bank at sunset, Karan's Camp

involved in organising of a local annual Mpumalanga indigenous plant sale, with talks on various topics by local experts.

The organic farming method incorporates raised beds, no chemical fertilisers and sprays, water conservation strategies such as mulching and the manual management of watering activities. Organic food production is thus achieved with little wastage. All food is processed and packaged on the farm for local distribution.

Veld management practices include fire prevention measures such as the slashing of fire breaks, removing felled trees, conserving indigenous fauna and flora and setting up a catalogue of indigenous flowering plants. The Jacklins also run an indigenous plant nursery and propagate and sell indigenous trees, shrubs and bulbs.

The Jacklins provide an exemplary example of organic, environmentally friendly and sustainable farming methods.

Karan's Camp

The third finalist was Karan's Camp in the Timbavati Private Nature Reserve. This area covers some 2 000ha in an area famous for its white lions and forming part of the greater 2.3 million hectare Kruger National Park protected area.

The perennial problem of bush encroachment in savannas has been addressed by the landowner Mr. Karan with the ARC as ecological advisors and Game Ranch Management Services as contractors doing the bush control. The area was previously cleared in an *ad hoc* fashion resulting in thick stands of coppicing *Colophospermum mopane* veld. This was not aesthetically pleasing and negatively impacted on game viewing. The overall management objective is to conserve a wide diversity of large herbivores as a base for outdoor recreation and to optimise revenue through the wise use of natural resources in the area.

A monitoring study was initiated to assess the ecological impact of a bush removal programme at the local scale, and its long-term sustainability. Vegetation change was determined in terms of trends in (1) woody species composition, (2) herbaceous species composition and cover, (3) woody plant density, and (4) grass production. Studies were set up within three pairs of adjacent sites. Within each pair of sites, one was cleared and the other was not. The sites were permanently marked on the ground using concrete blocks, and accurate instructions for their relocation were made. Vegetation monitoring has been carried out annually since 1995.

Over the 12 years of this study, areas that have undergone bush control have consistently maintained a relatively higher percentage of perennial grasses, a favourable grass cover (basal cover index and tuft diameter) and higher grass production levels than areas that were not thinned. The thinned areas also had an improved visibility and game viewing potential, important in terms of the management goals of this property, and contributed to biodiversity in that they offer an open habitat within relatively closed surrounding *Colophospermum mopane* woodland. Further, due to the co-ordinated effort of all involved the return time for re-treatment is a highly satisfactory 7 years. The owner is commended for his efforts in maintaining the monitoring and re-treatment programmes. The result is a model example of an ecologically and economically viable bush control programme.

And the winner is...

The APNR was finally selected as the winner fighting off tough competition from the other two finalists. Congratulations on a well run private protected area.

Next year's Peter Edwards Award will be chosen from land-users in Gauteng, and members are encouraged to send in their nominations for the award as soon as possible. Nomination forms can be obtained on the GSSA website or by contacting the Administrator. The Peter Edwards Award is crucial for recognising the efforts of land managers who, year after year, patiently apply the best management strategies to conserve their natural resources.

PANNAR®

50 Years of Quality Seed

Success is in our Genes

A complete forage crop package

Nutritious green forage crops for excellent autumn, winter and spring grazing.

Forage Cereals Package:
Planting date and expected grazing period.

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
DRAKENSBERG	x	xx								
LE TUCANA	x	xx								
PAN 248	x	xx								
PAN 233 & PAN 263	x	xx								
SOROM	x	xx								
PAN 299	x	xx								

Forage Cereals

Dryland and/or supplementary irrigation

Oats

- DRAKENSBERG
- LE TUCANA

Triticale

- PAN 248
- PAN 299

Stooling Rye

- PAN 233
- PAN 263
- SOROM

Management Hint: For a balanced fodder flow and longer utilisation, plant more than one cultivar between February and April.

Intensive Forage Crops

Irrigation

Annual Ryegrass

- VOYAGER 55 and VOYAGER 31
- DARGLE
- MISPAH
- ENERGYL

Perennial Ryegrass

- QUARTET
- DOBSON

Tall Fescue

White, Red and Berseem Clover

Management Hint: Plant when maximum day temperature begins to drop below 25°C. Plant shallow and roll to ensure good contact with soil and moisture.

LIVING THE PANNAR EXPERIENCE

FOR INFORMATION CONTACT:
MPUMALANGA AND LIMPOPO: Delmas (013) 665 6400
EASTERN FREE STATE AND GAUTENG: Heidelberg (016) 341 5881
FREE STATE AND NORTHERN CAPE: Kroonstad (056) 216 3000
NORTH WEST PROVINCE: Klerksdorp (018) 406 9808
KWAZULU-NATAL AND EASTERN CAPE: Greytown (033) 413 9500
DEVELOPING FARMERS (033) 413 9559
www.pannar.com - e-mail: infoserve@pannar.co.za

GF/E/08/24